Issaquah Creek Valley
Ground Water Management Plan:

Management Strategies

March 1999
Final

Data and information contained in this document are current as of the period of project performance: 1989 - 1995.

Submitted by:

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WASHINGTON STATE DEPARTMENT OF ECOLOGY

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(Published Separately)

Executive Summary

Issaquah Creek Valley
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Executive Summary

Overview

The Issaquah Creek Valley Ground Water Management Area is a ninety-three square mile area located east and southeast of Lake Sammamish. As mapped on the following page, the boundaries are defined by the natural drainage of the Tibbetts Creek and Issaquah Creek watersheds and the water service area of the Sammamish Plateau Water and Sewer District. Urban development is mostly concentrated in the City of Issaquah and along the I-90 corridor. Most of the remainder of the management area outside of the City limits is rural, characterized by low-density residential uses, forest and agricultural lands, a sand and gravel mine, and a regional landfill. The lower Issaquah Valley aquifer, which provides the primary supply for the area, is located beneath the urban areas of the City. One hundred percent of the water used for private, municipal, industrial and agricultural purposes in the Issaquah Creek Valley Ground Water Management Area is provided by ground water sources.

The Issaquah Creek Valley Ground Water Advisory Committee developed this plan. They were appointed by the Department of Ecology and are submitting the plan to the State for certification. The Ground Water Advisory Committee consists of many different groups that manage, develop, or rely on ground water in the area. Committee members from local government, special purpose districts, water associations, and representatives of agriculture, well drilling, forestry, industry, and environmental organizations met over a nine year period to develop the Issaquah Creek Valley Ground Water Management Plan.

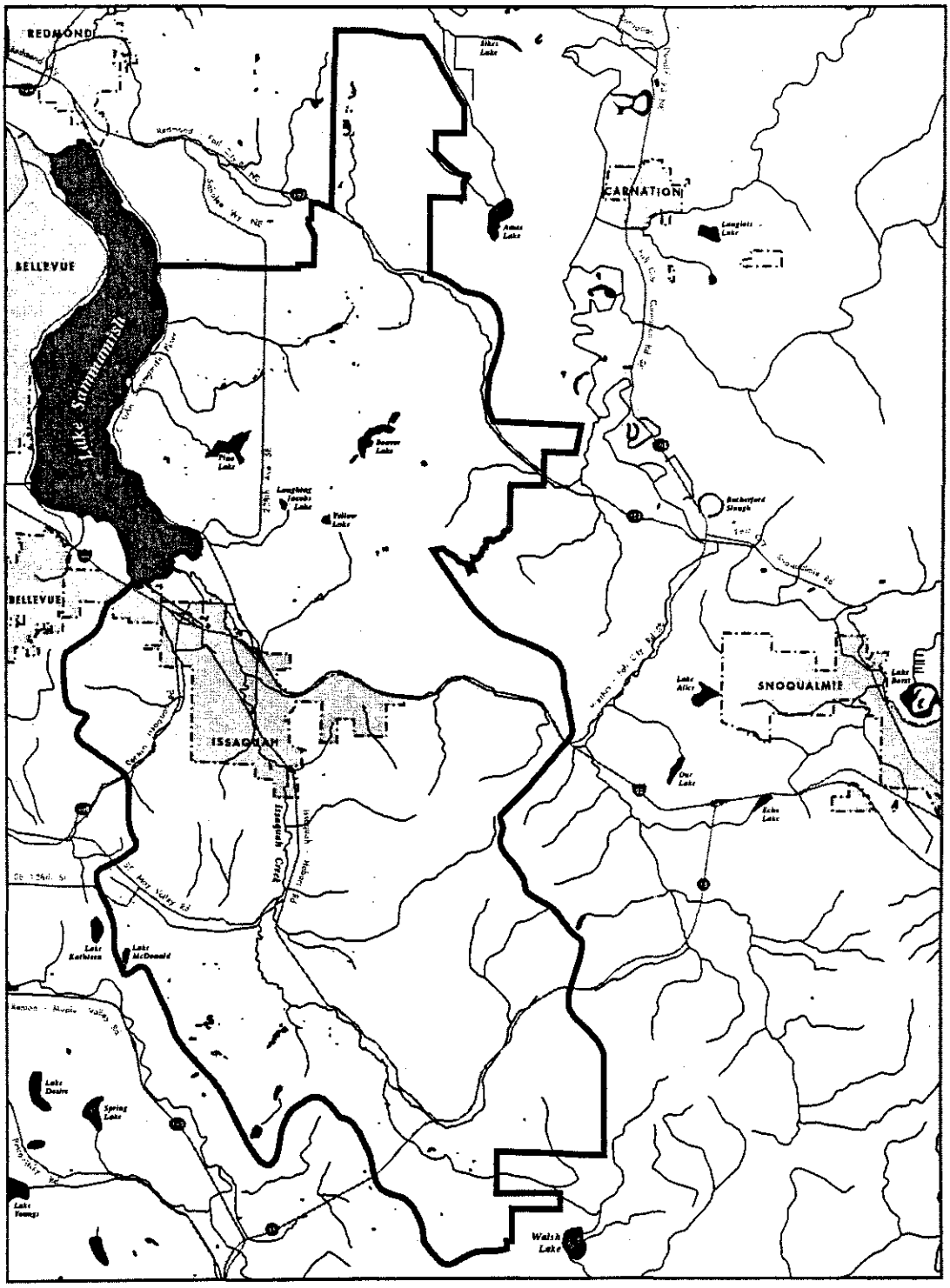
The plan contains an introduction, recommended ground water management strategies, and a recommended implementation process. The supplement to the plan contains the area characterization and background for each issue addressed by the proposed management strategies, references and appendices.

Ground Water Management Plan Goals

The philosophy underlying development of the plan is to protect ground water quality and assure ground water quantity for current and future uses. To achieve this goal, a broad range of strategies are proposed in the plan for consideration when making land use decisions; designing surface water facilities; regulating hazardous materials, on-site sewage disposal, and well construction; and retrofitting of existing infrastructure.

The Issaquah Creek Valley Ground Water Management Plan contains eighteen specific goals intended to provide direction for programs that protect ground water quality and quantity. The goals are divided into three categories and are summary as follows:

Issaquah Creek Valley Ground Water Management Area



Goals Related to Both Ground Water Quantity and Quality Four goals are proposed that would direct future program development to use special area designations that would help protect ground water resources, develop and implement a data collection and management program, infiltrate storm water, and increase educational efforts for the citizens and local officials of the management area.

Goals Related to Ground Water Quality Water quality in the Issaquah Creek Valley Ground Water Management Area is excellent. The emphasis of this proposed plan is to develop strategies and recommended programs to protect the integrity of the existing water quality. Thirteen goals are proposed that address hazardous materials management, infrastructure (e.g., sewage treatment, underground storage tanks, and landfills), pesticides, and sand and gravel mining. The goals for each of these subject areas simply state that ground water contamination should be prevented.

Goal Related to Ground Water Quantity The proposed management plan contains one goal, which is to manage the quantity of ground water resources of King County to optimize the current and long term benefits. The Issaquah Creek Valley Ground Water Advisory Committee found that the best way to address this goal was to through conservation, education and to develop and implement a long term monitoring and data collection program that would provide decision makers with information on the relationship between land use, ground water use, and ground water levels.

Recommendations

The Issaquah Creek Valley Ground Water Management Plan provides a description of the ground water resources, identifies potential threats to long term water quality and quantity, recommends management strategies for protection, and suggests funding methods for implementation. The recommendations in this plan are important because they foster cooperation among local governments in solving problems that affect a regional resource and because implementation will require a unique and cooperative approach.

After careful study and deliberation about the possible and effective ground water protection measures, the Issaquah Creek Valley Ground Water Advisory Committee adopted approximately sixty-six management strategies. Only those that were given highest priority are noted in this Executive Summary.

Water Quality Management strategies that have been prioritized as "high" address the vulnerability of the lower Issaquah Valley aquifer system and its importance in supplying all of the potable water in the area. These strategies include:

- Incorporating an assessment of water quality impacts from specific land uses in a "Guidance for Environmental Reviewers," especially in areas that are determined to be highly susceptible to ground water contamination, or in high recharge areas;

- Assessing impacts of right-of-way maintenance by chemicals, and suggesting or requiring other methods if right-of-way maintenance methods could impact ground water;
- Developing basic strategies that King County could implement to assist purveyors in their well head protection efforts;
- The King Conservation District helping small farmers prepare and implement Farm Plans for ground water and other resource protection;
- Developing a Sole Source Aquifer Petition to identify the area as a sole source aquifer, which means that partially federally funded projects (such as a freeway interchange) must include ground water protection measures; and,
- Assessing stormwater management facilities' impact upon ground water, and making a recommendation for upgrade if necessary.

Water Quantity Continued urbanization in the Issaquah Creek Valley Ground Water Management Area will require greater volumes of ground water to be withdrawn from the Issaquah Valley aquifer system. Where an aquifer system provides the only source of water to an area and the maintenance of stable ground water levels could be affected by new development, management strategies to assist in preserving ground water quantity are recommended. These include:

- Assessing development's potential impact to recharge areas or infiltration potential during environmental review. Also, an analysis of aquifer capacity and associated surface water and ground water interaction should be performed, if water rights application is part of the development proposal;
- Adopting general aquifer protection policies to provide a basis for implementing specific requirements;
- Providing information to decision makers related to land and water use;
- Providing education for citizens and local governments by adding to existing educational efforts, and developing needed new education; and,
- Mapping physically susceptible and recharge areas to provide a visual tool for decision makers and the public when discussing groundwater concerns.

Implementation

The Issaquah Creek Valley Ground Water Management Plan is intended to provide a framework to assist cooperation between regulatory agencies through implementation of the adopted management strategies. The management plan recommends forming an oversight committee for ground water protection activities in the planning area. The Issaquah Creek Valley Management Committee would consist of one representative of King County, City of Issaquah, Sammamish Plateau Water and Sewer District, Muckleshoot Indian Tribe, and the ground water advisory committee, as appointed by the Metropolitan King County Council.

The key task for implementing agencies is to develop programs, projects, budgets, and regulations consistent with this plan. Implementing agencies include:

Local Government

- City of Issaquah
- City of Sammamish
- King County
  - Department of Natural Resources
  - Department of Development and Environmental Services
  - Department of Transportation
  - Seattle-King County Department of Public Health
  - Office of Strategic Planning
  - Office of Emergency Management

Special Purpose District

- Sammamish Plateau Water and Sewer District

State Agencies

- Department of Ecology
- Puget Sound Water Quality Authority
- King County Cooperative Extension
- King Conservation District

Funding

A major source of long term funding must be developed to implement the ground water management plan. The Ground Water Advisory Committee recommends that the Metropolitan King County Council and Issaquah City Council authorize a ballot measure to create an Aquifer Protection Area to provide funding for the implementation of the plan (per Chapter 36.36 RCW). The ballot measure must specifically state the programs that would be implemented and time frame in which they would be completed. If voters approve the Aquifer Protection Area, the County can collect monthly ground water and septic system user fees. These funds must be used only for Issaquah Creek Valley Ground Water Management Area activities. However, the Metropolitan King County Council has preferred that a range of funding options be explored before an Aquifer Protection Area be authorized, so this issue is considered "unfinished business" in the plan.

The programs identified in this plan will have substantial public costs. The Ground Water Advisory Committee prioritized the programs into high, medium and low categories in part because of anticipated funding limitations. Based on preliminary estimates, implementing the high priority projects would cost approximately 3.56 million dollars. Medium and low priority projects would cost approximately $356,000 and $253,600, respectively.

Acknowledgments

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Acknowledgments

The Issaquah Creek Valley Ground Water Advisory Committee (GWAC), the Seattle-King County Health Department and the King County Department of Natural Resources would like to thank the numerous organizations and citizens for their contributions during the development of this plan. The GWAC was formed in 1987 and met regularly throughout the planning process. The GWAC's role was to develop the plan according to state regulations, to respond to concerns expressed by the affected agencies, and to submit the plan to Washington State Department of Ecology for certification. The tremendous amount of time and effort of the GWAC is the foundation for this plan.

This GWMP has been produced by the Issaquah Creek Valley Ground Water Advisory Committee (GWAC), in conjunction with: the Seattle-King County Health Department; the King County Department of Natural Resources, Surface Water Management Division; the Department of Ecology; the City of Issaquah; and the Sammamish Plateau Water and Sewer District. The King County Department of Development and Environmental Services, King County Council Staff, and the King Conservation District also contributed information or staff.

The Seattle-King County Health Department's Environmental Health Division initiated the ground water planning process. Under direction and support from Charles Kleeburg, then Chief of the Division, William J. Lasby committed to undertaking this complex and lengthy task. Mr. Lasby directed the development of the Plan from 1987 through 1995, and is recognized for his dedication and leadership. Also, the professional and volunteer staff of the SKCHD ground water program are recognized for their perseverance through the many unanticipated setbacks and demands of ground water program development. A special thank you to Sue Keller-Ring and Tom Gearhart for the time and effort they volunteered on this project.

The plan was prepared with the assistance of the following consulting teams: Parametrix, Inc. (prime consultant for this project, responsible for overall product development and administration), Pacific Groundwater Group and Jim Carr and Associates (technical data analysis and area characterization), Hall and Associates (public involvement). Concept Engineering surveyed the water resource monitoring wells.

Issaquah Creek Valley
Ground Water Advisory Committee

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Jack Brooks	Class 4 Water System Designer
Carla Carlson*	Muckleshoot Indian Tribe
Karen Castner*	Citizen Advisory/Issaquah Community
Holly Coccoli	Muckleshoot Indian Tribe
Denise Doherty Smith	King County Master Gardener
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The following individuals contributed to the GWMP development as former members, alternates, or as staff in the ground water program.

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Tyler Jarvis*	East Hill Hardware, Inc.
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Bob Johnson	Overdale Park Water Association
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** Denotes Alternate*

Chapter One

Introduction

Issaquah Creek Valley
Ground Water Management Plan

March 1999

Introduction

Citizens and officials of King County are stewards of the ground water resource both for present and future generations. This plan is intended to inform and guide ground water protection efforts of the citizens and officials. This Ground Water Management Plan has been developed because: (1) ground water is a limited resource that is vital to the future of this area, the well being of its residents, and the vitality of our living natural resources; (2) ground water is not a separate body of water nor is it a separate environmental resource; and (3) no external water source is available nor will it be in the foreseeable future. Therefore, ground water needs to be protected and managed as a part of the entire hydrologic system, ecosystem, and economic system.

Ground water provides 100 percent of the water used in the Issaquah Creek Valley Ground Water Management Area for private, municipal, industrial, and agricultural needs. Also, ground water provides base flow to surface water bodies during low rainfall to sustain fish, wildlife, and recreation. The ground water resource must be protected from sources of contamination because once a ground water source is contaminated, it may be lost forever. Moreover, the cost of protecting ground water from contamination is considerably less than the cost of remedial action. Ensuring ground water availability is also crucial. The natural hydrologic system can be interrupted by aquifer over use, creating impermeable surfaces, and other results of urbanization.

1.1 Ground Water Management Program Purpose and Scope

The purpose of the Washington State Department of Ecology's (Ecology) ground water management program is to develop and implement local ground water management plans. These plans are intended to represent consensus of the Issaquah Creek Valley Ground Water Advisory Committee regarding the most practical ground water protection measures to safeguard quality and to ensure continued availability of this vital resource. Ecology's ground water management program provides the direction for local and state agencies to develop regulations and programs for protecting ground water.

The purpose of the Issaquah Creek Valley Ground Water Management Plan is to provide a framework for cooperation between various agencies through implementation of the adopted ground water protection measures. It is also intended to serve as a guide to further focused research on the aquifers in addressing data and regulatory protection gaps.

1.2 Ground Water Management Program History

In response to growing concern in Washington State about ground water resources, the state legislature passed Substitute House Bill 232 in 1985 (Chapter 90.44.400 RCW *Regulation of Public Ground Waters*). This legislation directed Ecology to:

- Identify specific locations in need of ground water management programs.
- Establish a program to provide financial assistance to these locations.

- Develop guidelines for the implementation of local ground water management strategies.

Ecology responded by adopting regulations defining a ground water management area as an area that encloses one or more aquifers, and which exhibits a justifiable concern for the quality and/or quantity of the ground water (*Ground Water Management Areas and Programs* Chapter 173-100 WAC).

Ecology's ground water program establishes protocols and guidelines for developing a local ground water management plan. A ground water management plan is designed to protect ground water quality and assure ground water quantity for current and future uses. The guidelines establish a process that allows for ground water issues, concerns and opportunities from all interested groups and agencies to be incorporated into the planning process. The process is designed so that a ground water management plan can be initiated and developed on the local level while being supported by state legislation and regulations. The ground water management program process also provides local government with a method to achieve comprehensive ground water protection goals.

On May 19, 1986, King County petitioned Ecology to designate the Issaquah Creek Valley as a Ground Water Management Area. The petition document outlined the following ground water protection problems:

- Potential contamination sources threaten ground water quality, or ground water is susceptible to contamination;
- Major aquifers have the potential for over use based on projected future demands; and,
- An approved coordinated water system plan identified a need for a Ground Water Management Plan.

Ecology designated the Issaquah Creek Valley Ground Water Management Area on October 7, 1986 and approved the membership of the Issaquah Creek Valley Ground Water Advisory Committee, which consists of a broad cross section of interests with representatives from many groups. Ecology selected the Seattle-King County Health Department to be the lead agency because it has jurisdiction throughout the Ground Water Management Area and has a regulatory role in water systems, on-site sewage systems, and other environmental health concerns. On January 1, 1996, the Metropolitan King County Council assigned responsibility for the ground water program to the Department of Natural Resources, Surface Water Management Division. Subsequently, the division was renamed the Water and Land Resources Division. In March 1996, the Department of Ecology approved a boundary change that moved all of Sammamish Plateau Water and Sewer District into the Issaquah Creek Valley Ground Water Management Area.

1.3 Management Plan Process Goals and Objectives

The first step in developing a ground water management plan is to establish goals and objectives. The Ground Water Advisory Committee and the Seattle-King County Department of Public Health developed the following goal and objectives to help guide the process for development of the plans.

Goal To protect the quality and quantity of ground water by providing guidance for effective coordinated management of the ground water resource.

Objectives

- Designate the Issaquah Creek Valley area as a Ground Water Management Area, thereby making it eligible for state grants designated for development of ground water management programs and plans.

- Develop a ground water management plan. This plan must:

  1. Be consistent with federal regulations, state ground water management laws and local ordinances.
  2. Include the public and local agencies' participation in drafting, reviewing, and modifying the plan.
  3. Include the following (as required by Chapter 173-100 WAC *Ground Water Management Areas and Programs*):

     - A public involvement plan to educate and inform the public about ground water and the planning process. The public will be informed of the need to protect the ground water resource from contamination and overuse.
     - An area characterization section that includes mapping jurisdictional boundaries showing land and water use management authorities' boundaries and goals; a description of the locale; the hydrogeology; the ground water quality; and the current ground water use and future needs.
     - Identification and description of threats to ground water; stating goals and objectives related to these threats; and recommending strategies that solve or reduce these threats. Technical understanding of the ground water resource will be developed to assist decision-makers in formulating public policy.
     - An implementation process for the plan, which includes: (1) a work plan for each affected agency and jurisdiction, (2) an effectiveness monitoring system, and (3) a process for periodic review and revision.

- Obtain local approval and state certification of the plan, which will ensure implementation of the recommended ground water protection measures. Public

agencies will work cooperatively to fulfill their responsibilities to protect the ground water resource. Local, state, and regional land use and water use plans, policies, and regulations will be effective in protecting the ground water resource.

1.4 Plan Contents

The proposed Issaquah Valley Creek Ground Water Management Plan contains management strategies and a proposed implementation process. The supplement contains the area characterization. Each of these sections are briefly described below.

The "Recommended Ground Water Management Strategies" address the potential threats to ground water quality and quantity. The recommended management strategies are prefaced by adopted goals and a summary statement of the issues explored by the Ground Water Advisory Committee and followed by recommended management strategies. This section also contains a work plan for each management strategy, including identifying the responsible agencies and priority.

The "Recommended Implementation Process for the Ground Water Management Program" describes the preferred methods for funding and implementing the plan. It also contains tables showing the management strategies. The management strategies are listed in order, based on the Ground Water Advisory Committee priorities for funding and implementation. Another table lists the management strategy by responsible agency, in implementation order, with priority.

The Supplement to this plan contains the area characterization and other background materials. The area characterization section describes the ground water management area and how its boundaries were chosen. It lists the governments and agencies that manage land and water use and describes their responsibilities. The section characterizes historical land use activities that impact ground water quality and quantity; it also describes the area's hydrogeology and characterizes past and present ground water quality. In addition, the section provides estimates of historical and current rates of ground water use and makes projections of future ground water supply needs.

The complete issue papers providing discussion for each recommended ground water management strategy, with unabridged background information, are available upon request from the Ground Water Program in the Water and Land Resources Division.

1.5 Management Plan Team and Responsibilities

Development of this plan was a coordinated effort between local and state government and citizen representatives on the Ground Water Advisory Committee. The following provides a brief explanation of the responsibilities of each group in developing the ground water management plan.

Issaquah Creek Valley Ground Water Advisory Committee

The Ground Water Advisory Committee has played a critical role in developing a sound ground water management plan. The Issaquah Creek Valley Ground Water Advisory Committee consists of a broad cross section of ground water interest groups, including local, state, and federal government agencies, large and small businesses, environmental organizations, and citizens. The Ground Water Advisory Committee has been responsible for assuring that the plan is both technically and functionally sound. It is on behalf of the committee that the plan is being submitted to Ecology for certification. The committee's specific duties included:

- Overseeing development of the Ground Water Management Plan;
- Reviewing the work plan, schedule, and budget developed by the lead agency;
- Assuring that the plan is functional and will not cause environmental or economic hardship;
- Verifying that the plan is consistent with the state's regulations on ground water protection; and,
- Formulating and implementing a public involvement plan.

Department of Ecology

Ecology appointed the Ground Water Advisory Committee in cooperation with local governments and participated on the advisory committee. Ecology staff reviewed and approved interim plan products (e.g., Public Involvement Plan, Data Collection and Analysis Plan, Quality Assurance/Quality Control Plan, and the Data Management Plan), participate on the Ground Water Advisory Committee, and held a public hearing on the draft plan. In addition, Ecology will certify this final Ground Water Management Plan.

Seattle-King County Health Department

The Seattle-King County Health Department was responsible for coordinating the activities necessary to develop this proposed Ground Water Management Plan. As lead agency, this included the preparation of a work plan, coordinating data collection, scheduling advisory committee meetings, developing the issue papers, drafting the plan based on committee direction, and obtaining concurrence from the affected agencies.

King County Department of Natural Resources

The Metropolitan King County Council transferred the ground water management program from the Seattle-King County Health Department to the Surface Water Management Division as part of the County's reorganization plan. Transfer of the program occurred on January 1, 1996, which coincides with the Surface Water Management Division being placed in the new Department of Natural Resources.

Subsequently, the division was renamed the Water and Land Resources Division and is now the lead agency for the Ground Water Management Program.

City of Issaquah

An interlocal agreement between the City and King County was signed to help coordinate the ground water management plan activities. The city assigned one person to serve as liaison between the two parties and provided three members for on the ground water advisory committee. In addition, the City has been responsible for:

- Assisting in development of a detailed scope of work and budget;
- Assisting in the preparation of the draft grant application;
- Assisting King County in obtaining approval of grant application;
- Participating in consultant selection process; and
- Financing a portion of the local matching share for the Ground Water Management Plan by contributing approximately $35,700 cash and $34,500 of in-kind services.

Sammamish Plateau Water and Sewer District

The District also provided three members to serve on the Ground Water Advisory Committee and has been responsible for:

- Participating in the consultant selection process;
- Providing financial support to various ground water educational events;
- Providing technical support for wellhead and ground water studies; and
- Contributing approximately $33,900 cash and $7,400 of in-kind services.

1.6 Public Review, Certification, and Implementation

Public Review

Upon completion of a draft plan, Ecology held a public hearing for comment and review of the plan. This public hearing was held at the Clark Elementary School in the City of Issaquah on April 13, 1995. Public comments from that hearing are included as Appendix A of this document. The lead agency collected public and agency comments during the three month period between April and July, 1995. Comments received during this period were analyzed by the Ground Water Advisory Committee and, where appropriate, included in the text of this document.

The Draft Issaquah Creek Valley Ground Water Management Plan has been reviewed under the requirements of the State Environmental Policy Act. The Seattle-King County Health Department prepared an environmental checklist and published a Determination of Nonsignificance in March of 1995. No comments were received pertaining to the

adequacy of the environmental review and the determination was sent to the Department of Ecology after the public comment period had closed.

Various drafts of this Plan have been prepared, leading up to the present finalization. A Draft was published in December 1994 for concurrence review and comment by various affected agencies. Comments collected during the comment period (through July 1995) were discussed with the affected agencies and governments and necessary changes incorporated into a final draft published in March 1996. This draft was submitted to the Metropolitan King County Council, and was assigned to the Law, Justice, and Human Services Committee, and hearings were held in July - October 1996 and August - September 1997. However, the plan was not passed, either for concurrence or non-concurrence, in either 1996 or 1997.

In 1998 there was a new effort to move the plan along. This time the plan was referred to two committees, the Utilities and Natural Resources Committee and the Growth Management Committee. Hearings were held in May and June of 1998, and the plan was approved, with conditions, for passage by the Council. The Ground Water Advisory Committee (GWAC) met on July 2, 1998 to discuss the issues, and some of their members testified before Council during its final hearings on the Plan on July 6. As part of the testimony, a letter was presented to Council detailing the GWAC's understanding of the changes, and is included in Appendix B. That same day, the County Council passed Motion 10496 that basically concurred with the plan, although with conditions. The motion, and a sample letter that was attached by Council to the motion, are also included in Appendix B.

The Department of Natural Resources (DNR) sent these concurrence materials to the GWAC on September 3rd with a cover letter. The chair of the GWAC, Ms. Catherine Moody, responded with a letter to the GWAC (dated September 7th) indicating the committee's general acceptance of the changes. All of these items are included in Appendix B.

Certification

The plan was revised according to Council's motion and submitted to Ecology in March 1999. Following Ecology's review of the plan and determination that it is consistent with the intent of Chapter 173-100 WAC ("Ground Water Management Areas and Programs", see Appendix D) the Plan will be certified and its implementation can begin.

Implementation

Affected agencies and jurisdictions are responsible for implementing the plan following certification by Ecology. Implementation of the plan by water purveyors, cities, and the County is voluntary. The plan may be modified under the supervision of the new Issaquah Creek Valley Ground Water Management Committee. This committee will

advise implementing agencies, oversee ground water management activities, review new issues, and consider new programs that may emerge after the plan is certified. It will be the responsibility of the Management Committee to develop a process for how to incorporate new issues and programs.

Chapter Two

Recommended Management Strategies

Issaquah Creek Valley
Ground Water Management Plan

March 1999

Recommended Management Strategies

2.1 Introduction

Ground water management plans contain management strategies to address the potential threats to ground water quality and quantity in the planning area. The Ground Water Advisory Committee was charged with the task of identifying the topics or potential problems of concern and adopting management strategies. The Issaquah Creek Valley Ground Water Advisory Committee identified the following topics for consideration: special area designations to enhance ground water protection, storm water management, hazardous materials management, underground storage tank management, on-site sewage disposal system use, pesticides and fertilizers, well construction and abandonment, sewer pipes, solid waste landfills, burial of human remains, sand and gravel mining, biosolids and effluent, and ground water quantity.

In developing the management strategies, the Issaquah Creek Valley Ground Water Advisory Committee made maximum use of existing governmental programs and regulatory structures. The Issaquah Creek Valley Ground Water Advisory Committee was determined to build on existing efforts rather than developing new and potentially duplicative programs. Also, the Ground Water Advisory Committee realized that the adopted strategies could not totally prevent contamination problems from occurring in the Issaquah Creek Valley aquifers, but that implementation of the management strategies should greatly limit the frequency and severity of such problems.

The Ground Water Advisory Committee prioritized management strategies based on relative impact to ground water and the method used to address the problem (such as regulation or education). The Ground Water Advisory Committee prioritized the management strategies because they recognized that not all management strategies could be implemented at the same time (so they could be implemented over several years), and that some agencies might not concur with all recommended management strategies. Prioritization allows the Ground Water Advisory Committee to indicate the relative importance of each recommended management strategy. This process resulted in twenty different ranking levels. These are grouped into high (1 - 8), medium (9 - 15), and low (16 - 20).

This chapter covers those issues that affect both ground water quality and quantity (Section 2.2); those that affect ground water quality only (Section 2.3); and those that affect ground water quantity only (Section 2.4). The sections first describe the goals for each issue, then specific issues with each topic are stated, and the adopted management strategy(ies).

Summary of Technical Findings and Recommendations

The following discussion illustrates the relationship between the technical information found in the Area Characterization and the recommended management strategies in the

Plan. The recommended management strategies can be classified as pertaining to either ground water quantity, ground water quality or both quantity and quality.

Water Quality Issues

One hundred percent of the water used for private, municipal, industrial and agricultural purposes in the Issaquah Creek Valley Groundwater Management Area is provided by ground water sources. The ground water system in this area is composed of mountain, upland and valley aquifers. The high-capacity production wells, which provide the primary water supply, are located in the lower Issaquah Valley. At least three major aquifer zones have been identified in these deposits; an upper, lower and deep zone. Data collected for this Plan do not show regional confining layers within this aquifer system. Without a protective layer, the water table of the most shallow of the valley aquifers is considered to be highly susceptible to contamination from surface sources.

Water supply wells draw from all three zones in the valley, which have been demonstrated to be in limited hydraulic continuity, or connected. Pumping the deeper wells can cause the water in the upper aquifer to be pulled down toward the deeper aquifer. However, the natural direction of flow in the aquifer system near Lake Sammamish is upward from the deep and lower zones. It is possible, but unlikely, that if the upper aquifer zone is contaminated, the water quality in all three zones could become contaminated as well. The production wells draw water from a considerable depth in the upper zone, therefore ground water supply from the upper zone is considered to be moderately susceptible to contamination.

Ground water in the Issaquah Creek basin comes from precipitation in the basin. Ground water recharge occurs when precipitation travels through soil and reaches the water table of the uppermost aquifer. Areas where ground water is most susceptible to contamination are where precipitation and potential contaminants can travel easily through the soil. The areas with the highest infiltration potential are those with sand and gravel deposits. The most significant of these areas lies east of the City of Issaquah on the uplands between the East and North Forks of Issaquah Creek.

Aquifers are considered to be "vulnerable" where the soil is permeable, depth to ground water is shallow, and where a potential contamination source is present. (An example would be where a dry cleaners, using an on-site sewage disposal system, is located over a gravel aquifer.) Given the location of municipal wells, the lower Issaquah Creek valley is a vulnerable aquifer system. In the lower valley, high-capacity wells have been completed at depths of ninety-five feet below ground surface and deeper in coarse-grained sediments, which generally are not separated from the surface by impermeable materials. Several potential contaminant sources are present in the City of Issaquah and surrounding areas, and may increase in number as development increases. In addition, commercial and industrial growth is likely to continue in the downtown area in the vicinity of the lower valley aquifer system. Most large supply wells are located near major transportation corridors and in the vicinity of high-intensity land uses.

The upper Issaquah Valley aquifer system has been, and will continue to be, very vulnerable to contamination. This system, located in the southern part of the Ground Water Management Area, is affected by known contaminant sources including the Cedar Hills Landfill and Queen City Farms Industrial Waste Site (currently on the U. S. Environmental Protection Agency's Superfund List). These sites have contaminated the regional groundwater system in the upper valley, upgradient of the lower valley area. Both sites have ongoing clean-up activities to mitigate the ground water contamination.

During the period of this study, one known contamination incident has occurred in the lower Issaquah Creek Valley involving leakage from an underground storage tank containing petroleum products. Traces of petroleum based contaminants were detected as deep as approximately sixty feet below ground surface. This event threatened, but did not impact, the water quality in an existing high-capacity production well. The incident increased the awareness of the importance of ground water protection in this area.

Even with the potential for contamination, water quality in the lower Valley has been found to be generally excellent. Although no volatile organic compounds have been detected in major aquifers or wells, volatile organic compounds have been found in shallow ground water at spill sites in the lower valley. Therefore, land use activities do appear to impair local water quality. The Ground Water Advisory Committee discussed many land use activities that could affect ground water quality, and recommended management strategies for these activities. These activities will have the greatest impact on ground water when they occur in ground water recharge zones and in zones of high ground water susceptibility.

Management strategies that have been prioritized as "high" address the vulnerability of the lower Issaquah Valley aquifer system, and it's importance in supplying the majority of the potable water in the area. These strategies include:

- Incorporating an assessment of water quality impacts from specific land uses in a "Guidance for Environmental Reviewers," especially in areas that are determined to be highly susceptible to ground water contamination, or in high recharge areas.
- Assessing impacts of right-of-way maintenance by chemicals, and suggesting or requiring other methods if right-of-way maintenance methods could impact ground water.
- Development of basic strategies that King County could implement to assist purveyors in their wellhead protection efforts.
- The Conservation District would help small farmers prepare and implement Farm Plans for ground water and other resource protection.
- Developing a Sole Source Aquifer Petition to identify the area as a sole source aquifer. This means that partially federally funded projects must include ground water protection measures (such as a freeway interchange).
- Assessing stormwater management facilities' impact upon ground water, and making a recommendation for upgrade if necessary.

Water Quantity Issues

The ground water quantity issue has two components: recharge and water use. Land use activities affect both recharge and demand for water. Decrease in ground water recharge can be caused by development (by paving and building over high recharge areas or areas of high infiltration potential).

Recharge to the lower valley aquifers is primarily from precipitation falling directly on the lower valley, and on the eastern plateau areas. The eastern plateau areas of the Ground Water Management Area (Grand Ridge and Lake Tradition) do not directly overlie the valley aquifers, however, they may provide up to thirty percent of the direct recharge to the lower Issaquah Valley ground water system. Therefore, it is important that these areas be included in mapping of susceptible ground water and of high recharge areas, and that development trends be assessed in these areas. The recently approved Grand Ridge development, recognizing it's location on this recharge area, will include several measures to protect ground water, such as recharging ground water with surface water runoff, and homeowner education material.

The demand for water in this area is expected to increase, as more development occurs. According to the King County Comprehensive Plan, demand for water will exceed current supply for the City of Issaquah and the Sammamish Plateau Water and Sewer District by the year 2005. Updated figures reported by the purveyors indicate that the City of Issaquah's demand will exceed current supply in 2005 and Sammamish Plateau Water and Sewer District's demand will exceed current supply in 2012. No external water sources are available, nor will they be in the near future. Further water appropriations would be necessary to meet both instantaneous demand and annual demand by the year 2010. However, the Sammamish Plateau Water and Sewer District was not granted additional water volume (only supplemental rights) in their water right application for a lower Issaquah Valley well, in January of 1996. Water right applications in the Issaquah Creek Valley are evaluated by the Department of Ecology for impacts to senior rights and surface water. The surface waters of the basin are closed to further appropriations. If adequate mitigation were developed for an appropriation, the application for water rights would be approved.

Recently it has been difficult for the City of Issaquah and the Sammamish Plateau Water and Sewer District (the two major purveyors in the Ground Water Management Area) to obtain additional water rights for valley wells from the Department of Ecology, based on the continuity of surface and ground waters in the basin. These purveyors are using creative alternatives to maximize their current water appropriation to meet requirements of the Growth Management Act and accommodate anticipated accelerated growth in the area. The City of Issaquah is changing their operating strategy from an average day (pumping rate) storage strategy to peak day storage. The City intends to use storage to offset peak demand, and is currently assessing the feasibility of building reservoirs for storage purposes. The Sammamish Plateau Water and Sewer District is also currently

adjusting operations of the distribution and storage systems to enhance their existing water rights and pumping capabilities.

The Issaquah Wellhead Protection Plan addresses zoning and future land use with respect to aquifer protection within the City of Issaquah in areas of high susceptibility or high recharge. Recommendations in this plan should be followed to assure appropriate land use in most critical areas.

In summary, continued growth in the Issaquah Creek Valley Ground Water Management Area will require greater volumes of water than is currently withdrawn from the Issaquah Valley aquifer system. To meet this need, purveyors are investigating conventional and unconventional supply alternatives. New developments should recognize and mitigate their potential impact to the ground water supply. In this case, where an aquifer system provides the only source of water to an area, and the maintenance of stable ground water levels is of importance, the Ground Water Advisory Committee recommends management strategies to assist in preserving ground water quantity. These include:

- Assessing development's potential impact to recharge areas or infiltration. Also, an analysis of aquifer capacity and associated surface water/ground water interaction should be performed, if water rights application is part of the development proposal. This would add to the current environmental threshold determination review (which currently only addresses withdrawal or direct contamination).
- Adoption of general aquifer protection policies to provide the policy framework for implementation of specific requirements.
- Providing information to decision makers to aid them in land and water use decisions.
- Providing education for citizens and local governments by adding to existing educational efforts, and developing needed new education.
- Mapping physically susceptible and recharge areas to provide a visual tool for decision makers and the public when discussing groundwater concerns, and to provide an estimate of the land area and governments involved in groundwater protection.

2.2 Programs Related To Both Ground Water Quantity and Quality

During the planning process, two significant legislative acts influenced the Ground Water Advisory Committee's recommendations. The first is the Growth Management Act, which was passed by the Washington legislature in 1990. This act requires local government to identify and protect areas that are critical for aquifer recharge. The Ground Water Advisory Committee responded by recommending some actions that are countywide in applicability rather than limited to the Ground Water Management Area. This is in keeping with the directive of the Growth Management Act to local governments to cooperatively protect aquifer resources on a county or regional basis.

The second is wellhead protection requirements in the State Department of Health Wellhead Protection Program. The program requires public water system purveyors to delineate wellhead protection areas for each public water system and develop programs to protect ground water in those areas. The Ground Water Advisory Committee recognized the need for King County to be able to respond to recommendations in Wellhead Protection Plans for land use and other ground water protection strategies.

The Ground Water Advisory Committee identified four topics that affect ground water quantity and quality: special area designation; data collection and management; storm water management; and education. The goals that guided development of the recommended management strategies for each are:

Special Area Designations to Enhance Ground Water Protection. To use available special area designations in conjunction with local regulations and policies to enhance ground water protection efforts in the Issaquah Creek Valley Ground Water Management Area.

Data Collection and Management Program. To protect ground water quantity and quality by developing and implementing a data collection and management program.

Storm Water Management. To promote storm water management practices that provide the greatest amount of recharge while protecting ground water quality.

Education Program. To increase individual participation in protecting the ground water resource by educating citizens in the Issaquah Creek Valley Ground Water Management Area about ground water, the threats to quantity and quality, and ways they can reduce those threats.

2.2.1 Special Area Designations to Enhance Ground Water Protection

A number of special federal, state, and local area designations may be used to enhance a Ground Water Management Program. 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 an important result of a special area designation. Among the special area designations discussed in this chapter are the following:

- Areas with a critical recharging effect on aquifers used for potable water per the Growth Management Act (Chapter 36.70A RCW);
- Well Head Protection Areas, according to the 1986 amendments to the federal Safe Drinking Water Act;
- Environmentally Sensitive Areas, according to State Environmental Policy Act Rules (Chapter 197-11 WAC);
- Special Protection Areas, according to Water Quality Standards for Ground Waters of the State of Washington (Chapter 173-200 WAC);

- Sole Source Aquifers, according to the federal Safe Drinking Water Act of 1974; and
- Aquifer Protection Areas, according to Chapter 36.36 RCW.

Areas with a Critical Recharging Effect on Aquifers Used for Potable Water per Chapter 36.70A RCW, Growth Management Act

The Growth Management Act of 1990 requires all counties and cities in Washington to plan in order to manage growth. This act, much of which is codified in Chapter 36.70A RCW, requires that the largest and fastest growing counties (and the cities within them) conduct land use planning to achieve protection of critical areas.

The Growth Management Act also requires that the comprehensive plans contain land use controls to protect quality and quantity of ground water used for public water supplies (Chapter 36.70A.070(1) RCW). King County adopted the November 1994 King County Comprehensive Plan to meet the Growth Management Act requirements. The King County Comprehensive Plan contains policies to designate and protect critical aquifer recharge areas. The City of Redmond has adopted its Comprehensive Plan, and adopted development regulations in 1996.

The Well Head Protection Program Under the Federal Safe Drinking Water Act

The 1986 amendments to the Safe Drinking Water Act established a Well Head Protection Program intended to safeguard ground waters that are tapped by public water supply wells. A Well Head Protection Area is defined in the Safe Drinking Water Act as "the surface and subsurface area around a well or wellfield supplying a public water system through which contaminants are reasonably likely to move toward and reach such water well or wellfield" (42 U.S.C.A. 300h-7(e)). Due to the nature of well head 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. Public water system purveyors are responsible for delineating the Well Head Protection Area and inventorying sources of contamination within the Well Head Protection Area. Local land use authorities (cities, counties) are responsible for zoning controls and pollution sources outside the authority of the federal or state government. 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 public water systems are entities that do not control surrounding land use, the success of the Well Head Protection Program will depend on the willingness of other local governments to impose necessary land use or other restrictions.

Considering the large number of public water systems, implementing individualized land use controls for each would be unworkable for King County. However, it should be possible to develop a basic Well Head Protection Program under which water purveyors

could apply to the county for protection. The City of Issaquah and the Sammamish Plateau Water and Sewer District have completed the lower Issaquah Valley Well Head Protection Plan (Golder Associates, November, 1993). They may ask King County to enact wellfield protection measures for the area outside of the City of Issaquah.

Environmentally Sensitive Area Designation Under the State Environmental Policy Act

The State Environmental Policy Act (SEPA) rules are implemented in unincorporated King County through the King County Code, "County Environmental Procedures" (Title 20.44). The Department of Development and Environmental Services is responsible for environmental review in relation to code requirements and for implementing SEPA compliance for private development proposals in King County. Municipalities within King County have either adopted the SEPA rules by reference or have developed their own regulations incorporating them. Municipalities conduct environmental review for projects occurring within incorporated boundaries.

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. This list of exempted types of activities is 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.

Local governments have the authority to lower thresholds for requiring environmental review by designating certain portions of their land use jurisdiction as an Environmentally Sensitive Area. These areas are generally more vulnerable to the adverse effects of land and water-use activities. Designation would permit the Metropolitan King County Council and city councils to eliminate from environmental review many of the categorical exemptions that are currently allowed.

Sole Source Aquifer Designation Under the Federal Safe Drinking Water Act

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 percent, of their funding from the federal government are affected.

The two Sole Source Aquifers in King County are in the lower Cedar River Valley and Vashon Island. There are a number of positive aspects of a Sole Source Aquifer designation, the most important of which is its public awareness value.

Aquifer Protection Areas Under Chapter 36.36 RCW
The purpose of an Aquifer Protection Area is to establish a funding base for ground water protection, preservation, and rehabilitation programs. Aquifer Protection Areas are established through an election ballot issue requiring approval from a simple majority of voters within the proposed Aquifer Protection Area. If voters approve the Aquifer Protection Area, 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.

Issue 1 General Protection of Aquifers: Effective aquifer protection requires cooperation between land use jurisdictions because aquifers do not coincide with jurisdictional boundaries. General policies that provide guidance for land use decisions could be adopted by King County and the City of Issaquah in the Issaquah Creek Valley Ground Water Management Area to provide a basic level of protection for aquifers.

SA-1A Elimination of Categorical Exemptions to the State Environmental Policy Act: King County and the City of Issaquah will jointly determine whether any categorical exemptions to the State Environmental Policy Act should be eliminated in the most physically susceptible and recharge areas as identified (mapped) in the Ground Water Management Plan.

Who:	King County and the City of Issaquah via the Management Committee.
Priority:	High (Level Equivalent: 3)
Cost:	0.25 FTE staff per local government; 2 local governments involved.
Funding Source:	Aquifer Protection Area Fund.

SA-1B Designation of Environmentally Sensitive Areas: If any categorical exemptions are determined to be eliminated (under SA-1A) King County and the City of Issaquah will designate the most physically susceptible and recharge areas in the Issaquah Creek Valley Ground Water Management Area as an Environmentally Sensitive Area as authorized by the State Environmental Policy Act so that those categorical exemptions may be eliminated.

Who:	King County and the City of Issaquah.
Priority:	High (Level Equivalent: 3)
Cost:	0.25 FTE staff per local government. Also, King County Department of Development and Environmental Services, Code Development Section estimates 0.013 FTE.
Funding Source:	Aquifer Protection Area Fund.

SA-1C Adoption of General Aquifer Protection Policies: King County and the City of Issaquah within the Issaquah Creek Valley Ground Water Management Area will adopt the following policies for the Issaquah Creek Valley Ground Water Management Area:

1. Ground water-based public water supplies should be protected by preventing land uses that may adversely affect ground water quality or quantity to the extent that the supply of high-quality drinking water to present and future populations might be jeopardized.
2. While protection and sustainable use of ground water based drinking supplies in the Issaquah Creek Valley Ground Water Management Area is preferred over importing water from sources outside of the Ground Water Management Area, importing water will not be prohibited if necessary to support urban development within the Urban Growth Area.
3. King County will protect the quality and quantity of ground water by implementing King County Comprehensive Plan policies U-206, NE-335 and NE-336, which state:

U-206 Environmental standards from urban development should emphasize ways to allow maximum permitted densities and uses of urban land. Mitigating measures should be encouraged to serve multiple purposes, such as drainage control, ground water recharge, stream protection, open space, cultural and historic resource protection and landscaping. When technically feasible, standards should be simple and measurable, so they can be implemented without lengthy review processes.

NE-335 In making future zoning and land use decisions that are subject to environmental review, King County shall evaluate and monitor ground water policies, their implementation costs, and the impacts upon the quantity and quality of ground water. The depletion or degradation of aquifers needed for potable water supplies should be avoided or mitigated, and the need to plan and develop feasible and equivalent replacement sources to compensate for the potential loss of water supplies should be considered.

NE-336 King County should protect ground water in the Rural Area by:

a. Preferring land uses that retain a high ratio of permeable to impermeable surface area and that maintain or augment the infiltration capacity of the natural soils; and
b. Requiring standards for maximum vegetation clearing limits, impervious surface limit, and, where appropriate, infiltration of surface water. These standards should be designed to provide appropriate exceptions consistent with Policy R-216.

4. Well Head Protection Programs will provide direction for focusing intense aquifer protection efforts in those areas, usually urban, where the existing built environment presents very significant risks to public drinking water systems.

Who:	King County Office of Strategic Planning and the City of Issaquah
Priority:	High (Level Equivalent: 3)
Cost:	King County Office of Strategic Planning: 0.04 FTE
Funding Source:	General agency funds

SA-1D Enhanced Environmental Review to Protect Aquifers: King County and the City of Issaquah will jointly develop guidance to assist environmental reviewers to:

- Identify proposed development that may significantly impact ground water in physically susceptible and recharge areas as mapped by the Ground Water Management Plan;
- Recognize and require adequate information to assess impacts upon ground water; and,
- Recognize and propose effective mitigation.

Who:	King County Department of Natural Resources for the approval of the Management Committee.
Priority:	High (Level Equivalent: 3)
Cost:	0.5 FTE at King County Department of Natural Resources. City of Issaquah to be determined.
Funding Source:	Aquifer Protection Area Fund.

SA-1E Define and Map Ground Water Susceptibility Areas: King County and the City of Issaquah will place a priority on implementation of the Issaquah Ground Water Management Plan in physically susceptible and recharge areas. These areas include areas physically susceptible to ground water contamination and aquifer recharge areas. Areas of unusual susceptibility to ground water contamination (important to identify to protect ground water quality) are defined and mapped according to the following criteria:

- *Soil permeability* - Soil units are defined by the Natural Resources Conservation Service in the Soil Survey of the King County Area (Soil Conservation Service, 1973). Soils were given a 25% rating. A full rating was not used, since that would duplicate surficial geology in the mapping equation. Soils that are excessively drained or are somewhat excessively drained are rated high; soils that are well drained or moderately well drained are rated moderate; and soils that are somewhat to very poorly drained are rated low.
- *Geologic materials* - United States Geological Survey maps provide information on surficial geology. A clean sand and/or gravel is rated high, tight silt or clay is rated low, and materials (mixtures of sand, silt or clay) that fall between the two categories are rated as moderate.
- *Depth to water* - Driller's logs and previous investigations are used to determine depth to water. Existing water table elevation maps are used, if available. High (0-25 feet from surface), moderate (26-75 feet from surface), and low (greater than 75 feet from surface) contamination potentials are assigned. Depth to water greater than 100 feet would assume that a relatively permeable layer would likely exist above the water table.

Areas receive overall ratings by use of an overlay map that incorporates ratings from the three physical parameters. All parameters are assigned equal weight. A combined rating score is assigned to each portion of the mapped area. Determination of whether an area has a high, moderate, or low susceptibility is then made by conservative interpretation of the combined rating. For example, a combined rating score of high-high-moderate-moderate is given an overall rating of high while a rating of high-moderate-low-low is given an overall rating of moderate. A composite map shows the physically susceptible areas rated high, moderate, and low.

The maps produced for the Ground Water Management Plan and for the King County Comprehensive Plan were based on available information. Both the Ground Water Management Plan and the Comprehensive Plan specify that the maps will be refined as new information becomes available. Identification and protection of areas important for ground water quantity and quality is required by the Growth Management Act. King County expects to meet this requirement by starting with the maps currently produced, and adding information such as new information from wellhead studies and environmental evaluations, so that they are useful for planning and ground water protection. A recharge map to address ground water quantity concerns needs to be developed.

Who:	King County, the City of Issaquah. The lead agency should be responsible for dissemination of reliable data about the location of the recharge areas.
Priority:	High (Level Equivalent: 3)
Cost:	No initial cost; task is accomplished by concurring with Ground Water Management Plan. King County expects costs associated with further refinement of the maps. King County Department of Development and Environmental Services, Code Development Section: 0.06 FTE.
Funding Source:	General agency funds would be used to disseminate mapped information. The Aquifer Protection Area Fund would support further revision of the maps.

Issue 2 Well Head Protection: Public water system purveyors are required to meet federal wellhead protection requirements to delineate and adopt measures to protect well head protection areas. The Ground Water Management Plan will fulfill some wellhead protection needs by providing educational material and general ground water protection strategies. However, specific strategies to provide an increased level of protection to public water systems will be required by the Washington Department of Health. To accommodate the needs of hundreds of large system purveyors, King County needs the purveyor assistance in developing a basic approach to wellhead protection in the unincorporated areas.

SA-2 Basic Well Head Protection Program: King County, the City of Issaquah, public water system purveyors, and others jointly facilitate wellhead protection in King County by assigning to the Ground Water Management Committee the following tasks:

1. Develop and recommend, for adoption by the Metropolitan King County Council, strategies that King County could implement to aid in wellhead protection.

2. Incorporate minimum state wellhead protection requirements into the Ground Water Management Plan to allow for their implementation to be eligible for funding by the Aquifer Protection Area Fund.

This recommendation is supported by King County Comprehensive Plan policy NE-333 which provides for: "...b. Developing a process by which King County will review, and implement, as appropriate adopted Wellhead Protection Programs in conjunction with cities and ground water purveyors...."

Task 1. Develop minimum wellhead protection requirements and recommend for adoption by the Metropolitan King County Council.

Who:	King County, the City of Issaquah, and public water system purveyors via the Management Committee.
Priority:	High (Level Equivalent: 2)
Cost:	Included in the cost of participation in the Management Committee. See Chapter 3, Table 3.8.1 for estimate. King County Department of Development and Environmental Services, Code Development Section: 0.56 FTE, King County Department of Natural Resources 0.5 FTE.
Funding Source:	Aquifer Protection Area Fund.

Task 2. Incorporate minimum wellhead protection requirements into the Ground Water Management Plan.

Who:	King County, the City of Issaquah, and public water system purveyors via the recommendations of the Management Committee.
Priority:	High (Level Equivalent: 2)
Cost:	Included in the cost of participation in the Management Committee. See Chapter 3, Table 3.8.1 for estimate.
Funding Source:	Aquifer Protection Area Fund.

Issue 3 Sole Source Aquifer Petition: Sole Source Aquifer designation enhances local ground water protection efforts by increasing the level of public concern about the aquifer and by providing additional protection when certain types of development are being reviewed by permitting agencies. A petition must be prepared and submitted to the Environmental Protection Agency for review and approval to obtain the designation.

SA-3 Submit Sole Source Aquifer Petition: The King County Department of Natural Resources will prepare and submit to the Environmental Protection Agency a petition for federal Sole Source Aquifer designation for the Issaquah Creek Valley Aquifer.

Who:	King County Department of Natural Resources
Priority:	High (Level Equivalent: 1)
Cost:	0.25 FTE.
Funding Source:	Aquifer Protection Area Fund.

2.2.2 Data Collection and Management Program

Long-term data collection of ground water quality and quantity, precipitation and stream flow is necessary for the continued development of a conceptual characterization of ground water hydrology within the ground water management area. Further data collection and analysis is needed along with an expanded network of existing and new wells for the development of a conceptual model of groundwater hydrology. The collected data needs to be entered into a database and analyzed to provide useful information for making resource management decisions. Data is collected and analyzed so that state and local agencies can:

- Determine water resource trends in ground water quality and quantity;
- Make informed decisions on such issues as land use and water rights;
- Plan for peak water use and population growth impacts;
- Track development of new water sources;
- Develop and refine a water resource model;
- Respond to data requests from water agencies and other interested parties; and,
- Respond to incidents such as water level declines.

Issue 1 Data Collection, Analysis and Management: Ground water resource data gathered on a long-term basis enables land and water use agencies to make informed decisions. Data collection and analysis to date has been used to develop a general characterization of ground water hydrology. Additional data collection and analysis is needed to refine characterization of the aquifer and to manage the resource.

DCM-1 Data Collection, Analysis, and Management Program: The King County Department of Natural Resources will develop and implement a data collection and management program that:

1. Collects data needed according to the Data Collection List.
2. Continues data entry into the database, manages the data for quality control and applicability to analysis techniques, shares the data with other agencies and ensures data compatibility with other data collection efforts.
3. Analyzes the data to:
   a. refine a conceptual understanding of the ground water hydrology determination of the available resource,
   b. protect the resource from depletion and contamination,
   c. assess the impacts of land use on the resource, and

d. determine if a numerical model is needed or would be useful for ground water management.

Task 1. Tag existing and new wells where found.

Who:	Seattle-King County Health Department, Ecology, City of Issaquah, Sammamish Plateau Water and Sewer District, well drillers and volunteers.
Priority:	High (Level Equivalent: 1)
Cost:	0.5 FTE for Seattle-King County Health Department/yr. City of Issaquah and Sammamish Plateau Water and Sewer District: To be determined
Funding Source:	Aquifer Protection Area Fund

Task 2. Monitoring of water quality, water level, precipitation, and stream discharge parameters. Where water level declines or ground water contamination is observed, appropriate action would be taken. Conduct other activities listed in the attached table.

Task 3: Enter data collected into the King County Department of Natural Resources database. Maintain database and provide this data regularly to Ecology, the City of Issaquah and Sammamish Plateau Water and Sewer District.

Task 4: Develop a ground water hydrology model

Who:	King County Department of Natural Resources
Cost:	King County Department of Natural Resources 1 FTE/yr. Non-FTE costs: $170,340.
Priority:	High (Level Equivalent: 1)
Funding Source:	Aquifer Protection Area Fund.

DCM-2 Data Collection, Analysis and Management: Ecology: Ecology will input local ground water management area data into Ecology's ground water database.

Who:	Ecology
Cost:	0.06 FTE/yr.
Funding Source:	General Agency Funds

2.2.3 Ground Water Quality and Quantity Issues Associated with Storm Water Management

Past and present storm water management practices account for some ground water quantity and quality problems. Ground water quality may be affected if storm water containing contaminants is recharged intentionally or inadvertently. Also, the amount of precipitation is diverted to surface water when, under natural conditions, it would be recharged to ground water. As a result, there is a decrease in the quantity of water recharged to ground water.

Issue 1 Runoff Versus Recharge: The King County Surface Water Design Manual encourages, but does not require infiltration as a method of storm water management. The Manual requires that there be no increase in peak runoff rates. Potential ground water recharge could be lost to runoff, thereby causing depletion of aquifers. Many cities in Ground Water Management Areas have adopted or use the King County Surface Water Design Manual for reference in their storm water management programs and are, therefore, likely following the same policy towards infiltration.

ST-1 Runoff Versus Recharge: ***Surface Water Design Manual*:** King County and the City of Issaquah will amend/adopt surface water design manuals to promote that runoff be treated and infiltrated. The treatment should ensure that the infiltrated water will not increase pollutant loading to the ground water. Extreme caution should govern recharge and infiltration policies and be based on a site-by-site evaluation. No net reduction of recharge in any new development or redevelopment in the most physically susceptible and recharge areas will be the guiding policy.

Who:	King County and the City of Issaquah
Priority:	High (Level Equivalent: 1)
Cost:	To be determined.
Funding Source:	City of Issaquah and King County general funds.

Issue 2 Ground Water Quality Concerns: Numerous studies have demonstrated that nonpoint source pollution is a major contributor to ground water degradation. Water quality controls and infiltration of storm water will increasingly be used to reduce nonpoint source pollution effects upon both surface and ground water resources. Technology associated with these practices is in the early stages and long-term effects on ground water quality are unknown. While water quality controls will improve the quality of the water discharged to the ground, the increasing emphasis on infiltration poses risks. Infiltration will be employed most often in areas with glacial and alluvial soils associated with recharge areas. Regardless of the comprehensiveness of new requirements, treatment systems will sometimes fail for a variety of reasons and they cannot be expected to function optimally at all times. Additionally, nonpoint source pollution that is not borne by storm water will infiltrate and reach ground water regardless of storm water management techniques.

ST-2A Ground Water Quality Concerns - Facility Requirements: King County and the City of Issaquah within the Issaquah Creek Valley Ground Water Management Area will require that all types of stormwater facilities be designed to protect ground water quality. The Ground Water Advisory Committee supports the changes to the King County *Surface Water Design Manual*, to meet the State's requirements.

ST-2B Facility Study: King County and the City of Issaquah will jointly sponsor study of the effectiveness of the facilities described in ST-2A.

ST-2C Facility Monitoring: King County will monitor a sample of the facilities described in ST-2A in actual use and prepare a report of findings.

Who:	King County and City of Issaquah.
Priority:	High (Level Equivalent: 2)
Cost:	Costs for regulation change to be provided by the City of Issaquah; the study needs to be developed to determine its costs.
Funding Source:	General agency funds.

Issue 3 Education: Considerable effort is underway to educate the public on the prevention of nonpoint pollution and improper disposal of hazardous materials. Educational strategies are found in the Education Program.

Issue 4 Coordination Between Surface and Ground Water Planning Efforts: Surface and ground water planning efforts should be effectively coordinated to make the best use of limited resources.

ST-4A Coordination Between Surface and Ground Water Planning Efforts - Ecology Programs: Ecology will assess surface and ground water quality planning programs to determine how they could be combined or coordinated in a way that is both scientifically justified and which provides for greater efficiency.

Who:	Ecology
Priority:	Medium (Level Equivalent: 12)
Cost:	0.32 FTE
Funding Source:	General agency funds.

ST-4B Coordination Between Surface and Ground Water Planning Efforts - Puget Sound Water Quality Action Team: The Puget Sound Water Quality Action Team recognizes that surface and ground water form a continuous and dynamic system which must be comprehensively protected. The Puget Sound Water Quality Management Plan should be revised to address all water quality issues in the Puget Sound drainage basin, including ground water.

Who:	Puget Sound Water Quality Action Team
Priority:	Medium (Level Equivalent: 14)
Cost:	To be determined.
Funding Source:	General Agency Funds.

ST-4C Coordination Between Surface and Ground Water Planning Efforts - King County: King County will assess its water resource planning efforts to determine how to effectively coordinate them to provide the best possible protection of water resources. The Metropolitan King County Council recognized this need when they transferred the ground water program into the Water and Land Resources Division of the Department of Natural Resources. Water and Land Resources and the Wastewater Division staff are

currently assessing how to best provide comprehensive water resource management (i.e., surface water, ground water, and sewage treatment) during the creation of the new Water Resources Division.

Who:	King County Department of Natural Resources
Priority:	High (Level Equivalent: 3)
Cost:	None, efforts are currently underway
Funding Source:	General funds should be used to cover staff time spent in this effort.

Issue 5 Assessment of Existing Storm Water Facilities: Existing storm water management facilities (or the lack of facilities) in the most physically susceptible areas and Well Head Protection Areas may pose a risk to ground water quality and the population served by public water systems. Some facilities were constructed when there was little concern about ground water quality. Of particular concern are dry wells used in commercial and industrial areas. Alternatively, there are areas in which no storm water facilities other than ditches were constructed to accompany development. This situation may be found in areas with highly permeable soils that were developed prior to current regulations. Storm water enters ditches in these areas and rapidly infiltrates without benefit of treatment.

ST-5 Assessment of Existing Storm Water Facilities in the Most Physically Susceptible and Recharge Areas: King County and the City of Issaquah will assess the adequacy of storm water facilities in the most physically susceptible areas and Well Head Protection Areas to protect ground water quality and to give these areas high priority for water quality facility retrofit as warranted. This includes an inventory of facilities in areas, assign ranking depending on facility type, and identifying which facilities should be retrofitted and develop schedule.

Who:	King County Water and Land Resources and the City of Issaquah
Priority:	High (Level Equivalent: 3)
Cost:	To be determined.
Funding Source:	General agency funds; this activity can be included in the current inventory of facilities.

Issue 6 Roadway Runoff: The State Highway Runoff Program provides for improved water quality and quantity controls for storm water runoff from new and existing state highways. The King County *Surface Water Design Manual* requires water quality and quantity controls for new roadways in King County. Many cities have similar requirements. However, state and local programs may not address quality and quantity problems associated with existing roadways. Existing contamination problems may be identified via Basin Plans developed by King County Water and Land Resources Division in cooperation with cities (and via other processes) to identify needed capital improvements. King County and cities then address the problems identified as funding allows.

ST-6 Roadway Runoff: King County and the City of Issaquah will:

- Direct their transportation or public works departments to give high priority to physically susceptible areas and wellhead protection areas when identifying and correcting water quality problems associated with existing roadways, and
- Develop a program to retro-fit existing structures, as required by the National Pollution Discharge Elimination System, which will require stormwater quality and quantity controls comparable to new regulations when conducting major renovation or widening of roads.

King County Department of Transportation, Road Services Division does not concur with the first paragraph under ST-6 because ground water criteria are not currently factored into the process for allocating resources. This recommendation is placed in the Unfinished Agenda, noting Department of Transportation concerns.

Issue 7 Soil Amendment: Glacial till soils impede the infiltration of precipitation and are associated with relatively high runoff volumes subsequent to clearing of natural vegetation. Pesticides and nutrients used in landscaping may be carried off-site with runoff instead of being retained in the soil where they can be used or broken down by natural processes. Contaminated runoff is carried to aquifer recharge areas where it may contribute to ground water contamination. Glacial outwash soils and railroad ballast also present problems in relation to pesticides and other contaminants. These chemicals may penetrate well beyond the root zone due to poor attenuation capability of the soil resulting in contamination of shallow aquifers.

ST-7 Soil Amendment Study: King County and the City of Issaquah will jointly evaluate the ground water quality and quantity benefits of soil amendment. Soil amendment requirements shall be implemented if the proposed research proves to be a practical method of improving water quality, increasing infiltration, and reducing storm water runoff.

Who:	King County, City of Issaquah, Center for Urban Water Resources, University of Washington.
Priority:	Medium (Level Equivalent: 11)
Cost:	To be determined with input from Center for Urban Water Resources Management. Estimate 0.24 FTE for the King County Department of Natural Resources.
Funding Source:	Centennial Clean Water Funds should be sought. Local governments would have to pool resources for matching funds. Other grant sources may also need to be explored. Alternatively, local governments could pool resources to fund the study.

2.2.4 Ground Water Education Program

Providing citizens with information on the ground water resource and protection may be a particularly effective protection method. Understanding, caring and commitment are

needed to protect a finite basic resource that is affected by a wide variety of activities. Although regulations may help, groups of informed citizens actively caring for ground water under their own communities might be more effective. Providing technical assistance will not address all the concerns, but it will entice some community members to take individual action.

A number of education programs are focused on individual sources of contamination. However, no comprehensive ground water education program focuses on the following tasks:

- Aid in developing resource protection messages that are consistent regardless of the specific education program;
- Coordinate with other resource protection programs that focus on a specific issue, such as solid waste, hazardous waste, and storm water management;
- Develop specific education activities and materials for point and nonpoint sources of contamination that do not have their own individual programs;
- Support research on ground water resource; and
- Encourage and promote conservation.

A comprehensive program would coordinate existing environmental education programs to develop consistent messages about the ground water resource and ground water protection. This component would be done by briefing environmental educators about King County's ground water system and supporting joint programs. The program would respond to local ground water quality and quantity concerns not already covered by other programs, and provide assistance for local planning efforts and other ground water protection projects.

Issue 1 Existing Educational Programs: Considerable effort is underway to educate the public about the prevention of nonpoint pollution, conservation, well construction and improper disposal of hazardous materials. Agencies or jurisdictions involved include King County, the City of Issaquah, Puget Sound Water Quality Action Team, Ecology, King Conservation District, Natural Resources Conservation Service, public and private schools and others. Existing educational materials need to contain ground water resource protection information.

ED-1 Existing Education: King County and City of Issaquah will jointly carry out a ground water education program that reviews existing educational activities and make use of these programs when applicable. The King County Department of Natural Resources will review applicable educational efforts underway to determine whether the protection of ground water is emphasized. The King County Department of Natural Resources will seek the cooperation of the parties involved to include ground water information and concerns in the educational programs. The specific elements of the program are:

- Existing educational program content will be reviewed for agreement with Issaquah Creek Valley Ground Water Management Plan policies and goals. The King County Department of Natural Resources will review the current educational programs of the Natural Resources Conservation Service, Cooperative Extension, and others to ensure that the Issaquah Creek Valley Ground Water Management Plan goals and policies are reflected.

- The Local Hazardous Waste Management Program in King County will coordinate with the Household Hazardous Waste Education Committee to include information about the risks to ground water associated with the disposal of household hazardous wastes to on-site sewage systems as part of their household hazardous waste educational activities.

- King County, the City of Issaquah and the Sammamish Plateau Water and Sewer District will work with local nurseries, Washington State University Cooperative Extension Service and the Conservation Districts to promote the availability of appropriate seed stocks, plants, and materials to achieve xeriscaping (use of low water-use plants).

- The ground water education program will support conservation education efforts in the schools, and for the general public, as described in the Interim Guidelines (Interim Guidelines for Public Water Systems Regarding Water Use Reporting, Demand Forecasting Methodology, and Conservation Programs). These would include, but not be limited to, the items listed under Public Education in Section IV of the Implementation of the Guidelines.

- King County will educate residents about landscaping practices that promote aquifer recharge through an informational brochure prepared by Cooperative Extension and the King County Department of Natural Resources.

- In regards to storm water management, this effort will ensure that educational activities are adequate to communicate to the public: (1) how ground water may become contaminated via surface water pollution, and (2) ways in which ground water recharge may be encouraged.

- The Seattle-King County Health Department will coordinate measures to increase public awareness about the potential impacts of discharging household chemical products to an on-site sewage system. Such measures would be an extension of activities scheduled as part of the Local Hazardous Waste Management Plan.

- Educational efforts would complement and combine with current efforts of the King County Department of Natural Resources, Cooperative Extension, and the Conservation District. This information could be disseminated through the Master Gardener and other programs of Cooperative Extension. Awareness of the

problem of reduced aquifer recharge may increase responsibility and concern for aquifer recharge areas in the community. Educational programs on how landscaping practices can affect aquifer recharge could be coupled with education on the effects of pesticide and herbicide use on ground-water quality. A discussion of proper disposal of household hazardous wastes could be included. Landscaping tips will include a discussion of native vegetation and its role in facilitating moisture infiltration.

- Coordinate with and support Ecology's well identification, well construction, proper well maintenance, contamination sources, and well decommissioning projects. Informed and involved well owners and other community members are probably more likely to comply with the well construction and decommissioning regulations. Ways to inform and involve well owners might include distributing a questionnaire about wells to homes in the community; developing and distributing an educational brochure for homeowners; and supplementing the brochure with community educational programs. The questionnaire should be designed to elicit the number of wells on each property, the construction methods used, and the number of wells that require decommissioning. The brochure should include recommended practices and legal requirements for well construction and decommissioning. It should also include the reasons why practices such as sealing the well are both advisable and required by law so that homeowners are knowledgeable before they make plans to construct or decommission a well. The education program will cover the same information, and provide the public with an opportunity to ask individual questions.

Issue 2 New Educational Elements: Several issues do not have an existing education program upon which to build. These have been identified through the Ground Water Advisory Committee's consideration of ground water protection issues. These specific elements need to be adopted as part of the education program.

ED-2 New Educational Elements: King County and the City of Issaquah will jointly carry out a ground water education program that will develop specific educational activities and materials covering sources of contamination. The King County Department of Natural Resources will report to the Management Committee on the adequacy of existing educational programs to address ground water concerns. This report will include proposed changes as a result of review of existing educational programs. The King County Department of Natural Resources will then develop a supplemental educational program to address identified deficiencies, if necessary and present it to the Management Committee for review and adoption. New educational programs will be developed and implemented according to the adopted Ground Water Advisory Committee actions below:

1. King County will develop and carry out a public education program intended to increase the awareness of proper on-site sewage system operation and

maintenance, including the risks associated with disposal of hazardous wastes in such systems.

2. King County and the City of Issaquah will jointly educate homeowners and owners of exempt tanks regarding tank abandonment requirements of the Uniform Fire Code through the Issaquah Creek Valley Ground Water Management Plan Education Program.

3. Information about the relationship between solid waste disposal and ground water will be included in the educational program.

ED-3 New Education Elements - Volunteer Program. Volunteers will, under the direction of an assigned King County Department of Natural Resources staff person, provide an education resource for local schools, community groups, and the public at large, on issues concerning ground water. Responsibilities of these volunteers should include but not be limited to:

- Acquiring a basic understanding of hydrology, geology, and public health issues affecting ground water quality and quantity.
- Assisting the King County Department of Natural Resources staff in identifying available educational resources, materials and programs that address ground water issues and either coordinate with, incorporate or direct people to these programs.
- Assisting the King County Department of Natural Resources staff in developing a basic curriculum guide to be used by the speakers which is kept up to date with the current practices of ground water management.
- Meet with the King County Department of Natural Resources staff, local water district staff and local government on a regular basis to identify new concerns and current issues concerning water quality and quantity.

Who:	King County Department of Natural Resources, City of Issaquah, Sammamish Plateau Water and Sewer District, under direction of the Management Committee.
Priority:	High (Level Equivalent: 1)
Cost:	0.5 FTE per year City of Issaquah, 0.5 FTE, Sammamish Plateau Water and Sewer District, 0.04 FTE.
Funding Source:	Aquifer Protection Area Fund.

2.3 Programs To Protect Ground Water Quality

The Ground Water Advisory Committee researched ten subject areas that could potentially affect ground water quality. These include: hazardous materials management, underground storage tank management, on-site sewage treatment and disposal system use, use of pesticide and fertilizer, well construction and decommissioning, sewer pipes, solid waste landfills, burial of human remains, sand and gravel mining, and biosolids and

sewage effluent. The goals, under which individual management strategies were developed for these subject areas, are:

Hazardous Waste Management. To ensure that ground water is not contaminated through improper management of hazardous wastes.

Hazardous Waste Contamination Sites. To assist federal and state cleanup programs in: discovering hazardous waste disposal sites in King County, and communicating to the public, the health risks associated with ground water pollution at those sites.

Hazardous Material Spills. (1) To ensure that spills of hazardous materials are prevented. (2) To be adequately prepared to respond to spills of hazardous materials to avoid ground water contamination.

Underground Storage Tank Management. To ensure that underground chemical and fuel storage tanks and piping systems are managed adequately to prevent contamination of ground water.

On-Site Sewage Treatment and Disposal System Use. To promote on-site sewage treatment and disposal practices that are effective in protecting ground water resources from possible adverse impacts.

Use of Pesticide and Fertilizer. To prevent ground water contamination from the use of pesticide and fertilizer.

Well Construction and Decommissioning. To protect the quality of ground water in the county by ensuring that proper well construction and decommissioning procedures are followed.

Sewer Pipes. To prevent the degradation of ground water which may be caused by waste water leaking from gravity sewer pipes and side sewers, and to prevent the loss of water through infiltration to gravity sewer pipes and side sewers.

Solid Waste Landfills. To prevent the occurrence of ground water contamination problems that are associated with the operation of solid waste disposal facilities.

Burial of Human Remains. To prevent the degradation of ground water from embalming fluids, disintegrating metal caskets, decaying human remains and other materials associated with processing bodies for burial or cremation.

Sand and Gravel Mining. To ensure that regulatory programs are adequate to prevent adverse effects upon ground water quality due to sand and gravel mining operations, including reclamation.

Biosolids and Sewage Effluent. To provide assurance that the ground water in King County will not be contaminated by the reuse of wastewater effluent.

2.3.1 Ground Water Protection Issues Associated with Hazardous Materials Management

Industrial and commercial processes produce and use hazardous substances. Hazardous materials use is not, however, limited to industries and businesses. They are widely available and used by almost everyone. The impact of these substances on the environment, particularly ground water, is often determined by the management practices of the businesses and individuals that use them.

Issue 1 State Hazardous Waste Plan: The Washington State Hazardous Waste Plan has identified many deficiencies in the existing state program to regulate hazardous waste. These problems were identified by an Ecology-sponsored advisory committee made up of business leaders, government agency staff and elected officials, environmentalists, consulting firms, and educators over a period of two years. Ecology has stated that it is committed to carrying out the recommendations developed by the committee. Implementation of the recommended strategies is necessary for the state to manage hazardous wastes in a manner that will protect ground water.

HM-1 State Hazardous Waste Plan - Implementation: The Ground Water Advisory Committee adopts the following resolution: "The Ground Water Advisory Committee supports the findings and recommendations of the Washington State Hazardous Waste Plan. The Ground Water Advisory Committee requests that Ecology and the Washington Legislature fund and carry out the provisions of the Plan with a sense of urgency in recognition of the threat posed to ground water from hazardous wastes." The Ground Water Advisory Committee will communicate this resolution to the Director of Ecology, the Assistant Director for Waste Management, and to the Washington Legislature. The request to carry out the solutions recommended by the Hazardous Waste Plan is communicated to Ecology during the review and certification process for the Ground Water Management Plan. No additional action is needed.

Issue 2 Dangerous Waste Management Unit: The Washington Dangerous Waste Regulations require a setback from the dangerous waste management unit to the aquifer of beneficial use. However, no setback is required from the unit to ground water, in general. In effect, the regulations indicate that the dangerous waste management unit may be located in ground water.

HM-2 Dangerous Waste Management Unit Setback - Regulation Amendment: Ecology is requested to amend the Dangerous Waste Regulations (Chapter 173-303 WAC) to require setbacks from the seasonal high ground water level. The request to modify the setback from ground water is communicated to Ecology during the review and certification process for the Issaquah Creek Valley Ground Water Management Plan. No additional action is needed.

Issue 3 Hazardous Waste Facilities Zones: King County has not designated zones in which hazardous waste storage and treatment facilities may be considered. Failure to designate zones will result in preemption by Ecology of the right to interpret local zoning codes for the purposes of siting such facilities. This preemption is not permanent and local jurisdiction is returned upon designation of zones.

Issue 4 Hazardous Waste Contamination Sites - Site Referral and Public Education:

The Washington State Department of Health seeks a cooperative relationship with local health departments in the following areas: (1) referral of possible hazardous waste disposal sites, illness clusters, incidents of contaminated drinking water supplies, and related concerns to the Washington State Department of Health, Office of Toxic Substances; (2) assistance in gathering data in regard to these referrals; (3) public education oriented towards health concerns in relation to hazardous waste sites, including those that may involve contaminated ground water.

HM-4 Hazardous Waste Contamination Sites - Site Referral and Public Education by the Seattle-King County Health Department: The Seattle-King County Health Department, in regard to hazardous waste contamination sites, will provide assistance to the Washington State Department of Health in site discovery including collection of information on site history; and assistance to the Washington State Department of Health in public health information and referral on hazardous waste sites.

Who:	Seattle-King County Health Department.
Priority:	Medium (Level Equivalent: 9)
Costs:	0.10 FTE
Funding Source:	Aquifer Protection Area Fund.

Issue 5 Implementation of the Uniform Fire Code: Article 80 of the Uniform Fire Code is a valuable tool to prevent hazardous material spills in business, industrial, and institutional settings. Two obstacles to comprehensive implementation of Article 80 are:

- Many jurisdictions within the Ground Water Management Areas have not fully developed their hazardous materials programs. They lack adequate staff, training, and enforcement tools to implement Article 80.

- The State Building Code Council has adopted a less stringent version of Article 80 that exempts important hazardous materials from full regulation by the fire services. In addition, some businesses and industries have been exempted from the requirement for Hazardous Materials Management Plans and Hazardous Materials Inventory Statements.

- Some local jurisdictions within Ground Water Management Areas have not passed ordinances to retain the original scope of Article 80.

HM-5 Implementation of the Uniform Fire Code in Physically Susceptible Areas: King County and the City of Issaquah within the Issaquah Creek Valley Ground Water Management Area will:

- Commit staff and funding for comprehensive implementation of Article 80 in both new and existing facilities using both educational and regulatory approaches;
- Propose ordinances for adoption, if they have not already done so, that provide adequate enforcement tools to ensure compliance with Article 80 and that restore the requirements for:
  1. Hazardous Materials Management Plans;
  2. Hazardous Materials Inventory Statements;
  3. Storage requirements for "Carcinogens, irritants, sensitizers, and other health hazard solids, liquids and gases" found in Uniform Fire Code 80.315; and
  4. Emphasize regulatory attention and educational activity in physical susceptibility areas.

The lead agency for implementation of the Ground Water Management Plan will develop criteria for evaluating the hazardous materials management programs of fire services and include an annual evaluation in its regular reports to the Ground Water Advisory Committee and the Ground Water Management Committee. The King County Department of Natural Resources will continue to encourage program development and implementation on an ongoing basis.

Who:	King County Department of Natural Resources.
Priority:	Medium (Level Equivalent: 9)
Costs:	0.50 FTE.
Funding Source:	Aquifer Protection Area Fund.

Funding to implement this action needs to be discussed with the King County Fire Marshal and the City of Issaquah's fire department. The goal of this discussion is to determine whether implementation can be funded by hazardous materials permit fees alone or whether aquifer protection fees should be considered to supplement fire service activities.

Some local governments in King County have already instituted a hazardous materials permit fee as a way to fund their program. This is probably the best long-term solution to hazardous materials regulation. Each jurisdiction will assess its existing program and determine the best means to fund improvements, if needed. Their part of the program would include: hazardous materials program development including ordinances; and hazardous materials program implementation.

Who:	King County Fire Marshal and the City of Issaquah fire department.
Priority:	Medium (Level Equivalent: 9)

Costs: To be determined by each participant.
Funding Source: To be determined by each participant.

Issue 6 Implementation of the Emergency Planning and Community Right-to-Know Act: Most experts conclude that the King County Local Emergency Management Plan does not adequately address ground water issues associated with large chemical spills. The Local Emergency Management Plan has not, to date, considered the locations of sensitive areas, such as aquifer protection areas, in developing emergency response measures. This is in part because of the lack of available information.

HM-6 Implementation of the Emergency Planning and Community Right-to-Know Act in Physically Susceptible and Recharge Areas: King County, as lead agency for the Local Emergency Management Plan, and the City of Issaquah will consider ground water protection in the Local Emergency Management Plan:

- Strengthen coordination between agencies and jurisdictions that might be involved in responding to a major chemical spill;

- A hazard analysis that takes into consideration the locations of physically susceptible areas, wellhead protection areas, Sole Source Aquifers, high recharge areas and public water systems using ground water sources; and

- Firefighting techniques and emergency response techniques that favor ground water protection in physically susceptible and recharge areas;

The King County Department of Natural Resources will:

- Provide maps of physical susceptibility areas and well locations to the King County Office of Emergency Management.

- Provide information about the emergency response techniques necessary to protect aquifers and wells for Local Emergency Planning Committee consideration, and incorporation into the Local Emergency Management Plan.
- Review existing literature and determine the need to contract for a consultant with expertise in this area.

- Develop recommendations for the Office of Emergency Management, as coordinator of the Local Emergency Planning Committee. It is recommended that the lead agency work through the Local Emergency Management Plan process.

The King County Department of Natural Resources will discuss funding to implement this action with the King County Office of Emergency Management Manager and the City of Issaquah's fire department the funding that may be necessary to implement this action. The goal of this discussion is to determine whether implementation can be funded by an industry-supported program. Perhaps a portion of hazardous materials permit fees

referred to in Action HM-5 could be dedicated to supporting the Local Emergency Management Plan. The possibility of supplementing hazardous materials permit fees with aquifer protection fees would be considered.

Task 1. Include ground water protection measures in the Local Emergency Management Plan.

Who:	King County Office of Emergency Management in cooperation with the City of Issaquah and other members of the Local Emergency Planning Committees.
Priority:	Medium (Level Equivalent: 9)
Costs:	To be determined by King County Office of Emergency Management Manager.
Funding Source:	To be determined.

Task 2.	Communicate the locations of physical susceptibility areas and wells to emergency responders.
Who:	King County Department of Natural Resources
Priority:	Medium (Level Equivalent: 9)
Costs:	Negligible. The work involved in preparing/obtaining maps is accounted for in the Data Collection and Management section.

Task 3. Prepare a report for the Office of Emergency Management on firefighting and emergency response techniques that are protective of ground water for consideration by the Local Emergency Planning Committee.

Who:	King County Department of Natural Resources
Priority:	Medium (Level Equivalent: 9)
Costs:	0.25 FTE/yr.
Funding Source:	Aquifer Protection Area Fund.

Task 4. Develop recommendations regarding firefighting and emergency response techniques for the King County Office of Emergency Management for inclusion in the Local Emergency Management Plan; Ensure that this information is shared with emergency responders throughout King County.

Who:	Ground Water Management Committee
Priority:	Medium (Level Equivalent: 9)
Costs:	Costs are accounted for in the implementation plan for Chapter 3, Table 3.8.1.

Task 5. Report on the progress of development and implementation of the Local Emergency Management Plan in relation to Ground Water Advisory Committee concerns.

Who:	King County Department of Natural Resources

Priority: Medium (Level Equivalent: 9)
Costs: 0.08 FTE.
Funding Source: Aquifer Protection Area Fund.

Issue 7 Prevention of Aquifer Contamination Associated With Transportation-Related Hazardous Material Spills: An assessment of the risk of aquifer contamination from transportation-related hazardous material spills in King County could provide information regarding the significance and characteristics of this problem. The information obtained could be used to identify risk reduction strategies.

HM-7A Transportation-Related Hazardous Materials Spills - Purveyor Assessment in Well Head Protection Programs: Purveyors of large public water systems (1,000 connections or more) will assess the risk of transportation-related hazardous material spills in their wellhead protection areas; and develop and implement risk reduction strategies as needed.

Purveyors should indicate whether they intend to address this concern via wellhead protection programs. The lead agency will report to the Management Committee on progress in implementation briefs. It is intended that a progress report will be provided in year three of plan implementation because wellhead protection programs are just beginning to be developed. The Management Committee will review this issue according to its priorities and address it prior to the plan update.

Task 1. Assess the risk of transportation-related hazardous material spills in wellhead protection areas.

Who: Public water system purveyors (1,000 connections or more), including the City of Issaquah.
Priority: Medium (Level Equivalent: 9)
Costs: To be determined by purveyors and the City of Issaquah.
Funding Source: Purveyors' operating budgets, with some Aquifer Protection Area Fund support.

Task 2. Develop and implement risk-reduction strategies as needed.

Who: Public water system purveyors (1,000 connections or more), including the City of Issaquah
Priority: Medium (Level Equivalent: 9)
Costs: To be determined by purveyors.
Funding Source: To be determined by purveyors. Limited use of the Aquifer Protection Area Fund might be available.

HM-7B Transportation-Related Hazardous Material Spills - Management Committee Evaluation: The Ground Water Advisory Committee resolves that it will be the responsibility of the Ground Water Management Committee to evaluate recommendations developed and actions taken by the Washington State Department of

Health's Transportation Engineering Subcommittee to determine whether further actions should be taken on a countywide basis to protect aquifers from transportation-related hazardous material spills.

Who:	Management Committee
Priority:	Medium (Level Equivalent: 9)
Costs:	Costs associated with the functions of the Management Committee are accounted for in Chapter 3, Table 3.8.1. There are no further costs anticipated.

Prepare a brief evaluation of progress made by purveyors in addressing this issue for the Ground Water Advisory Committee and Management Committee.

Who:	King County Department of Natural Resources
Priority:	Medium (Level Equivalent: 9)
Costs:	0.08 FTE /yr.
Funding Source:	Aquifer Protection Area Fund.

2.3.2 Ground Water Concerns Associated with Underground Storage Tank Management

Commercial underground petroleum and chemical storage tanks represent perhaps the most significant potential threat to ground water quality in King County. Leakage from underground storage tanks and associated piping often occurs without detection and even relatively small amounts of certain compounds can have serious adverse impacts on ground water quality. Once released from an underground storage tank, some volatile organic compounds and petroleum products can rapidly migrate to ground water.

The precise number of underground storage tanks that are located in King County is not known. However, Ecology estimates that at least 6,550 such tanks are currently in operation, not including home heating oil tanks. Underground storage tanks are regulated by federal, state, and local governments. Private sector pressures from insurance and lending institutions also bring increasing pressure to bear upon owners and operators of underground storage tanks to install and maintain systems in a manner which reduces liability risks by avoiding spills.

Leaking underground home heating oil tanks may present a threat to ground water quality. Both federal and state regulations adopt a less aggressive approach to regulation of heating oil tanks, however, because of differences in the constituency and migration of fuel oils in the soil.

Potential problems associated with home heating oil tanks include leakage from operating tanks and releases from improperly abandoned tanks containing residual product. Many of the existing home heating oil tanks within King County are likely to be bare steel tanks

without cathodic protection and, as such, a large percentage may be leaking or will leak in the future.

Issue 1 Augment State Underground Storage Tanks Program: The underground storage tank management program administered by Ecology does not have the resources to field check and monitor for compliance with regulations.

UST-1A Augment State Underground Storage Tanks Program - Designation As Environmentally Sensitive Area Under Chapter 90.76 RCW: King County Department of Natural Resources will prepare a petition to Ecology to designate the Issaquah Creek Valley Ground Water Management Area as an Environmentally Sensitive Area under Chapter 90.76 RCW Underground Storage Tanks for the Metropolitan King County Council and City of Issaquah's consideration.

An Environmentally Sensitive Area designation under authority of Chapter 90.76 RCW is not the same as an Environmentally Sensitive Area designation under Chapter 197-11-908 WAC of the State Environmental Policy Act; although, a single area could be designated as an Environmentally Sensitive Area under both Chapter 90.76 RCW and SEPA. Designation under RCW 90.76 affects only the construction and operation of underground storage tanks while designation under SEPA can affect a much broader range of land-use activities.

UST-1B Augment State Underground Storage Tanks Program - Inspection: King County Department of Natural Resources, in conjunction with King County Department of Development and Environmental Services, should prepare a program and related ordinances to enhance the current inspection of underground storage tank installation and removal in Environmentally Sensitive Areas to include the relevant requirements of Chapter 173-360 WAC Underground Storage Tank Regulations, for the Metropolitan King County Council and City of Issaquah's consideration.

Task 1: Prepare and submit a petition to designate the Issaquah Creek Valley Ground Water Management Area as an Environmentally Sensitive Area. After Environmentally Sensitive Area designation, there may be additional work, such as publicity, mapping, and notifying affected agencies.

Task 2: To enhance the current inspection program governing underground storage tank installation and removal in Environmentally Sensitive Areas so that it includes the relevant requirements of Chapter 173-360 WAC Underground Storage Tank Regulations, the following steps are needed:

- Determine local regulatory authority.
- Develop elements of an enhanced program, including training and evaluation.
- Determine role of local agencies in implementation. For example, King County Fire Marshal's office and local fire service jurisdictions could

assume responsibility for underground storage tank management, provided that they have the capacity.

- Amend ordinances as necessary to implement program.

Task 3: Develop and implement a training program for inspectors concerning additional requirements of the Underground Storage Tank Regulations so they can carry out the inspections referred to in Task 2. The Management Committee must decide who is to provide this training. This program includes determining the additional training needed, identifying inspectors in need of this training, and training all inspectors within a given time frame.

Task 4: Determine how to modify local program based upon Ecology's annual reports evaluating the state of the underground storage tank program and an annual review of the effectiveness of local programs. Evaluation methods need to be developed.

Who:	Tasks 1, 2, 4: King County Department of Natural Resources in conjunction with King County Department of Development and Environmental Services Task 3: Management Committee to determine.
Priority:	High (Level Equivalent: 5)
Cost:	Minimum King County Department of Natural Resources staff: 0.5 FTE for three years
Funding Source:	The enhanced local program is funded by industry in the form of increases in current inspection fees and supplementary annual tank fees. The latter may be used to pay for training of inspection staff. Other tasks could be funded through the Aquifer Protection Area Fund.

UST-1C Augment State Underground Storage Tanks Program - Disclosure and Secondary Containment: King County Department of Natural Resources will prepare an ordinance, for Metropolitan King County Council consideration, about underground tanks. The ordinance should contain the following provisions: disclosure at the time of sale of any property in King County of the number, location, and legal status of existing underground fuel and chemical storage tanks; and, require secondary containment for new tanks.

Who:	King County Department of Natural Resources
Priority:	Medium (Level Equivalent: 10)
Cost:	0.08 FTE
Funding Source:	Aquifer Protection Area Fund.

Issue 2 Exempt Tanks: Chapter 173-360 WAC Underground Storage Tank Regulations are reactive in some respects. The regulations focus on monitoring and post-leak detection, rather than prevention of leaks. Construction and monitoring requirements still

allow leaks and consequently contamination of the environment. Additionally, certain classes of underground storage tanks are partially or completely exempt from federal and state regulation.

UST-2A Exempt Tanks - Secondary Containment: The King County Department of Natural Resources will prepare an ordinance for the Metropolitan King County Council's consideration requiring secondary containment for underground chemical storage tanks as defined by Chapter 173-360-120 WAC and for the following exempt or deferred tanks: heating oil tanks of all sizes and motor fuel tanks of 1,100 gallons or less.

Task 1: The Management Committee needs to determine who would enforce this ordinance.

Task 2: Prepare an ordinance for the Metropolitan King County Council's (or other appropriate body) consideration requiring secondary containment for underground storage tanks (as in Chapter 173-360-120 WAC) and for exempt tanks.

Who:	King County Department of Natural Resources, under Management Committee advisement.
Priority:	High (Level Equivalent: 6)
Cost:	King County Department of Natural Resources, 0.08 FTE.
Funding Source:	Aquifer Protection Area Fund. Plan review by fire protection agencies would be fee supported.

UST-2B Exempt Tanks - Tested for Integrity: The King County Department of Natural Resources will prepare an ordinance on underground tanks for the Metropolitan King County Council's consideration requiring that all underground fuel and chemical storage tanks without secondary containment that are in use and exempt from the state Underground Storage Tank Regulations must be tested for integrity at regular intervals by qualified personnel and tagged to either allow or prohibit future product delivery.

Who:	King County Department of Natural Resources
Priority:	High (Level Equivalent: 6)
Cost:	0.08 FTE.
Funding Source:	Aquifer Protection Area Fund.

Issue 3 Heating Oil Tanks. Home heating oil tanks may not be maintained or abandoned properly. Homeowners often are unaware of requirements for the proper operation and abandonment of underground heating oil tanks. There are currently no programs in place to educate citizens or to provide incentives for proper operation and abandonment. Also, homeowners are reluctant to abandon tanks properly and under permit due to the expense associated with remediating a site with contaminated soil.

UST-3 Heating Oil Tanks - Education: King County and the City of Issaquah will jointly educate homeowners and exempt tank owners on the tank abandonment requirements of the Uniform Fire Code through the Issaquah Creek Valley Ground Water Management Plan Education Program.

2.3.3 Ground Water Quality Issues Related to On-Site Sewage Treatment and Disposal System Use

Ground water contamination associated with domestic on-site sewage system effluent can involve a number of contaminants including nitrate, bacteria, viruses, and trace organic chemical compounds. Nitrate is often considered the most significant contaminant associated with domestic wastewater since it is highly resistant to removal from treatment mechanisms present in the soil profile. Bacteria and viruses can be attenuated during migration through a few feet of fine to medium textured soils provided that unsaturated flow conditions can be maintained. If on-site sewage systems are improperly designed or constructed, installed in inadequate soils, used at too high of a development density, or used to dispose of non-domestic wastewater, they can adversely affect surface and ground water quality and public health.

Issue 1 Nitrate Concerns: The designs of most on-site sewage treatment and disposal systems installed in Type 1 soils (coarse sands or coarser) prior to April 1987 (the effective date of King County Board of Health Title 13) did not incorporate enhanced treatment technology. These systems often support development densities that exceed one residential unit per acre. The poor treatment efficiency of conventional on-site sewage systems installed in coarse textured soils suggests a potential for nitrate contamination of underlying ground water, especially in areas where the density of on-site sewage systems is relatively high. Nitrate concentrations may build up in the zone of contribution to public water systems to unacceptable levels resulting in irreversible loss of drinking water supplies.

OS-1 Nitrate Concerns in Well Head Protection Programs: The Ground Water Advisory Committee requests that the following be considered by the Management Committee: (1) Require that Well Head Protection Programs for systems serving over 1,000 connections incorporate nitrate loading analysis in determining the level of risk to public water supplies associated with on-site sewage treatment and disposal systems and other sources of nitrate; and (2) Work with land use authorities to require alternative methods of sewage treatment and disposal where nitrogen levels are found to be unacceptable (more than 5 mg/L).

Who:	Management Committee
Priority:	High (Level Equivalent: 2)
Cost:	To be determined.
Funding Source:	Aquifer Protection Area Fund.

Issue 2 Hazardous Materials: Some types of commercial, industrial, and institutional facilities use or store hazardous materials in their day-to-day operations or dispose of unregulated or small quantities of hazardous wastes. In these cases, hazardous materials or wastes may be discharged to on-site sewage treatment and disposal systems.

OS-2A Commercial Hazardous Materials - Inventory, Education, Monitoring: King County will: (1) inventory commercial, industrial, and institutional facilities served by on-site sewage treatment and disposal systems which potentially use, store, or dispose of hazardous materials; (2) educate operators on hazardous materials management; and (3) selectively monitor those facilities that appear to represent a significant risk to ground water quality.

Who:	Seattle-King County Health Department. Some education of operators is being done through the Local Hazardous Waste Management Program.
Priority:	High (Level Equivalent: 7)
Cost:	0.25 FTE.
Funding Source:	Aquifer Protection Area Fund.

OS-2B Hazardous Materials - Prohibit Non-Domestic Sewage: The Seattle-King County Health Department will prepare amendments to Title 13 of the Code of the King County Board of Health to expressly prohibit the use of on-site sewage systems for disposal of any materials or substances other than domestic sewage as defined in Chapter 246-272-010 WAC for King County Board of Health consideration.

Who:	Seattle-King County Health Department
Priority:	High (Level Equivalent: 3)
Cost:	0.04 FTE.
Funding Source:	Aquifer Protection Area Fund.

Issue 3 Household Hazardous Wastes: Household hazardous wastes can enter the wastewater stream when residues from cleaning and paint products or quantities of unwanted chemical substances are disposed of in a sink or toilet. When discharged to an on-site sewage system, household hazardous wastes may pass through the system and migrate to underlying ground water. While wastes from any single residence are not likely to have detectable impacts on underlying ground water, the cumulative effects of many residences may be significant. Many people are unaware that common household products often contain chemical compounds that can represent an environmental or even public health hazard if improperly handled.

OS-3A Household Hazardous Wastes - Education in the Local Hazardous Waste Program in King County: The Local Hazardous Waste Program in King County will coordinate with the Household Hazardous Waste Education Committee to include information about the risks to ground water associated with the disposal of household

hazardous wastes to on-site sewage systems as part of their household hazardous waste educational activities.

Who:	Seattle-King County Health Department
Priority:	High (Level Equivalent: 3)
Cost:	0.125 FTE.
Funding Source:	Aquifer Protection Area Fund.

OS-3B Household Hazardous Wastes - Public Education: King County will develop and carry out a public education program intended to increase the awareness of proper on-site sewage system operation and maintenance, including the risks associated with disposal of hazardous wastes in such systems. This will be included in the Education Program.

Issue 4 Operation and Maintenance: Homeowners and businesses need to be aware of the location and proper operation and maintenance of on-site sewage treatment and disposal systems.

OS-4A Operation and Maintenance - Plan Recorded With Property Deed: The Seattle-King County Health Department will prepare amendments to Title 13 of the Code of the King County Board of Health for King County Board of Health's consideration to require that the as-built on-site sewage treatment and disposal system plan be recorded with the property deed so that it be transferred with the title at the time of property purchase. In addition, information concerning the relationship between on-site system maintenance and operation practices and ground water protection will be added to the standard as-built plan form.

Who:	Task 1: Seattle-King County Health Department
Priority:	High (Level Equivalent: 2)
Cost:	0.04 FTE.
Funding Source:	Aquifer Protection Area Fund.

OS-4B Operation and Maintenance - Management Program: The Seattle King County Health Department will examine the feasibility of a on-site sewage system management program to determine its effectiveness in the protection of ground water in the Issaquah Creek Valley Ground Water Management Area.

Who:	Seattle-King County Health Department
Priority:	High (Level Equivalent: 6)
Cost:	0.5 FTE/yr.
Funding Source:	Aquifer Protection Area Fund.

2.3.4 Ground Water Quality Issues Related to the Use of Pesticide and Fertilizer

Pesticides and fertilizers are used for the control of plant and animal pests and promotion of plant growth. Pesticides are a large and varied group of substances that are specifically designed to kill biological organisms including weeds, insects, and rodents. Fertilizer is used to promote plant growth. Pesticides and fertilizers are used for agriculture, home, forestry and rights-of-way maintenance. Pesticides and fertilizer have the potential to contaminate ground water even when they are used according to the label instructions. The King County Comprehensive Plan policy, NE-502 states that King County should actively encourage the use of environmentally safe methods of vegetation control and that herbicide use should be minimized.

Issue 1 Pesticide and Fertilizer - Past Use: Past use of pesticide and fertilizer may pose a threat to ground water quality.

PF-1A Pesticide and Fertilizer - Past Use: Mapping of Vulnerable Aquifer Areas: Include land uses that have the potential for pesticide and fertilizer use in the determination of vulnerable aquifer areas. See the strategy described in the "Special Protection Areas section.

PF-1B Pesticide and Fertilizer - Past Use: Monitoring: The King County Department of Natural Resources and the City of Issaquah will monitor for pesticides and fertilizers in the physical susceptibility areas, where they are expected to occur based upon past land use.

Who:	King County Department of Natural Resources
Priority:	High (Level Equivalent: 1)
Cost:	No additional cost to include as part of the Data Collection and Management Program. These costs should be included in that program.
Funding Source:	There is no additional cost associated with this action that has not been included in the "Special Protection Areas" recommended management strategies.

Issue 2 Pesticide and Fertilizer Use: Use of pesticide and fertilizer may pose a threat to ground water quality.

PF-2A Pesticide and Fertilizer Use: Farm Plans: King County and the City of Issaquah will encourage and support the development of Farm Plans using Best Management Practices for any agricultural user of pesticide and fertilizer in physically susceptible areas.

Who:	King Conservation District
Priority:	High (Level Equivalent: 4)
Cost:	0.87 FTE.

Funding Source: Aquifer Protection Area Fund or special assessment.

PF-2B Pesticide and Fertilizer Use: Cooperative Extension Pesticide Reduction Program: King County and the City of Issaquah will encourage participation in the Cooperative Extension Pesticide Reduction Program to protect ground water within the Issaquah Creek Valley Ground Water Management Area.

King County and the City of Issaquah (the Management Committee) would evaluate its effectiveness and possible applicability for implementation in other areas in the county to determine whether this program would be useful for ground water protection. This evaluation would be done with Cooperative Extension at the end of the Program. The Management Committee must also determine funding needs and sources. A potential funding source could be development fees as a mitigation for non-point source pollution.

Who:	Cooperative Extension
Priority:	Medium (Level Equivalent: 11)
Cost:	No additional cost, the evaluation is included in the program.

Who:	King County Department of Natural Resources, and the City of Issaquah under direction by the Management Committee
Priority:	Medium (Level Equivalent: 11)
Cost:	To be determined
Funding Source:	Aquifer Protection Area Fund.

PF-2C Pesticide and Fertilizer Use: Roads and Utility Rights-Of-Way Maintenance: King County and the City of Issaquah will use non-chemical vegetation maintenance practices chemicals that degrade into non-harmful elements and that are not persistent in the environment for roads and utility rights-of-way in the Issaquah Creek Valley Ground Water Management Area. King County and the City of Issaquah will determine whether maintenance practices by others for roads and utility rights-of-way in the Issaquah Creek Valley Ground Water Management Area needs to be restricted to non-chemical methods or chemical usage as described above.

This action is supported by King County Comprehensive Plan policy, NE-502 which states that King County should actively encourage the use of environmentally safe methods of vegetation control and that herbicide use should be minimized. A good example of this type of program is the King County Department of Transportation, Roads Maintenance Division, which developed and implemented an integrated pest management program.

Task 1: Adopt policy that only non-chemical vegetation maintenance or non-leaching chemicals be used for rights-of-way maintenance.
Task 2: Research practices by other organizations
Task 3: Determine whether prohibition in an ordinance is needed based upon research.

Who:	Task 1. King County and the City of Issaquah
Priority:	High (Level Equivalent: 1)
Cost:	0.15 FTE City of Issaquah to be determined. There may be increased costs associated with these methods.
Funding Source:	Aquifer Protection Area Fund.

Who:	Task 1, 2, and 3. King County and the City of Issaquah (Management Committee)
Priority:	High (Level Equivalent: 1)
Cost:	To be determined. King County Department of Development and Environmental Services, Code Development Section: 0.5 FTE
Funding Source:	Aquifer Protection Area Fund.

Issue 3 Education and Proposed Programs: Many issues on the use of fertilizers and pesticides are best addressed by the State Strategy, the Puget Sound Water Quality Action Team Plan and various educational efforts. Implementation of many of the programs outlined in the Strategy and the Plan depend upon public support and funding from the Legislature and other sources. Existing educational efforts may not address the ground water protection policies and goals of the Issaquah Creek Valley Ground Water Management Plan.

PF-3A Education and Proposed Programs: Small Farmers and Homeowners: The Ground Water Advisory Committee supports the strategies in "Protecting Ground Water: A Strategy for Managing Agricultural Pesticides and Nutrients. April, 1992" and the 1991 Puget Sound Water Quality Action Team Plan (Household Hazardous Waste Program: HHW-2 Information and Education on Less-Toxic Alternatives for Household Products and Non-point Source Pollution Program: NP-17 Puget Sound Pest Management Information Program) to help insure that small farmers and homeowners receive more information about pesticide and fertilizer use. This support is provided by stating it here, no additional action is needed.

PF-3B Education and Proposed Programs: Education Section: Existing educational program content will be reviewed for agreement with the Issaquah Creek Valley Ground Water Management Plan policies and goals. The King County Department of Natural Resources will review the current educational programs of the Natural Resources Conservation Service, Cooperative Extension, and others to ensure that the Issaquah Creek Valley Ground Water Management Plan goals and policies are reflected. This will be done as part of the Issaquah Creek Valley Ground Water Management Plan Education Section.

2.3.5 Ground Water Quality Issues Related to Well Construction and Decommissioning

Wells provide a link between an aquifer and the earth's surface. Modern wells consist of a well casing that extends downward from the ground surface to the aquifer within a

cylindrical bore hole. The Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC) 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. Regulations also require that any well that: is unusable; has been permanently discontinued; is in such disrepair that its continued use is impractical, or is an environmental, safety, or public health hazard, must be decommissioned.

Issue 1 State Program: Existing regulations for well construction and decommissioning are not adequately enforced. Ecology does not receive enough funding to inspect more than a small percentage of wells during construction or decommissioning.

WC-1A State Program: Adequate Funding: Ecology, King County, the City of Issaquah and the Sammamish Plateau Water and Sewer District will support legislation that provides funding for the well construction and decommissioning program.
Task 1: Develop and submit legislation, with input from affected parties

Who:	Ecology
Priority:	High (Level Equivalent: 4)
Cost:	To be determined. Ecology estimates 0.64 FTE
Funding Source:	General agency funds.

Task 2: Support proposed legislation

Who:	King County, City of Issaquah, Sammamish Plateau Water and Sewer District
Priority:	High (Level Equivalent: 4)
Cost:	Probably minimal, to be determined
Funding Source:	General agency funds.

WC-1B State Program Delegation to King County: King County and Ecology will develop a local health department program for implementation of the delegated portion of the well construction and decommissioning program in King County.

Who:	Ecology and Seattle-King County Health Department
Priority:	Low (Level Equivalent: 18)
Cost:	Seattle-King County Health Department: 0.5 FTE. Ecology: 0.64 FTE
Funding Source:	Aquifer Protection Area Fund.

Issue 2 Well Identification: Wells need to be identified so that Ecology can implement programs to protect the ground water resource. Currently, there is no method to systematically identify wells; wells that were drilled before 1973 were not required to submit well logs to Ecology. Furthermore, no program exists to identify wells that will be decommissioned.

WC-2A Well Identification at Sale of Property: King County Department of Natural Resources will develop an ordinance for Metropolitan King County Council and the City of Issaquah's consideration that requires property sellers to disclose to buyers the existence of used or unused wells on a property.

Who:	King County Department of Natural Resources
Priority:	Low (Level Equivalent: 16)
Cost:	0.08 FTE
Funding Source:	Aquifer Protection Area Fund.

WC-2B Well Identification During Environmental Review, Rezone and Land Use Permit Applications: King County Department of Natural Resources will develop an ordinance for the Metropolitan King County Council and the City of Issaquah's consideration that requires applicants to establish the location and status of wells present on the property in question during SEPA review, rezone and land use permit applications. King County and the City of Issaquah will provide this information to Ecology.

Who:	King County Department of Natural Resources
Priority:	Low (Level Equivalent: 16)
Cost:	King County Department of Natural Resources: 0.08 FTE.
Funding Source:	Aquifer Protection Area Fund.

Issue 3 Decommissioning Cost: Improperly decommissioned wells may become a channel for contamination to the aquifer. The decommissioning cost may prevent property owners from disclosing improperly decommissioned wells.

WC-3A Decommissioning Cost: Funding Source: King County will explore the possibility of having a funding source for decommissioning of wells for those property owners who disclose that they have a well which is no longer being used, and which has not been decommissioned according to Ecology's regulations.

Task 1: Report to the Management Committee on the feasibility of providing money for well decommissioning.

Who:	King County Department of Natural Resources
Priority:	Low (Level Equivalent: 17)
Cost:	0.125 FTE
Funding Source:	Aquifer Protection Area Fund.

Task 2: Revise the Issaquah Creek Valley Ground Water Management Plan, if necessary.

Who:	Management Committee
Priority:	Low (Level Equivalent: 17)
Cost:	This will be part of Management Committee tasks

Funding Source: Aquifer Protection Area Fund.

WC-3B Decommissioning Cost: Alternative Procedures: Ecology, during WAC revision, will consider alternatives to present requirements for cost-effective well decommissioning procedures that would also protect public health.

Who:	Ecology
Priority:	Low (Level Equivalent: 17)
Cost:	0.14 FTE
Funding Source:	General agency funds.

Issue 4 Education: There is a lack of public knowledge about the public health significance of the requirements for well construction, operation, maintenance and decommissioning.

WC-4 Education: Coordinate With Ecology: The Ground Water Management Plan Education Program will coordinate with and support Ecology's well identification, well construction, maintenance, contamination sources and well decommissioning projects.

2.3.6 Ground Water Concerns Associated with Sewer Pipes

The more recently installed sewer pipes in King County are fabricated from polyvinyl chloride (PVC), a durable material that is virtually leak-free. However, prior to the use of PVC, sewer pipes were made from materials such as concrete, brick, clay and ductile iron. Joints were more susceptible to leaking with the use of these materials. Many of these older pipes are still in use.

Infiltration is ground water entering sewer pipes through leaking joints or defects. Inflow refers to direct flows of storm water into sewer pipes through hookups such as roof and footing drains. To date, data on the extent and magnitude of this potential problem is unavailable. There have been no studies conducted on exfiltration of wastes from sewer lines in King County and the possible impacts on ground water quality.

Issue 1 Infiltration and Exfiltration: Infiltration of ground water into gravity sewer pipes may be causing significant loss of ground water from the Issaquah Creek Valley Ground Water Management Area. Exfiltration of sewage from leaking sewer pipes may be causing ground water contamination.

SP-1A Infiltration and Exfiltration - Determine Problem: King County will: review and analyze existing studies and ongoing programs developed by King County Department of Natural Resources (Water Pollution Control) and local sewer districts to determine whether infiltration and exfiltration are problems in the Issaquah Creek Valley Ground Water Management Area and, analyze conclusions and determine appropriate follow-up action, if any.

Who:	King County Department of Natural Resources
Priority:	Low (Level Equivalent: 20)
Cost:	0.5 FTE.
Funding Source:	Aquifer Protection Area Fund.

SP-1B Sewer Maintenance Programs: Encourage the King County Department of Natural Resources, Division of Water Pollution Control, the City of Issaquah and the Sammamish Plateau Water and Sewer District to continue or adopt regularly scheduled leak detection and repair programs, and public education programs related to side sewer maintenance.

Who:	King County Department of Natural Resources
Priority:	Low (Level Equivalent: 18)
Cost:	Minimal.
Funding Source:	General agency funds.

SP-1C Leakproof Piping: Encourage King County to amend the Comprehensive Land Use Plans and King County Code 13.24 to require that: new sewer piping to be installed in physically susceptible and recharge areas be leakproof, and that existing leaking sewer pipes, including side sewers, be replaced with leakproof piping in physically susceptible and recharge areas according to a schedule contained in the Sewer Utility Comprehensive Plans. This request is communicated during the Ground Water Management Plan review process. No further action is necessary.

Issue 2 Ground Water Depletion: Sewer pipes installed on sloping ground could provide a conduit for ground water, depleting valuable ground water reserves from a specific area.

SP-2 Ground Water Depletion - Backfill Materials and Seals: Encourage Ecology to consider amendments to sewer construction specifications which stop the transmission of ground water along pipe alignments. These provisions shall include Best Management Practices for backfill materials and/or the use of impermeable seals at appropriate intervals.

Who:	King County Department of Natural Resources
Priority:	Low (Level Equivalent: 18)
Cost:	Minimal.
Funding Source:	Aquifer Protection Area Fund.

2.3.7 Ground Water Quality Issues Related to Solid Waste Landfills

The ground water impact from landfills is from 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 from the solid waste. Ground water that has been

contaminated by leachate may affect public health. Ground water that is not currently being used for drinking water also needs to be protected from leachate contamination, as it may become a drinking water source in the future.

Issue 1 Standards: King County Board of Health standards can be improved to provide better ground water protection. Ecology has revised the state solid waste regulation to include ground water provisions (adopted as Chapter 173-351 WAC). Seattle-King County Health Department has not yet adopted this WAC by reference.

SW-1 King County Board of Health Standards: The Seattle-King County Health Department will prepare amendments to Title 10 to adopt Chapter 173-351 WAC by reference for consideration by the King County Board of Health.

Who:	The Seattle-King County Health Department would propose that the King County Board of Health amend Title 10. This includes writing the revision, advertising the hearing, briefing the King County Board of Health and having a majority vote in favor.
Priority:	High (Level Equivalent: 4)
Cost:	Seattle-King County Health Department: 0.04 FTE.
Funding Source:	General agency funds.

Issue 2 Education: The public may not be aware of the relationship between landfilling solid waste and the threat to ground water quality

SW-2 Education Program: Include information about the relationship between solid waste disposal and ground water in the educational program.

2.3.8 Ground Water Concerns Associated with Burial of Human Remains

Cemeteries are found throughout King County, and it is possible that, under certain hydrogeologic conditions, burial practices have affected or are affecting local ground water quality. The threat to ground water from decomposing corpses and caskets includes chemicals, bacteria, viruses and metals. Currently, there are 70 cemeteries in King County ranging in size from 20 burial sites to 140,000 burial sites. Nothing is known about the existing or potential effect of decomposing corpses and caskets on ground water within King County.

Issue 1 Lack of Information: Information is insufficient to determine ground water impairments from embalming fluids, decaying human remains, and other materials associated with the burial of human remains in King County.

C-1 Information - Studies: The lead agency will evaluate existing information on cemeteries (including the results of the Woodlawn Cemetery, New York, investigation when made available) and conduct a study within the county to determine whether cemeteries are contaminating ground water. Findings of this study can be critically reviewed and compared with findings of other studies nationwide. Information gathered

can be used to establish siting criteria for new and existing cemeteries or to take other appropriate follow-up actions, if required.

Who:	King County Department of Natural Resources
Priority:	Low (Level Equivalent: 19)
Cost:	0.04 FTE
Funding Source:	Centennial Clean Water Fund

2.3.9 Ground Water Quality Issues Related to Sand and Gravel Mining

Productive sand and gravel mines are often located over vulnerable aquifers. Mining activities in these areas can increase ground water vulnerability to contamination from both the extraction process and site reclamation.

Issue 1 Regulatory Modifications: Sand and gravel mining can cause changes in the site or include activities that increase the potential for contamination of important aquifers. Major changes have occurred at the state level regarding general permitting of sand and gravel mining operations.

SG-1. Regulatory Modifications: National Pollutant Discharge Elimination System Permit Program and Ecology's "General Permit" Requirements. King County Department of Natural Resources will develop a comprehensive list of best management practices in grading permits issued for gravel pits for the Metropolitan King County Council and the City of Issaquah's consideration. King County and the City of Issaquah should comply with the National Pollutant Discharge Elimination System and Ecology's "General Permit" requirements.

For the general permit drafted by Ecology, sand and gravel facilities are required to manage, treat and discharge their wastewater in a manner consistent with the Ground Water Quality Standards and National Pollutant Discharge Elimination System. This general permit includes the implementation of best management practices and monitoring of discharges to ground water with annual reporting of the monitoring data to Ecology. The General Permit provides positive controls to protect both surface water and ground water from contamination. The King County Road Services Division, Department of Transportation has prepared an approved National Pollutant Discharge Elimination System General Permit for each of their active and inactive sand and gravel mining operations in King County.

Task 1: Develop a (or use Ecology's) list of best management practices.
Task 2: Include the list in the requirements for grading permits.
Task 3: Meet General Permit and National Pollutant Discharge Elimination System requirements for King County or city owned sand and gravel sites.

Who:	King County, City of Issaquah
Priority:	Not ranked

Cost: King County Department of Natural Resources: 0.125 FTE.
Funding Source: Aquifer Protection Area Fund.

Issue 2 Aquifer Impacts and Regulation: Sand, gravel, and rock quarry mining can cause changes in the site or include activities which increase the potential for contamination of important aquifers. Major changes have occurred at the state level regarding general permitting of sand, gravel, and rock quarry mining operations. Ecology is requiring performance standards as part of the General Permit for all mines in King County. All discharges from sand, gravel, and rock quarry mines must meet the Ground Water Standards (Chapter 173-200 WAC) and the Surface Water Standards (Chapter 173-201A WAC).

SG-2A Ground Water Protection: Support Changes: The Ground Water Advisory Committee actively supports changes in regulations and practices which would provide better protection of ground water.

SG-2B Aquifer Impacts and Regulation - SEPA Guidance: A SEPA guidance document will include the following best management practices for sand, gravel and rock quarries:

1. For sites with a planned excavation depth lower than the ground water table, a detailed hydrologic report should be filed. This may be a part of a complete Environmental Impact Statement or be an appendix to a SEPA checklist.
2. When mining activities are to be located in designated well head protection areas, special protection areas, physically susceptible areas, or principal recharge zones, an Environmental Impact Statement should be required.
3. Where possible, mining sites should utilize internal drainage, in order to support continued ground water recharge and minimize off-site discharges.
4. When ground water is exposed during the mining operation and resulting impoundment is larger than three acres, ground water 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.
5. Associated activities such as concrete, asphalt or other batch processing plants should not contaminate ground water.
6. 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.
7. Fuel (oils) storage and handing 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.
8. All sites should maintain a fuels/hazardous waste management plan. This would be maintained by the operator and be available on the site at all times.
9. At closure of the site, after accidental spills, or at the request of the King County Department of Development and Environmental Services/Ecology, all

contaminated material should be removed and disposed of with approved methods and at approved disposal sites. This material should not be used as fill at the site.

10. 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 insure stability of the site. Future land-use decisions should reflect increased ground water 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 quality or supply of inert fill.
11. Excavation pits should not be used as landfill disposal sites for unclassified or no-inert wastes. In general, municipal landfills are not an appropriate use of gravel sites located over semi-confined and unconfined ground waters.
12. 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 10 and 11.
13. Future land use should reflect the increased vulnerability of ground water at the site and the change in the water balance of the area.

Task 1: Prepare letters of support to Ecology, King County Department of Natural Resources, and King County.

Who:	Ground Water Advisory Committee Chair.
Priority:	High (Level Equivalent: 1)
Cost:	Minimal.
Funding Source:	Aquifer Protection Area Fund.

Task 2: Keep informed regarding legislative actions; alert Ground Water Advisory Committee chairs and members when support is needed.

Who:	King County Department of Natural Resources
Priority:	High (Level Equivalent: 1)
Cost:	Minimal.
Funding Source:	Aquifer Protection Area Fund.

Task 3: Prepare letter of support and/or phone contact when legislation is considered.

Who:	Ground Water Advisory Committee chairs and members.
Priority:	High (Level Equivalent: 1)
Cost:	Minimal.
Funding Source:	Aquifer Protection Area Fund.

Task 4: Develop guidance to assist environmental reviewers.

Who:	King County Department of Natural Resources, for the approval of the Management Committee.

Priority:	High (Level Equivalent: 1)
Cost:	0.50 FTE. The cost of review, amendment, and approval of the guidance will be included in the cost of participation in the Management Committee.
Funding Source:	Aquifer Protection Area Fund.

Issue 3 Land Use of Inactive or Reclaimed Mines: Subsequent land use of inactive and/or reclaimed sand and gravel mining sites should reflect the potential increased susceptibility of aquifers to contamination. There is currently no formal requirement that this be given special consideration.

SG-3A Land Use of Inactive or Reclaimed Mines: Comprehensive Plan Policy: King County Office of Strategic Planning and Department of Natural Resources will propose an amendment to the King County Comprehensive Plan for the Metropolitan King County Council's consideration to include a policy that provides that land use of inactive and/or reclaimed sand and gravel mines be carefully evaluated during environmental review in light of the potential increased susceptibility of aquifer contamination due to mining activities. The City of Issaquah would consider a similar amendment.

Who:	King County Office of Strategic Planning, in conjunction with the King County Department of Natural Resources, will prepare Comprehensive Plan amendments. The Metropolitan King County Council should consider Comprehensive Plan amendments depending upon their schedule and approval of the work plan which provides for all plan amendments.
Priority:	High (Level Equivalent: 1)
Costs:	King County: 0.15. City of Issaquah costs to be determined.
Funding Source:	Aquifer Protection Area Fund.

SG-3B Zoning Code - Reclamation Plans: King County will provide comments to the State Department of Natural Resources on mine reclamation plans proposed within the Issaquah Creek Valley Ground Water Management Area. Additionally, consistent with KCCP Policy NE-333, King County will develop with affected jurisdictions, Best Management Practices for mining operations.

Task 1: Revise zoning code to protect ground water in reclaimed sand and gravel mining operations.

Who:	King County and the City of Issaquah
Priority:	High (Level Equivalent: 1)
Costs:	King County Department of Natural Resources: 0.15 FTE, Department of Development and Environmental Services, Code Development: 0.05 FTE.
Funding Source:	General agency funds.

Task 2: Review Chapter 78.44 RCW and the King County's role in protecting ground water during and after mine reclamation. Assess Chapter 78.44 RCW, as amended in 1993 and 1994 in relation to King County Code Chapter 21.A.22

Who:	King County Department of Natural Resources
Priority:	High (Level Equivalent: 1)
Costs:	Included in Task 1.
Funding Source:	Aquifer Protection Area Fund.

2.3.10 Ground Water Concerns Associated with Biosolids and Sewage Effluent

Biosolids are the treated and primarily organic sewage solids generated from wastewater treatment plants. Biosolids may be utilized for various beneficial uses including compost and fertilizer production, agricultural and silvicultural land application, land reclamation, and the manufacture of various construction materials. The Ground Water Advisory Committee determined that no additional action was needed for this issue.

Sewage effluent is the liquid waste left after sewage has settled. This liquid may be untreated, or it may be further settled, filtered, and disinfected, depending on final use. Reuse of effluent is regulated by the State Water Pollution Control Act (Chapter 90.48 RCW) administered by Ecology and by the Wastewater Reclamation and Reuse Interim Standards.

Issue 1 Guideline Revision: Recently, an increased need for conservation of water resources has focused interest in reuse of treated effluent. The effluent guidelines are being revised and will need to comply with the State ground water standards. However, it is not known if special protection for the most physically susceptible and recharge areas will be considered.

BSE-1 Ecology Guideline Revision: Ecology will include ground water protection in the revised guidelines for the reuse of effluent. The guidelines need to include constraints for the reuse of effluent in the most physically susceptible and recharge areas.

Who:	Washington State Department of Health and Ecology
Priority:	Low (Level Equivalent: 16)
Cost:	Ecology: 0.24 FTE
Funding Source:	General agency funds.

2.4 Ground Water Quantity Issues

The Ground Water Advisory Committee adopted this goal to guide the development of the recommended management strategies: To manage the quantity of ground water resources of King County to optimize the current and long-term benefits.
Ground water quantity is important because ground water is used for drinking water, irrigation, industrial processes, and provides flow to streams, which support fish and

other wildlife. Aquifers, and related surface water levels, are maintained by preserving recharge. The two main threats to preserving recharge and ground water levels are by reducing recharge by increasing permeable surfaces and by overuse. Recharge occurs only through relatively undisturbed, permeable soils. Population growth, with it's related construction of buildings and roads, causes an increase in impermeable surfaces and the demand for ground water.

The state of Washington has attempted to balance the needs of its citizens with maintaining the water resource. Ecology administers laws dealing with water appropriations and allocations. Allocations to new users must not conflict with existing use; however, the information needed to know when such a conflict may occur is lacking. Some areas of the state have experienced the effects of unwise use of aquifers, such as water level decline and seawater intrusion. Parties involved in water use are developing and using innovative techniques, such as conservation and artificial recharge, to decrease water use and increase water availability. Recent interest in maintaining surface water resources has spotlighted the interaction of ground water and surface water. Future ground water resource management must consider this interaction.

The *Ground Water Areas Management and Programs* (Chapter 173-100 WAC) contains guidelines on program content which were to be adapted to the particular needs of a ground water management plan. Included in the program content is a section on alternatives, which outlines various land and water use management strategies that address each of the ground water problems discussed in a problem definition section. It states that the alternative management strategies would address water conservation, conflicts with existing water rights and minimum instream flow requirements, programs to resolve such conflicts, and long-term policies and construction practices necessary to protect existing water rights and subsequent facilities installed in accordance with the Ground Water Management Plan program and/or other water right procedures. This Plan does not address these topics, except for conservation. Several new state programs, initiated since the WAC was written, provide programs to resolve conflicts with existing water rights and minimum instream flow requirements, and long-term policies and construction practices necessary to protect existing water rights and subsequent facilities (generally, under the Water Resources Forum from the Chelan Agreement). The Ground Water Advisory Committee found that the best way to address ground water quantity issues is to develop and implement a long-term monitoring and data collection program to provide the decision makers with the necessary ground water information.

Issue 1 - Policies and Ordinances. The proposed King County clearing ordinance may provide broad protection for physically susceptible and recharge areas. However, King County may not adopt the proposed clearing ordinance. Also, environmental review needs to include information on development impacts to ground water quantity and quality.

WQ-1 Policies and Ordinances - Environmental Checklist: Petition Ecology to amend the environmental checklist to include impacts on the quantity of aquifer recharge.

Until the change by Ecology can be made, the City of Issaquah, King County and other reviewing agencies will consider impacts on the quantity of aquifer recharge during environmental checklist review.

Task 1: Revise environmental checklist.

Who:	Ecology, through rule revision
Priority:	High (Level Equivalent: 2)
Cost:	0.06 FTE
Funding Source:	General agency funds.

Task 2: Include impacts on the quantity of aquifer recharge in the environmental review guidance document.

Who:	King County Department of Natural Resources
Priority:	High (Level Equivalent: 2)
Cost:	0.25 FTE
Funding Source:	General Agency Funds.

Issue 2 Data Needs: A complete characterization of the aquifer resource is needed. This information is needed by Ecology for water rights application analysis, surface water/ground water interaction determination, possible ground water reservation, and other resource management concerns. To date, this has not been completed.

WQ-2 Data Needs: Information for Water Resource Decisions: Design and implement a ground water data collection management program that would enable Ecology and others (such as purveyors, land use planners and public officials) who make land and water use decisions to make water resource decisions based on more complete information.

Who:	King County and the City of Issaquah through the Management Committee
Priority:	High (Level Equivalent: 1)
Cost:	In DCM - 1.
Funding Source:	Aquifer Protection Area Fund.

Issue 3 Water Rights: Water rights records do not necessarily accurately reflect actual pumping rates and current use of the ground water resource.
WQ-3 Water Rights Records: Utilities will update their water right records and report to Ecology, according to the recommended program in the Five Year Water Resource Data Management Plan.

Who:	Water utilities
Priority:	High (Level Equivalent: 4)
Cost:	To be determined

Funding Source: General agency funds.

Issue 4 Conservation: Conservation has been shown to have a positive impact on ground water resources. There are some conservation methods that could be implemented to enhance current programs, including landscaping methods. King County Board of Health regulations for small water systems do not include conservation elements.

WQ-4A Conservation - Landscaping: King County Department of Natural Resources will develop a proposed landscaping ordinance to encourage conservation in new developments for the Metropolitan King County Council's consideration. Landscaping plans should incorporate native growth areas, use of plant species that are drought-tolerant, water efficient irrigation technologies, soil amendments, and limitations on the amount of turf. The City of Issaquah will consider adopting similar ordinances.

Who:	King County, City of Issaquah
Priority:	High (Level Equivalent: 7)
Cost:	Department of Natural Resources: 0.08 FTE. King County Department of Development and Environmental Services, Code Development: 0.22 FTE.
Funding Source:	Aquifer Protection Area Fund.

WQ-4B Conservation: Group B Small Public Water Systems: The Seattle-King County Health Department will propose a revision to regulations for existing, new, or expanded Group B Small Public Water Systems to cover water conservation goals and measures for consideration by the King County Board of Health.

WQ-4C Conservation: Individual Wells. The Seattle-King County Health Department will propose regulations for new and existing individual wells incorporating conservation measures, including source meters, for consideration by the King County Board of Health.

Who:	Seattle-King County Health Department, King County Board of Health.
Priority:	High, Medium (Level Equivalent: 8,13)
Cost:	0.08 FTE.
Funding Source:	Aquifer Protection Area Fund.

Issue 5 Education: Xeriscaping, Schools, Cooperative Extension Service: Education has also been shown to have a positive impact on ground water resources. These educational activities will be included in the Education Section.

Issue 6 Artificial Recharge: Artificial recharge is a new technique that is being tried in this area. However, not enough is known about the feasibility for long-term artificial recharge.

WQ-6 Artificial Recharge Investigate: Purveyors will investigate artificial recharge programs.

Who:	Public water systems
Priority:	High (Level Equivalent: 1)
Cost:	To be determined
Funding Source:	General agency funds.

Issue 7 Reservation: Ground water reservation may be used to limit the amount of ground water withdrawn from a system.

WQ-7 Reservation: Encourage utilities, tribes, local governments, and small public water systems to petition Ecology for water supply reservation of the ground water resource consistent with King County Coordinated Water Supply plans, and the Growth Management projections in the King County Comprehensive Plan for that area.

Who:	Ground Water Advisory Committee
Priority:	High (Level Equivalent: 1)
Cost:	No additional cost, stated in Ground Water Management Plan.

2.5 Unfinished Agenda

The Guidelines for Ground Water Management Area and Programs calls for concurrence on the recommended management strategies, and resolution of any non-concurrence issues by the Ground Water Advisory Committee. During review of the Draft Issaquah Creek Valley Ground Water Management Plan, some management strategies were identified that the reviewing agency could not commit resources to implementing at this time. The Department of Ecology's guidance for concurrence allows that unresolved issues may be placed into an Unfinished Agenda section. These issues may not be critical to the Plan, generally, that means they cannot relate to overall plan implementation and funding. However, Ecology retains the final determination on whether they are critical to the Plan. The following issue was identified by the Ground Water Advisory Committee during non-concurrence issue resolution as appropriate to be placed in the unfinished agenda:

Aquifer Protection Area: Metropolitan King County Council does not concur with the need to establish an Aquifer Protection Area until other funding options are considered. However, since this funding mechanism is favored by the City of Issaquah and the Sammamish Plateau WSD, this question remains an unresolved issue that will be addressed by the Issaquah Creek Valley Ground Water Management Committee at a later date. The original recommendation of the Ground Water Advisory Committee is as follows:

Recommendation: The Ground Water Advisory Committee recommends that the Metropolitan King County Council authorize a ballot measure that, if approved by the voters, would create the Issaquah Creek Valley Aquifer Protection Area to provide

funding for implementation of the Issaquah Creek Valley Ground Water Management Plan. These funds must be used only for Issaquah Creek Valley Ground Water Management Area activities.

The purpose of an Aquifer Protection Area is to establish a funding base for ground water protection, preservation, and rehabilitation programs. Aquifer Protection Areas are established through an election ballot issue requiring approval from a simple majority of voters within the proposed Aquifer Protection Area. If voters approve the Aquifer Protection Area, the county can collect monthly ground 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. Establishing an Aquifer Protection Area that includes territory located within a city must include approval of the city's governing body. The Metropolitan King County Council could propose an Aquifer Protection Area jointly with the City of Issaquah's Council approval for the entire Issaquah Creek Valley Ground Water Management area. This would require an interlocal agreement between the City of Issaquah and King County on funding and implementation of the Ground Water Management Plan under this option. Alternatively, an aquifer protection area can be proposed for the unincorporated areas by the Metropolitan King County Council action only.

Creation and adoption of the Issaquah Creek Valley Aquifer Protection Area could ensure adequate long-term funding for implementing the Issaquah Creek Valley Ground Water Management Plan. Community support would be demonstrated because the Aquifer Protection Area has to be approved by a majority of the people in the area. Also, an Aquifer Protection Area is in line with Ecology's Ground Water Management Plan implementation ideas and what other counties have used. There are laws and administrative structures either explicitly in place elsewhere, or there are models for forming or using an Aquifer Protection Area.

The Ground Water Advisory Committee recognizes that the ballot measure must describe the specific use, and any changes in specific uses or the fee would require voter approval. Fee collection is limited, in that the Aquifer Protection Area fees may only be collected from users of water withdrawn from an aquifer as opposed to a surface water source; the fee is not related to the amount of water used; and fees may be assessed on on-site sewage disposal only, not other sources of ground water contamination. When ballot measures are drafted for the Aquifer Protection Area, consideration must be given for how funds will be collected and distributed by those implementing agencies whose boundaries encompass more than one ground water management area.

If an Aquifer Protection Area ballot fails, then it is recommended that the Ground Water Advisory Committee and affected agencies devise an alternate source of funding to implement the Plan. One alternative is participation by the City, County and special purpose districts on a volunteer basis through their water rates or other revenue sources to fund implementation of the Issaquah Creek Valley Ground Water Management Plan.

Stormwater: ST-6 Roadway Runoff: King County and the City of Issaquah will:

- Direct their public works departments to give high priority to physically susceptible areas and Well Head Protection Areas when identifying and correcting water quality problems associated with existing roadways, and

- Develop a program to retro-fit existing structures, as required by the National Pollution Discharge Elimination System, which will require stormwater quality and quantity controls comparable to new regulations when conducting major renovation or widening of roads.

King County Department of Transportation, Road Services Division does not concur with the first bullet under ST-6. Road Services produces a six year program for road maintenance, and has already identified and prioritized the transportation needs in the County for the current budget. However, staff, during concurrence discussion, stated that consideration of location of a road, whether in a sensitive area, could be included as one of many factors in the prioritization done in the future.

Who:	King County and the City of Issaquah
Priority:	High (Level Equivalent: 3)
Cost:	Regulation development and increased costs for implementing the regulation to be determined.
Funding Source:	No additional funds are needed to request prioritization of the most physically susceptible and recharge areas for water quality and quantity improvements. Storm water utility fees or development impact fees allowed under the Growth Management Act may be used to fund improvements made during road renovation or widening.

Chapter Three

Recommended Implementation Process

Issaquah Creek Valley
Ground Water Management Plan

March 1999

Recommended Implementation Process for the Ground Water Management Program

3.1 Introduction

The ground water management planning process has been funded by Centennial Clean Water Fund grants administered by the Washington State Department of Ecology (Ecology) and contributions from King County, cities, and water utilities. However, implementation of the Ground Water Management Plan depends upon long term funding and appropriate assignment of responsibility. Executive and legislative branches of government and other public and private interests have important roles in the implementation of the Ground Water Management Plan to protect ground water quality and quantity. The recommended implementation process described in this chapter assigns roles and tasks and proposes a source of funding. Topics addressed include:

- Legislative authority
- Funding
- Washington Department of Ecology
- Ground Water Management Committee
- Ground Water Advisory Committee
- Lead agency
- Implementation Plan
- Process for evaluation and revision of the Ground Water Management Plan

Summary tables at the end of this chapter list actions to be taken during plan implementation. These tables also list priorities, who is responsible for implementation, an estimate of personnel time (in FTE, full-time equivalent), and a source of funds.

3.2 Legislative Authority

The land areas affected by this plan lie within the jurisdictions of the City of Issaquah, King County, and Sammamish Plateau Water and Sewer District. These entities are responsible for land use and/or maintaining municipal water supplies to provide sufficient and adequate potable water in their respective jurisdictions.

Metropolitan King County Council

The Metropolitan King County Council is legislative authority of the county. The Metropolitan King County Council exercises its legislative power by adoption and enactment of ordinances; by levying taxes, appropriating revenue and adopting budgets; and other powers as described in the King County Charter (King County Charter, Sections 220-270). The Council ensures that the policies in the King County Comprehensive Plan are carried out through ordinances implementing the Plan.

Seattle-King County Board of Health

The Seattle-King County Board of Health was created by Metropolitan King County Council Ordinance 12098 in response to a state law, RCW 70.05.035, which required that the County have a single board of health by January 1, 1996. Previously the Metropolitan King County Council served as the Board of Health for King County and the Seattle City Council served as the Board of Health for Seattle.

The Board of Health is constituted as a federated body: 11 of its 13 voting members are elected officials - 6 from the Metropolitan King County Council, 3 from the Seattle City Council and 2 from the Suburban Cities of King County. The two remaining voting members are health professionals, selected by the other members of the Board, who serve as citizen public health experts, assisting the Board to deal with complex, often technical, public health issues. A third health professional serves as a nonvoting member.

The Board has powers concerning health and sanitary measures for the protection of the public health within the county, including:

- Enacting such county rules and regulations as are necessary in order to preserve, promote, and improve public health, and provide for the enforcement thereof; and
- Establishing fee schedules for issuing or renewing permits or for such other services as are authorized, provided that such fees or services shall not exceed that actual cost of providing any such services. Fee schedules shall be established by board rules and regulations.

Affected City Councils, Special Purpose Districts and Others

City councils, elected by the citizens within the city boundaries, are the legislative body for the incorporated cities. They have powers and authority similar to that of the county council; most importantly, they are the land use and policy bodies for the incorporated cities. Other administrative bodies include the board of commissioners for water districts, sewer districts, and water associations. These boards set policies and rates for the provision of water and sewer service within their service areas.

Recommendation: The Ground Water Advisory Committee recommends that legislative authority for adoption and implementation of the plan be shared between the Metropolitan King County Council, the King County Board of Health, the Issaquah City Council, and Sammamish Plateau Sewer and Water District. These legislative bodies are needed to implement the plans because they encompass actions that are typically under the purview of one or more, but not the others. King County Board of Health authority is particularly important because it allows for the adoption of ordinances that are effective in both the unincorporated areas and in the cities of King County. Roles of each legislative authority are recommended as outlined below:

Metropolitan King County Council

- Adopt the Ground Water Management Plan after it has been certified by Ecology;
- Appoint members of the Ground Water Management Committee;
- Adopt revisions to the Ground Water Management Plan;
- Review, amend as necessary, adopt, and allocate annually aquifer protection funds subject to the interlocal agreement with the City of Issaquah, and affected governments and agencies based upon the original and yearly amended implementation plan; and,
- Adopt ordinances necessary for the implementation of the Ground Water Management Plan (generally addressing such matters as land use, zoning, and regulations governing the activities of county agencies).

King County Board of Health

- Adopt ordinances necessary for the implementation of the Ground Water Management Plan (generally addressing activities regulated by the Seattle-King County Health Department; e.g., on-site sewage disposal, small public and private drinking water systems, solid waste disposal, etc.).

Issaquah City Council

- Adopt the Ground Water Management Plan after it has been certified by Ecology;
- Adopt ordinances as needed to implement the Ground Water Management Plan within city limits; and
- Adopt revisions to the Ground Water Management Plan.

Sammamish Plateau Sewer and Water District

- Adopt the Ground Water Management Plan after it has been certified by Ecology;
- Adopt measures as needed to implement the Ground Water Management Plan within their jurisdiction;
- Adopt revisions to the Ground Water Management Plan; and
- Adopt funding mechanism through water rates as applicable.

3.3 Funding

A major source of long-term funding must be developed to implement the Ground Water Management Plan. This source of funding would be augmented by grants and any specific use or service fees. Tables 3.8.1 and 3.8.2 indicate actions for which grants and specific use/service fees are appropriate.

A variety of methods could be available to fund ground water protection. One method is to establish an Aquifer Protection Area under Chapter 36.36 RCW. The King County

Board of Health could adopt a Rule and Regulation to establish added fees on permits for a variety of water users or potential contaminators. Water purveyors could establish funding through increasing their rates or other methods. An unexplored method for emergency or long-term funding could be through the "Sewerage, Water, and Drainage Systems (County Services Act Chapter 36.94 RCW)". Description of the funding methods:

Aquifer Protection Area. The purpose of an Aquifer Protection Area is to establish a funding base for ground water protection, preservation, and rehabilitation programs. Aquifer Protection Areas are established through a ballot issue requiring approval from a simple majority of voters within the proposed Aquifer Protection Area. If voters approve the Aquifer Protection Area, the county can collect ground water and septic system user fees. Aquifer Protection Area funding can support virtually all activities associated with the implementation of a Ground Water Management Program.

Special Purpose Districts, Cities with Water Departments, and Others could fund regional and individual components of the adopted ground water plan through their water rates. Annually, beginning in April, the Management Committee will meet to determine the level of funding required for the next year's implementation activities. The concurring agencies will evaluate their level of participation. Through a series of individual interlocals, the regional aspects of the plan and King County participation could be funded along with individual utility responsibilities.

Chapter 36.94 RCW. The County Council may act under the emergency provisions granted to it under Chapter 36.94 RCW to float a short-term bond providing operating funds for the implementation of the groundwater management program.

Recommendation: King County is currently exploring approximately 6-8 long term funding alternatives for the purpose of implementing a ground water management program. If a regional funding source cannot be identified, the Issaquah Creek Valley Ground Water Management Committee should assess the feasibility of establishing an Aquifer Protection Area to provide funding for implementation of the Plan.

3.4 Washington Department of Ecology Role

A certified Ground Water Management Plan is codified in the Washington Administrative Code and is a regulation that Ecology is responsible for administering. Ecology will rely on local government cooperation to implement the Plan, but it may assist the lead agency, if needed, to gain compliance with provisions of the adopted Plan.

3.5 Ground Water Management Committee

The Issaquah Creek Valley Ground Water Management Plan will be implemented by various agencies. These agencies and the public should be represented in oversight of the Issaquah Creek Valley Ground Water Management Plan.

Recommendation: The Ground Water Advisory Committee recommends the formation of the Issaquah Creek Valley Ground Water Management Committee (Management Committee) that will coordinate ground water protection activities in the Issaquah Creek Valley Ground Water Management Area. The Issaquah Management Committee should consist of a one representative from King County, the City of Issaquah, the Sammamish Plateau Water and Sewer District, the Muckleshoot Indian Tribe, and a Issaquah Ground Water Advisory Committee member in advisory capacity. Future members of the management committee would represent entities, such as other water utilities and associations, which voluntarily fund plan programs. Representatives should appoint an alternate to represent them when they are unavailable to attend meetings. The Management Committee will receive comments and input from the Issaquah Ground Water Advisory Committee through their representative on the Management Committee. The Management Committee shall be established by motion by the Metropolitan King County Council with members appointed by the Council, serving staggered terms of three years.

The Management Committee should meet regularly to provide oversight to the implementation, and to address the topics as assigned in the Issaquah Ground Water Management Plan. It is expected that they would solicit information and participation from experts and interested parties as necessary. The Issaquah Creek Valley Ground Water Management Committee will carry out the following tasks:

- Monitor the implementation of the Issaquah Creek Valley Ground Water Management Plan, including:
  1. Review annual reports on implementation prepared by the lead agency; and
  2. Determine whether implementation is adequate and whether changes are needed in priorities, monitoring, reporting etc. during the implementation period.

- Update the Issaquah Creek Valley Ground Water Management Plan:
  1. Act as a forum to consider new or ongoing ground water protection issues of significance to all Ground Water Management Areas;
  2. Determine whether revisions are needed to the Issaquah Creek Valley Ground Water Management Plan; and
  3. Review, amend as necessary, and recommend for adoption by the Metropolitan King County Council, King County Board of Health, and the Issaquah City Council an updated Ground Water Management Plan five years after certification of the original Ground Water Management Plan by Ecology.

- Perform tasks as assigned in the Issaquah Creek Valley Ground Water Management Plan (i.e., facilitating wellhead protection in King County; determining categorical exemptions to SEPA that should be eliminated in physically susceptible and recharge areas and development of guidance documents to assist environmental reviewers in King County and cities).

Public Involvement: Interested public groups and individuals should be kept informed of the Issaquah Management Committee's work and implementation progress by inclusion on a notification list. Those on the list should receive the Management Committee's meeting agenda and minutes and routine updates on the plan's progress. The Management Committee's meetings should be open to the public. Also, if the Issaquah Management Committee is aware of an agency or individual that has an interest in a topic under discussion, they should be invited to attend. Elected officials should also be included on the notification list. Elected officials may also have the opportunity to have presentations on the Issaquah Creek Valley Ground Water Management Plan progress.

Dispute Resolution: The Management Committee should develop a process for resolving disputes between those implementing the plan or for other interested agencies and individuals. The Committee should first attempt to resolve any disputes before they are appealed to local legislative bodies.

Bylaws: Decisions of the Management Committee will be by consensus whenever possible. The Management Committee should adopt bylaws that outline procedures for resolving lack of consensus and that Issaquah Creek Valley Ground Water Advisory Committee recommendations will be carefully and promptly considered, and followed by a written response. The Management Committee should adopt by-laws.

Individual members of the Management Committee will have the responsibility to coordinate internally with the entity represented. For example, a representative of a city needs to communicate and coordinate with their council and public works, planning, and building departments, and other affected departments about ground water management issues.

The Management Committee may make use of subcommittees to accomplish some of its tasks. For example, a subcommittee might address the topic of hazardous materials transport through aquifer protection areas. Federal and State agencies will be asked to serve in a technical capacity, as appropriate, on the subcommittees.

Water purveyors relying on a ground water source may be asked to contribute to technical subcommittees formed to advise the Management Committee. Purveyors may serve regardless of whether their system is located in the Issaquah Creek Valley Ground Water Management Area, because subcommittees will be deliberating upon issues that will affect all ground water purveyors, not just those in the Issaquah Creek Valley Ground

Water Management Area. An example of such an issue is minimum wellhead protection for public water systems in King County where minimum wellhead protection strategies may be developed by the Issaquah Management Committee that add to what is already contained in the Ground Water Management Plan.

3.6 Ground Water Advisory Committee

The Issaquah Creek Valley Ground Water Advisory Committee was established to develop the Issaquah plan. After it is certified by Ecology, the Ground Water Advisory Committee's duties are completed. However, successful implementation of the Issaquah Creek Valley Ground Water Management Plan depends upon support by the affected agencies and the community.

Recommendation: The Ground Water Advisory Committee recommends that they continue to meet at their discretion. The role of the Ground Water Advisory Committee is to monitor implementation of the Issaquah Ground Water Management Plan and to make recommendations to the Management Committee via its representative. The Ground Water Advisory Committee will also review and comment upon the first Issaquah Creek Valley Ground Water Management Plan update.

3.7 Lead Agency

Implementation of the Issaquah Creek Valley Ground Water Management Plan will require staff to perform day-to-day tasks. This staff needs to be familiar with the Issaquah plan, database management, local concerns, the budget process, and be technically capable. This staff will need to provide administrative functions to the satisfaction of the Issaquah Management Committee and the legislative authorities.

Recommendations: The Ground Water Advisory Committee recommends that the King County Department of Natural Resources serve as lead agency for implementation of the Issaquah Creek Valley Ground Water Management Plan in unincorporated King County and the City of Issaquah within its City limits. An interlocal agreement should be developed and executed for specific work within each of their boundaries. In fulfilling its role as lead agency, the King County Department of Natural Resources and the City of Issaquah will:

- Refine cost estimates of the Issaquah Creek Valley Ground Water Management Plan in consultation with implementing governments and agencies;
- Assist the Metropolitan King County Council in determining the aquifer protection fee; and,
- Prepare an annual proposed allocation of the aquifer protection funds, based upon the adopted Issaquah implementation plans, for review and adoption by the Management Committee, affected governments and agencies, and the Metropolitan King County Council.

3.8 Implementation Plan

Ground Water Advisory Committee recommended implementation priorities are listed in the Implementation Plan included in this section as Tables 3.8.1 and 3.8.2. Setting priorities enables the Ground Water Advisory Committee to ensure that ground water protection is maximized in the near term. The schedule contained in the Implementation Plan provides a framework within which all governments and agencies can begin discussion of their Ground Water Management Plan implementation activities. Implementation efforts by King County, the City of Issaquah, and the Sammamish Plateau WSD will be phased in over time. These efforts are dependent upon the availability of funding.

The first table is organized by Ground Water Advisory Committee - determined priority. The second table is organized by the agency or government that will be responsible for implementing the action.

3.9 Process for Evaluation and Revision of the Ground Water Management Plan

Recommendation: The Issaquah Creek Valley Ground Water Advisory Committee recommends that a process for periodic evaluation and revision of the Issaquah Creek Valley Ground Water Management Plan is established to ensure that its goals are achieved efficiently under changing conditions.

The Management Committee, the Issaquah Creek Valley Ground Water Advisory Committee, the lead agencies, and governments and agencies affected by the Issaquah Ground Water Management Plan will be involved in future evaluation and revisions. The first revision will be five years from the date of Issaquah Creek Valley Ground Water Management Plan certification by Ecology. Subsequent revisions will also be done on five-year intervals unless the Management Committee determines that more frequent updates are needed.

The concurrence process will be initiated by the King County Department of Natural Resources and the City of Issaquah following adoption of revisions by the Management Committee. Public hearings will be held as required by law. The draft update will be submitted to the Metropolitan King County Council for review when all affected governments and agencies have concurred and before it is submitted to Ecology.

The Issaquah Creek Valley Ground Water Management Plan updates at time intervals less than five years should be avoided due to the lengthy process of review, public hearings, concurrence, and adoption. Other mechanisms may be used to implement short-term changes either in substance or priority. For example, a grant could be sought to carry out a specific new task that the Management Committee feels is urgent but which is not included in the current Issaquah Creek Valley Ground Water Management Plan. Alternatively, plan priorities could be changed to step up activity related to an issue that the Management Committee determines is more urgent than others.

The King County Department of Natural Resources will assist the Management Committee in its evaluation of the Issaquah Creek Valley Ground Water Management Plan by preparing annual implementation reports. The City of Issaquah will provide information for assembly of the annual reports. The Management Committee will use the reports to determine whether and how Issaquah Ground Water Management Plan should be modified when it is updated. These reports will cover such topics as:

- Progress in implementing plan elements in comparison with established priorities and schedule;
- Problems encountered in implementation of specific program elements;
- Proposed revisions or priority adjustments to address problems encountered in implementation; and,
- Changes in federal, state, or local laws affecting the management plan.

The King County Department of Natural Resources will incorporate proposed revisions into the Issaquah Creek Valley Ground Water Management Plan.

Table 3.8.1

Implementation Priority

Issaquah Creek Valley
Ground Water Management Plan

March 1999

Table 3.8.1 Implementation Priority

Management Strategy	Agent	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
DCM - 1 Data Collection Analysis and Management	City of Issaquah (task 1)	TBD	0.00	0.00		General Funds	high
DCM - 1 Data Collection Analysis and Management	King County Dept. of Natural Resources (Task 2, 3, 4)	1.00	0.00	0.00	APF		high
DCM - 1 Data Collection Analysis and Management	King County Dept. of Natural Resources (Task 1) Non-FTE Costs	1.57	0.00	0.00	APF		high
DCM - 1 Data Collection Analysis and Management	Sammamish Plateau (task 1)	TBD	0.00	0.00		General funds	high
DCM - 1 Data Collection Analysis and Management	SKCHD (task 1)	0.50	0.00	0.00	APF		high
DCM - 2 Data Collection Analysis and Management	Ecology	0.06	0.00	0.00		General Agency Fund	high
ED - 1,2,3 Education Program	King County Dept. of Natural Resources	0.50	0.00	0.00	APF		high
Education	City of Issaquah	0.47	0.00	0.00		General Funds	high
Education	Sammamish Plateau	0.04	0.00	0.00		General Agency Fund	high
Management Committee Tasks: SA - 2, WC - 3A, HM - 7B, PF - 2B, OS - 1	Management Committee	1.41	0.00	0.00	APF		high
PF - 1A Pesticide and Fertilizer Past Use	King County Dept. of Natural Resources		0.00	0.00	APF		high
PF - 1B Pesticide and Fertilizer Past Use	King County Dept. of Natural Resources (DCMP)		0.00	0.00	APF		high
PF - 2C Pesticide and Fertilizer Use	City of Issaquah	TBD	0.00	0.00		General Agency funds	high
PF - 2C Pesticide and Fertilizer Use	DDES Code Development	0.50				General Funds	high
PF - 2C Pesticide and Fertilizer Use	King County Dept. of Natural Resources	0.15	0.00	0.00	APF		high
SA - 3 Sole Source Aquifer Petition	King County Dept. of Natural Resources	0.25	0.00	0.00	APF		high
SG - 1 Regulatory Modifications	City of Issaquah	TBD	0.00	0.00		General Funds	high
SG - 1 Regulatory Modifications	King County	TBD	0.00	0.00	APF		high
SG - 2A, 2B Aquifer Impacts	King County Dept. of Natural Resources	0.50	0.00	0.00	APF		high
SG - 3A Land Use of Inactive or Reclaimed Mines	City of Issaquah	TBD	0.00	0.00		General Funds	high

Table 3.8.1 Implementation Priority

Management Strategy	Agent	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
SG - 3A Land Use of Inactive or Reclaimed Mines	King County Dept. of Natural Resources	0.15	0.00	0.00	APF		high
SG - 3B Zoning code - Reclamation plans	City of Issaquah	TBD	0.00	0.00		General Funds	high
SG - 3B Zoning code - Reclamation plans	DDES Code Development	0.50	0.00	0.00		General Funds	high
SG - 3B Zoning code - Reclamation plans	King County Dept. of Natural Resources	0.15	0.00	0.00	APF		high
ST - 1 Runoff Versus Recharge	City of Issaquah	TBD	0.00	0.00		General Funds	high
ST - 1 Runoff Versus Recharge	King County	TBD	0.00	0.00		General Agency Funds	high
WQ - 2 Data Needs	King County Dept. of Natural Resources in DCMP		0.00	0.00	APF		high
WQ - 6 Artificial Recharge	City of Issaquah	TBD	0.00	0.00		General Funds	high
WQ - 6 Artificial Recharge	Sammamish Plateau	TBD	0.00	0.00		General Funds	high
WQ - 7 Reservation	GWAC	No addition	0.00	0.00	APF		high
OS - 1 Nitrate Concerns	Management Committee	TBD	0.00	0.00	APF		high
OS - 4A Operation and Maintenance	SKCHD	0.04	0.00	0.00	APF		high
SA - 2 Basic WHPP	DDES Code Development	0.56	0.00	0.00		General Funds	high
SA - 2 Basic WHPP	King County Dept. of Natural Resources	0.50			APF		high
SA - 2 Basic WHPP	Management Committee	0.00	0.00	0.00	APF		high
ST - 2A, 2B, 2C Ground Water Quality Concerns - Facility Requirements, Study, Monitoring	King County Dept. of Natural Resources		0.00	0.00	APF	General funds	high
WQ - 1A Policies and Ordinances	King County Dept. of Natural Resources	0.25	0.00	0.00	APF	General Funds	high
WQ - 1A Policies and Ordinances	Ecology	0.06	0.00	0.00		General Funds	high
HM - 1 State Hazardous Waste Plan-Implementation	King County Dept. of Natural Resources		0.00	0.00	APF		high
OS - 2B Hazardous Materials	SKCHD	0.04	0.00	0.00	APF		high
OS - 3A Household Hazardous Wastes	SKCHD (LHWMP)	0.13	0.00	0.00	APF		high
SA - 1A Elimination of categorical exemptions to SEPA	City of Issaquah	0.25	0.00	0.00		General Funds	high
SA - 1A Elimination of categorical exemptions to SEPA	King County Dept. of Natural Resources (Task 1,2,3)	0.25	0.00	0.00	APF		high

Table 3.8.1 Implementation Priority

Management Strategy	Agent	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
SA - 1B Designation of Environmentally Sensitive Areas	DDES Code Development	0.13	0.00	0.00		General Funds	high
SA - 1B Designation of Environmentally Sensitive Areas	King County Dept. of Natural Resources	0.25	0.00	0.00	APF		high
SA - 1C Adoption of General Policies	City of Issaquah	TBD	0.00	0.00		General Funds	high
SA - 1C Adoption of General Policies	King County Office of Strategic Planning	0.04	0.00	0.00		General funds	high
SA - 1D Enhanced environmental review to protect aquifers	City of Issaquah	TBD				General Funds	high
SA - 1D Enhanced environmental review to protect aquifers	King County Dept. of Natural Resources	0.50	0.00	0.00	APF		high
SA - 1E Define and Map Areas	City of Issaquah	TBD	0.00	0.00		General Funds	high
SA - 1E Define and Map Areas	DDES Code Development	0.06	0.00	0.00		General Funds	high
SA - 1E Define and Map Areas	King County Dept. of Natural Resources	1.00	0.00	0.00	APF		high
ST - 4C Coordination Between Surface and Ground Water Planning Efforts: King County	King County Dept. of Natural Resources	0.25	0.00	0.00	APF		high
ST - 5 Assessment of Stormwater Facilities	City of Issaquah	TBD	0.00	0.00		General Funds	high
ST - 5 Assessment of Stormwater Facilities	King County SWM	TBD	0.00	0.00		General funds	high
PF - 2A Pesticide and Fertilizer Use	Conservation District	0.87	0.00	0.00	APF		high
SP - 1C Leakproof Piping	King County Dept. of Natural Resources		0.00	0.00	APF		high
SW - 1 Standards	SKCHD	0.04	0.00	0.00		General funds	high
WC - 1A State Program	City of Issaquah	TBD	0.00	0.00		General funds	high
WC - 1A State Program	Ecology	0.64	0.00	0.00		General funds	high
WC - 1A State Program	Sammamish Plateau	TBD	0.00	0.00		General funds	high
WQ - 3 Water rights	City of Issaquah	TBD	0.00	0.00		General Funds	high
WQ - 3 Water rights	Sammamish Plateau	TBD	0.00	0.00		General Agency Funds	high
UST - 1A, 1B Augment State UST Program	King County Dept. of Natural Resources	1.50	0.00	0.00	APF		high
OS - 4B Operation and Maintenance	SKCHD	0.50	0.00	0.00	APF		high
UST - 2A Exempt Tanks	King County Dept. of Natural Resources	0.08	0.00	0.00	APF		high

Table 3.8.1 Implementation Priority

Management Strategy	Agent	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
UST - 2B Exempt Tanks	King County Dept. of Natural Resources	0.08	0.00	0.00	APF		high
OS - 2A Commercial Hazardous Materials	SKCHD	0.25	0.00	0.00	APF		high
WQ - 4A Conservation	City of Issaquah	TBD	0.00	0.00		General Funds	high
WQ - 4A Conservation	DDES Code Development	0.22	0.00	0.00		General Funds	high
HM - 4 Hazardous Waste Contamination Sites	SKCHD	0.00	0.10	0.00	APF		medium
HM - 5 Implementation of the Uniform Fire Code	City of Issaquah	0.00	TBD	0.00		General Funds	medium
HM - 5 Implementation of the Uniform Fire Code	King County Fire Marshal	0.00	TBD			TBD	medium
HM - 5 Implementation of the Uniform Fire Code	King County Dept. of Natural Resources	0.00	0.50	0.00	APF		medium
HM - 6 Implementation of the Emergency Planning and Community Right-to-Know Act	King County Dept. of Natural Resources (Task 3)	0.00	0.25	0.00	APF		medium
HM - 6 Implementation of the Emergency Planning and Community Right-to-Know Act	King County Dept. of Natural Resources (Task 5)	0.00	0.08	0.00	APF		medium
HM - 6 Implementation of the Emergency Planning and Community Right-to-Know Act	King County: Emergency Management (Task 1)	0.00	TBD	0.00		TBD by King County Office of Emergency Management	medium
HM - 7A Transportation-Related Hazardous Materials Spills-Purveyor Assessment	City of Issaquah	TBD	0.00	0.00		General Funds	medium
HM - 7A Transportation-Related Hazardous Materials Spills-Purveyor Assessment	Sammamish Plateau (Task 1)	TBD	TBD	0.00		Purveyor funds	medium
HM - 7B Transportation-Related Hazardous Material Spills-Management Committee Evaluation	King County Dept. of Natural Resources (Task 4)	0.00	0.08	0.00	APF		medium
UST - 1C Augment State UST Program	King County Dept. of Natural Resources	0.00	0.08	0.00	APF		medium
PF - 2B Pesticide Reduction Program	Cooperative Extension					General Funds	medium
PF - 2B Pesticide Reduction Program	Management Committee		0.00	0.00	APF		medium
ST - 7 Soil Amendment	King County Dept. of Natural Resources	0.00	0.25	0.00	APF	Centennial Clean Water Fund grant	medium

Table 3.8.1 Implementation Priority

Management Strategy	Agent	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
ST - 4A Coordination Between Surface and Ground Water Planning Efforts: Ecology Programs	Ecology	0.00	0.32	0.00		General funds	medium
WQ - 4B, C Conservation	SKCHD		0.08	0.00	APF		medium
ST - 4B Coordination Between Surface and Ground Water Planning Efforts: Puget Sound Water Quality Action Team	Puget Sound Water Quality Action Team	0.00	0.00	0.00		General Agency Fund	medium
HM - 2 Dangerous Waste Management Unit Setback	Ecology	0.00		0.00	APF		medium
BSE - 1 Guideline Revision	Ecology	0.00	0.00	0.24		General Funds	low
WC - 2A Well Identification	King County Dept. of Natural Resources	0.00	0.00	0.08	APF		low
WC - 2B Well Identification	King County Dept. of Natural Resources	0.00	0.00	0.08	APF		low
WC - 3A Decommissioning cost	King County Dept. of Natural Resources	0.00	0.00	0.13	APF		low
WC - 3B Decommissioning cost	Ecology	0.00	0.00	0.14		General Agency funds	low
SP - 1B Sewer Maintenance Programs	King County Dept. of Natural Resources	0.00	0.00		APF	General Agency funds	low
SP - 2 Groundwater depletion - Backfill	King County Dept. of Natural Resources	0.00	0.00		APF		low
WC - 1B State Program	Ecology	0.00	0.00	0.64		General Agency Funds	low
WC - 1B State Program	SKCHD	0.00	0.00	0.50	APF		low
C - 1 Information - Studies	King County Dept. of Natural Resources	0.00	0.00	0.04	APF		low
SP - 1A Infiltration and Exfiltration	King County Dept. of Natural Resources	0.00	0.00	0.50	APF	General Agency funds	low
ST - 6 Roadway Runoff	King County DOT	0.00	0.00	TBD		Unfinished Agenda	
TOTAL		16.25	1.73	2.34			

Table 3.8.2

Implementing Agencies

Issaquah Creek Valley
Ground Water Management Plan

March 1999

Table 3.8.2 Implementing Agencies

Management Strategy	Agency	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
PF - 2C Pesticide and Fertilizer Use	City of Issaquah	TBD	0	0.00		Agency	high
SG - 1 Regulatory Modifications	City of Issaquah	TBD	0	0.00		Agency	high
SG - 3A Land Use of Inactive or Reclaimed Mines	City of Issaquah	TBD	0	0.00		Agency	high
SG - 3B Zoning code - Reclamation plans	City of Issaquah	TBD	0	0.00		Agency	high
WQ - 6 Artificial Recharge	City of Issaquah	TBD	0	0.00		Agency	high
Education	City of Issaquah	0	0	0.00		Agency	high
ST - 1 Runoff Versus Recharge	City of Issaquah	TBD	0	0.00		Agency	high
DCM - 1 Data Collection Analysis and Management	City of Issaquah (task 1)	TBD	0	0.00		Agency	high
SA - 1A Elimination of categorical exemptions to SEPA	City of Issaquah	0	0	0.00		Agency	high
SA - 1C Adoption of General Policies	City of Issaquah	TBD	0	0.00		Agency	high
ST - 5 Assessment of Stormwater Facilities	City of Issaquah	TBD	0	0.00		Agency	high
SA - 1E Define and Map Areas	City of Issaquah	TBD	0	0.00		Agency	high
WC - 1A State Program	City of Issaquah	TBD	0	0.00		Agency	high
WQ - 3 Water rights	City of Issaquah	TBD	0	0.00		Agency	high
	City of Issaquah	TBD	0	0.00		Agency	high
HM - 5 Implementation of the Uniform Fire Code	City of Issaquah	0	TBD	0.00		Agency	medium
HM - 7A Transportation-Related Hazardous Materials Spills-Purveyor Assessment	City of Issaquah	TBD	0	0.00		Agency	medium
SA - 1D Enhanced environmental review to protect aquifers	City of Issaquah	TBD				Agency	high
SUBTOTAL FOR CITY OF ISSAQUAH		1	0	0.00			
PF - 2A Pesticide and Fertilizer Use	Conservation District	1	0	0.00	APF		high

Table 3.8.2 Implementing Agencies

Management Strategy	Agency	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
SUBTOTAL FOR CONSERVATION DISTRICT		1	0	0.00			
PF - 2B Pesticide Reduction Program	Cooperative Extension		No additional			Agency	medium
SUBTOTAL FOR COOPERATIVE EXTENSION		0	0	0.00			
SG - 3B Zoning code - Reclamation plans	DDES Code Development	1	0	0.00		Agency	high
PF - 2C Pesticide and Fertilizer Use	DDES Code Development	1				Agency	high
SA - 2 Basic WHPP	DDES Code Development	1	0	0.00		Agency	high
SA - 1B Designation of Environmentally Sensitive Areas	DDES Code Development	0	0	0.00		Agency	high
SA - 1E Define and Map Areas	DDES Code Development	0	0	0.00		Agency	high
WQ - 4A Conservation	DDES Code Development	0	0	0.00		Agency	high
SUBTOTAL FOR DDES		2	0	0.00			
DCM - 1 Data Collection Analysis and Management	King County Dept. of Natural Resources (Task 1) Non-FTE Costs	2	0	0.00	APF		high
UST - 1A, 1B Augment State UST Program	King County Dept. of Natural Resources	2	0	0.00	APF		high
DCM - 1 Data Collection Analysis and Management	King County Dept. of Natural Resources (Task 2, 3, 4)	1	0	0.00	APF		high
SA - 1E Define and Map Areas	King County Dept. of Natural Resources	1	0	0.00	APF		high

Table 3.8.2 Implementing Agencies

Management Strategy	Agency	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
ED - 1,2,3 Education Program	King County Dept. of Natural Resources	1	0	0.00	APF		high
SG - 2A, 2B Aquifer Impacts	King County Dept. of Natural Resources	1	0	0.00	APF		high
SA - 2 Basic WHPP	King County Dept. of Natural Resources	1			APF		high
SA - 1D Enhanced environmental review to protect aquifers	King County Dept. of Natural Resources	1	0	0.00	APF		high
WQ - 1A Policies and Ordinances	King County Dept. of Natural Resources	0	0	0.00	APF	Agency	high
ST - 4C Coordination Between Surface and Ground Water Planning Efforts: King County	King County Dept. of Natural Resources	0	0	0.00	APF		high
SA - 1B Designation of Environmentally Sensitive Areas	King County Dept. of Natural Resources	0	0	0.00	APF		high
SA - 1A Elimination of categorical exemptions to SEPA	King County Dept. of Natural Resources (Task 1,2,3)	0	0	0.00	APF		high
SA - 3 Sole Source Aquifer Petition	King County Dept. of Natural Resources	0	0	0.00	APF		high
SG - 3A Land Use of Inactive or Reclaimed Mines	King County Dept. of Natural Resources	0	0	0.00	APF		high
SG - 3B Zoning code - Reclamation plans	King County Dept. of Natural Resources	0	0	0.00	APF		high
PF - 2C Pesticide and Fertilizer Use	King County Dept. of Natural Resources	0	0	0.00	APF		high
UST - 2A Exempt Tanks	King County Dept. of Natural Resources	0	0	0.00	APF		high

Table 3.8.2 Implementing Agencies

Management Strategy	Agency	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
UST - 2B Exempt Tanks	King County Dept. of Natural Resources	0	0	0.00	APF		high
PF - 1A Pesticide and Fertilizer Past Use	King County Dept. of Natural Resources		0	0.00	APF		high
PF - 1B Pesticide and Fertilizer Past Use	King County Dept. of Natural Resources (DCMP)		0	0.00	APF		high
WQ - 2 Data Needs	King County Dept. of Natural Resources in DCMP		0	0.00	APF		high
ST - 2A, 2B, 2C Ground Water Quality Concerns - Facility Requirements, Study, Monitoring	King County Dept. of Natural Resources		0	0.00	APF	Agency	high
HM - 1 State Hazardous Waste Plan-Implementation	King County Dept. of Natural Resources		0	0.00	APF		high
SP - 1C Leakproof Piping	King County Dept. of Natural Resources		0	0.00	APF		high
HM - 5 Implementation of the Uniform Fire Code	King County Dept. of Natural Resources	0	1	0.00	APF		medium
HM - 6 Implementation of the Emergency Planning and Community Right-to-Know Act	King County Dept. of Natural Resources (Task 3)	0	0	0.00	APF	Centennial	medium
ST - 7 Soil Amendment	King County Dept. of Natural Resources	0	0	0.00	APF	Clean Water Fund grant	medium
HM - 7B Transportation-Related Hazardous Material Spills-Management Committee Evaluation	King County Dept. of Natural Resources (Task 4)	0	0	0.00	APF		medium

Table 3.8.2 Implementing Agencies

Management Strategy	Agency	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
HM - 6 Implementation of the Emergency Planning and Community Right-to-Know Act	King County Dept. of Natural Resources (Task 5)	0	0	0.00	APF		medium
UST - 1C Augment State UST Program	King County Dept. of Natural Resources	0	0	0.00	APF		medium
WC - 3A Decommissioning cost	King County Dept. of Natural Resources	0	0	0.13	APF		low
SP - 2 Groundwater depletion - Backfill	King County Dept. of Natural Resources	0	0		APF		low
SP - 1B Sewer Maintenance Programs	King County Dept. of Natural Resources	0	0		APF	Agency	low
C - 1 Information - Studies	King County Dept. of Natural Resources	0	0	0.04	APF		low
SP - 1A Infiltration and Exfiltration	King County Dept. of Natural Resources	0	0	0.50	APF	Agency	low
WC - 2A Well Identification	King County Dept. of Natural Resources	0	0	0.08	APF		low
WC - 2B Well Identification	King County Dept. of Natural Resources	0	0	0.08	APF		low
SUBTOTAL FOR King County Dept. of Natural Resources		9	1	0.82			
DCM - 2 Data Collection Analysis and Management	Ecology	0	0	0.00		Agency	high
WQ - 1A Policies and Ordinances	Ecology	0	0	0.00		Agency	high
WC - 1A State Program	Ecology	1	0	0.00		Agency	high
ST - 4A Coordination Between Surface and Ground Water Planning Efforts: Ecology Programs	Ecology	0	0	0.00		Agency	medium

Table 3.8.2 Implementing Agencies

Management Strategy	Agency	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
HM - 2 Dangerous Waste Management Unit Setback	Ecology	0		0.00	APF		medium
BSE - 1 Guideline Revision	Ecology	0	0	0.24		Agency	low
WC - 3B Decommissioning cost	Ecology	0	0	0.14		Agency	low
WC - 1B State Program	Ecology	0	0	0.64		Agency	low
SUBTOTAL FOR ECOLOGY		1	0	1.02			
WQ - 7 Reservation	GWAC	No additional	0	0.00	APF		high
SUBTOTAL FOR GWAC		0	0	0.00			
SG - 1 Regulatory Modifications	King County	TBD	0	0.00	APF		high
ST - 1 Runoff Versus Recharge	King County	TBD	0	0.00		Agency	high
SA - 1C Adoption of General Policies	King County Office of Strategic Planning	0	0	0.00		Agency	high
ST - 5 Assessment of Stormwater Facilities	King County SWM	TBD	0	0.00		Agency	high
HM - 5 Implementation of the Uniform Fire Code	King County Fire Marshal	0	TBD	TBD		TBD	medium
HM - 6 Implementation of the Emergency Planning and Community Right-to-Know Act	King County: Emergency Management (Task 1)	0	TBD	0.00		TBD	medium
ST - 6 Roadway Runoff	King County DOT	0	0	TBD		Unfinished Agenda	
SUBTOTAL FOR OTHER KING COUNTY AGENCIES		0	0	0.00			
OS - 1 Nitrate Concerns	Management Committee	TBD	0	0.00	APF		high
SA - 2 Basic WHPP	Management Committee	0	0	0.00	APF		high

Table 3.8.2 Implementing Agencies

Management Strategy	Agency	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
PF - 2B Pesticide Reduction Program	Management Committee		0	0.00	APF		medium
Management Committee Tasks: SA - 2, WC - 3A, HM - 7B, PF - 2B, OS - 1	Management Committee	1	0	0.00	APF		
SUBTOTAL FOR MANAGEMENT COMMITTEE		1	0	0.00			
ST - 4B Coordination Between Surface and Ground Water Planning Efforts: Puget Sound Water Quality Action Team	Puget Sound Water Quality Action Team (PSWQA)	0	0	0.00		General Agency Fund	medium
SUBTOTAL FOR PSWQA		0	0	0.00			
Education	Sammamish Plateau	0	0	0.00		General Agency Fund	high
WQ - 6 Artificial Recharge	Sammamish Plateau	TBD	0	0.00		Agency	high
DCM - 1 Data Collection Analysis and Management	Sammamish Plateau (task 1)	TBD	0	0.00		Agency	high
WC - 1A State Program	Sammamish Plateau	TBD	0	0.00		Agency	high
WQ - 3 Water rights	Sammamish Plateau	TBD	0	0.00		Agency	high
HM - 7A Transportation-Related Hazardous Materials Spills-Purveyor Assessment	Sammamish Plateau (Task 1)	TBD	TBD	0.00		Purveyor funds	medium
SUBTOTAL FOR SAMMAMISH PLATEAU		0	0	0.00			
DCM - 1 Data Collection Analysis and Management	SKCHD (task 1)	1	0	0.00	APF		high
OS - 4A Operation and Maintenance	SKCHD	0	0	0.00	APF		high
OS - 2B Hazardous Materials	SKCHD	0	0	0.00	APF		high
OS - 3A Household Hazardous Wastes	SKCHD (LHWMP)	0	0	0.00	APF		high
SW - 1 Standards	SKCHD	0	0	0.00		Agency	high

Table 3.8.2 Implementing Agencies

Management Strategy	Agency	Priority High FTE Estimate	Medium Priority FTE Estimate	Low Priority FTE Estimate	AP Fund	Other Fund Source	GWAC ranking
OS - 4B Operation and Maintenance	SKCHD	1	0	0.00	APF		high
OS - 2A Commercial Hazardous Materials	SKCHD	0	0	0.00	APF		high
HM - 4 Hazardous Waste Contamination Sites	SKCHD	0	0	0.00	APF		medium
WQ - 4B, C Conservation	SKCHD		0	0.00	APF		medium
WC - 1B State Program	SKCHD	0	0	0.50	APF		low
SUBTOTAL FOR SKCHD		1	0	0.50			
TOTAL		16	2	2.34			

Appendices

Appendix A: Public Comment

Appendix B: Letters of Concurrence or Comment

Issaquah Creek Valley
Ground Water Management Plan

March 1999

Appendix A

Public Comment

Issaquah Creek Valley
Ground Water Management Plan

March 1999

Issaquah GWMA Hearing Transcript
April 13, 1995

Welcome to the Issaquah Creek Valley Ground Water Management Area Program and I would like to welcome you to the hearing tonight. Let the record show that it is 9:10 p.m. April 13, 1995, and this hearing is being held in Issaquah at the Clark Elementary School. Again the primary purpose of this hearing is to take comments on the draft Issaquah Creek Valley Ground Water Management Area Program. The legal notice for this hearing was published in the *Washington State Register* on April 5, 1995. Notices were also published on or about the same date in the *Issaquah Press* and the *Bellevue-Journal American*. In addition, notices were mailed out to about 150 people, interested parties, or firms and copies of the plan were mailed out about the first of April. Again, if you would like to speak, please fill out one of the cards over there on the table and give it to me and we will put you on the bottom of the stack here and get to you in order. Because this is a hearing and not a workshop, we won;t respond to your questions, if you have a question that you want answered, please go ahead and ask it and we will respond to it in writing later on. We won't respond necessarily tonight but we do reserve the right, however, to ask you clarification questions to make sure we understand what you are saying. When it is your turn to speak, come up here and identify yourself and whom you might represent and one speaker at a time. It is not a platform to be arguing with the audience, so we wanted to make that clear too. So, when I call your name, just please on come up and identify yourself and whom you represent.

The first person is Dick Harms. My name is Dick Harms and I live in Providence Point which of course is in the Sammamish Plateau Water District; and most of you are probably aware King County has started herbicide spraying they're planning on starting on the south end of the county and working north. They're using Oust? and Roundup in their spray presumably they'll get to the Issaquah Valley aquifer about the latter part of next month, so it's highly unlikely that this plan will be approved anytime to stop them from spraying. Their using Oust and Roundup. Roundup is class 1 with a danger warning and Oust is class 3 with a caution warning. Now, there's no doubt that these herbicides are highly toxic the only question is how much of this stuff gets into the ground water. The manufacturers makes some general safety claims, self-serving type of safety claims which you would naturally expect however, there's no way to calculate the amount that gets into ground water because of the many complicated variables. Some of these variables are soil type, soil p.h., soil microbiology, soil temperature, rain fall type of vegetation, aquifer geology, and of course the type of herbicide. What is needed is continuous monitoring of all wells, all major wells for all types of herbicides and pesticides in addition of course to all the other pollutants that we have to worry about. Another questions that none of the agencies face up to is possible synergistic inter-reaction between the hundreds of herbicides and pesticides and believe me there's more being put on the market everyday. So maybe there's thousands I know of at least hundreds. Now the animal kill tests they use for to determine the toxicity of these herbicides and pesticides is

one at a time. In other words they get 50% animal kill with a given concentration of herbicide or pesticide. But they never test them in combination, of course the testing problem would be fantastically when you consider the permutations of and combinations of hundreds maybe thousands of different chemicals. It interesting to note that there is some epidemiological studies of the effect of herbicides on human beings and apparently there is a high correlation between herbicide exposure and digestive cancer, genetic cancer, and lymph system cancer. Seems to me that since human health is involved the burden of proof is on the people who want to expose the public to these toxic substances. The County is presently prohibited from spraying in the recharge areas of Vashon Island, Maury Island, and the Snoqualmie Valley. I think there is no fundamental reason why we should not have the same protection also, of course, the County spraying and recharge areas is an extremely bad example, I just don't understand how they can justify this and it effectively undermines the entire ground water education program. Of course, the answer is they want save money the County of course is trying roundup $300 million dollars for a Mariners Stadium. I urge everyone to write to Larry Kimble, of the King County's Roads Department urging him not to spray in our recharge area. Incidently, I have the phone number and address of these people if anybody would like to get it from me I would be glad to oblige. Hopefully when this plan is approved, the road people will be prohibited from spraying in our recharge areas. Now, in conclusion I would like to make a few quick general comments. Seems to me that the basic problem with ground water is that its a case of out of sight out of mind. However, everyone should remember that this is the water that they and their families drink. With a rapidly increasing population, we will have a serious problem in the near future unless we take step now to limit usage and pollution of our aquifer. I don't know when this is going to happen but I feel fairly confident that based on historical data, of aquifers back East and other part of the country sooner or later we are going to have a limitation in our aquifer, both pollution and usage. As a matter of fact, it looks to me like Issaquah is selling water they don't have. When our water supply deteriorates, as it inevitably will, our property values will also deteriorate. Finally, I would like to say, it behooves all of us to protect the aquifer and support the Issaquah Valley Creek Ground Water Management Plan. Thank You.

Doug Rushton: Thank You. The next person to speak is Mr. **Ken Rau**

Good evening my name is **Kent Rau** and I'm the representing the Overdale Water Association. I'm currently the manager for that system. I maintain a certified license by the State of Washington for Overdale Water and Lake Ellis West by Falls City. I appreciate the efforts of this committee to keep on top these water issues. Overdale is concerned about what we see, what we read, and what we hear. Overdale Water Association is a small community owned and operated provider located between Issaquah and Sammamish Plateau Water and Sewer Districts. We're not very big in

some cases nobody know we exist. We have current services of 135 active hookups and we have obligations for a 160 in the final size of the district. We have water rights and water certificates that date back to the mid 1950's. This issue we're going through does not surprise me. On September 15, 1986, we transmitted our concerns about additional water usage from our common aquifer to Mr. Mark Spar, of Water District 82 at that time. Also, this was transmitted to Mr. Roy Bishop, District Manager, Department of Water Resources. We still have the same concerns. How we recognize a water rights does not guarantee the artisan flow of our southeast 56th Street well. We can then document that our well down there, some physical installations not changed since it's installation in 1958. We have in fact because of concerns done water conservation procedures and we've installed water meters, and in fact our water usage per home is probably 25% of what it was in 1975. We have recent evidence of changes in behavior of our common aquifer. On certain occasions the artisan outflow has ceased to appear; and I would like to remind everybody that I've been associated with that system since 1975 and I'm very familiar with that particular well's characteristics. Last summer and last fall, this fall however, the artisan outflow ceased to flow in our well. Overdale Water Association believes this change is directly attributable to the increase drawing of water from our common aquifer by other users. Lake Sammamish Plateau Water and Sewer District contracted with Carr & Associates to conduct pumping tests under first wells installed near I-90. The report documents that in fact the code of influence of their pumping tests could been seen as far north as our Southeast 56th Street well and please be reminded that the pumping test was only a 72 hour test. Since then, Lake Sammamish Plateau Water District has increased its yearly average acre-feet taken from the common aquifer by more than four times the amount which was in affect on the pumping tests were conducted. Since that time another well has been installed and tested and is either on line or is ready to go line when they have that need. Changes have been made by the Issaquah Water System over the years however, I or Overdale does not have much information on that. While the physical dimensions of our water system have not changed, dynamic results of changes to the aquifer caused by external conditions effecting the visual artisan outflow has been noticed by Overdale. We hereby respectively request that before this group or any group wants to allocate any new or additional increased water to any current or future use in the area receiving water from the Issaquah aquifer, that a formal study be in honor taken to ensure Overdale Water Associations and our users are not negatively impacted. The trustees of the Overdale Water Association and the Overdale community consider this matter to be critical and in need of immediate consideration. Thank you.

Doug Rushton: Thank You. The next speaker is **James W. Johnston.** Who I don't see here now so he must have left. Mr. Johnston are you here? Ok, we'll move to the next person, who is **Norm Nielson.** Ok, Mr. Nielson apparently has left as well. The next person to speak is Mr. David Bush.

My name is **David Bush.** I'm a local resident and I've read the summary of the committee's report and I would like to complement the committee first of all on the report and I very much support the idea of conserving and protecting the aquifer that we are all living above. My concern with the aquifer is two fold. One with quantity and the other with quality but I'm a geologist I earn my living seeking water and seeking oil in the past not currently employed with that capacity but in looking for water sources one thing that I am noting as an admission in the report is truly seeking water sources within the bedrock. The report states that the bedrock is mostly impervious my concern, and I'm not just pressing this concern because I have any hope that there's a larger water supply down there some where, the supply is pretty well measurable right now, my concern is that we have drawn an outline essential of the watershed for Issaquah Creek and we're calling that the management area. My concern is that there maybe supply and the lower Issaquah Valley wellhead protection plan testing that was done two years ago showed that there's real gaps in the water balance that may be coming from subbasement flow that is, flow that is from the bedrock. There are a couple of features in the Issaquah aquifer that could contribute to that. One is the Tiger Mountain syncline and this syncline basically runs from the toward the top of Tiger Mountain towards the northwest Lake Sammamish's lies within that syncline, axial folds in that syncline could very well be contributing to the water supply in the lower Issaquah Valley aquifer if that's true there's a good possibility of more recharge up on the upper parts of Agar Mountain also from Squak Mountain and currently those are shown as relatively low recharge areas for potential. One of the other things is that the syncline is made up of sedimentary rocks again the idea that they are impervious doesn't go along with the fact that we mine coal here for about 90 years; coal is a soft sediment and soft sediments are associated with other impermeable sediments. When they mine the coal here, they mine down just to the level of the current creek and it didn't go deeper because they have water problems they mine from the creek level up. It's much easier in that we can drain the water out of the mouths of those coal mines which leads me to believe that there is some contribution from those sediments. The other possible contributor is more recent discovery that there a large fault system in Seattle fault that trends through the lower end of Lake Sammamish and that fault system could be a tremendous conduit of water for much farther east than the current management plan shows. Both of those may contribute to the lower Issaquah aquifer and if they do, we need to be aware of that and be protecting and conserving where ever that source is as well. The other thing has to do with the drawdown and the cycling that we started to see last year. If the drought conditions continue we may see and certainly if our usage continues to rise we are going to continue to see some of those shallower wells. Every time we have a drawdown in the form of calling it depression that draws in surface contaminants that we haven't seen much movement in the past. The lower Issaquah Valley has a wellhead protection plan that has been put out in draft form that shows a one, five, and ten year zone of influence and once we start creating those cones

around those shallow wells, that zone of influence is going to increase or steepen and will draw in more and more contaminants, potential contaminants, there is I think 19-20 known underground storage tank many of which have leaked in the past, there's still some surface contamination associated with those as we cycle those shallower wells forming those cones each summer and fall we're going to draw more and more of that into the areas of our pumping. That's my secondary concern on the quality. Once again, I would like to complement the committee's report and if we could all continue to conserve and protect the aquifer that we've got I think that's our main focus. Thank you.

Doug Rushton: Thank you. The next person we have to speak is Dave Garland.

Dave Garland. I'm here as a citizen tonight. I have fifteen years experience with the State Department of Ecology as a Hydrogeologist. I was also a member of the Bear Creek Ground Water Management Advisory Committee for over a year if I recall. I found that the pace of things was rather slow after many meeting, very little had been accomplished and I see that the results now, ten years after the designation of Redmond and Issaquah as ground water management areas having proposals to do things that should have been done under the previous grant. This grant is the product, this document, is the product of the $300,000 dollar grant. Many of the items within recommend such things as five and six hundred dollar letters why weren't such letters written during the period of the grant? I look at this list of proposals and really the meat of this is in the center were the management strategies are listed with cost. I noticed in your poster display at the break, the price tag was not given at the bottom of each proposed items. One of the items is a $225,000 cemetery study. A study to see if burying people, $228,000 which would be covered by the Centennial Clean Water Fund, cigarette tax monies and the aquifer protection fund which is essentially monies from a taxing district that would be established in this ground water management area. So we are talking about raising taxes here, and this same study is also proposed in Redmond, and I'm wondering if a couple of other areas have this study proposed that we have this million dollar study of the effect of cemeteries on ground water quality. One of my biggest problems and I'm all for ground water quantity and quality protection but when I see government agencies gone awry with gold-plated scheme that do very little to protect ground water but rather enrich county health agencies and other agencies. Then I have to cry foul. Many of the programs here don't pertain to Issaquah such as seawater intrusion. What are we doing with seawater intrusion in Issaquah? Again, the cemetery study. There may be cemeteries in Issaquah there are two cemeteries in Redmond and right next door we have a large municipal well. This well is sampled regularly for long list of parameters and nothing has been found related to the cemetery. In fact, today caskets today are buried today in large concrete vaults; there has been no contamination in the Redmond wells which are shallow the material around the

cemetery is very permeable if anything was coming out it would have been shown by the sampling of those wells. So, and I'm not sure if any local studies are proposed here or if we would simply be looking at the literature perhaps for Woodlawn Cemetery in New York, I don't know. Anyway that cemetery is mentioned here in the document. The problems have not really been defined. Do we have contamination here from on-site systems, sewer pipes, hazardous waste, pesticides? Very expensive proposals are being put forth for what I see are non-existent problems. One of the big ones for me is that many of the things proposed are already in place. There a lot of what is proposed in this plan is redundant with existing government functions. The problem of Overdale's artisan well should be dealt with by existing programs, Water Resources, Department of Ecology, should be right on that and at least explain to you that flowing, that the condition of your well flowing is not a guarantee by the water right as long as you can, the laws refers to reasonable pumping lift and as long as you can pump the same amount of water that you've always enjoyed which you can as I know even after a well stops flowing if the water level is a foot below the surface the well stills functions typically as it always has, so the condition of flowing is not a guarantee but I can understand the concerns when water levels drop I would watch that to and I think that your Department of Ecology should be taking care of that for you. It does not require hundreds of thousands of dollars in the program. Well, I think I've already said many, many of the proposed tasks do nothing for water quality or water quantity but rather primarily enrich the King County Health Department. I'm all for the King County Health Department; I work with staff people there, I respect the staff as professionals and yet I think this whole proposal needs to be gone over very carefully and the gentleman said earlier, many of the functions can be made more efficient things that are being done now need to be re-prioritized with Issaquah's ground water in mind. Thank you.

Doug Rushton: Thank you. That was the last of the cards that I have. Is there anyone else that would like to fill out a card and speak? Are you sure? Going, going, ok. I have no other names of people that want to testify. All testimony presented tonight will receive equal weight with any written comments we receive and if you would to submit additional or other written comments, submit them either to Bill Lasby or myself please by June 16, 1995. Both of our address are over here on some notecards. Excuse me, on some sheets of paper over there. Again be sure we have them by June 16. After the comment period, after June 16, what we'll be doing is the lead agency, Seattle-King County Health, will take all the comments they receive from effective governments and the public, consolidate those and give them to the GWAC. The GWAC resolves areas of nonconcurrency if there are any and they submit them to Ecology for certification. Again, our intent at some point is to combine this ground water stuff with the studies, the watershed basin, water excuse me, basin assessments and maybe do a regulation on this. If we do that we will go

through another hearing process and that will be open to the public as well as this. Ok. If I or any of the Seattle-King County staff or Kathryn can be a help to you after this please stop us we would be happy to talk with you. Appreciate your time in coming to this and your comments it's been a valuable use of time. And last chance and this is for sure, for the hearing part. Ok, let the record show that it's 9:38 p.m. and this hearing is adjourned.

gwma\king\issaquah\issahrg.sum
Gwma #3: king\issaquah\issahrg.sum

June 7, 1995

King County Dept. of Environ. Health
Attn: Carl Osaki, Chief
King Co. Environmental Health Division
201 Smith Tower, 506 2nd Avenue
Seattle, WA. 98104

BERNARD
DEVELOPMENT COMPANY

RE: Issaquah Creek Valley Ground Water Management Plan

This two inch thick document appears to contain Management Strategies and Programs that will prevent the surface use of land that has been planned to receive growth in the King County Comprehensive Plan. This is done by mistakenly defining all land in the Plan area as a "Single Source Aquifer," and as an "Environmentally Sensitive Area," and the entire drainage basin as an "Aquifer Recharge Area." Suddenly, existing polices already adopted for situations elsewhere by the County, not ever intended to apply in mass to this huge land area, would restrict the planned growth that is intended here by the King County Comprehensive Plan to accommodate GMA growth requirements).

My personal background is that of a Mining Engineer, Colorado School of Mines (plenty of geology here), and a real estate developer having years of experience dealing with development (including ground water and aquifer issues) in Issaquah and Preston.

The aquifer under Issaquah is fed by water coming through glacial deposits beneath hillsides southwest, south, southeast, east, and northeast of Issaquah. This is not a "Single Source Aquifer".

While Environmentally Sensitive Areas exist within the defined aquifer basin, the entire land area is not an Environmentally Sensitive Area. Freeways, the town of Issaquah, Lake Sammamish, and both developed and undeveloped lands exist here, that are not "Environmentally Sensitive Areas."

One could claim that any drop of water falling on land could be a source of aquifer recharge, but this would be a mistake. Aquifers in this case obtain their water from different surface and ground water sources. Issaquah actually has several separate aquifers beneath it, separated by hard compacted impervious layers of consolidated earth material and clay. Preston has aquifers of its own, with water sources unrelated to aquifers south and north of Issaquah. There is not one aquifer in this defined region with one large homogeneous "Aquifer Recharge Area." Parts of the land area just has ground water below, not significantly recharging the various aquifers. One example is Lake Sammamish, fed by surface and ground water. If all the land area in the defined study area was an Aquifer Recharge Area, Lake Sammamish would be recharging the aquifer(s), and there would never be any threat of an aquifer water shortage (unless Lake Sammamish dried up), because for all practical purposes "aquifer areas" beneath Issaquah are well below the surface level of Lake Sammamish; the lake itself would be the only aquifer recharge ever needed for Issaquah.

If the Issaquah Creek Valley Ground Water Management Plan is adopted without change, growth intended (and planned for) in the newly adopted King County Comprehensive Plan would be frustrated by policy and program conflicts between the Comprehensive Plan and the Issaquah Creek Valley Ground Water Management Plan.

In addition to being geologically incorrect, defining the entire Issaquah Creek Ground Water Management Plan area as a Single Source Aquifer and the entire area as a "Critical Area," and the whole basin as an "Aquifer Recharge Area" (as this Plan does) would (when combined with associated polices in this Plan and elsewhere for the use of these terms) prevent the very growth accommodated and planned for in the recently passed King County Comprehensive Plan and the related growth planned for and passed by the King County Council this past December, and by the city of Issaquah, meeting requirements of the Growth Management Act.

Unless changes are made, special protection polices (intended just to apply to Vashon Island, the only defined single source aquifer when the Comprehensive Plan was passed) and related new land use restrictions (when added to the Issaquah Creek Valley Ground Water Management Plan area, by also defining this as a single source aquifer) would unnecessarily place new growth limits on the land in the Issaquah Creek Ground Water Management Plan Area. This is the entire City of Issaquah, all of the Grand Ridge Area, a major Urban portion of the Sammamish Plateau, and the industrial area in Preston.

I-90 / Preston Industrial Park
8110 304th Avenue SE
Preston, Washington 98050
206-222-7979 Fax: 206-222-7970

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DEVELOPMENT COMPANY

For example, the Plan says "Each ground water management plan, according to WAC 173-100, must contain management strategies to address the perceived threats to ground water quality and quantity in the planning area." This statement does not mean areas should be improperly defined as Single Source Aquifers, Critical Areas, or be improperly defined as an Aquifer Recharge Area. The rule of reasonability comes into play here. Dealing with perceived threats does not mean applying unreasonable measures or untrue definitions and resulting unreasonably restrictive new land use restrictions. Other than relatively small water rights (compared to a very large water supply), the Plan does not address overall quantity use needs (present or future) or any statement of an overall potential sustainable quantity supply (that could exist with efficient new strategically located wells tapping the various aquifers in the Plan Area).

There are additional deficiencies. For example, the Preston Industrial Park Water Association (a Class A purveyor), is not identified as such. Water rights listed in the plan omit existing known legal and vested water rights in the Preston area, and likely elsewhere.

By defining the entire basin as a Sole Source Aquifer, restrictions of the Federal Safe Drinking Water Act of 1974 come into play. By (mistakenly) calling the entire basin a Special Protection Area, major use and development restrictions of the Water Resources Act of 1971 apply, and RCW 90.48, and Water Pollution Control polices. New unnecessarily restrictive polices or regulations could be adopted that would (through a well head protection program) prevent the surface use or development of land within a 10-year time of ground water travel to the well from the recharging area. This could be nearly all land in the Plan Area, not available for use. Another unnecessary restriction is that Categorical exemptions (small land uses exempted from SEPA rules) are eliminated when the entire basin is designated an Environmental Sensitive Area, as proposed. If this was passed, SEPA analysis would have to be done even for the periodic use of Washington Department of Agriculture-approved chemicals to maintain a utility or transportation right-of-way in its design condition [i.e., no more salting I-90 in snow conditions, without an EIS]. Best Management Practices would apply to all small farms; extremely onerous to those farmers. **Calling the entire basin a Special Protection Area is not reasonable.**

Perhaps most concerning, is that Appendix A of the Plan says "POLICIES, PLANS, AND REGULATIONS (available upon request)." But when we contacted the Lead Agency (Seattle-King County Health Department, Environmental Health Division, Ground Water Section), we were told this was a misprint mistake. We were told NO POLICIES, PLANS, AND REGULATIONS EXIST FOR REVIEW BY THE PUBLIC. See the attached Exhibit A page.

One wonders if the idea is to have the County Council pass the Plan in its broad sense, then have the Department of Health adopt just about any Policies, Plans, and regulations it wishes; independent of what the County Council might intend.

This plan contains new land use restrictions that substantially reduce growth planned for in both Urban and Rural areas of the Issaquah Plan Area. While some actions are prudent, we understand that ESHB 1010 provides that rules may only be adopted as specifically authorized by state or federal law. A subtle part of this Plan may be to restrict land use unnecessarily. If so, it is appropriate to pay newly restricted land owners for their loss of land use caused by unnecessarily increased land use restrictions.

What is the purpose of newly preventing the surface use and development of that land in the Issaquah Ground Water Area that is anticipated and accommodated by the Comprehensive Plan? There is no evidence that aquifer water is threatened with extinction, even though new wells are likely needed at strategic locations to tap added ground water sources. We feel that aquifer water use (through existing and new sustainable water rights) in the many aquifers contained here is only very partially used, due to an absence of a strategically located, tested, and developed well network. Has this potential been calculated? Estimated by experts? Have outside water sources (like the huge new North Bend water source for Seattle and Eastside communities) been considered as a substitute? For example, Bellevue used to be largely served by wells and Lake Washington water. Now the Bellevue service area is served by water sources from outside of Bellevue. The cost of using outside water sources may be far less than the value of land use restricted unnecessarily (if polices in the present draft of the **Issaquah Creek Valley Ground Water Management Plan** were adopted without study and change).

BERNARD
DEVELOPMENT COMPANY

The whole issue of water supply in the Issaquah Ground Water Area may be one of properly developed infrastructure, not new land use restrictions.

The implementation cost of this plan (see Table 4.8.1) paid by Issaquah, the County, others, and new fees on taxpayers and land owners are not determined or even estimated, due to missing elements.

For reasons explained above, this Plan should not be adopted in its present form, and it should be stated in the Plan that no new rules exist; meeting requirements of ESHB 1010. The Plan should only be adopted when clearly stated list of policies, plans, rules and regulations that are specifically authorized by state or federal laws are referenced, and that those adopted accompany the Plan and first receives a thorough public review and hearing, prior to those adoptions. At the same time, the Plan is a good start, bringing up issues to deal with. Many of these issues (correction of important technical inaccuracies, land use planning conflicts with proposed restrictions, definition of present overall water use, potential new in-basin sources, future need estimates, and coordination with the proposed Issaquah Creek Valley Ground Water Management Plan) need to be dealt with prior to adoption of this Plan. If this is not done, property owners' land use will be unnecessarily restricted by this plan.

What is needed is an attainable and sustainable Water Supply Plan to meet all planned land use needs in the planning area, as a crucial element of this Ground water Management Plan. This does not mean all government owned and operated water supplies (for all elements), and this should not mean that private parties (or small groups acting together) cannot develop their own independent and private water supplies. More likely, Urban areas will have more "central public" sources. Rural Areas will have more, smaller independent water sources.

So far, this Ground Water Management Plan seems to focus heavily on new land use restrictions, not new development of existing and new water sources to meet growth infrastructure requirements of the Growth Management Act, to support land use plans. Before adoption of this Plan, major new revisions are needed, those listed above and pulling together new water sources with the goal and plan of meeting and attaining all land use potential in the Plan Area, for the present adopted land use plans. As provided in the Growth Management Act, the land use plan comes first -- then the plan to provide adequate utilities and infrastructure. The whole GMA idea is to plan land use, utilities and other infrastructure for the growth, not to plan to limit growth due to existing or marginally increased utility capacity.

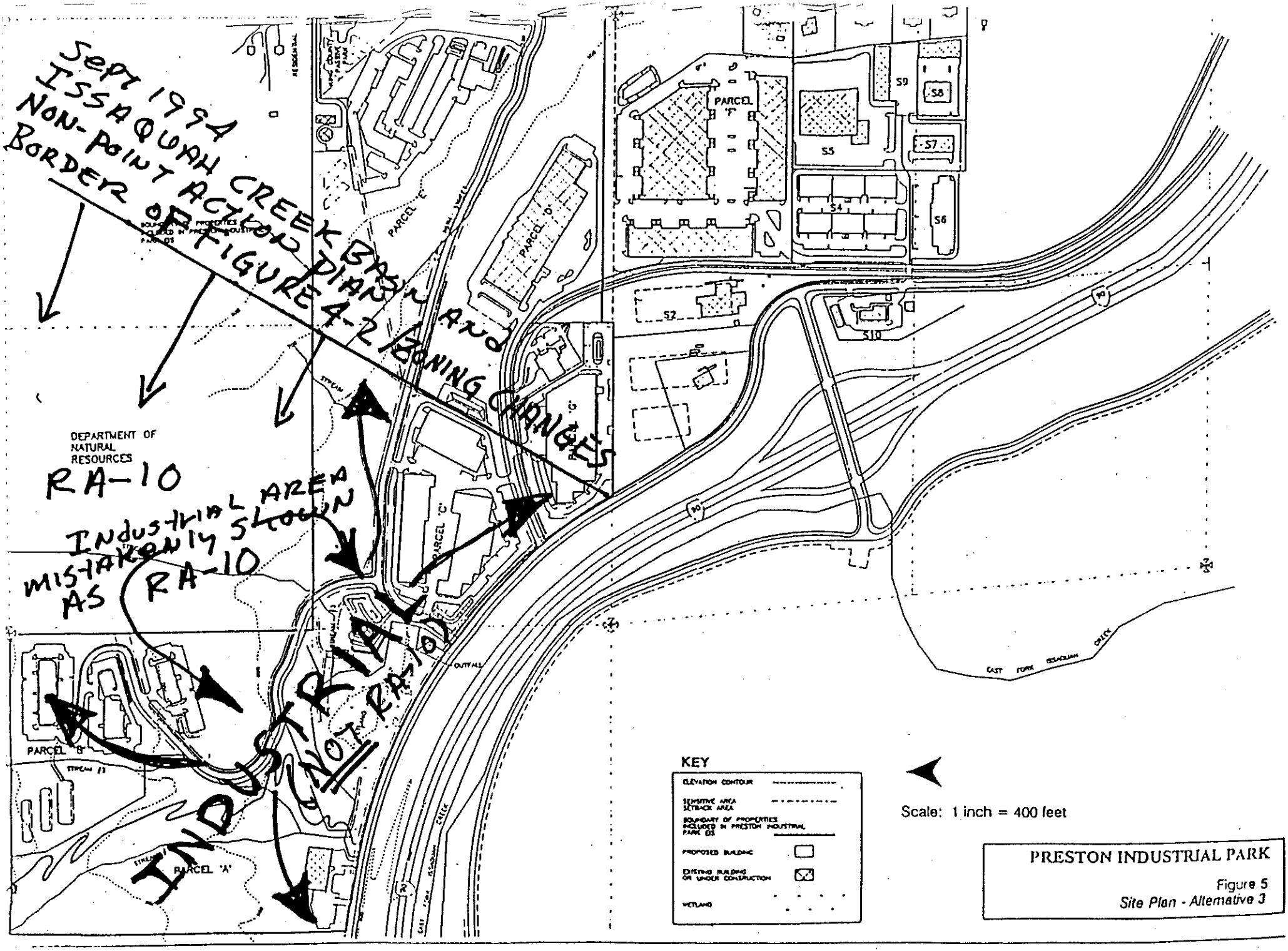
So far the **Issaquah Creek Valley Ground Water Management Plan** is deficient, containing more big picture errors and restrictions to growth than it does planing for new water supplies to meet growth needs. New strategies, aggressive new water supply planning, and other key changes are needed before this Plan is considered for adoption. We are planning for major new residential and work populations in the Plan Area, particularly the Urban portions. Even though some may not support this as a goal, this is the task. More work is needed. It would be a mistake to adopt this plan now, in its present state or with only minor tune-ups.

Sincerely,

J. Thomas Bernard
President

Enclosure: **6/7/95 comments on the Issaquah Creek Basin and Nonpoint Action Plan**
Preston Industrial Park Site Plan

CC (with enclosures): William J. Lasby, Project Manager; Seattle-King Co. Health Dept.
Paul Shallow, Env. Health Specialist; Seattle-King Co. Health Dept.
King County Council
Preston Industrial Associates, Ed Wolfe
Preston Industrial Park Water Association members


Sept 1994
ISSAQUAH CREEK BASIN PLAN AND
NON-POINT ACTION
BORDER OF FIGURE 4-2 ZONING CHANGES
DEPARTMENT OF NATURAL RESOURCES
RA-10
INDUSTRIAL AREA MISTAKENLY SHOWN AS RA-10
INDUSTRIAL
NOT RA-10
PARCEL "A"
PARCEL "B"
PARCEL "C"
PARCEL "D"
PARCEL "E"
PARCEL "F"
PARCEL "G"
S2
S4
S5
S6
S7
S8
S9
S10
STREAM
OUTFALL
EAST FORK ISSAQUAH CREEK
KEY
ELEVATION CONTOUR
SENSITIVE AREA SETBACK AREA
BOUNDARY OF PROPERTIES INCLUDED IN PRESTON INDUSTRIAL PARK DS
PROPOSED BUILDING
EXISTING BUILDING OR UNDER CONSTRUCTION
WETLAND
Scale: 1 inch = 400 feet
PRESTON INDUSTRIAL PARK
Figure 5
Site Plan - Alternative 3

June 7, 1995

Jim Kramer, Division Manager
King Co. Dept. of Public Works
Surface Water Management Division
700 Fifth Avenue, Suite 2200
Seattle, WA. 98104

BERNARD
DEVELOPMENT COMPANY

Re: **Issaquah Creek Basin and Nonpoint Action Plan**

I just became aware of this Plan, reading the September 1994 version one week ago. Apparently this Plan is due for review by the State Department of Community Trade and Economic Development, then action by the King County Council. **Please do not take fast action, and first consider the following comments. Prior changes are needed and the scope of the Plan needs to be changed.**

This plan contains new land use restrictions that substantially reduce growth planned for in both Urban and Rural areas of the Issaquah Creek Basin. While some actions are likely needed (to avoid increased low lands flooding), we understand that ESHB 1010 provides that rules may only be adopted as specifically authorized by state or federal law. A subtle part of this Plan may be to restrict uplands storm drainage to be greater than the natural amount, to reduce lowlands flooding. If so, it is appropriate to pay upland owners appropriately for their increased land use restrictions (as their land development occurs with extra costs for extra water detention, extra infiltration, and extra land set aside for these extra storm drainage control purposes).

Where new rules are adopted, those actions should be deferred or delayed until King County and Issaquah have planned and zoned additional property for new growth, replacing what new development is restricted by this Plan. New restrictions in the Plan are on major land areas, with no identification of the total amount of new development that could not occur if the Plan is adopted (compared to what could occur without adoption of the Plan). Other errors in the plan should also be corrected prior to adoption. More information follows.

It would be a growth management error to adopt new regulations and restrictions restricting major areas of growth that are planned for in the King County and Issaquah comprehensive plans -- unless new property is first planned and zoned for replacement growth, to offset the growth potential lost through these new regulations. The process should be to 1) identify what total growth amount is restricted in each zoning category, 2) identify new replacement growth areas and zoning, then 3) concurrently pass amendments to the King County Comprehensive Plan and establish new zoning, at the same time the Issaquah Creek Basin Plan (and those new restrictions) are adopted.

Yes, it is important to avoid flooding and maintain reasonable storm drainage water quality. But it is equally important to do so while maintaining growth that has been planned for and committed to by both jurisdictions in their Comprehensive Plans; their share of the 20 year supply called for in the Growth Management Act, and without violating the spirit or letter of ESHB 1010, or acting precipitously before ESHB is effective.

This Issaquah Creek Basin planning area is a major portion of King County, approximately 10 miles long and 8 miles wide (about 80 square miles), in the heart of King County. The town of Issaquah is the center of the Issaquah Creek Basin Planning Area. About half of the Planning Area land is in King County's designated Urban Area, and half is designated Rural. This is a major planned urban and rural growth area in King County.

For watershed management purposes, this Plan recommends changing the present King County Comprehensive Plan, Issaquah's Comprehensive Plan, and related polices to restrict development that would otherwise occur on the affected land area.

Assuming that both Issaquah and King County's Comprehensive Plans (implementing GMA) were sufficient but not over-abundant with new development planning and zoning for the next 20 years of growth, before the Watershed Plan was implemented, each jurisdiction now needs to plan and zone for compensating locations where the newly prevented growth can be relocated. In this adoption, citations should also be included, stating where any rules that are adopted are specifically authorized by state or federal law.

Under The Growth Management Act, King County and each sub-jurisdiction, is required to accommodate (with plans, sufficient usable land and zoning, and infrastructure) the State's projected growth in population and jobs in King

190 Preston Industrial Park
18110 304th Avenue SE
Preston, Washington 98050
[illegible]

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DEVELOPMENT COMPANY

County, for the next 20 years. But by restricting growth by adding restrictions, the Issaquah Creek Basin and Nonpoint Action Plan frustrates and prevents use of property that was planned for in adoption of recent comprehensive plans. The Watershed plan is quite clear in stating that substantial new development (that would otherwise occur) would be prevented in both urban and rural areas by adoption of the new policies and restrictions contained in the Plan.

For this reason and to be consistent with requirements of the Growth Management Act, at a minimum and before Watershed Plan adoption, King County and Issaquah should each identify the growth amount that could be prevented by these polices; then simultaneously adopt Comprehensive Plan revisions that provide for equal new substitute growth locations (inside the Urban Growth Boundary for urban growth that is restricted, and in the Rural Area for rural growth that is restricted); to offset growth opportunities that are lost due to new regulations and policies contained in the Issaquah Creek Basin and Nonpoint Action Plan [or subsequent implementing rules].

This Plan also has some notable inaccuracies that require correction, before Plan adoption. For example, a major portion of in-town Issaquah is inaccurately mapped (Figure 4.3) as 25 year and 100 year flood plain (the new 51 acre Trammel Crow shopping Center property on Gilman Boulevard). With first hand knowledge as a former owner's representative of this same property, I personally know the existing site elevation is well above a 25 and 100 year flood plain. King County's DDES flood plain mapping information is not accurate for this property, and may not be accurate elsewhere in the Basin planning area. The recently completed shopping center on this site is proof that no 25 or 100 year flood plain exists here, or no building permit would have been issued. This error example calls into question the accuracy of all flood plain maps contained in the Plan.

The Plan also omits Preston industrial zoning designation (on Property owned by Preston Industrial Associates, "PIA"), by mistakenly mapping this property (Figure 4.2) at the east end of I-90 in the Planning area as RA-10; and recommending that existing zoning of properties be changed to show zoning indicated on the map. This PIA property was rezoned to industrial (I) from RA-10, in the process of adopting of the current King County Comprehensive Plan. Those owners are not anticipating a surprise down zone to RA-10, or a conflict in policy or rules wording that would encourage someone to oppose development on their property, based on this new Watershed Plan. PIA is planning legal new development, based on King County's recent extensive environmental review and return of this property to Industrial zoning (January 1995).

Are there other zoning mis-designations or surprise new designations in new "recommended zonings" of the Issaquah Basin Plan that might catch owners unaware? Have the owners of designated rezone land been directly notified of this proposed new zoning change? Have those owners been directly asked and given the opportunity to address their position on these issues?

Another conflict is that the Plan recommends that the County and City of Issaquah purchase easements on private property (BW 7.2, pages 4-17 and 4.18)) for a 100 foot wide natural corridor along streams (not counting stream width) and later adding public access, trails, and picnic areas. But BW 5 (page 4-12) calls for a 100 foot wide buffer on each side of certain streams and wetlands, with no compensation to the owner. One policy takes 100 feet, the other policy takes 200 feet. One policy calls for payment to the owner, the other does not. These conflicts need to be fixed, with it made clear that payment is provided and property not restricted when easements are not purchased; even if development is not recommended.

Recommended clearing restrictions on existing lots (BW 3.1, page 4-6) would create non-SAO (King County Sensitive Areas Ordinance) open space requirements (with no payment to the owner) where the owner could not harvest timber, clear the land, or locate their house or other buildings at their own selected location on their property; to take their own selected advantage of terrain, views, water sources, access restrictions, farming locations, utilities, wetlands, or better building ground conditions. BW 3.2, page 4-9, (clearing restrictions) would prevent cutting trees and locating a house or buildings in the best location, if there is less than 65% tree cover on the lot. If there is only one or a few trees on a lot, in the wrong location, or a wetlands where the trees do not exist, the lot could for all practical purposes be unusable for new development. Is this not a new Property Rights taking, a "rule" prohibited by ESHB 1010?

The challenge here is how to deal with Issaquah Basin flooding and water quality issues using methods that work and are as specifically permitted by state or federal law, but still providing the 20 years of designated growth property,

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DEVELOPMENT COMPANY

without placing undue burdens and costs on private property owners to accommodate public needs. State and Federal law may exist in some flood plain areas, but are not known to exist on simple "steep hillsides," or for cutting trees on private land when proper forest practices are observed and required permits are obtained.

Most likely, to implement a revised version of this Plan, greater density will need to be provided in Urban Areas (like Issaquah), and by expanding the Urban Area boundary, and by providing for islands of growth in rural areas. But it is a planning and legal growth management and ESHB 1010 mistake to pass plans depending on growth to occur in planning areas, then pass regulations amounting to rules further restricting growth -- unless compensating new growth areas are provided and unless those restrictions are specifically provided for in state or federal laws. This is supposed to be the discipline of the Growth Management Act, requiring jurisdictions to plan for 20 years of growth, not to make the 20 year growth plan, then make new regulations that restrict and limit that growth to less than a 20 year supply. ESHB has a similar intent, to avoid new unauthorized "rules" from restricting land use.

In summary, this Plan needs work and repositioning. From a policy standpoint, the County Council and City of Issaquah should either designate new up zone substitute growth locations prior to adoption of this Plan as policy, or state that this Plan will not become effective until substitute growth land is designated and zoned. And even those actions should be limited to what ESHB 1010 permits.

If this is not done, I believe the County and Issaquah would be violating Growth Management Act requirements that it designate and zone land for 20 years of growth, because they would be taking land planned for growth property away from use (by adding new growth restrictions and regulations, restricting growth), within only a few months of adopting their new "GMA compliant" Comprehensive Plans. And ESHB 1010 would be violated.

Finally, this Issaquah Creek Basin and Nonpoint Action Plan (for surface water) comes at a time when the Issaquah Creek Valley Ground Water Management Plan (for sub-surface water) is also being reviewed. There are even greater problems with the Issaquah Creek Valley Ground Water Management Plan in its present form. But in any case, both plans need to be coordinated and reviewed together. Otherwise policies may conflict or unwarranted restrictions (corrected in one plan) may not be corrected in the other plan. Both plans deal with substantially the same land area. Our comments on the Issaquah Creek Valley Ground Water Management Plan are also attached.

Sincerely,

J. Thomas Bernard
President

Enclosure: 6/7/95 comments on the Issaquah Creek Valley Ground Water Management Plan
Preston Industrial Park Site Plan

CC (with enclosures): Ike Nwankwo, State Growth Mgmt Planner;
Dennis Canty, Project Manager; Surface Water Mgmt.
King County Council
Preston Industrial Associates, Ed Wolfe

HELLER EHRMAN WHITE & McAULIFFE
ATTORNEYS
A PARTNERSHIP OF PROFESSIONAL CORPORATIONS

6100 COLUMBIA CENTER
701 FIFTH AVENUE
SEATTLE
WASHINGTON 98104-7098
FACSIMILE (206) 447-0849
TELEPHONE (206) 447-0900
WRITER'S DIRECT DIAL NUMBER
(206) 389-6210

ANCHORAGE
LOS ANGELES
PALO ALTO
PORTLAND
SAN FRANCISCO
TACOMA

June 20, 1995

Mr. Bill Lasby, Project Manager
Seattle-King County Department of Public Health
Environmental Health Division, Ground Water Section
Smith Tower
506 Second Avenue, Room 201
Seattle, Washington 98104

RE: Draft Issaquah Creek Valley Ground Water Management Plan

Dear Mr. Lasby:

This firm represents the Edgehill Water Association (the "Association") in connection with groundwater issues. Through this letter, I am submitting Edgehill Water Association's comments on certain issues in the draft Issaquah Creek Valley Ground Water Management Plan (the "Plan") proposal which was made available for public review on April 13, 1995.

By way of background, the Edgehill Water Association is a non-profit Washington corporation formed in 1952. The Association's purpose is to provide and manage domestic water for the 38 homes it serves in the Edgehill neighborhood of Issaquah. (The attached map show the neighborhood's location.) The Association is governed by a 6-member board that meets regularly. The Association employs a water systems technician, conducts weekly water monitoring, and complies with all state and county regulations with respect to water quality. Although it is difficult to determine the exact location of the boundaries of the Groundwater Management Area in the Plan, the Association believes that a portion of its membership may be affected.

The Association has rights to appropriate groundwater from three wells located within the neighborhood for its community domestic water supply. The Association's ground water appropriation rights are confirmed by the three Certificates of Water Rights issued by the Department of Ecology. The priority dates for the certificates are: June 23, 1954 (Permit No. 3524), February 3, 1956 (Permit No. 4034), and May 13, 1974 (Permit No. G1-21627P). The attached map shows the well locations.

As a general matter, the Edgehill Water Association supports the joint efforts of the state and local agencies in developing a comprehensive plan to protect the quality and quantity of groundwater in the Issaquah Valley. The Association is concerned that continued development in the Issaquah Valley could negatively impact the quality and quantity of groundwater. The reason for our interest is simple: the quality and quantity of the Association members' domestic water supply depends on proper management of this resource.

General Comment. The Association does however have a number of concerns that some of the proposals in the Plan could affect the water rights held by the Association. Since the 1950s when the State of Washington granted the Association groundwater rights, the Association has functioned efficiently, safely and with little or no impact on surrounding areas. As the Ground Water Advisory Committee is aware, the Washington State legislation authorizing the development of ground water management plans and programs specifically states that such plans "shall not affect any water rights existing as of May 21, 1985." RCW 90.44.440. All of the Association's water right permits establish priorities before 1985. Thus, any provision or proposal in the Plan that affects the Association's existing water rights would be unlawful. Moreover, the Plan itself states as one of its objectives the need to be consistent with Washington's groundwater management laws. Plan at 1-3.

Specific Comments. With this general concern in mind, the Association has several specific comments on the Plan.

1. The Committee should clarify the boundaries of the plan and determine whether the Association's wells are within the Plan area. The Edgehill neighborhood lies on the far western edge of the proposed boundary. As a result, it is difficult to determine from the maps and descriptions whether any portion of the Association's membership may fall within the boundaries of the proposed Plan's boundaries. We request a clarification as to whether the Edgehill neighborhood falls within the boundaries of the Plan area. The locations of the wells are given in the water rights permits.

Furthermore, if as part of the data gathering tasks identified on page 2-15 the Committee determines that the Association's water usage does not impact the Issaquah aquifer, the Committee should exclude the entire Association from the Plan's boundaries.

2. The Association objects to user fees for septic systems within the proposed area. On pages 4-5 to 4-6 of the Plan, the Committee proposes establishing an Aquifer Protection Fund to support many of the proposals in the Plan. The Association

opposes any proposal that would impose fees on the Association's domestic water supply. The Plan states that "users that benefit should [financially] support the GWMP." Plan at 4-5. It is for this very reason that fees should not be imposed on the Association's water supply: the Association does not benefit from the programs in the proposed Plan.

The Association is responsible for maintaining the quality of the groundwater that its members use for domestic purposes. The potability of the Association's domestic water is regularly tested in compliance with all regulations. This testing is paid for by Association members who remit an annual water fee to maintain the system. Any contamination from the Association member's septic systems would affect the Edgehill neighborhood water prior to entering the groundwater at a lower elevation. The Association monitors water quality frequently and its members are conscious that it is in their best interests to maintain septic systems properly so that the neighborhood's domestic water remains potable. Because of the frequent monitoring and care by the Association members not to contaminate their drinking water, additional septic system fees charged to the Edgehill Association members by the county are not justified.

The Association also objects to the proposal to assess fees based on the amount of ground water withdrawn. The Association's ground water permits confirm the Association's rights to the groundwater. When it applied for these permits, the Association paid all required fees. Any proposal to assess fees for appropriations guaranteed by these permits would be an unlawful attempt to affect the Association's vested rights in these permits. It would also violate RCW 90.44.440 which, as quoted above, provides that the Plan "shall not affect any water rights existing as of May 21, 1985."

The Association further objects to the imposition of fees in light of the conclusion in the Draft Summary Report that "ground water quality in the Issaquah Ground Water Management Area basin is generally excellent." Draft Summary at 1-6. If the groundwater quality is already excellent, the existing groundwater users should not be assessed fees to address either non-existent problems or problems that would only arise from new sources of contamination. The Association's members have assumed the responsibility and the expense of maintaining their domestic water supply system; they should not also have to bear the cost of maintaining other systems. Furthermore, the Draft Plan omits the amount of the proposed fees. See Plan at 4-6. The Association cannot provide meaningful comment on the proposal to assess fees without knowing the amount of the fees.

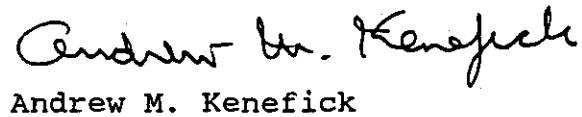
3. The Association objects to meters on private wells to monitor withdrawals from the aquifer. At pages 3-131 to 3-142 of the Plan, the Committee has proposed requiring the installation of meters on private wells to monitor water usage. The Association believes that this requirement is unnecessary and an unlawful restriction on the Association's water right permits. As stated above, because the Edgehill neighborhood is on the far western edge of the proposed Plan area, the Edgehill Water Association may not have any impact on the Issaquah aquifer and should not be subject to any metering requirements on private wells. In addition, monitoring would infringe on the water rights granted by the Department of Ecology. Although the Department of Ecology can require metering of ground water withdrawals as a condition of a new water right permit, Ecology cannot impose such a condition on existing water right permits. The statute states, "[Ecology] may require withdrawals of groundwater to be metered ... as a condition of a new water right permit." RCW 90.44.450 (emphasis added). To impose such a requirement on an existing source would unlawfully affect the water rights vested in the Association.

* * *

Thank you for considering these comments. The Association would appreciate additional notice about further developments regarding the Plan and how we may respond to potential effects on our neighborhood water system. Please send copies of all future correspondence and relevant public notices to me at the above address and Craig Gillin, President, Edgehill Water Association, 19032 SE 63rd Place, Issaquah, Washington 98027.

Sincerely,

HELLER EHRMAN WHITE & McAULIFFE

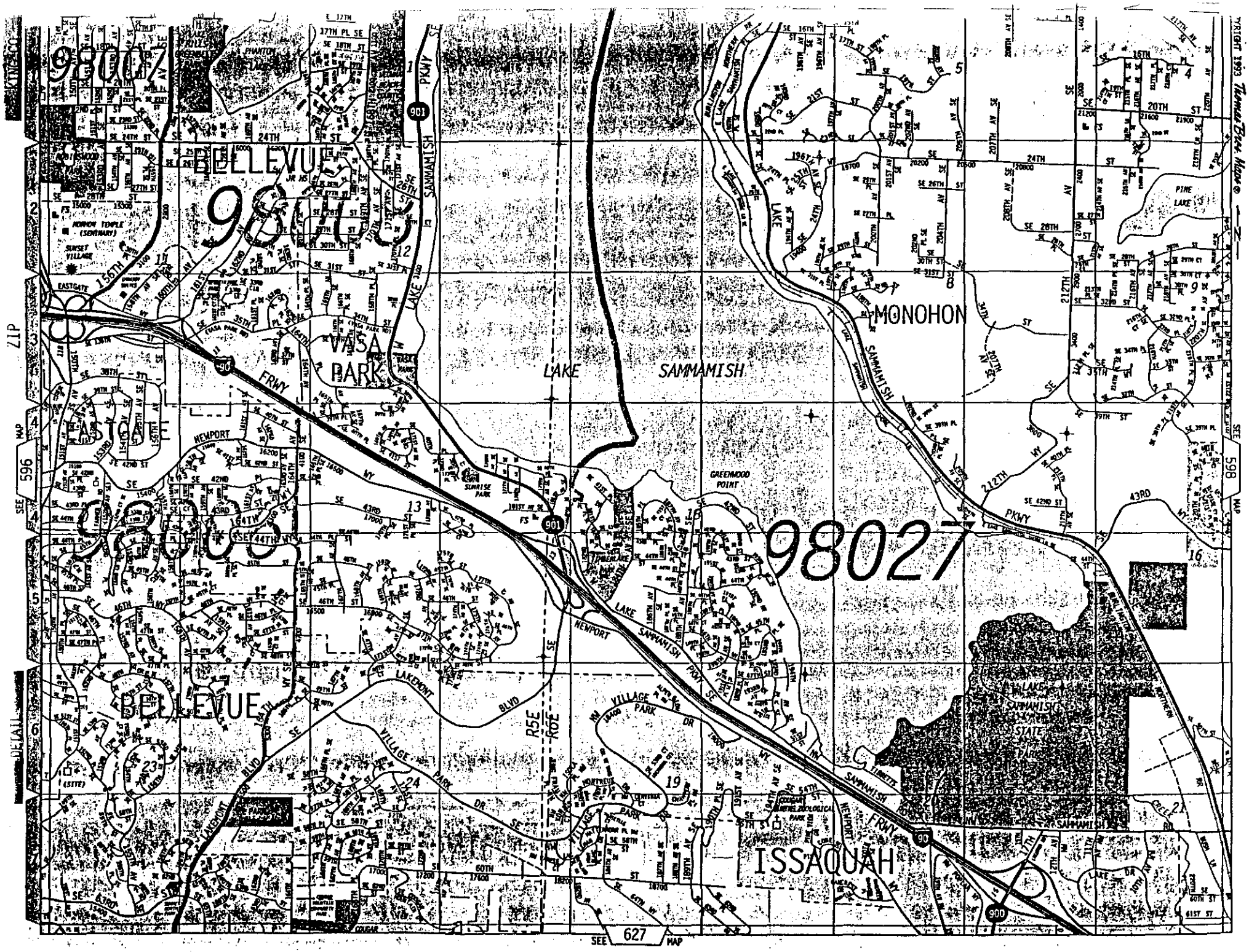


Andrew M. Kenefick

Attachments

cc: Steve Clark, City of Issaquah
Doug Rushton, Washington State Dept. of Ecology

I:\AMK\OTHER\EDGEHILL.LL1


98007
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LAKE SAMMAMISH
MONOHON
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ISSAQUAH
BELLEVUE
SAMMAMISH PKWY
FRWY
NEWPORT WY
LAKEMONT BLVD
VILLAGE PARK DR
LAKE SAMMAMISH PKWY
SAMMAMISH STATE PARK
GREENWOOD POINT
SUNRISE PARK
SUNSET VILLAGE
EASTGATE
PINE LAKE
R5E
R6E
SEE MAP 596
SEE MAP 598
SEE 627 MAP
DETAIL
ZIP
Thomas Bros. Maps ®

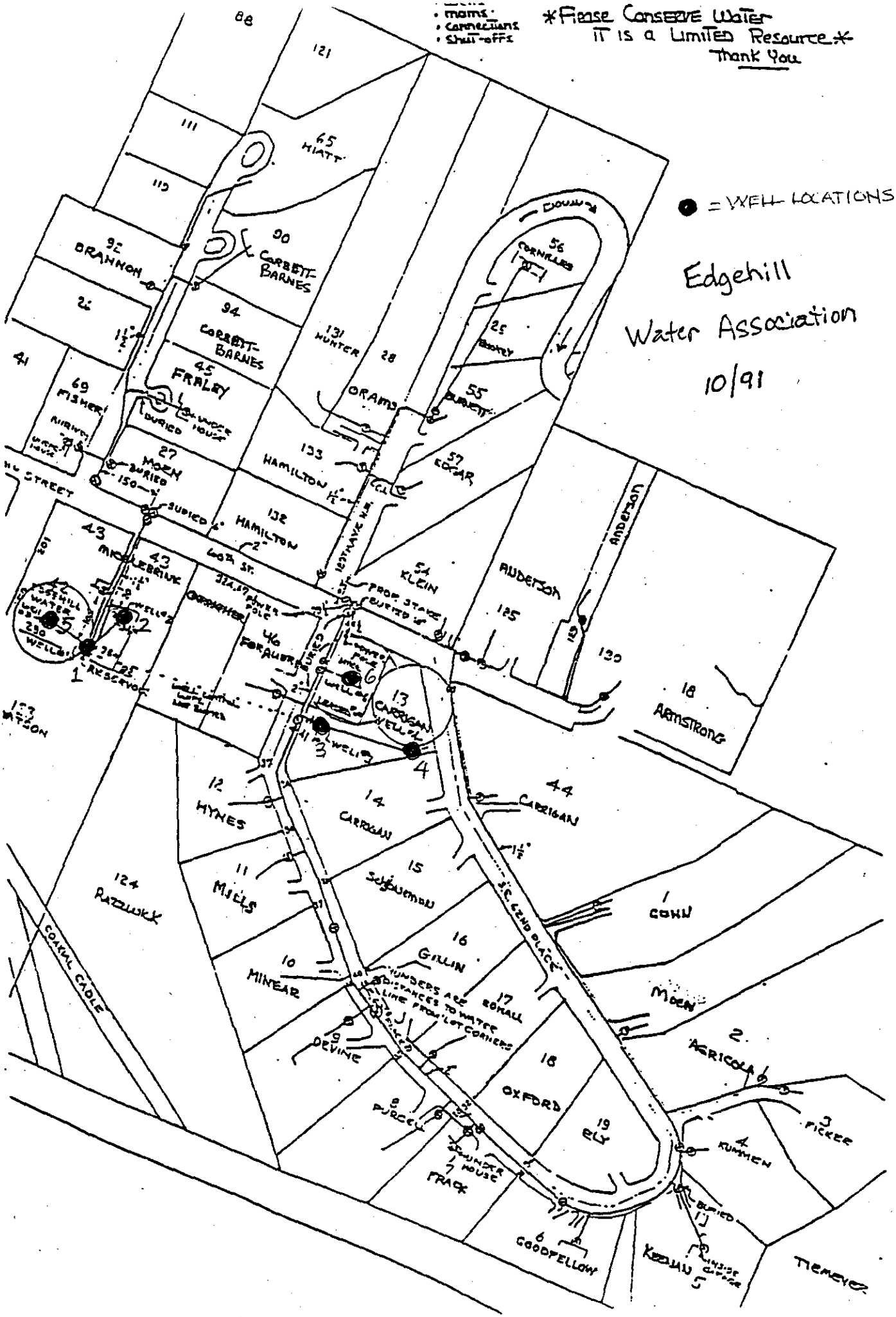
• mains
• Connections
• Shut-offs

*Please Conserve Water
It is a Limited Resource*
Thank You

● = WELL LOCATIONS

Edgehill Water Association

10/91



Appendix B

Letters of Concurrence or Comment

Issaquah Creek Valley
Ground Water Management Plan

March 1999

King County
Department of Development
and Environmental Services
3600 - 136th Place Southeast
Bellevue, Washington 98006-1400

August 9, 1996

TO: Mark Issacson, Project Manager, Surface Water Management Division

FM: Robert S. Derrick, Director, Department of Development and Environmental Services

RE: Issaquah Creek Valley Groundwater Management Plan

Thank you for including the majority of the revisions we requested to the November draft of the Issaquah Creek Valley Groundwater Management Plan (GWMP). With resolution acceptable to the Department of the following outstanding issues, the Department of Development and Environmental Services (DDES) will be able to concur with the plan:

1. Funding. The tasks assigned to DDES are identified to be funded by "General Agency Funds". As discussed in our previous comments, DDES is a fee-supported agency and needs specific funding to conduct any work that does not generate fees. An acceptable funding source will have to be identified for the agency to complete the assigned tasks or they are unlikely to be completed. We again request that the tasks be funded through the Aquifer Protection Fund or some other specific source.
2. Planning. The proposed draft removed some DDES tasks that were included in earlier drafts under the pretext that the Management Committee, which under the plan decides what action to take in these areas, may not decide to propose regulations. It is imperative that cost projections include the assumption that at least some of the decisions will include proposed regulations. Otherwise, these tasks are unfunded and unplanned; with little probability that they will ever be implemented. Particularly since the original plan recommendations were for regulations, it is inappropriate to not have contingency funding in the plan for these tasks.
3. Coordination with other GWMPs. Most of the tasks that are identified for DDES are consistent across all of the GWMPs. Where similar tasks exist, DDES concurs with the level of effort and proposed schedule identified in the Redmond Bear Creek GWMP; not with this plan. Since the completion of tasks identified under this one plan will complete the majority of the tasks identified for DDES in the other plans, the funding of these tasks should be shared across all plans.

It is our understanding that some of these issues will not be resolved until after the King County Council has reviewed and concurred with the plan. We look forward to working with the Management Committee to resolve any outstanding issues and move forward with a successful implementation of the plan. After the Council has reviewed and concurred with the plan, the outstanding issues have been resolved, and the funding has been secured, we look forward to implementation of the tasks identified for our agency.

RSD:js

cc: Catherine Moody, Chair, Ground Water Advisory Committee
Doug Rushton, Washington State Department of Ecology
Greg Kipp, Deputy Director, Department of Development and Environmental Services
ATTN: Jerry Balcom, Supervisor, Code Development Section
Mark Carey, Manager, Land Use Services Division
Tom McDonald, Manager, Building Services Division

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
P.O. Box 47600 • Olympia, Washington 98504-7600
(206) 407-6000 • TDD Only (Hearing Impaired) (206) 407-6006

RECEIVED
JAN 29 1996
SURFACE WATER MANAGEMENT DIVISION
OFFICE SUPPORT SERVICES

January 24, 1996

Trudy Rolla
Ground Water Management Plan Program
Surface Water Management Division
700 Fifth Avenue, Suite 2200
Seattle, Washington 98104

Dear Ms. Rolla:

Re: Draft Issaquah Creek Valley Ground Water Management Plan

I have reviewed the changes made to the draft Issaquah Creek Valley Ground Water Management Plan. The Department of Ecology concurs with the revised draft plan.

I look forward to working with you to certify and complete the Issaquah Creek Valley Ground Water Management Plan. I can be reached at 360/407-7255 if you have any questions.

Sincerely,

Laura H. Lowe

Laura H. Lowe
Environmental Planner
Shorelands and Water Resources Program

LL:ll

cc: Grant File

City of Issaquah
Post Office Box 1307
Issaquah, WA 98027-1307

(206) 391-1000
Fax: (206) 391-1036

December 19, 1995

Dr. Alonzo Plough, Director
Seattle-King County Health Department
Room 201 Smith Tower
Seattle, Washington 98104

Subject: Concurrence
Draft Issaquah Creek Valley Ground Water Management Plan

Dear Dr. Plough:

This letter presents the City's position of concurrence with the Draft Ground Water Management Plan as revised to address the previously stated (June 1995) issues. The City will work with other agencies to implement the plan where there is a clear benefit to the citizens of this community and as the City's budget allows.

It is the City's understanding that the revised plan recommends the formation of an Aquifer Protection Area (APA) to finance the implementation of the plan. This will require a ballot issue for those people located in the proposed APA.

The City looks forward to a cooperative effort in providing protection to the groundwater/drinking water for this community.

Sincerely,

Rowan Hinds, Mayor
City of Issaquah

cc: City Council
Sammamish Plateau Water and Sewer District
Greg Wilder, Public Works Director
Project/Day Files

RCH/stl

SAMMAMISH PLATEAU

WATER AND SEWER DISTRICT

Larry / Bill
good work

December 14, 1995

Dr. Alonzo L. Plough
Director
Seattle King County Department of Health
Environmental Health Division
Room 201 Smith Tower
Seattle, Washington 98104

RE: Issaquah Creek Valley Ground Water Management Plan

Dear Dr. Plough:

Please find enclosed a copy of Resolution No. 1897 expressing Sammamish Plateau Water and Sewer District's concurrence with the Issaquah Creek Valley Ground Water Management Plan. We are sending all agencies involved with the ground water management plan, a copy of the enclosed resolution for their files.

Please let me know if you have any questions.

Sincerely,

Ronald E. Little
General Manager

REL:dcp

Enclosure

95-12-56CONCRRNC.DOC

1510 - 228th Ave. S.E. • Issaquah, Washington 98029 • 392-6256 • Fax 391-5389

Do your part, be water smart.

SAMMAMISH PLATEAU WATER & SEWER DISTRICT
KING COUNTY, WASHINGTON

RESOLUTION NO. 1897

RESOLUTION OF THE BOARD OF COMMISSIONERS OF SAMMAMISH PLATEAU WATER AND SEWER DISTRICT, KING COUNTY, WASHINGTON, EXPRESSING CONCURRENCE WITH THE ISSAQUAH CREEK VALLEY GROUND WATER MANAGEMENT PLAN.

WHEREAS, the Seattle King County Dpartment of Health in conjunction with the Issaquah Creek Valley Ground Water Management Committee (GWAC) prepared a draft Issaquah Creek Valley Ground Water Management Plan (Plan)for the District's review and comment; and

WHEREAS, the GWAC requested that the District express its concurrence with the plan as provided for in applicable state law and administrative regulations; and the District Board of Commissioners having previously considered the Plan and having provided comments and a letter of non-concurrence to the GWAC regarding such Plan; and

WHEREAS, the Plan having been revised to address and include the District's comments and concerns to the District's satisfaction; now therefore,

BE IT RESOLVED, by the Board of Commissioners of Sammamish Plateau Water & Sewer District, King County, Washington, as follows:

1. The District concurs with the goals, provisions and procedures set forth in the Plan as revised.

2. District staff are hereby authorized and directed to provide a copy of this resolution of concurrence to the Seattle King County Department of Health, the GWAC, the King County Council, the City of Issaquah, and the King County Department of Public Works - Surface Water Management Division and to keep the Board further advised regarding the status, further adoption and implementation of such Plan.

ADOPTED at a regular open public meeting of the Board of Commissioners, Sammamish Plateau Water & Sewer District, King County, Washington, held on the 4th day of December 1995.

Jack H. Merritt, President

Gifford W. Miller, Secretary

Robert E. George, Commissioner

ATTEST:

_____

Gifford W. Miller
Secretary of the board

I, the undersigned Secretary of the Board of Commissioners of the Sammamish Plateau Water and Sewer District of King County, Washington, do hereby certify that the within and foregoing is a true and correct copy of Resolution No. 1897, adopted at the regular open public meeting thereof held on the 4th day of December 1995.

Gifford W. Miller

City of Seattle
Norman B. Rice, *Mayor*

King County
Gary Locke, *Executive*

Seattle-King County Department of Public Health

Alonzo L. Plough, Ph.D., MPH, *Director*

MEMORANDUM

October 9, 1995

TO: Laura Lowe, Department of Ecology
Catherine Moody, Chair of the Issaquah Creek Valley Ground Water Advisory Committee
Bill Lasby, Supervisor, Drinking Water and Ground Water Programs

FROM: Carl Osaki, Chief, Environmental Health Division

RE: **Draft Issaquah Creek Valley Ground Water Management Plan**

Thank you for the opportunity to review the draft Issaquah Creek Valley Ground Water Management Plan. The draft plan reflects a tremendous amount of work completed by the Ground Water Advisory Committee (GWAC), the project consultant, Parametrix Inc., the staff of the City of Issaquah and Sammamish Plateau Sewer and Water District.

Additionally, Seattle-King County Health Department staff have provided support as the lead agency to carry this process to the current draft stage. The Seattle-King County Health Department (SKCHD) recognizes the need for protection of the ground water of this region, and fully supports efforts to protect the ground water resources within this planning area.

After review of the draft plan by our Environmental Health Program Supervisors for content and impacts, we have assembled the following general and specific comments. Our comments are made in the hope of obtaining the best plan for this area and achieving Metropolitan King County Council acceptance of the document. Please note that our review of the plan focuses primarily on Chapter 3, the policies and actions to implement the plan. We, as the Seattle-King County Health Department, concur with the plan as written except where specifically noted below in our comments. We look forward to working with the GWAC, the City of Issaquah, and the Sammamish Plateau Sewer and Water District on a local level to implement the plan.

GENERAL COMMENTS:

1. **Plan Implementation Funding**

Our primary issue is the costs associated with carrying out this plan. While we realize that these costs are spread out over several years, the necessary funding is going to be

difficult to obtain at this time. Specifically, in a time of regulatory reform and government down sizing, requesting the citizens of an area to support a new program by a household based fee will be difficult. Without financial support secured, carrying out the implementation tasks identified to this department will place a financial burden on our existing funding sources, and possibly jeopardize other important public health programs we currently are carrying out. Our concurrence with this plan is conditional, subject to the establishment of the permanent funding source to implement and fully fund the plan recommendations.

2. **Lead Agency Role for Plan Implementation**

The Plan proposes that SKCHD be designated as the Lead Agency. However, the Metropolitan King County Council adopted a new organizational structure. This created a new Department of Natural Resources, and assigned the Surface Water Management Division responsibility for the ground water program. Even with this change, we want to maintain responsibility for those tasks directly related to protection of public health.

3. **Ground Water Management Area Plan Specificity**

The ground water management plan as drafted reflects a preventative public health focus on potential issues within the study area. This plan, along with others being developed within King County, attempted to address all potential contamination sources within the area, and structure policies and implementation actions from a county-wide focus. This has resulted in issues being raised in areas where there is no current problem as a way to support those issues in other areas. The thought process was that if all the areas were the same, implementation of programs and specific regulations would be easier to enact and carry out. We feel that this direction may have been in error, and to help sharpen the focus of the protective strategies within each area, some of the policies with no direct application within this planning area could be eliminated. This is not to say that we are targeting policies developed to prevent future contamination where there is no current problem. In our specific comments, we have identified certain actions we feel have no or very limited application to this planning area.

SPECIFIC COMMENTS:

1. **SA-3 Sole Source Aquifer Petition**: Seattle-King County Health Department will prepare and submit to the Environmental Protection Agency a petition for federal Sole Source Aquifer designation for the Issaquah Creek Valley Aquifer.

   Response: We concur with the idea of a sole source aquifer being developed to protect the Issaquah Creek valley aquifer. However, with the transfer of the responsibilities of

this program to SWM, we do not feel that this is a role that the Seattle-King County Health should undertake in the implementation of the plan. Additionally, we understand that a citizen group has commenced preparing the designation request. We will support that effort with any information from our database to aid in the development of that proposal.

2. **DCM-1A Data Collection, Management, and Analysis Program:** The Lead Agency will develop and implement a Data Collection, Management, and Analysis Program.

   Response: We concur with this task provided that adequate funding is provided to this agency for its possible future participation in the DCMP, and with the above amendment.

3. **ST-2C Ground Water Quality Concerns - Study:** King County and the City of Issaquah will jointly sponsor study of the effectiveness of the facilities described in ST-2B.

   Response: We concur with this recommendation with the understanding that this study, if done, should be the responsibility of SWM. They have the knowledge, specific program responsibility, and the resources to more effectively handle the task.

4. **HM-1 State Hazardous Waste Plan - Implementation:** The GWAC adopts the following resolution: "The GWAC supports the findings and recommendations of the Washington State Hazardous Waste Plan. The GWAC requests that Ecology and the Washington State Legislature fund and carry out the provisions of the Plan with a sense of urgency in recognition of the threat posed to groundwater from hazardous wastes." The GWAC will communicate this resolution to the Director of Ecology, the Assistant Director for Waste Management, and the Washington State Legislature.

   Response: We are concerned that this recommendation is no longer timely, and is low in overall importance. We could concur if this recommended management strategy is still timely, and if the plan was amended to say that this is implemented by being included in the plan, and no further action is necessary, similar to other support statements.

5. **HM-5 Implementation of the Uniform Fire Code:** King County and the City of Issaquah within the Issaquah Ground Water Management Area will:

   - Commit staff and funding for comprehensive implementation of Article 80 in both new and existing facilities using both educational and regulatory approaches;
   - Propose ordinances for adoption, if they have not already done so, that provide adequate enforcement tools to ensure compliance with Article 80 and that

restore the requirements for:

- Hazardous Materials Management Plans;
- Hazardous Materials Inventory Statements; and
- Storage requirements for "Carcinogens, irritants, sensitizers, and other health hazard solids, liquids and gases" found in Uniform Fire Code 80.315;
- Emphasize regulatory attention and educational activity in sensitive aquifer recharge areas.

Response: Given the numerous agencies involved in this recommended management strategy, we would suggest clarifying the roles of the LEMP and the LEMC in this action, versus the role of the Lead Agency for carrying out the recommended management strategy of the GWMP.

Also, with the complexity of this issue, it probably needs more work by the agencies involved. We would recommend putting this in the Unfinished Agenda, as it is worthwhile, but needs more exploration as to impact on ground water resources and methodology. Also, funding needs to be established for the Lead Agency first year activities.

6. **UST - 1A, 1B, 1C, 2A, 2B, 3A, 3C, 3D. Underground Storage Tanks: Related Actions**

Response: We concur with the educational approach to this potential problem. (**UST-3D Heating Oil Tanks - Education:** King County and the City of Issaquah will jointly educate homeowners and exempt tank owners regarding tank abandonment requirements of the Uniform Fire Code through the Issaquah Ground Water Management Plan Education Program.)

However, given the lack of evidence of documented ground water contamination, but acknowledging the concern of Ecology for this, we would recommend that these recommended management strategies be placed in the Unfinished Agenda. We realize that an actual documented contamination problem is not necessary to recommend management strategies in the GWMP, as other recommended management strategies are based on potential problems.

7. **OS-2A Hazardous Materials:** King County will: (1) inventory commercial, industrial, and institutional facilities served by on-site sewage disposal systems which potentially use, store, or dispose of hazardous materials; (2) educate operators on hazardous materials management; and (3) selectively monitor those facilities that appear

Response: We conditionally concur with this action based on the modification that the recommended management strategy, discussion and implementation specifically allows for agreement of LHMP fund expenditure through the LHMP decision process. Spending these funds must be authorized by the agencies involved in the LHWMP.

8. **OS-2B Hazardous Materials:** The SKCHD Environmental Health Division will (1) explore legal mechanisms for prohibiting the use and/or sale of products marketed as on-site sewage system additives which are intended to dissolve grease accumulations or to reduce the frequency of sludge removal from the septic tank and (2) prepare an ordinance for King County Board of Health's consideration which would prohibit the sale and/or use of such products within the cities and unincorporated areas of King County.

   Response: The new WAC supersedes this recommended management strategy and we recommend that it be deleted.

9. **OS-2C Hazardous Materials:** Seattle-King County Health Department will prepare amendments to Title 13 of the Code of the King County Board of Health to expressly prohibit the use of on-site sewage systems for disposal of any materials or substances other than domestic sewage as defined in WAC 246-272-010 for King County Board of Health consideration.

   Response: We concur with recommended management strategy. This is proposed to be included in the next revision of Title 13.

10. **OS-3A Household Hazardous Wastes:** ~~The Local Hazardous Waste Management Program in King County~~ ~~King County~~ will coordinate with the Household Hazardous Waste Education Committee to include information about ~~emphasize the~~ risks to ground water associated with the disposal of household hazardous wastes to on-site sewage systems ~~when conducting~~ as part of their household hazardous waste educational activities ~~as part of the Local Hazardous Waste Management Plan.~~

    Response: We conditionally concur with this task provided that the revised wording provided by our staff is inserted as shown above. The ground water plan cannot commit LHWMP funds.

11. **OS-3B. Household Hazardous Wastes:** ~~King County~~ ~~Seattle-King County Health Department~~ will develop and carry out a public education program intended to increase awareness of proper on-site sewage system operation and maintenance, including the risks associated with proper disposal of hazardous wastes in such systems.

Response: We concur with this recommendation with the above change. The SKCHD currently has a public education program for on-site sewage disposal system maintenance. Additional funding would allow us to expand this program.

12. **OS-4A Operation and Maintenance:** Seattle-King County Health Department will prepare amendments to Title 13 of the Code of the King County Board of Health for King County Board of Health's consideration to require that the as-built on-site sewage treatment and disposal system plan be recorded with the property deed so that it be transferred with the title at the time of property purchase. In addition, information concerning the relationship between on-site system maintenance and operation practices and ground water protection should be added to the standard as-built plan form.

Response: We concur with recommended management strategy, as amended above. This is proposed to be included in the next revision of Title 13.

13. **OS-4B Operation and Maintenance:** Seattle-King County Health Department will examine the feasibility of a county-wide on-site sewage system management program to determine it's effectiveness in the protection of ground water.

Response: We concur. The SKCHD has started a process to catalogue the on-site sewage disposal and treatment systems in King County in order to quantify areas with failing systems.

14. **WC-1B State Program:** King County and Ecology will develop a local health department program for implementation of the delegated portion of the well construction and abandonment program in King County.

Response: We concur, this type of program follows the SKCHD goals and objectives subject to the establishment of adequate funding.

15. **Solid Waste: Related Actions**

~~**SW-1A Standards:** Ecology will determine whether the existing Minimum Functional Standards for Solid Waste Handling are consistent with the state Ground Water Quality Standards and revise as necessary.~~

SW-1B Standards: Seattle-King County Health Department will prepare amendments to Title 10 to ~~prohibit siting or expansion of landfills in high potential recharge areas (Aquifer Protection Areas)~~ adopt Chapter 173-351 WAC by reference for consideration by the King County Board of Health.

~~SW-1C Standards: Ecology (Minimum Functional Standards) and Seattle-King County Health Department (Title 10) will prepare amendments to their regulations to clearly state that cell expansion is subject to current standards, including location, for King County Board of Health's consideration.~~

Response: We concur with the wording change shown above. Ecology has revised the state solid waste regulation to include the ground water provisions: these are now adopted as Chapter 173-351 WAC. This WAC covers the GWAC's earlier concerns about liner separation and cell expansion. SKCHD has not yet adopted this WAC by reference.

16. **SW-2 Waste Screening:** Seattle-King County Health Department ~~and King County Solid Waste~~ will evaluate the effectiveness of the Waste Clearance and Screening Program and provide a report to the Management Committee within two years.

Response: We do not concur with this issue. The discussion needs to be clarified so that only the aspects of the Waste Clearance and Screening Program relating to ground water protection was evaluated, we could concur with the recommended management strategy.

17. **SW-3 Abandoned Sites:** ~~King County will proceed with investigation and remediation of the abandoned sites in a timely manner.~~ Seattle-King County Health Department will evaluate remediation efforts of King County on abandoned sites and make a report to the Management Committee.

Response: We concur with this task provided the above revised wording is inserted in the plan.

18. **BSE-1 Regulatory Program Staffing:** Seattle-King County Health Department will adequately staff the biosolids program.

Response: We cannot concur with this task and this action should be deleted. The SKCHD program no longer needs additional support.

19. **WQ-2A Data Needs:** Design and implement a ground water data collection management program ....

Response: We concur, this recommended management strategy is included in the DCMP, with associated funding.

20. Water Quantity: Related Actions WQ-4B and WQ-4C.

WQ-4B Conservation: Seattle-King County Department of Public Health will propose a revision to regulations for existing, new or expanded Group B Public Water Systems to address water conservation goals and measures for consideration by the King County Board of Health.

WQ-4C Conservation: Seattle-King County Department of Public Health will propose regulations for new and existing individual wells incorporating conservation measures, including source meters, for consideration by the King County Board of Health.

Response: We concur, these could be included in the next Title 12 revision.

CO:blo

/wpw

Memo

December 21, 1995

To: Laura Lowe, Department of Ecology
Catherine Moody, Chair of the Issaquah Ground Water Advisory Committee
Jack Davis, Chair of the Redmond-Bear Creek Ground Water Advisory Committee
Bill Lasby, Supervisor, Drinking Water and Ground Water Program

From: Joy Keniston-Longrie, Environmental Programs Manager, King County Department of Metropolitan Services

Re: Draft Issaquah Creek Valley and Redmond-Bear Creek Ground Water Management Plans

Thank you for including the revisions we requested in the draft Issaquah Creek Valley and Redmond-Bear Creek Valley Ground Water Management Plans. We, as the Department of Metropolitan Services, concur with the plans. We do however, have the following comments about this final draft:

- The State Dangerous Waste Regulations WAC 173-303 are still listed as the Federal Dangerous Waste Regulations WAC 173-303 throughout the document.

- The quotations and statements dealing with the SQG's and their generation and accumulation rates will need to change soon to reflect the pending changes to the Dangerous Waste Regulations. Those regulations will change shortly, shortly defined as, whenever the lawsuit against Ecology and the regulatory change process is settled.

- The statements about the services offered by the LHWMP may become inaccurate during 1996 due to the merger and the LHWMP plan update process.

- The responsibilities of various King County and Metro units mentioned in these documents will probably change during the first half of 1996 due to the merger process.

- All references to Metro will be inaccurate as of 1/1/96. After midnight of 12/31/95 Metro no longer exists.

After the Metropolitan King County Council has reviewed and concurred with the plan, and the funding has been secured, we look forward to implementation of the tasks identified for our agency.

Jas ✓
Vas -
SKLOK ✓

STATE OF WASHINGTON

DEPARTMENT OF AGRICULTURE

P.O. Box 42560 • Olympia, Washington 98504-2560 • (360) 902-1800

June 5, 1995

Mr. Doug Rushton
Department of Ecology
PO Box 47600
Olympia, WA 98504-7600

Dear Mr. Rushton:

I have reviewed the Issaquah Creek Valley Ground Water Management Plan. I found nothing in conflict with Department of Agriculture rules or policy. I have a couple of minor comments on the pesticide and fertilizer section of the plan.

In the section dealing with WSDA's regulatory authority on page 3-98, I would suggest adding Chapter 17.21 RCW, the Washington Pesticide Application Act. This law provides the authority for licensing and recordkeeping for pesticide applicators, including farmers. My second comment refers to the discussion of the WSDA Record Database Pilot Project on page 3-99. The discussion implies fertilizer was included in the project. The project did not include fertilizers. Applicators are not required to keep records of fertilizer applications.

If I can be of further assistance, please feel free to call me at (360) 902-2047.

Sincerely,

PESTICIDE MANAGEMENT DIVISION

Lee Faulconer

Lee Faulconer
Branch Manager, Program Development

LF:sb

enclosure: Chapter 17.21 RCW

Post-it Fax Note 7671	Date 6/20	# of pages ▶ 1
To TRUDY ROLLA	From D. RUSHTON	
Co./Dept. SEA KING HEALTH	Co.	
Phone #	Phone # 407-6642	
Fax # 206 296 5997	Fax #	

King County
Solid Waste Division
Department of Natural Resources
Yesler Building
400 Yesler Way, Room 600
Seattle, WA 98104-2637
(206) 296-6542

February 20, 1996

TO: Mark Isaacson, Project Manager, Surface Water Management Division

FM: Kevin Kiernan, Engineering Services Manager KK

RE: Issaquah Creek Valley Groundwater Management Plan

Thank your for providing us the opportunity to review the revised draft of Management Strategies for the Issaquah Creek Valley Ground Water Management Plan. This revised draft is responsive to our previous comments that original management strategies were too broad, did not recognize protection afforded by existing regulations, and did not focus on the Ground Water Management Area (GWMA). The changes which have been made in this revised draft to a large degree alleviate our prior concerns. We would; however, like to be provided the opportunity to provide input and comment on future determinations with regard to the following:

- Elimination of certain categorical exemptions to SEPA (SA-1A).
- Designation of Environmentally Sensitive Areas (SA-1B).
- Adoption of General Aquifer Protection Standards (SA-1C).
- Enhanced Environmental Review to Protect Aquifers (SA-1D).
- Definition of Ground Water Recharge Areas (SA-1E).
- Basic Well Head Protection Program (SA-2).
- Sole Source Aquifer Petition (SA-3).

We are particularly concerned that the Sole Source Aquifer Petition, if one is to be filed and if one exists, will accurately represent the limits of the Sole Source and is based upon sound scientific evidence.

Again, thank you for the opportunity to comment and for your thoughtful consideration of our prior comments. If you have any questions please call me on extension 6-4419.

KK:SJ:mfn
SJ4/mimcm.doc

cc: Rodney G. Hansen, Manager, Solid Waste Division
Shirley Jurgensen, Supervising Engineer

King County
Water and Land Resources Division
Department of Natural Resources
700 Fifth Avenue, Suite 2200
Seattle, WA 98104-5022
(206) 296-6519
(206) 296-0192 FAX

September 3, 1998

Catherine Moody
Chair, Issaquah Creek Valley Ground Water Advisory Committee
10817 176th Circle Northeast
Redmond, WA 98052

Dear Ms. Moody:

Enclosed please find a copy of Motion 10496, passed by the Metropolitan King County Council on July 6, 1998, regarding their concurrence with the Issaquah Creek Valley Ground Water Management Plan.

As you know, County Council voted to require several changes in the Management Strategies document. Their recommendations, and the rationale for each, are listed in the enclosed concurrence letter that Council wrote (dated June 12 with the motion number "10496" stamped on each page). It is essentially the same requirements that you had reviewed (after final Council committee action) and discussed with the Ground Water Advisory Committee on July 2nd, as discussed in the written testimony you offered at the Council hearing. The concurrence letter does include the modification you suggested, incorporated by Councilman Derdowski, to change the issue of Aquifer Protection Area (in Section 3.3) to an unfinished business category.
The concurrence letter states agreement with the goals and objectives of the groundwater program and specifies the revisions that are necessary for Council's concurrence with the plans. We will include both the motion and concurrence letter in Appendix B ("Letters of Concurrence") of the Management Plan.

As we discussed, the best course of action for the sake of groundwater protection seems to be to make the changes required by Council, finalize the plans and submit them to Ecology for certification, and proceed to implementation. This cover letter, transmitting to you the motion and concurrence letter from Council, describes in detail the changes we will make to the document to accomplish these requirements. Please let us know at your earliest convenience if you agree with the approach and the proposed changes. Since the changes were anticipated at the time of the meeting, I would not expect that another meeting of the Ground Water Advisory Committee would be required to ratify these changes.

These changes are described in the following paragraphs.

Management Strategy SA-1C (p. 2-10): change point number 2 to: "While protection and sustainable use of ground water based drinking supplies in the Issaquah Creek Valley Ground Water Management Area is preferred over importing water from sources outside of the Ground Water Management Area, importing water will not be prohibited if necessary to support urban development within the Urban Growth Area.".

Management Strategy SG-3B (Reclamation Plans, p. 2-51 to top of 2-52): replace with the following: "King County will provide comments to the State Department of Natural Resources on mine reclamation plans proposed within the Issaquah Creek Valley Ground Water Management Area. Additionally, consistent with KCCP Policy NE-333, King County will develop with affected jurisdictions, Best Management Practices for mining operations." We will keep this issue in mind in developing our approach to Well Head Protection.

Management Strategy HM-3 (p. 2-27), to designate zones for hazardous waste storage and treatment, will be deleted. The text of Issue 3, just above this location, will be kept as is. Also, we will again keep this issue in mind in developing approaches to Well Head Protection.

Section 3.3 (p. 3-4) for the Metropolitan King County Council to authorize a ballot measure to establish an Aquifer Protection Area: the text (from immediately following "Recommendation" to the beginning of Section 3.4) will be moved to Section 2.5, Unfinished Agenda, on page 2-57. The removed text will be replaced with the following: "**Recommendation:** King County is currently exploring approximately 6-8 long term funding alternatives for the purpose of implementing a ground water management program. If a regional funding source cannot be identified, the Issaquah Creek Valley Ground Water Management Committee should assess the feasibility of establishing an Aquifer Protection Area to provide funding for implementation of the Plan."

In Section 2.5, immediately before the text which was moved from Section 3.3, the following will be inserted: "**Aquifer Protection Area**: Metropolitan King County Council does not concur with the need to establish an Aquifer Protection Area until other funding options are considered. However, since this funding mechanism is favored by the City of Issaquah and the Sammamish Plateau WSD, this question remains an unresolved issue that will be addressed by the Issaquah Creek Ground Water Management Committee at a later date. The original recommendation of the Ground Water Advisory Committee is as follows:"

Section 3.5 (p. 3-6): the following sentence will be added to the end of the first paragraph on p. 3-6: "The Management Committee shall be established by motion by the Metropolitan King County Council with members appointed by the Council, serving staggered terms of three years." Section 3.8 (pp. 3-8, Implementation Plan): the last sentence in the first paragraph of this section will be replaced with the following: "Implementation efforts by King County, the City of Issaquah, and the Sammamish Plateau WSD will be phased in over time. These efforts are dependent upon the availability of funding."

As the enclosed concurrence letter by County Council says, King County is pressing ahead to begin implementation of the groundwater program. We, at King County Department of Natural Resources, are developing approaches for the various management strategies included in the Management Plans, working on a long-term funding option which will allow us to expanding our efforts in new directions, and establishing contacts with agencies and municipalities which may help this effort. We will of course be able to accomplish more when long-term funding is secured.

Thank you for the dedication and diligence of the Issaquah Creek Valley Ground Water Advisory Committee on this lengthy project. Please contact me at 206-296-8323 to discuss any questions you have about the above changes to the plans, and about what we can do to start the implementation phase of the groundwater program.

Sincerely,

Ken Johnson

Ken Johnson
Groundwater Program Lead

KJ:pra27

Enclosures

cc: Distribution List

09/23/97

ROB MCKENNA
PETE VON REICHBAUER
CYNTHIA SULLIVAN
LARRY PHILLIPS
JANE HAGUE

Introduced By: Brian Derdowski

sub 6/12/98 kn

Proposed No.: 97-602

MOTION NO. 10496

A MOTION regarding concurrence with the recommendations contained in the Issaquah Creek Valley Ground Water Management Plan.

WHEREAS, the Washington State Growth Management Act requires jurisdictions to designate critical areas, including areas with a critical recharging effect on aquifers used for potable water, RCW 36.70A.050, and

WHEREAS, Policy C-5 of the Countywide Planning Policies states that all jurisdictions that are included in ground water management plans shall support the development, adoption and implementation of the plans, Ordinance 11446, and

WHEREAS, Policy NE-333 of the King County Comprehensive Plan states that King County should protect the quality and quantity of the ground water countywide by placing a priority on implementation of ground water management plans, and

WHEREAS, the Washington State Department of Ecology has designated King County as the lead agency responsible for coordinating and undertaking the activities necessary for development of ground water management programs in the county, WAC 173-100-080, and

WHEREAS, a ground water advisory committee has been established for the Issaquah Creek Valley ground water management area, and

WHEREAS, the ground water advisory committee contained representatives of local governments, special purpose districts, water associations, agricultural interests, well drilling firms, forestry companies, industry and environmental organizations, and

WHEREAS, the Issaquah Creek Valley ground water advisory committee has overseen the development of the Issaquah Creek Valley Ground Water Management Plan, and

WHEREAS, the oversight provided by the ground water advisory committee has included reviewing the work plan, schedule and budget for development of the plan, assuring that the proposed plans are technically and functionally sound and verifying that the proposed plan is technically and functionally sound and verifying that the proposed plan is consistent with Washington state laws and authorities of affected agencies, WAC 173-100-090, and

WHEREAS the city of Issaquah and the Sammamish Plateau Water and Sewer District are required to implement some of the recommendations in the Issaquah Creek Valley Ground Water Management Plan and have issued letters of concurrence, and

WHEREAS, following the metropolitan King County council's review and comment on the plan's recommendations, the Issaquah Creek Valley Ground Water Management Plan will be submitted to the Washington State Department of Ecology for certification in accordance with WAC 173-100-120, and

WHEREAS, following the Department of Ecology's certification of the Issaquah Creek Valley Ground Water Management Plan, the metropolitan King County council will

be responsible for implementing those portions of the Plan which are within their jurisdictional authority to implement;

NOW, THEREFORE BE IT MOVED by the Council of King County:

The King County executive is hereby requested to transmit to the Issaquah Creek Valley Ground Water Advisory Committee a letter, substantially in the form attached, identifying the county's findings and indicating areas of county concurrence and non-concurrence with recommendations contained in the Issaquah Creek Valley Ground Water Management Plan. This letter should contain the following:

1. a clear statement of concurrence or nonconcurrence;
2. a statement of agreement with the goals and objectives of the ground water program; and
3. specific revisions necessary for county concurrence.

PASSED by a vote of 11 to 0 this 6th day of July, 1998.

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON

Ronald Miller
Chair

ATTEST:

Clerk of the Council

Attachments: Concurrence Letter

104964

June 12, 1998

Catherine Moody
Chair, Issaquah Ground Water Advisory Committee
10817 176th Circle NE
Redmond, WA 98052

Dear Ms. Moody:

King County generally agrees with the goals and objectives of the Issaquah Creek Valley Ground Water Management Plan, yet makes a statement of nonconcurrence based on its finding of inconsistency between the recommendations contained in the Plan and the intent of RCW ch. 90.44 and other federal, state and local laws. The County recognizes the importance of the Plan's recommendations to preserve and protect ground water, a highly valued natural resource. The County's role in implementing the recommendations of this Plan reflects the County's responsibility as a resource manager, a land development regulator, and the permitting authority for the unincorporated areas of King County.

King County's statement of nonconcurrence is based on its finding of inconsistency between several recommendations included in the Plan and adopted county comprehensive planning policies and county laws. These recommendations must be modified as set forth below to achieve consistency and to allow county concurrence with the Draft Ground Water Management Plan. These recommendations include Management Strategy SA-1C, Management Strategy SG-3B, Management Strategy HM-3, Section 3.3, Funding, Section 3.5, Ground Water Management Committee and Section 3.8, Implementation. A summary of the basis for non-consistency and the changes necessary for King County concurrence follows.

King County does not concur with the "import" language currently included in Management Strategy SA-1C. This finding of inconsistency is based upon the fact that that the strategy:

1. is inconsistent with County Wide Planning Policy CA-6;
2. is inconsistent with King County Comprehensive Plan Policy NE-335;
3. is inconsistent with King Count Comprehensive Plan Policy F-304; and
4. would affect portions of the Issaquah Creek Ground Water Management Area that are within the Urban Growth Area; water importing may be necessary to support urban development within the UGA.

King County can make a finding of consistency only if the text of Management Strategy SA-1C is amended as follows: "While protection and sustainable use of ground water based drinking supplies in the Issaquah Creek Valley Ground Water Management Area is preferred over importing water from sources outside of the Ground Water Management Area, importing water will not be prohibited if necessary to support urban development within the Urban Growth Area.".

King County does not concur with Management Strategy SG-3B (Reclamation Plans) as it is currently written. This finding of inconsistency is based upon the fact that the State DNR has regulatory authority over mine reclamation plans. King County's regulatory authority is limited to offering comments on proposed reclamation plans to DNR for consideration.

King County can make a finding of consistency only if the text of Management Strategy SG-3B is amended as follows: "King County will provide comments to the State DNR on mine reclamation plans proposed within the Issaquah Creek Valley Ground Water Management Area. Additionally, consistent with KCCP Policy NE-333, King County will develop with affected jurisdictions, Best Management Practices for mining operations."

King County does not concur with the recommendation of Management Strategy HM-3 to designate zones for hazardous waste storage and treatment. This finding of inconsistency is based upon the fact that the strategy:

1. is redundant; these issues are currently regulated by the Model Toxic Control Act; and
2. does not reflect King County's current use of industrial zoning, which is where King County allows hazardous wastes to be stored and treated.

King County can make a finding of consistency only if Management Strategy HM-3 is deleted.

King County does not concur with the recommendation in Section 3.3, for the Metropolitan King County Council to authorize a ballot measure to establish an Aquifer Protection Area. This finding of inconsistency is based upon the Council's adoption of Ordinance 12926 which required the King County Executive to provide a proposal for long term funding of King County's ground water program. King County's funding efforts will focus on identification of a long term funding source, and establishment of an Aquifer Protection Area will not be authorized until after these efforts have been exhausted.

King County understands that establishment of an Aquifer Protection Area is supported by the city of Issaquah for funding ground water activities. Therefore, King County concurrence with the GWMP is subject to the expansion of Section 2.5, Unfinished Agenda, to include an explanation of why the Aquifer Protection Area remains an unresolved issue that will be address by the Issaquah Creek Ground Water Management Committee at a later date.

King County does not concur with the recommendations of Section 3.5 as they are currently written. King County can concur with the Issaquah Creek Valley Ground Water

Management Plan if a statement is added to Section 3.5 which states: "The Management Committee shall be established by motion by the Metropolitan King County Council with members appointed by the Council, serving staggered terms of three years."

King County does not concur with the recommendations contained in Section 3.8 regarding implementation of the Plan. A finding of inconsistency is based upon existing obligations imposed by federal, state and local laws related to county revenues and expenditures. These limitations restrict the county from being able to fully commit to Plan implementation following certification.

King County can make a finding of consistency only if the text of Section 3.8 is amended to include the following statement: "King County implementation efforts will be phased in over time and is dependent upon the availability of funding.".

King County places a high priority on implementing the specific management strategies relating to wellhead protection, development of best management practices, education, and mapping of critical acquifer recharge areas. Once the Council adopts a long-term funding option, the County would start to undertake other implementation activities. Such activities would include coordinating and staffing the anticipated interjurisdictional ground water management committees; developing a data collection and management program to monitor ground water quality and quantity; and enhancing education programs to promote ground water protection.

Thank you for the dedication and diligence of the Issaquah Creek Valley Ground Water Advisory Committee on this lengthy project. Please contact Mark Isaacson, Department of Natural Resources, Water and Land Resources Division, at 206-296-8369 to discuss starting this work.

Sincerely,

Ron Sims
King County Executive

Issaquah Valley Ground Water Advisory Committtee

Address Line 2
Country

July 6, 1998

Madam Chair and members of the Metropolitan King County Council,

I wish to thank the Natural Resources Committee and the Growth Management Committee of the Council for their expeditous and thorough consideration of the Ground Water Management Plans, followed by their adoption of Proposed Substitute Motion 97-602 on June 12, 1998. Staff also has done yoeman service to Council and the public in organizing the Studies into managable units and informing the interested members of the public of changes and meeting dates.

Because the Isssaquah Creek Valley Ground Water Advisory Committee had not met in over two years, I called a meeting last Thursday, July 2 to review and discuss the changes called for in the draft letter of non-concurrence you provided. The names of the GWAC members in attendance is appended. I will briefly review the committee's preliminary responses to the draft letter.

- Management Strategy SA-1C: Import language

Events have overtaken us. The City of Issaquah has written to Seattle Public Utilities requesting it to sell water to the City which now forecasts that its water supply will be fully utilized by the year 2002 or 2003. We agree to the amendment.

- Management Strategy SG-3B: Reclamation Plans

The amended text is agreeable to the committee. However, a Wellhead Protection Plan has been adopted which protects both City of Issaquah and Sammamish Plateau Water and Sewer District Wells in the lower valley.In Wellhead Protection Zones, the City of Issaquah may impose additional restraints on mining operations. We believe the King Coounty Comprehensive Plan also recognizes Wellhead Protection Plans and should include them in their Best Management Practices documents.

- Management Strategy HM-3: Hazardous Waste Storage and Treatment

In the unincorporated area of the Issaquah basin there are production wells belonging to the SPWSD in the industrial zone. The Wellhead Protection Plan is applicable here, we believe.

- Section 3-3: A ballot measure to establish an Aquifer Protection Area.

Establishing an Aquifer Protection Area, including voter approval of a levy to provide funding, was a condition of concurrence insisted upon by the Mayor and Council of the City of Issaquah and the commissioners of the SPWSD. It will be necessary for both bodies of elected officials to revisit this issue which they consider a matter of equity to the citizens of their jurisdictions. To avoid delaying the certification of the Ground Water Management Plan, we would favor placing this issue in the "unfinished business" category.

- Section 3.5: Ground Water Management Committee

The agencies to be represented on the Growth Management are the principal water rights holders in the Issaquah Basin. The present Issaquah Ground Water Advisory Committee will be dissolved when the Management Plan is

certified. A new Advisory Committe will be instituted by the Ground Water Management Committee or the King County Council to represent citizens concerns including those Class A, Class B and residential well owners who live in the unincorporated area south of the City of Issaquah.

- Section 3.8 Implementation Plan

We agree to the requested amendment. Since the City of Issaquah and the SPWSD are also charged with implementation efforts in the Plan, they request that their names be added to the amendment.

The Issaquah Creek Valley will be available to meet, as necessary, to bring this Plan into concurrance with the Metropolitan King County Council.

Issaquah Creek Valley Ground Water Advisory Committee

Catherine Moody, Chair	League of Women Voters of Lake Washington East
Ruth Shearer	Citizen
Denise Smith	K. C. Master Gardner
Ruth Kees	Environmental Council
Bert Giberson	Grange
Bob George	SPWSD
Sheldon Lynne	City of Issaquah
Mark Isaacson	King County Department of Natural Resources
Ken Johnson	King County Department of Natural Resource

YOUR NAME GOES HERE (Signature below)

Issaquah Valley Ground Water Advisory Committtee

September 7, 1998

F. Y. I.

To Members of the Issaquah Creek Valley Ground Water Advisory Committee,

Dear Ken,

I am assuming that you have received the packet dated September 3, from Ken Johnson, King County Ground Water Lead. He references my testimony to the King County Council on July 6, 1998. I am enclosing a copy of that testimony. I tried to convey to the Council the concerns and points of disagreement that some of you expressed at our meeting of July 2, 1998.

I believe that the results are ones that we can live with.....and the best we can do. If you wish to meet again, let me know. I want to be sure that we are all satified with the Study as amended by the King County Council.

Thanks to all of you for your patience and diligence in this labor. Protecting the quality and quantity of ground water in the Issaquah basin was and is a worthwhile mission.

It has been a great pleasure to me to have known you and to have worked with you to complete this project.

Sincerely yours,

Catherine Moody

Supplement to the Issaquah Creek Valley Ground Water Management Plan:

Area Characterization

March 1999
Final

Data and information contained in this document are current as of the period of project performance: 1989 - 1995.

Submitted by:

Issaquah Creek Valley Ground Water Management Committee

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Water and Land Resources Division
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Funded in part by the Washington Department of Ecology Centennial Clean Water Fund.

WASHINGTON STATE DEPARTMENT OF ECOLOGY

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Area Characterization

Issaquah Creek Valley
Ground Water Management Plan

March 1999

AREA CHARACTERIZATION

1.0 INTRODUCTION

This report provides an updated characterization of the Issaquah Creek Valley Ground Water Management Area and includes information from the 1993 Lower Issaquah Valley Wellhead Protection Plan. The report also summarizes the results of ground water data collection and analysis activities conducted between 1989 and 1992 as part of the Issaquah Creek Valley Ground Water Management Plan (IGWMP). Information developed by USGS for the East King County ground water management program relating to the Sammamish Plateau is included, as this area was added to the Issaquah Creek Valley Ground Water Management Area in 1996, after the data collection and analysis had been done for both areas.

This updated area characterization is a compilation of information from previous water investigations conducted in the Issaquah Creek Valley Ground Water Management Area, and data collected as part of this ground water planning process. The physical characteristics of the Issaquah Creek Valley Ground Water Management Area are described and regulatory agencies with authority in the area are discussed. Section 2 presents a detailed description of the boundaries of the Issaquah Creek Valley Ground Water Management Area. Section 3 identifies and describes the various federal, state, and local agencies that have political jurisdiction over the Issaquah Creek Valley Ground Water Management Area.

Section 4 discusses climate, topography and drainage. The plans and policies affecting the ground water resource, and the impacts of present and future land use on ground water quality and quantity are discussed in Section 5. Water applications including sources, services, water rights, population projections and water supply and demand are discussed in Section 6. Section 7 discusses hydrology, geology, hydrogeology, new wells, the wellhead protection plan study by Golder Associates, data collection and analysis, and data needs. Section 8 contains conclusions and recommendations for protecting the ground water resource.

Data Collection

The data collection and analysis task included ground water quality and quantity data, rainfall data and stream flow data. Data were collected by various entities, including personnel from the City of Issaquah and Sammamish Plateau Water and Sewer District, Seattle-King County Health Department, King County Surface Water Management Division, King County Solid Waste Division, volunteers, and the environmental firms of Carr/Associates, Pacific Ground Water Group, and Parametrix. For the Sammamish Plateau area, the U.S. Geological Survey collected data from a network of public and privately owned water wells as part of data collection activities for the East King County Ground Water Management Plan (the Sammamish Plateau area was later added to the

Issaquah Creek Valley Ground Water Management Area). These activities are described in the "Data Collection and Analysis Plan for East King County, Washington, Ground Water Management Area Study", July 1, 1991.

The data collection effort was based on recommendations by project consultants Carr & Associates, Pacific Ground Water Group and Parametrix, Inc. as defined in the Data Collection and Analysis Report (February 1990 and 1992) and the U.S. Geological Survey. This report was reviewed and approved by Ecology, the Seattle-King County Health Department, the Sammamish Plateau Water and Sewer District, and the Issaquah and East King County Ground Water Advisory Committees. All data collected were handled and saved as instructed by the July 1989 Data Management Plan approved by Ecology and the Issaquah Creek Valley Ground Water Advisory Committee (GWAC), and the "Data Collection and Analysis Plan for East King County, Washington, Ground Water Management Area Study", July 1, 1991.

The objective of the data collection and analysis task in the development of the Issaquah Creek Valley Ground Water Management Area plan was to further public understanding of the entire Issaquah Creek Valley water resource (quantity and quality) and to identify data gaps that are needed to determine baseline conditions and facilitate protection of the Issaquah Creek Valley Ground Water Management Area ground water. This was accomplished through the generation and interpretation of historical and new data collected during this study, as described below. The first area characterization reports (July 1990 and December 1991) examined existing information on physical climate, surficial geology, geography, climate, water use and land uses. The draft Ground Water Management Plan (March 1996) updated the 1990 and 1991 reports and included a description of new data collected and an analysis of these data, information from new wells drilled, and a summary of the wellhead protection study conducted by Golder Associates for the City of Issaquah and the Sammamish Plateau Water and Sewer District in 1993. This final version of the Plan presents little new data but accomodates the report to the changes in the boundary of the Ground Water Management Area.

Rainfall data were collected from 1988 to 1990 from eighteen stations by personnel from the King County Surface Water Management and Solid Waste Divisions of King County Department of Natural Resources, the Washington State Department of Natural Resources, and volunteers living in this area. Stream gauge data were collected from 1988 to 1990 from seventeen sites by personnel from the King County Surface Water Management Division, the Washington State Department of Natural Resources, and the U.S. Geological Survey. Ground water levels were measured from 1989 to 1992 from forty-eight well sites by personnel from the City of Issaquah, Sammamish Plateau Water and Sewer District, and the Seattle-King County Health Department. Ground water levels on the plateau were initially documented by USGS from well logs, and were subsequently measured by Seattle-King County Health Department for 2.5 years at ten sites.

Ground water quality samples were collected from nineteen wells by personnel from the City of Issaquah, Sammamish Plateau Water and Sewer District, and the Seattle-King County Health Department. Ground water quality data were also collected at the Cedar Hills Landfill by personnel from the Department of Natural Resources, Solid Waste Division. Ground water quality data were collected in the area surrounding the Cedar Hills Landfill by personnel from the Solid Waste Section of the Environmental Health Division of the Seattle-King County Health Department. Ground water quality samples on the plateau were initially collected by USGS, and were subsequently collected by Seattle-King County Health Department at one site. As part of this study, one monitoring well was drilled in the central part of the Issaquah Creek Valley Ground Water Management Area to collect data to evaluate hydrostratigraphy, ground water flow and water quality. Three wells were later drilled in the lower Issaquah valley as part of the City of Issaquah and the Sammamish Plateau Water and Sewer District's Wellhead Protection study.

2.0 ISSAQUAH GROUND WATER MANAGEMENT AREA BOUNDARIES

The Issaquah Creek Valley Ground Water Management Area (GWMA, Figure 2.1) is a 94 square-mile area about 15 miles east of Seattle (Figure 2.2). The GWAM consists of the Issaquah Creek and Tibbetts Creek drainage basins and the Sammamish Plateau and forms the southern and eastern portion of the larger Lake Sammamish watershed. The Sammamish Plateau, east of Lake Sammamish, at the boundary of the service area of the Sammamish Plateau Water and Sewer District and the former Cascade View Water District, was added to the Issaquah Creek Valley Ground Water Management Area in 1996, at the request of the Sammamish Plateau Water and Sewer District (Figure 2.3). This change was made in March 1996, after the publication of the Draft Ground Water Management Plan.

This final version of the Ground Water Management Plan includes a number of text and graphics changes required by this boundary change. However, since most of the Area Characterization analysis had been completed for the March 1996 Draft Ground Water Management Plans, there may be some minor discrepancies in the data for the area of the change.

The GWMA boundaries were primarily defined by the natural divides of the Issaquah Creek and Tibbetts Creek drainage basins. All drainage basins in the Issaquah Creek Valley Ground Water Management Area flow into Lake Sammamish including the Issaquah, North Fork, East Fork, Tibbetts, Mason, Fifteen Mile, Carey, and Holder Creek drainage basins (Carr Associates 1986). However, 1.5 square miles of the Issaquah Creek basin were excluded from the Issaquah Creek Valley Ground Water Management Area because they fell within the boundaries of the City of Seattle's Cedar River Watershed. The current boundary assumes that ground water contours conform to the surface topography of the Issaquah and Tibbetts Creek drainage basins and that the existing study area demarcates a ground water confluent that eventually flows into Lake Sammamish. Future changes to the current Issaquah Creek Valley Ground Water Management Area

boundary may be made if necessary, after additional documentation of the hydrogeologic characteristics of the Issaquah Creek Valley Ground Water Management Area.

3.0 JURISDICTIONS IN THE ISSAQUAH GROUND WATER MANAGEMENT AREA

This section discusses the role of public agencies with jurisdiction in the Issaquah Creek Valley Ground Water Management Area. The ground water-related policies and activities of the agencies in the Issaquah Creek Valley Ground Water Management Area are organized below by federal, state, county and local agencies, respectively.

3.1 Federal Agencies

Federal agencies influence ground water management in various ways, both as regulatory bodies and as policy makers. Federal agencies with jurisdiction in the Issaquah Creek Valley Ground Water Management Area are discussed below.

3.1.1 United States Environmental Protection Agency

The U.S. Environmental Protection Agency administers numerous programs that influence ground water management in the Issaquah Creek Valley Ground Water Management Area, provides technical assistance to state and municipal officials on a variety of ground water-related issues, and acts as a regulatory agency. As a lead agency, the U.S. Environmental Protection Agency deals with water pollution, underground storage tanks, pesticide and herbicide use, liquid waste, landfills, hazardous waste management (including Comprehensive Environmental Response, Compensation, and Liability Act, Superfund Amendments and Reauthorization Act of 1986 sites and generators), and drinking water management. As a support agency, the U.S. Environmental Protection Agency is involved with regulation of lagoons and holding ponds, sewage waste disposal, sludge application, spill control and prevention, solid waste handling, storm-water runoff, ground water, surface water, wetlands, and wells and water rights. The U.S. Environmental Protection Agency administers the Sole Source Aquifer Program, the Pesticides in Ground Water Survey, and the Agricultural Chemicals in Ground Water Strategy. The U.S. Environmental Protection Agency also oversees the cleanup investigation and ground water monitoring of the Queen City Farms Superfund site.

3.1.2 U.S. Department of Agriculture

The U.S. Department of Agriculture provides technical assistance to landowners and communities concerning municipal sludge applications, livestock, crops, irrigation design, wildlife, and animal-waste ponds. The U.S. Department of Agriculture is a lead agency for pesticide and herbicide programs, and it administers programs such as fish and wildlife conservation programs and watershed projects.

3.1.3 The Soil Conservation Service/Natural Resources Conservation Service

As part of the U.S. Department of Agriculture, the Soil Conservation Service, currently known as the Natural Resources Conservation Service, provides technical assistance in soil erosion control and pesticide and herbicide use. It also plays a support role in agriculture, diking and drainage, forestry, lagoons, surface water, and wetlands.

3.2 Washington State Agencies

Some agencies operate at the state level but also influence ground water issues at a local level. The following discussion cites those state agencies that will influence the Issaquah Creek Valley Ground Water Management Area.

3.2.1 Washington State Department of Ecology (Ecology)

Ecology is charged with protecting the waters of the state; therefore, Ecology's activities affect ground water management decisions in the Issaquah Creek Valley Ground Water Management Area both directly and indirectly. Funding for the development of the Issaquah Creek Valley Ground Water Management Plan came from the Centennial Clean Water fund, a grant administered by Ecology. Ecology issues discharge permits, performs compliance monitoring, enforces discharge regulations, and responds to pollution incidents. Ecology serves as a lead agency in over 20 environmental categories, including aquifer depletion, seawater intrusion, water resources, well construction and abandonment, and water rights. As a regulatory agency, Ecology is responsible for the cleanup of leaks and spills of hazardous materials, except in navigable waters, oversight of Resource Conservation and Recovery Act facilities and state hazardous waste cleanup sites, and the regulation of underground storage tanks. Ecology is working with the U.S. Environmental Protection Agency on the remediation of the Queen City Farms site.

3.2.2 Washington State Department of Health, Office of Environmental Health Programs

The Washington State Department of Health is involved in a variety of programs that influence ground water management. As part of the Northwest Drinking Water Operations Programs, the Washington State Department of Health is responsible for plan approval for Group A public water supplies, including well site inspections and final system certificate of completion review and it administers the wellhead protection program. The Washington State Department of Health conducted an area wide ground water monitoring project in the spring of 1995. This project included a statewide sampling of 1326 wells for pesticides and herbicides including 77 sites in King County. Results of the analysis indicated two wells in King County exceeded the U.S. Environmental Protection Agency's detection limit for pesticides/herbicides. The results of this project has allowed the Washington State Department of Health to grant area wide waivers to purveyors for ongoing monitoring.

Under the heading of On-Site Sewage Program, the Washington State Department of Health is the state agency responsible for enforcing Chapter 248-96 Washington Administrative Code (WAC), the regulations that prescribe design and installation standards for septic systems. These regulations are currently under revision to increase effectiveness in protecting public health and water quality. The Washington State Department of Health is also responsible for guideline development and performance review of alternative sewage disposal systems.

3.2.3 Washington State Department of Natural Resources

The management of state lands for coal and timber production in the Issaquah Creek Valley Ground Water Management Area is the responsibility of the Washington State Department of Natural Resources. The Washington State Department of Natural Resources also collects hydrologic data as part of its timber management program.

3.2.4 Washington State Department of Transportation

The Washington State Department of Transportation is involved in highway planning and in the Issaquah Basin carries out shoulder and ditch maintenance as well as roadside spraying for plant control. Interstate 90 and State Routes 900, 18, and 202 are the only roads maintained by the Washington State Department of Transportation in the study area.

3.2.5 Washington State Department of Trade and Economic Development

The Washington State Department of Trade and Economic Development provides guidelines for implementing the Growth Management Act.

3.2.6 King Conservation District

The King Conservation District works with the urban and agricultural community to implement animal management and land use practices that increase productivity while minimizing soil erosion and water pollution. The King Conservation District is neither a branch of county government nor an enforcement agency, but rather a political subdivision of state government authorized by Chapter 89.08 RCW. The King Conservation District is dedicated to the conservation and best uses of the natural resources of King County.

3.3 King County Agencies

King County agencies, which operate in the Issaquah Creek Valley Ground Water Management Area, conduct activities that either directly or indirectly affect ground water management in the area.

3.3.1 The Metropolitan King County Council

The Metropolitan King County Council has legislative authority to enact ordinances and regulations governing protection of ground water resources, including land use provisions. In the past, the Metropolitan King County Council administered water resource, land use, and wetlands programs in addition to assisting in community plan reviews. The Metropolitan King County Council has adopted the King County Comprehensive Plan, and the community plans for Tahoma/Raven Heights, East Sammamish, Newcastle, Bear Creek, and Snoqualmie (See Figure 3.1).

3.3.2 King County Office of Strategic Planning

The Office of Strategic Planning is primarily involved in developing the King County Comprehensive Plan, subarea land use plans, affordable housing, and economic development. Additionally, this Office is involved in coordinating King County's review of comprehensive plans for all water and sewer systems operating in unincorporated King County.

3.3.3 King County Department of Development and Environmental Services

The King County Department of Development and Environmental Services regulates and enforces land development and zoning in the Issaquah Creek Valley Ground Water Management Area. Its specific duties include development control, commercial and residential permitting, sensitive area monitoring, and environmental review. The Department of Development and Environmental Services also implements the community plans for Tahoma/Raven Heights, East Sammamish, Newcastle, and Snoqualmie by issuing building permits and by administering rezones and plats.

3.3.4 Seattle-King County Health Department, Environmental Health Division

The Seattle-King County Health Department is an advisory and regulatory body involved in a wide variety of related topics, including regulation of Group B public water systems. The Seattle-King County Health Department was the lead agency for the Issaquah Creek Valley Ground Water Management Plan through December of 1995. The Seattle-King County Health Department coordinated the activities necessary for ground water management plan development. Additionally, the Seattle-King County Health Department collected ground water quality and quantity data, managed the ground water database, drafted technical issue papers, and prepared the budget for development of the Issaquah Creek Valley Ground Water Management Plan. On January 1, 1996, the King County Department of Natural Resources, Surface Water Management Division replaced the Seattle-King County Health Department as lead agency for completion and implementation of the Issaquah Creek Valley Ground Water Management Plan.

The Seattle-King County Health Department is responsible for evaluating soil quality preparatory to permitting for on-site wastewater disposal systems. The Seattle-King

County Health Department issues permits for proposed on-site sewage systems; responds to complaints about, and regulates the repair of, failing systems; reviews all subdivision proposals for which on-site sewage disposal is proposed; and educates homeowners in the proper maintenance of their systems. The Solid Waste Section of the Seattle-King County Health Department is responsible for permitting landfills, overseeing and permitting sludge applications, and sampling ground water in areas around the Cedar Hills Landfill.

The Local Hazardous Waste Management Program in King County helps businesses and households in identifying hazardous wastes, reducing the amount of hazardous waste and in managing these wastes properly. This Program is a joint effort by the Seattle-King County Health Department, King County Department of Metropolitan Services, King County Department of Natural Resources Solid Waste Division, the Seattle Solid Waste Utility, and 32 cities in King County. The goal of the program is to divert the maximum amount of household hazardous waste and small quantity generator waste from disposal in the municipal waste stream and from the environment.

The Local Hazardous Waste Management Program in King County covers these areas: household hazardous waste education and collection; small quantity generator education/technical assistance; collection; compliance; and program evaluation. The household hazardous waste education coordinator is housed at the Seattle-King County Health Department, and staff in the other agencies collaborate on the household hazardous waste education activities. Household hazardous waste collection and waste handling is coordinated by both the King County Department of Natural Resources Solid Waste Division and the Seattle Solid Waste Utility. There are two fixed collection sites and one mobile collection facility. Small quantity generator education and technical assistance consists of a telephone information line, printed material, seminars and workshops, an industrial materials exchanges (IMEX), and on-site consultation. The coordinator for this section is at King County Department of Natural Resources, Water and Land Resources Division. Small quantity generator collection activities include providing waste collection facilities, operated by private firms under contract to local government, and encouraging licensed private sector hazardous waste handlers to take small quantity generator waste. These collection activities are coordinated by Solid Waste. The compliance coordinator is housed at King County Department of Natural Resources, Water and Land Resources Division. Compliance activities include the Interagency Regulatory Advisory Committee, which review proposed regulations, the field teams perform on-site audits and other advisory visits and respond to complaints about businesses. Evaluation of the program is accomplished by implementation of the evaluation strategy developed by Seattle-King County Health Department. The actual data analysis is carried out by consultants, overseen by Seattle-King County Health Department. (*Local Hazardous Waste Management Plan*, November, 1990, Final Plan and EIS and *Local Hazardous Waste Management Plan Annual Report*, Calendar Year 1994, June 1995.)

3.3.5 King County Department of Natural Resources

The following divisions of the Department of Natural Resources conduct the activities described below in the Issaquah Creek Valley Ground Water Management Area.

Solid Waste Division

The Solid Waste Division operates and maintains the Cedar Hills Landfill. The Solid Waste Division responsibilities include on-site ground and surface water quality monitoring.

Surface Water Management/Water and Land Resources Division

On January 1, 1996, the Surface Water Management Division became a part of the new King County Department of Natural Resources and assumed the lead agency role for the ground water program. Subsequently, the Surface Water Management Division was renamed the Water and Land Resources Division. Given the continuity between surface water and ground water in much of King County, the Water and Land Resources Division's management of surface water has a direct influence on the quantity and quality of water infiltrating to ground water.

The King County Water and Land Resources Division is responsible for a variety of programs that address surface water quality and quantity in the Issaquah Creek Valley Ground Water Management Area. The programs include basin planning, non-point source pollution control, wetlands, and the construction and maintenance of drainage and water quality facilities.

Wastewater Treatment Division

The Wastewater Treatment Division oversees most of the sewage collection and treatment for sewered areas in the Issaquah Creek Valley Ground Water Management Area, and is the designated regional water quality planning agency under the 1972 Clean Water Act. The Wastewater Treatment Division provides sewage treatment services to the City of Issaquah and the Sammamish Plateau Water and Sewer District.

Resource Lands and Open Space

The Water and Land Resources Division also includes the Open Space and Resources Lands Sections. These Sections provide resource planning services, administers County open space acquisition programs, public benefit rating system and other agriculturally related programs. The Resource Planning Section, Environmental Division was the lead agency for compilation of the natural environment chapter of the King County Comprehensive Plan. The Resource Planning Section also studies the interaction of wetlands and surface runoff and is involved in drainage basin planning.

3.3.6 Department of Transportation

The Department of Transportation consists of the former Department of Metropolitan Services (formerly Metro) and the former King County Department of Natural Resources, Roads Division.

Road Services Division

In addition to construction and maintenance of roads and associated drainage, the Department of Transportation, Road Services Division is responsible for vegetation control along the roadside.

3.4 Local Agencies

3.4.1 City of Issaquah

The City of Issaquah Planning Department, Environmental Community Services (SEPA), Parks Department and Natural Resources are the agencies primarily responsible for all issues related to ground water management within city limits. The Planning Department and Environmental Community Services are responsible for policy development and the permitting and review of new development(s) in the city. The City of Issaquah Public Works has responsibility for water and sewer system planning and administration, road maintenance, plant control on city property, and local water quality monitoring and protection.

3.4.2 Sammamish Plateau Water and Sewer District

The service area of the Sammamish Plateau Water and Sewer District is in the northern portion of the Issaquah Creek Valley Ground Water Management Area. Its role is to provide water and sewer service within this specific area as well as to advise on matters relating to ground water quality and quantity. Sammamish Plateau Water and Sewer District's legal mandate was provided under state statutes, Chapters 56 and 57 RCW (Little 1989).

3.4.3 City of Sammamish

Incorporation of the City of Sammamish was voted on and passed on November 3, 1998. The incorporation is scheduled to go into effect on August 31, 1999, which is after the finalization of this document.

4.0 PHYSICAL GEOGRAPHY

This section describes the Issaquah Creek Valley Ground Water Management Area's geographic setting, topography, and climate.

4.1 Geographic Setting

The Issaquah Creek Valley Ground Water Management Area is located in King County, Washington, east of the urbanized Seattle-Bellevue areas. The study area lies generally east and southeast of Lake Sammamish. The boundaries of the southern portion of the approximately 94-square-mile Issaquah Creek Valley Ground Water Management Area are largely defined by the natural drainage divides of the Tibbetts Creek and Issaquah Creek watersheds (see Figure 4.1). The Sammamish Plateau drains to Lake Sammamish by several small creeks. The major lakes on the Plateau include Pine, Beaver, Yellow, Laughing Jacobs and Allen Lakes. About 1.5 square miles (3.9 km^2) of the Issaquah Creek watershed southeast of State Route 18 (which lies within the boundary of the city of Seattle's Cedar River Watershed) is excluded from the Issaquah Creek Valley Ground Water Management Area.

The northern portion of the Ground Water Management Area is defined by the service area of the Sammamish Plateau Water and Sewer District, and includes portions of the watersheds for East Lake Sammamish (including several sub-basins), Evans Creek, Patterson Creek, and Ames Lake (Figure 4.1).

4.2 Topography

Much of the Issaquah Creek Valley Ground Water Management Area lies above 400 feet (122 m) elevation and can be described as hilly, uneven uplands or mountainous. Rugged, steeply sloped hillsides and a group of peaks locally known as the Issaquah Alps dominate the landscape.

To simplify later descriptions and establish geographic references, local terrain is subdivided into three physiographic units: mountains, uplands and valleys. The mountains and uplands are forested or partially cleared. Lower valleys are partially or completely cleared as pasture or residential/commercial areas. Figure 4.2 depicts Issaquah Creek Valley Ground Water Management Area physiographic units.

Mountain areas include all or portions of Grand Ridge, Cougar Mountain, Squak Mountain, West Tiger Mountain, Tiger Mountain, South Tiger Mountain, and Taylor Mountain. Peak elevations are between 1,400 and 3,000 feet (427 to 914 m). Tiger Mountain is the tallest peak at 3,004 feet (916 m). The various Tiger Mountain peaks and Taylor mountain area will hereafter be collectively referred to as the Tiger Mountain peak complex. Numerous peaks, pinnacle-like hilltops, steeply sloped ridges, cliffs, and sharply cut canyons typify the relief.

The uplands are generally situated between 400 to 700 feet (122 to 213 m) elevation and include several residential areas. The upland surface is shaped by small hills, gently sloping areas, and depressions. Drainage is not well-defined. Significant upland features include portions of the Sammamish Plateau, Union Hill Plateau, the lower western slope of Grand Ridge, Tradition Lake Terrace, Cedar Hills, and Hobart Plateau. Several small

lakes are situated on the uplands; these being Pine, Beaver, Yellow, Laughing Jacobs, Allen, Tradition, MacDonald, Francis, and Webster Lakes.

The valleys are bordered by the steep slopes and bluffs of the uplands and mountains. Valley areas are generally situated below 400 feet (122 m) elevation. The Lake Sammamish shoreline defines the lowest elevation at 25 feet (8 m) above mean sea level. Surface relief varies and includes features such as short canyon-like cuts, irregular hills, depressions, ponds, terraces, alluvial fans, and narrow to broad floodplains. Drainage in the valleys is dominated by the major streams described below. In addition, there is a portion of Patterson Creek Valley included to the northeast.

Tibbetts Creek and various unnamed streams and ditches drain about 6 square miles (16 km^2) in the northwest part of the Issaquah Creek Valley Ground Water Management Area, beneath Cougar and Squak Mountains. The lower reach of Tibbetts Creek joins a channelized drainage system that empties into Lake Sammamish.

Issaquah Creek and its tributaries drain approximately 60 square miles (155 km^2) of the Issaquah Creek Valley Ground Water Management Area. Six major streams feed Issaquah Creek. Fifteen-mile Creek, Mason (sometimes called MacDonald) Creek, Holder Creek, and Carey Creek join Issaquah Creek and drain the entire southern half of the Issaquah Creek Valley Ground Water Management Area. Issaquah Creek flows northward through a narrow gap between Squak Mountain and West Tiger Mountain to the City of Issaquah, where it is joined by its two remaining tributaries, the East Fork and the North Fork.

Below 400 feet (122 m) elevation, Issaquah Creek and certain stretches of its tributaries flow through somewhat broadened valleys, bordered by sharply rising slopes. During the rainy season and storm events, numerous unnamed, intermittent streams and springs rush down these slopes and contribute substantial flows to perennial streams. The valley widens to form a flat plain from the City's downtown to the shore of Lake Sammamish. Issaquah Creek and Tibbetts Creek flow across opposite sides of this valley and empty into the south end of Lake Sammamish.

4.3 Climate

Maritime air masses from the Pacific Ocean influence the climate year round and result in moderate temperatures. Short periods of hot, dry weather are caused by continental air masses brought by easterly winds. Likewise, short periods of cold winter temperatures are usually caused by frigid continental air masses.

Temperature data for the closest weather station at Landsburg (located south of the Issaquah Creek Valley Ground Water Management Area) are indicative of the cool, moderate climatic conditions associated with the region. July and August are typically the warmest months of the year, with an average temperature of 62° Fahrenheit (16.7° C).

Warm season temperatures from June through September average 60° (15.6° C). The colder months are November through March with temperatures averaging 40° (4.4° C). January is the coldest month, averaging 37° (2.8° C). The average annual temperature is 49° (9.6° C) with the extreme temperatures ranging from -27° to 100°F. For elevations above Landsburg's 535 feet (163 m), average temperatures are expected to be cooler.

During the fall and winter months, prevailing winds from the southwest bring in moist air about the same temperature as the ocean's surface. Precipitation is typically of light to moderate intensity and long duration. About 75 percent of the annual precipitation occurs from October through March. Winter precipitation occasionally falls as snow at the higher elevations. Refer to Figure 4.3.

In the spring and summer prevailing winds are from the northwest. The summer can be described as the dry season. Typically, less than 5 percent of the annual rainfall occurs in July and August. Although infrequent, thunderstorms are more likely to occur during the summer months.

5.0 LAND USE IMPACTS ON GROUND WATER

The following discusses land use plans and policies, and the impacts of various land use activities on the ground water resource in the Issaquah Creek Valley Ground Water Management Area.

5.1 Existing and Proposed Land Use

This section discusses plans and policies relating specifically to ground water management for each agency in the Issaquah Creek Valley Ground Water Management Area and the impacts to ground water from the various land use activities.

5.1.1 Plans and Policies Affecting Land Use

An understanding of existing land use activities and development trends in the Issaquah Creek Valley Ground Water Management Area requires a discussion of local and state land use policies influencing these factors. A summary of the King County Comprehensive Plan, Community Plans; City of Issaquah comprehensive plan, subarea plan, and ground water ordinance is included in this section. The Sammamish Plateau Water and Sewer District's authority does not permit it to adopt or enforce ground water regulations (Little, 1989).

King County Comprehensive Plan. The King County Comprehensive Plan establishes countywide policies and goals as well as a framework for policy making at the local level. The King County Comprehensive Plan is concerned with land use in the county and directs decisions affecting growth and land development. The King County Comprehensive Plan was revised in 1994 to comply with the Growth Management Act

and the King County Countywide Planning Policies. The King County Comprehensive Plan is updated annually.

The King County Comprehensive Plan establishes policy priorities for ground water management for all of King County, including the Issaquah Creek Basin. The Comprehensive Plan calls for the implementation of these policies through land use plans and development reviews. Ground water policies should also be used to guide the County's review of the plans prepared for water and sewer purveyors and other government projects.

The King County Comprehensive Plan establishes countywide policies and goals as well as a framework for policy making at the local level. The King County Comprehensive Plan is concerned with land use in the county and directs decisions affecting growth and land development. The King County Comprehensive Plan includes the following policies revised to comply with the Growth Management Act and the King County Countywide Planning Policies.

NE 332 In unincorporated King County, areas identified as sole source aquifers or as areas with high susceptibility for ground water contamination where aquifers are used for potable water are designated as Critical Aquifer Recharge Areas as shown on the map, entitled Areas Highly Susceptible to Ground Water Contamination. Since this map focuses primarily on water quality issues, the county shall work in conjunction with cities and ground water purveyors to designate and map recharge areas which address ground water quantity concerns as a new information from ground water and wellhead protection studies adopted by county or state agencies becomes available. Updating and refining the map shall be an ongoing process.

NE-333 King County should protect the quality and quantity of ground water countywide by:

a. Placing a priority on implementation of adopted Ground Water Management Plans;
b. Developing a process by which King County will review, and implement, as appropriate, adopted Wellhead Protection Programs in conjunction with cities and groundwater purveyors;
c. Developing, with affected jurisdictions, best management practices for new development and for forestry, agriculture, and mining operation recommended in adopted Ground Water Management Plans and Wellhead Protection Programs as appropriate. The goals of these practices should be to promote aquifer recharge quality and to strive for no net reduction of recharge to ground water quantity; and,
d. Refining regulations as appropriate to protect critical aquifer recharge areas when information is evaluated and adopted by King County.

NE-334 King County should protect ground water recharge quantity in the Urban Growth Area by promoting methods that infiltrate runoff where site conditions permit, except where potential ground water contamination cannot be prevented by pollution source controls and stormwater pretreatment.

NE-335 In making future zoning and land use decisions which are subject to environmental review, King County shall evaluate and monitor ground water policies, their implementation costs, and the impacts upon the quantity and quality of ground water. The depletion or degradation of aquifers needed for potable water supplies should be avoided or mitigated, and the need to plan and develop feasible and equivalent replacement sources to compensate for the potential loss of water supplies should be considered.

NE-336 King County should protect ground water in the Rural Area by:

a. Preferring land uses that retain a high ratio of permeable to impermeable surface area, maintain or augment the infiltration capacity of the natural soils and;
b. Requiring standards for seasonal and maximum vegetation clearing limits, impervious surface limit, and, where appropriate, infiltration of surface water. These standards should be designed to provide appropriate exceptions consistent with Policy R-216.

King County Community Plans. Community plans represent another legally binding policy document with jurisdiction in the Issaquah Creek Valley Ground Water Management Area. King County is divided into community planning areas allowing citizens and planning officials to develop local area goals, plans, and policies. Once adopted by the Metropolitan King County Council, a community plan becomes an official document affecting development and municipal expenditures in the community.

The King County Comprehensive Plan requires that within one year of adoption of the 1994 Plan that the County Executive should report to the Council with a work program to revise, replace, or repeal existing community plans within three years. The Council adopted the following King County Comprehensive Plan policies:

I-301 Existing community plans shall remain in effect and continue as official County policy until reviewed and revised to be consistent with the 1994 Comprehensive Plan and adopted as elements of the Comprehensive Plan, or until repealed or replaced. In the case of conflict or inconsistency between applicable policies in existing community plans and the 1994 Comprehensive Plan, the Comprehensive Plan shall govern.

I-302 The King County Executive will report to the Council by December 31, 1995 or by the time the first amendments to the Comprehensive Plan are adopted, whichever is sooner, with a work program to review and revised existing community plans to make them consistent with the Comprehensive plan, or to

replace or repeal them, within three years of adoption of this Plan. Any such review shall include extensive citizen participation and the participation of adjacent or affected cities.

King County Community Planning Areas in the Issaquah Creek Valley Ground Water Management Area are Tahoma/Raven Heights, East Sammamish, Newcastle, Snoqualmie, and a small portion of Bear Creek (Figure 3.1). Policies are developed for each community and, if adopted by the Metropolitan King County Council, they are included in the community plan.

Since the majority of the study area falls within the boundaries of the Tahoma/Raven Heights Community, land use policies for this community have a greater influence on land use in the Issaquah Creek Valley Ground Water Management Area than do policies for other communities. The Tahoma/Raven Heights Plan (King County Planning 1984) lists four general elements that describe the most important land use priorities in the area:

- The rural character should be preserved and balanced with new development;
- The compatibility of adjacent land uses should be maintained, especially with regard to new development and rural uses;
- Public services should meet existing demand before expanding to serve new development;
- Sensitive areas should be permanently protected, and development should be redirected whenever it poses a threat to sensitive areas.

The East Sammamish Community Plan was updated and adopted by the Metropolitan King County Council on May 25, 1993. The East Sammamish Community Plan includes Grand Ridge, which is located in the northeast area of the Issaquah Creek Valley Ground Water Management Area. The majority of Grand Ridge was designated rural with some quarry mining designations. The natural environment chapter of the East Sammamish Community Plan includes policies to implement the Issaquah Creek Valley Ground Water Management Plan (see Appendix B).

Ground water plans and policies specific to the Issaquah Creek Basin are developed in each of the four King County Community Plans with jurisdiction in the area. The key features of these plans relating to ground water include:

- The demand for water in Tahoma/Raven Heights should not exceed the area's ability to provide clean, plentiful ground water.
- As in the King County Comprehensive Plan, the Tahoma/Raven Heights Plan maintains that ground water recharge areas and watersheds should be identified and protected from potentially harmful land uses.
- The Snoqualmie Plan specifies that underground storage tanks holding potential water pollutants should have special containment and leak detection systems.

- The East Sammamish Plan includes the following key features related to ground water:

NE-8 Upon adoption, the recommendations of the Issaquah Creek, Redmond-Bear Creek and East King County Ground Water Management Program(s) should be implemented through zoning and other mechanisms to protect ground water resources.

GM-16 The eastern portion of Grand Ridge should retain its Rural designation and is not included within the UGA. Zoning for this eastern portion shall require rural clustering. The western portion of Grand Ridge that is less environmentally constrained shall also keep a Rural designation and is not within the UGA. Residential development within the western portion of Grand Ridge should require rural clustering. The western portion is substantially less constrained than the balance of Grand Ridge, and redesignation to Urban may be considered through a plan amendment study, once the Issaquah Wellhead Protection Study is complete. Such plan amendment study also must comply with the Ground Water Management Plan when approved by the Department of Ecology. Land use decisions should be compatible with the findings of the Wellhead Protection Study and the adopted Ground Water Management Plan.

GM-16 has been superseded by the 1994 King County Comprehensive Plan. Policy I-301 of the Plan states that existing community plans shall remain in effect and continue as official county policy until reviewed and revised to be consistent with the 1994 Plan and adopted as elements of the King County Comprehensive Plan or until repealed or replaced. In the case of conflict or inconsistency between applicable policies in existing community plans and the 1994 King County Comprehensive Plan, the Comprehensive Plan shall govern.

Policy U-510 of the Comprehensive Plan, designates the Grand Ridge site as an Urban Planned Development. The Grand Ridge area includes an Urban Planned Development, public open space and rural areas. The exact uses and development standards for the urban and rural areas will be determined upon agreement to an Urban Planned Development conditions by the Metropolitan King County Council.

NE-6 Public sewers are the preferred method for wastewater treatment in Urban Areas, including Urban Reserve Areas. Within Rural Areas, and Urban Areas where sewers are not yet available, proper siting and maintenance of septic systems should continue to receive special attention for new and existing land development to reserve the valuable ecological functions and beneficial public uses of water resources.

NE-11 All golf course proposals shall be carefully evaluated for their impact on surface and ground water quality and quantity, sensitive areas, and fish and wildlife resources and habitat.

NE-12 Water used for irrigating golf courses should come from non-potable water sources whenever possible. Use of natural surface water sources, such as streams, should be avoided due to impacts on fish and other wildlife habitat. A water conservation plan must be submitted with golf course applications and should address measures such as the use of drought-tolerant plant species.

FS-8 Areas identified as recharge areas should be protected. Methods to be considered should include use of clustered development, maintaining or redesignating the area for low-density development conditions, the amount of clearing and impervious area restrictions, and requiring stringent adherence to drainage and surface water runoff protection guidelines.

The Issaquah Creek Basin and Nonpoint Action Plan is one of a series of basin plans being completed within the Issaquah Creek Valley Ground Water Management Area. The plan focuses on drainage and flooding, water pollution, and programs with fish and wildlife habitat in the 61-square mile Issaquah Creek basin. The plan recommends a set of regulatory, programmatic, and capital improvement actions to address these problems. While the plan focuses on surface water issues, the maintenance of ground water quality and recharge was considered in the development of the recommendations. The plan was adopted by the Metropolitan King County Council on July 10, 1995 and the Issaquah City Council has incorporated sections of this plan into the Issaquah Comprehensive Plan.

City of Issaquah

Issaquah Comprehensive Plan. The Issaquah Comprehensive Plan is one of the guiding policy documents for the City of Issaquah. In accordance with the guidelines mandated by the Washington State Growth Management Act (GMA), Issaquah adopted its Comprehensive Plan on April 17, 1995. Additional documents related to the Issaquah Comprehensive Plan include: Environmental Impact Statement for the Comprehensive Plan, released to the public in February 1995; an updated Critical Areas Ordinance, adopted July 17, 1995; and a Shorelines Master Program, to be updated in 2000. The GMA requires the protection of Critical Aquifer Recharge Areas as well as many other critical areas. (Lewine, J. 1995)

Sub-Area Plans. In 1999 Issaquah adopted the Olde Town Subarea Plan. This plan includes an integrated Environmental Impact Study addendum document intended to provide programmatic environmental review and impact analysis.

Subarea Plans adopted prior to 1995 are being examined by the Planning Department for consistency with the Issaquah Comprehensive Plan. The 1983 I-90 Subarea Plan and the

1985 Newport Subarea Plan have been repealed. The existing 1989 Tibbetts-East Cougar Subarea Plan is not repealed; however, it is to be used for policy direction and for the community input that it contains, and not as a GMA consistent plan.

Natural systems, including surface water and ground water, are examined in all of the above plans. It will continue to be a major component in Issaquah's new and updated Subarea Plans. (Lewine, J. 1999)

Ground Water Ordinance. The City of Issaquah has a non-degradation ordinance for ground water quality protection at its wellheads.

State Policy Documents

The Shoreline Management Act, adopted by the legislature in 1971, protects shoreline resources according to the environmental designation of the shoreline. Each environmental designation represents a particular land use emphasis and approach to development. Policies and recommendations within each designation encourage land uses that enhance the natural character of the shoreline. In the study area, the Act applies only to Lake Sammamish and Issaquah Creek.

Ecology enforces the water quality standards for ground water of the State of Washington (Chapter 73-200 WAC. See Appendix C). Under these standards, the Ecology antidegradation policy ensures the purity of the state's ground water and protects the natural environment. Existing and future beneficial uses must be maintained and protected, and degradation of ground water quality that would interfere with or become injurious to beneficial uses is not allowed.

5.1.2 Existing Land Use and Development Trends

The City of Issaquah and the I-90 corridor represent the primary centers of development in the study area. The majority of the area, however, is rural in character.

Existing Land Use. Residential development is concentrated in the City of Issaquah, the Mirrormont area, and in the area northeast of Lake Sammamish State Park. In the City of Issaquah, the highest density of single-family and duplex residences is east of Front Street, whereas multi-family residences are found near Hobart Road and Wildwood Boulevard. Most of the western half of the City is zoned for single-family medium-density housing. In the Issaquah Creek Valley Ground Water Management Area there are approximately 6,295 single-family residences and 2,387 multi-family units (King County LDIS October 1993). Figure 5.1A shows existing land use in the Issaquah Creek Valley Ground Water Management Area as indicated by LandSat imagery.

The primary commercial and industrial zones in the Issaquah Creek Valley Ground Water Management Area are located within Issaquah's city limits. Industrial activities include a milk processing plant, a state-owned fish hatchery, and various manufacturing activities

in industrial parks located along the I-90 corridor. Issaquah also supports a variety of technical, retail, and professional services.

Industrial land use in unincorporated sections of the Issaquah Creek Valley Ground Water Management Area is limited to resource extraction and a regional landfill. Sand and gravel pits are located north of I-90 along the North Fork of Issaquah Creek and in the southwestern part of the study area near Cedar Grove Road. In addition, the Cedar Hills Regional Landfill is located in the study area on a 920-acre site north of Cedar Grove Road.

Issaquah Creek Valley's undeveloped portions include forest and agricultural lands. Logging operations take place in timber parcels to the northwest and east of Mirrormont. Agriculture in the Issaquah Creek Valley Ground Water Management Area is primarily pastoral with small farms each keeping 10 to 15 head of livestock scattered along the Issaquah-Hobart Road and in the Hobart area. Small-scale horticulture exists in individual plots throughout the study area, while a limited amount of row crops, orchards, and nurseries are located on the Hobart Plateau (Scheer 1988).

Residential Development Trends. Housing development in the Issaquah Creek Basin has increased in proportion to growth experienced in the rest of King County in the 1980s. Residential trends are reflected in Table 5.1 for the Issaquah Creek Valley Ground Water Management Area and in Table 5.2 for the City of Issaquah. In the City of Issaquah there were 29 single-family applications in 1991, 41 in 1992 and 81 in 1993. Household population forecasts are also discussed in Section 6.5 and in Table 6.5. The King County Comprehensive Plan designated the Issaquah Area as an Urban Area, where new development will be directed.

Commercial and Industrial Development Trends. With the exception of scattered markets and service stations, commercial development in the Issaquah Creek Valley Ground Water Management Area is contained within Issaquah city boundaries. Included in these plans are added retail facilities and office complexes (Issaquah/DDR 1989). Industrial development in Issaquah is limited to light assembly manufacturing and retail.

Growth of commercial and industrial services in the Issaquah Creek Valley Ground Water Management Area will increase the potential for ground water contamination. In addition, placement of these facilities over ground water recharge areas may reduce the quantity of ground water available for future use.

Agricultural Trends. Small-scale grazing and horticulture may drop off slightly in rural areas in the Issaquah Creek Valley Ground Water Management Area due to the increase in single-family housing development. The Tahoma/Raven Heights Communities Plan and the King County Comprehensive Plan designate the Hobart Plateau as rural. This designation may slow, or stop, the transition from agricultural uses to residential development.

Areas of Concern and Future Information Needs. Additional information is needed to enable accurate commercial and industrial development projections for the Issaquah Creek Basin. Figure 5.1B shows projections for future land use in the Issaquah Creek Valley Ground Water Management Area. Figure 5.1C shows proposed future land use specifically for the City of Issaquah. Information on the specific type and location of existing activities and new development occurring in the Issaquah Creek Valley Ground Water Management Area would also help to indicate where ground water contamination is likely to occur and to what extent the demand for ground water is likely to increase in the future.

5.2 On-Site Septic Systems

On-site septic systems can be found throughout the Issaquah Creek Valley Ground Water Management Area. They occur, to a limited extent, in those areas served by the City of Issaquah and Sammamish Plateau Water and Sewer District sanitary sewer collection systems. All on-site septic systems in the study area are regulated by the Seattle-King County Health Department. New on-site septic systems in the Issaquah Creek Valley Ground Water Management Area must conform to location and design guidelines established by the King County Board of Health Regulations, Title 13. On-site septic systems, if properly designed, installed, and maintained, may be the preferred alternative to sewers because of lower water use and reinfiltration of wastewater to the ground. The costs of installation and repair of on-site septic systems are minor when compared to the environmental and economic costs of installing and maintaining sewer systems. Depending on lot sizes and soil types these repairs may or may not conform to current regulations.

5.2.1 Soils and Sewage Effluent

According to the *Issaquah Creek Basin Current/Future Conditions and Source Identification Report,* King County Surface Water Management Division (October 1991), some soils, such as those in the Kitsap series, are more suitable for treating and absorbing sewage effluent than others. Clays and clay loams filter and attenuate contaminants well, but they do not absorb effluent adequately. Soils with a coarse texture, such as those in the Everett series, absorb effluent well, but do not remove contaminants because of their high permeability.

Soil depth is also important when determining the proper function of a sewage system. At least three feet of unsaturated soil is required to protect potable ground water aquifers. If a design reviewed by the Seattle-King County Health Department indicates that the soil depth and soil type on a proposed site are not appropriate for a conventional subsurface soil absorption system, an alternative type of system, such as a mound system or sand filter may be needed.

5.2.2 Areas of Concern and Future Information Needs

In 1990, the Seattle-King County Health Department reviewed on-site septic system records, past field surveys, and a field survey of 192 septic systems in the Issaquah Creek Basin. The file review of 1,432 systems provided an estimated on-site septic system failure rate of 5.5 percent; that is, 78 of the 1,432 systems are either currently failing or have failed in the past (Anderberg, 1991). The field survey indicated an overall 9 percent failure rate. Roughly 32 percent of the systems reviewed were installed before 1970, when the focus was on design for disposal, not treatment of wastewater. "Lack of septic system maintenance (pumping) may contribute to an increase in the number of failures in the future as only 10 percent of all systems have records of being pumped in the last 20 years" (*Issaquah Creek Basin Current/Future Conditions and Source Identification Report,* King County Surface Water Management Division (October 1991)).

These systems may be a source of nonpoint pollution to ground water if they are located in extremely permeable soils or within high recharge areas above ground water. The Issaquah Creek Valley Ground Water Management Area has limited areas of extremely permeable (Everett) soils and large areas of shallow (Alderwood) soils. Figure 5.2 shows where failing on-site septic systems are concentrated in relation to existing soil types. Many of the failure areas are located in Alderwood soils.

Another research priority should be locating all on-site septic systems, especially those with a history of failure and those located in potential ground water recharge zones. Septic drainage fields are a potential contributor of phosphates, nitrates, and synthetic organic chemicals to surface and ground water. More research is needed on the actual threat to ground water posed by drainage fields in the study area.

5.3 Sewers

The City of Issaquah, the Sammamish Plateau Water and Sewer District, and a small portion of the Northeast Sammamish Sewer and Water District, are the only sanitary sewer providers in the Issaquah Creek Valley Ground Water Management Area. The boundaries of these sewer service areas are shown in Figure 5.3. All other development in the study area operates on on-site septic systems. Information about existing sewered areas, capital improvement program areas, septic system areas within sewer utilities, and non-sewered areas with the Issaquah Creek Valley Ground Water Management Area can be found in the Technical Appendices of the King County Comprehensive Plan.

5.3.1 City of Issaquah

The City of Issaquah provides sanitary sewer service to most developed areas of the city. Older homes constructed before the installation of the sanitary sewer are not required to connect to the sewer system if their septic systems meet the Seattle-King County Health Department standards. The City of Issaquah has planned to extend sanitary sewers to the southern part of the city and has evaluated the impacts of extending service to Grand

Ridge and part(s) of Cougar Mountain as part of the Sewer Comprehensive Plan update. The City of Issaquah is not planning to extend the sanitary sewer to Mirrormont (Lynne 1994). Leaks have been detected in some of Issaquah's older sewer lines which were installed more than 30 years ago. Leaks in the Issaquah system are located by using cameras; leaks are repaired by grouting. Since the shutdown of a small sewage treatment facility on Issaquah Creek in 1962, the City of Issaquah has routed all sewage to King County Department of Natural Resources, Wastewater Treatment Division's treatment facility in Renton via a trunk line.

5.3.2 Sammamish Plateau Water and Sewer District

The Sammamish Plateau Water and Sewer District serves the majority of the Plateau in the northern portion of the Issaquah Creek Valley Ground Water Management Area. The Sammamish Plateau Water and Sewer District began to construct a sanitary sewer system in 1970. The Sammamish Plateau Water and Sewer District sewer system serves residences and also businesses north of the City of Issaquah limits. Future connections will be made to all new buildings constructed in this area and to those homes found to have inadequate septic systems by the Seattle-King County Health Department (Phillips 1989). As with the City of Issaquah's sewer system, all sewage from the Sammamish Plateau Water and Sewer District sewer system is sent through a trunk line to King County Department of Natural Resources, Wastewater Treatment Division's treatment facility in Renton.

5.3.3 Areas of Concern and Future Information Needs

For both of the referenced sanitary sewer collection systems, additional information is needed on existing and projected sewer quantities, as well as a detailed account of future service options and system expansion plans. This information, together with data on sewer line leaks, would provide a more complete picture of Issaquah Creek Valley Ground Water Management Area sewer service in relation to sensitive ground water areas.

5.4 Stormwater

5.4.1 Existing Systems

Storm water is important to ground water management for two reasons. First, storm water has the potential to carry contaminants, such as oil and grease found along roadways and other impervious surfaces, to ground water recharge zones. In addition, stormwater management can affect ground water quantity if stormwater is directed to ground water recharge areas.

There are several major roads in the Issaquah Creek Valley Ground Water Management Area: Interstate 90, State Routes 900, 18, and 202 the Issaquah-Hobart Road, Vaughn Hill Road and SE 56th Street. Common contaminants found in stormwater runoff from

roads include petroleum products, heavy metals, and soot. In areas where existing roads cross streams, untreated road runoff may be discharged directly to local streams in the Issaquah Creek Valley Ground Water Management Area. For example, untreated roadway runoff is discharged into the North Fork of Issaquah Creek at river mile 0.2 and 1.2 (*Issaquah Creek Basin Current/Future Conditions and Source Identification Report*, King County Surface Water Management Division, October, 1991).

The only stormwater systems in the Issaquah Creek Valley Ground Water Management Area are operated by the City of Issaquah and the King County Water and Land Resources Division. Storm sewers for the City of Issaquah conform to the same boundaries as its sanitary sewer system. Some portions of the storm system include oil and water separators and these are required in all parking area drainage systems. The city has recently established a Stormwater Management Utility to direct the improvement of stormwater systems in Issaquah (Rothnie 1989). Stormwater sewer services, provided by the King County Surface Water Management Division, are located in a limited number of areas in the remainder of the Issaquah Creek Valley Ground Water Management Area, including the Mirrormont area (Eckel 1989). Single line storm drains are also located throughout the study area, especially along most roadways, and empty into local surface water bodies.

Ecology has developed stormwater management guidelines, under the 1989 Puget Sound Water Quality Management Plan. The guidelines, which became effective in mid-1994, are directly relevant to I-90, and State Routes 18, 900, and 202, in the Issaquah Creek Basin. The guidelines will be implemented by local jurisdictions and the State Department of Transportation (King County Surface Water Management Division 1991). In addition, King County and the City of Issaquah, with partial funding from Ecology have prepared a basin plan for the Issaquah Creek watershed. This plan, which includes recommendations for the management of stormwater quality and quantity, will be submitted to the City of Issaquah and the Metropolitan King County Council for adoption in February 1995.

5.4.2 Areas of Concern and Future Information Needs

One problem associated with urban runoff is the complexity of the contaminants. Typical pollutants associated with forested areas are sediments and nutrients, whereas urban runoff carries more complex and variable pollutant types. The most common land use changes in the Issaquah Creek Basin are forest land to residential development and non-forested lowland to commercial development. The result is that more complex and variable contaminants may be seeping towards the ground water.

A research priority in this area should be to determine the extent to which storm water runoff represents a threat to ground water quality. This research would also locate those areas where a significant amount of vehicular oils and greases are channeled by storm water systems into sensitive ground water recharge zones.

5.5 Landfills and Industrial Waste Sites

Improperly managed landfills and industrial waste sites can represent a significant potential threat to ground water quality in the study area. Both the Cedar Hills Landfill and the Queen City Farms industrial waste site are located in the study area; however, there are no known buried or abandoned landfills.

There have been numerous cases of the illegal dumping of non-hazardous wastes throughout the Issaquah Creek Valley Ground Water Management Area, consisting of household trash, furniture, appliances, and car parts. The Seattle-King County Health Department has investigated these incidents and contacted the applicable agency, such as King County Roads, to remediate the site (for example, collect household garbage). In other instances, such as the dumping of oil and antifreeze near a creek on High Point Road, the case has been referred to the appropriate agency, in this instance, King County Surface Water Management (Slagle, K. October 1995).

Table 5.3 lists businesses in the Issaquah Creek Valley Ground Water Management Area where Ecology is investigating or monitoring the cleanup of toxic material spills. In most instances, ground water contamination is either suspected or confirmed.

5.5.1 Cedar Hills Landfill

Cedar Hills Landfill covers 920 acres in the southwestern portion of the study area, between the May Valley and Cedar Grove Roads. This regional landfill is closed to self-haulers, but accepts waste from the seven County-operated transfer stations located outside the Issaquah Creek Valley Ground Water Management Area and commercial collection companies. In 1992, 909,833 tons of solid waste were disposed, an average of approximately 2,500 tons per day (*King County Solid Waste Division Tonnage Report*, December, 1992). The expected life capacity of Cedar Hills is projected to be approximately 27 years (*1992 Comprehensive Solid Waste Management Plan and EIS*, Solid Waste Division, August 1993).

The wastes accepted at Cedar Hills are strictly in accordance with all applicable federal, state, and local regulations. The waste is municipal solid waste, except for the special wastes which are cleared through the Seattle-King County Health Department's waste clearance process. The Solid Waste Division also has a program to screen wastes coming into the system to minimize acceptance of unwanted materials.

The *Cedar Hills Draft Site Development Plan* was completed in 1987 (King County Solid Waste Division, 1987); its purpose was to ensure that the landfill: (1) meets the disposal needs of King County; (2) meets all applicable federal, state, and local laws and regulations; and (3) provides a method of waste disposal that protects the human health and safety and minimizes environmental impacts.

Under the guidance of the Site Development Plan, the Solid Waste Division had made significant engineering and operational changes to Cedar Hills to reduce environmental impacts and to meet new federal, state, and local regulations. Major improvements included: (1) construction of a storm water control system; (2) installation of an active gas collection and flare system; (3) installation of a leachate collection, pretreatment, and transmission system; (4) interim and final closure of all past refuse disposal areas; (5) installation of a composite clay and synthetic liner system under all new refuse disposal areas; and (6) expansion of the ground water and landfill gas monitoring programs.

Ground water quality at Cedar Hills has most recently been documented in the *Evaluation of Ground Water Quality Data* (EMCON April 1991) and the *1994 Annual Ground Water Data Evaluation Report* (King County Solid Waste Division, February, 1996). These annual reports evaluate data collected from monitoring wells completed in two separate ground water systems at Cedar Hills, including a shallow local system encompassing Vashon age deposits and a deeper regional system encompassing pre-Vashon deposits.

The local ground water system consists of discontinuous perched saturated lenses within five distinct stratigraphic units including the alluvium, recessional outwash, glacial till, stratified drift, and advance outwash deposits. Ground water impacts have been identified in perched lenses within the stratified drift on the east side of the landfill. These impacts have consisted primarily of the detection of vinyl chloride with sporadic detection of other compounds. A series of ground water extraction wells have since been installed to remediate the impacts and follow-up monitoring in the area is ongoing. Ground water impacts have also been observed in the stratified drift to the south of the landfill. Although concentrations of typical leachate indicator parameters have been dramatically reduced, there have most recently been detection of vinyl chloride. A consultant is presently under contract to evaluate possible remedial measures for this southern area, if they are determined to be necessary (Komorita 1994).

The deeper regional system below Cedar Hills consists of an aquifer of limited extent (Aquifer 2) and one of regional extent (Aquifer 3). There have been no landfill impacts identified in the regional system; however, as will be discussed in the following section, ground water impacts have been confirmed in the regional system at the Queen City Farms site located immediately to the south of Cedar Hills. The general ground water flow direction below Cedar Hills is to the north (Komorita 1994).

The hydrogeologic conditions at Cedar Hills have been extensively studied and most recently documented in the *Expanded Aquifer Monitoring Project Phase I Report* (EMCON November 1992). The Phase I Report summarizes all available hydrogeologic information about the landfill and the surrounding areas, and it identified data gaps which were completed as part of the Phase II portion of the project. The Phase II Report focused on characterization of the uppermost aquifer below the site (Komorita 1994).

The direction of ground water flow below Cedar Hills in this deep regional aquifer (Aquifer 3) has been documented to be in an northerly to north easterly direction. (*South Cedar Hills Remedial Investigation*, Sweet-Edwards/EMCON, January 1991, *Evaluation of Ground Water Quality Data*, Sweet Edwards/EMCON, April, 1991; *1992 Annual Ground Water Data Evaluation Report, Solid Waste Division*, July 1993; and *Expanded Aquifer Monitoring Phase I Report*, EMCON Northwest, February, 1994). Rural residential areas exist to the west, north, and east of Cedar Hills with Queen City Farms to the south. The residences immediately to the east have potable wells which are on the Solid Waste Division's quarterly ground water monitoring program (Komorita 1994).

The Seattle-King County Health Department, Solid Waste Section samples four wells biannually, around the Cedar Hills Landfill, for priority pollutants. None of these off-site monitoring wells, to date, has exhibited levels above primary drinking water standards for the constituents analyzed (Hickok 1994).

5.5.2 Queen City Farms Industrial Waste Site

Queen City Farms is located immediately south of the Cedar Hills Landfill and north of Cedar Grove Road. Before Queen City Farms was closed, the Boeing Company was a primary user of the farm as an industrial waste site in the 1950's and 1960's. Industrial liquid waste and drums were deposited at the site in three ponds (numbers 1 - 3) and in a trench. An additional three ponds (numbers 4 - 6) were used to contain unacceptable pig feed from the farm itself (Wall 1989).

After the designation of Queen City Farms as an U.S. Environmental Protection Agency Superfund site, ten ground water monitoring wells were drilled and contamination was found in water drawn from wells located near ponds 1 - 3. To mitigate the threat to ground water, Boeing and Queen City Farms have undertaken three cleanup measures: (1) the ponds have been backfilled with clean soil; (2) each pond has been capped with a liner; and (3) efforts have been made to intercept contaminants before they reach the shallow aquifer (Wall 1989).

Subsequent to these cleanup actions the King County Solid Waste Division conducted a remedial investigation of the portion of the Cedar Hills Landfill adjoining the Queen City Farms property. The remedial investigation concluded that the landfill was not contributing to ground water contamination at the Queen City Farms site (King County Solid Waste Division 1991).

The King County Solid Waste Division is monitoring surface water and ground water flow and quality on the portion of the landfill adjoining the Queen City Farms property (Orlean 1994). The King County Solid Waste Division provides the data collected from this site to the U.S. Environmental Protection Agency.

In addition, Queen City Farms, Inc. and the Boeing Company have conducted a remedial investigation of the Queen City Farms site. This remedial investigation concluded that

there are three shallow aquifers beneath the site. The upper two aquifers are contaminated with volatile organic compounds due to the past waste disposal practices on the property. The U.S. Environmental Protection Agency is currently negotiating with Queen City Farms, Inc. and the Boeing Company for cleanup of the two contaminated aquifers (Orlean 1994).

Further mitigation on the site was carried out in summer 1995. In the buried drums area it was found that soils were contaminated with polychlorinated biphenyls. Six hundred and twenty two tons of soil with polychlorinated biphenyls exceeding 100 parts per million were identified and will be hauled off site in drums. The remaining contaminated soil under 100 parts per million of polychlorinated biphenyls will be backfilled under the cap. This soil is presently stockpiled with a liner beneath it and a plastic cover over it. Wells monitored in the buried drum area determined that TCE and vinyl chloride are still prevalent in the ground water on site. Boeing has also been monitoring wells off site.

In the Initial Remedial Measure Area, a barrier (slurry) wall is to be erected to contain any contamination and prevent it migrating off site. This wall was to be erected in spring/summer 1996 and will include soil from the buried drums area. The design of this wall was to be finalized by the end of 1995.

The results of samples taken at the 4-Tek Industries site on the Queen City Farms were satisfactory. More monitoring wells are to be installed by Boeing for monitoring both on and off site. Monitoring of the site is ongoing by the U.S. Environmental Protection Agency (McPhillips, L. October 23, 30, 1995).

Presently, the Cedar Grove composting facility operates on the Queen City Farm site. While the composting operation is on the same property as the industrial waste site, it is outside the Issaquah Creek Valley Ground Water Management Area.

5.5.3 Areas of Concern and Future Information Needs

To better understand the potential risk to ground water posed by landfill activities in the Issaquah Creek Valley Ground Water Management Area, specific information is needed in the following areas:

- Ground water quality on and surrounding both the Cedar Hills Landfill and Queen City Farms, Inc. sites should continue to be evaluated. Data should be shared with the Seattle-King County Health Department's Drinking Water Program and entered into their database.
- The report findings and proposed future activities concerning ground water quality impacts both off- and on-site.
- The direction of ground water flows in the area of the landfills, as well as the depth and range of aquifers exposed to leachate contaminants.

5.6 Underground Storage Tanks

5.6.1 Description

Underground storage tanks represent another potential threat to ground water quality and quantity in the Issaquah Creek Basin. Faulty underground storage tank system components and poor facility management practices are the most cited causes of leaks and spills, collectively and commonly referred to as releases, from underground storage tanks. Releases from underground storage tank systems are especially problematic in areas with shallow aquifers or where ground water drawn from private wells is the primary source of drinking water (Knowlton 1994).

Ecology maintains a list of underground storage tanks in the Issaquah Creek Valley Ground Water Management Area. There are presently 78 underground storage tanks operational in the Issaquah Creek Valley Ground Water Management Area (see Table 5.4). The 1989 Ecology list had 123 operational underground storage tanks (1991 Issaquah Area Characterization report). This is consistent with a statewide trend toward fewer underground storage tanks in operation. This list is not all-inclusive, as it reflects only those systems reported to Ecology. The list does represent the majority of regulated underground storage tank systems in the area. Table 5.5 lists the age ranges of the underground storage tanks in the Issaquah Creek Valley Ground Water Management Area, and Table 5.6 lists the types of substances found in those underground storage tanks. Table 5.7 summarizes the sizes of underground storage tanks.

Figure 5.4 shows some of the underground storage tank locations on Ecology's list. While underground storage tanks are concentrated in the City of Issaquah, some are also found at the Cedar Hills Landfill, along the Issaquah-Hobart Road, near quarries and mines, in Hobart, at Lake Sammamish State Park, and at other commercial and industrial locations (Ecology 1989). The locations of underground storage tanks such as small, home heating oil tanks have not been identified.

Ecology implements Washington's Underground Storage Tank Regulations (Chapter 173-360 WAC). Written into this regulation are performance standards that must be achieved for all operational systems. These standards address released detection for tanks and ancillary piping, corrosion protection for tanks and ancillary piping; spill and overflow prevention and financial responsibility (i.e., an insurance policy that covers the costs for cleaning up a release). An annual underground storage tanks permit is issued for each system whose owner certifies compliance with Chapter 173-360 WAC. The cost of the annual permit is $75 (in 1995). The purpose of underground storage tank regulation is to preserve the quality of ground water (i.e., a pollution prevention program). The responsibility of complying with Chapter 173-360 WAC is that of the underground storage tank system's owner or operator. Ecology does not maintain underground storage tanks, but it does work to facilitate the owner's comprehension of the regulation. By regulation design compliance with performance standards translates into pollution

prevention. Ecology regularly coordinates facility inspections to ensure compliance with Chapter 173-360 WAC (Ecology 1994).

State regulation requires that underground storage tanks be upgraded to include a leak detection system (water tanks are exempt). The initiative to regulate underground storage tanks started with a federal law passed by the U.S. Congress (Hazardous and Solid Waste Amendments to Resource Conservation and Recovery Act, 1984) gave the U.S. Environmental Protection Agency the responsibility of writing federal regulations (40 CFR Parts 280 and 281, 1988). Within the federal regulation was the opportunity for states to pass and implement their own laws and regulations that would be no less stringent than the federal. The State of Washington took advantage of the opportunity and now has its own law and regulation in place (90.76 RCW, 1989 and Chapter 173-360 WAC 1990, respectively). Ecology received final authority from the U.S. Environmental Protection Agency to implement its regulation in summer, 1993. It is very similar to, but not identical to, the federal regulation. As of December 1993, all regulated underground storage tank systems were required to employ an approved method of release detection for tanks and piping. The only exception is any underground storage tank used for emergency power generation that was installed between 1980 and 1988. The release compliance dates for these underground storage tank systems is December 1995 (Ecology 1994).

5.6.2 Potential Ground Water Impacts

Underground storage tanks without special leak containment or leak detection systems represent a potential threat to ground water quality. At some point during the active life of any underground storage tank without environmental controls, hazardous substances stored in ground water recharge zones will probably lead to some form of ground water contamination.

Ground water in the City of Issaquah is presently susceptible to contamination from an underground storage tank leak or accident. In 1987, several service stations experienced gasoline leaks from their tanks. Where required, contaminated soil from around the leaking tanks was excavated to Ecology standards and taken to the Cedar Hills Landfill. A soil venting system was installed to exhaust gasoline vapors from the soil, and the leaking tanks were repaired or replaced. In addition, ground water monitoring wells were installed to detect petroleum hydrocarbons in the ground water. Drinking water wells for the City of Issaquah, located less than one-half mile away from one of the service stations, have been tested. Thus far, no petroleum hydrocarbon based contamination has been detected.

Since January 1989, Ecology has maintained a database of current and former underground storage tanks that have caused known contamination. Table 5.8 (Ecology 1994) lists 18 sites in the Issaquah Creek Valley Ground Water Management Area where underground storage tank cleanups are in progress or have taken place. Under the Model Toxic Control Act, underground storage tank owners are responsible for site cleanup and

for sending the report to Ecology, which gives them a cleanup status. Ecology is not an active participant; the sites are independently remediated by the owners(s). Of the 18 sites, seven (7) have completed remediation. Of these seven, only one had caused known ground water contamination. Four of the remaining sites have only soil contamination. Seven sites have ground water contamination. At one of these sites where Ecology is awaiting a report, Ecology is not aware that any remedial action and cleanup is necessary. At the remaining sites, cleanup is in progress or has occurred and site monitoring is ongoing.

5.6.3 Areas of Concern and Future Information Needs

Although underground storage tanks represent a potential threat to ground water in the Issaquah Creek Valley Ground Water Management Area, some incidents are either unreported or undetected. The documentation of unregulated home heating oil tanks is difficult not only due to the hidden nature of the tanks, but also because not enough is known about the location, composition, and contents of many of the abandoned underground storage tanks in the area. Homes that once used or still rely upon fuel oil stored in underground storage tanks are common in western Washington. Home heating oil tanks are small (between 300-500 gallons) compared to most regulated underground storage tanks, but more common. Smaller tanks were typically constructed of thinner gauge steel and provide shorter service than larger, regulated systems. The average useful life of a 500-gallon steel tank that does not have corrosion prevention (i.e. cathodic protection) has been estimated at about 20 years. Most underground home heating oil tanks in western Washington are old and not cathodically protected. Ecology does not regulate nor track information about underground home heating oil tanks (Knowlton 1994).

A priority of future research should be the identification of both commercial and residential underground storage tanks located in areas where there is significant recharge to aquifers. Special guidelines may be designed for the location and monitoring of underground storage tanks in these recharge zones. Oil tanks that have not been permanently decommissioned, whether by removal or closure on-site, may pose a serious threat to ground water resources in the Issaquah area. Improperly closed heating oil tanks (i.e. those which still contain petroleum products or have not been secured from reuse) are the greatest concern (Knowlton 1994).

5.7 Quarries and Mines

5.7.1 Description

Quarries and mines can pose problems for ground water management in that they often leave large portions of an aquifer directly exposed to surface water and industrial contaminants. These areas may be significant ground water recharge zones. Coal, peat, sand, and gravel resources are all found in the Issaquah Creek Valley Ground Water Management Area. Although coal mining drew most of the original settlers into the area

in the late 1800's, in recent decades, sand, gravel and bulk-fill activities have been the primary industries in the Issaquah Creek Valley Ground Water Management Area (King County Planning 1984).

Sand and gravel resources are located primarily northeast of the City of Issaquah, north of Mirrormont, and along Cedar Grove Road. Sand and gravel extraction currently takes place north of I-90 along the Issaquah-Fall City Road, at the crest of the Issaquah-Renton Road, and in the Cedar Grove area (King County Planning 1980). The largest sand and gravel pit in the Valley, the Lakeside site, north of I-90, now operates using surface water control measures that limit the ability of surface contaminants to reach ground water. Surface and industrial wastewater is contained on-site by transporting the water to a series of ponds where it percolates down through gravel and sand (Devitt 1989).

The Tibbetts Creek Basin west of the City of Issaquah contains two rock quarries. Surface water runoff from the Sunset quarry is turbid; however, it is not known whether this runoff carries pollutants or contaminates ground water. In addition, the Hazen Quarry, a new quarry, operates just south of the Sunset Quarry.

Although there are no active coal mines in the Issaquah Creek Valley Ground Water Management Area, coal resources are known to exist in many parts of the Issaquah Creek Valley. Abandoned coal mines are located primarily within the city limits of Issaquah, in the hills southwest and east of the city, and in the Tiger Mountain area (Walsh 1989).

5.7.2 Potential Ground Water Impacts

The gravel mines north of the city have a recorded history of surface water contamination. It is likely that contaminants do reach ground water at some point in the operation of a quarry. However, the quantity and type of pollutants that reach aquifers and their impacts on water quality are not yet known.

Abandoned coal mines represent additional points where an aquifer may be exposed to surface water contaminants. However, because they are either sealed or located in isolated areas, abandoned coal mines pose little known threat to water quality in the Issaquah Creek Valley Ground Water Management Area (Walsh 1989).

Short-term ground water fluctuations were clearly observed at the Lakeside Gravel Pit in response to wells pumping on an eight-hour work-day schedule. Short-term and longer-term declining and rising water level trends were due to climate and the effect of pumping at the Sammamish Plateau Water and Sewer District's well number *9 (Lower Issaquah Valley Wellhead Protection Plan,* Golder Associates, November 1993). This indicates a level of hydraulic connection between the ground water at the gravel pit and the District's Drinking Water Well Number 9.

5.7.3 Areas of Concern and Future Information Needs

Future quarry and mine development should be of special concern to ground water management in the area. However, additional information is needed to show how existing operations affect ground water quality. At this time, little is known about the impacts of industrial contaminants that seep into exposed aquifers at quarries, or of the potential ground water impacts of an accidental hazardous material spill at a quarry. The impacts on ground water quantity caused by recharge and pumping in the vicinity of mines should also be assessed.

5.8 Agriculture

5.8.1 Description

Agricultural activities causing nonpoint pollution can be divided into two groups: (1) practices associated with livestock keeping and (2) practices associated with crop production. Pollutants most identified with farming activities are sediment, nutrients, organic materials, pesticides, and pathogens. Activities that can generate these pollutants in crop production are soil tillage, improper application of fertilizers and pesticides, and irrigation. Animal production activities that generate these pollutants include: animal confinement, overgrazing of pastures, unrestricted livestock access to streams, and improper application of fertilizers and pesticides (Fitch 1994).
Livestock keeping is the primary agricultural activity in the Issaquah Creek Valley Ground Water Management Area, consisting of approximately 30 percent cattle, 55 percent horses, and 0.7 percent sheep. The remainder is equally divided between goats and llamas. Most of the livestock keeping is in hobby farming (Fitch 1994).

The background of these rural residents is varied and includes people from all professions and walks of life. The sizes of their operations may range from less than one acre to more than forty acres. Some residents are there just for the rural setting, while others treat five acres as a large backyard where they can keep horses. Other types of land uses include hobby farms, gardeners, part-time farmers and "alternative" farmers.

Prime agricultural land is formed on soils that were derived from alluvium or Vashon outwash. The alluvium is mostly unconsolidated silt, sand, and gravel valley fill with some clay. Because of this mix of material, the soil has variable permeability and water-holding capability. More often than not soils formed in alluvium are considered to be hydric. Soils that formed in the Vashon Outwash are composed of advance and recessional outwash, stratified drift, and associated deposits. Soils that developed in this material have high permeability and are considered recharge soils. Both soil formations are highly vulnerable to pollution resulting from poor animal keeping and crop-management practices (Fitch 1994).

Based on several hydrogeologic factors that influence the behavior and movement of contaminants in the ground, it is unlikely that the present livestock practices in the

Issaquah Creek Valley Ground Water Management Area threaten ground water quality. These hydrogeologic factors (seepage) are (1) the horizontal distance between the site and the point of water use; (2) slope of the land; (3) the depth to water table; (4) the vadose zone material; (5) the aquifer material; (6) soil depth and; (7) the attenuation potential of the soil. However, the same is not true for their impact on surface waters, streams and ponds. For example, there is very little use of fertilizers on pastures and/or hayfields in the area. The potential ground water threat from fertilizers is from truck crop farms, nurseries, Christmas tree farms, etc. Generally, this type of operation is commercial in nature. Fertilizer is generally applied once or twice a year and is applied in accordance with the requirements of the crop. When applied according to label directions there should not be a pollutant source (Fitch 1994).

The Washington State Department of Agriculture requires all commercial applicators and all applicators applying restricted-use pesticides (includes all aquatic applications) to be licensed. As licensed applicators, they are required to keep records for seven years including the type of chemical applied, quantities, location of applications, and other such information. The Department of Health is the agency responsible for public health effects and possible emergency measures in case of poisoning and Ecology regulates spill response requirements (Fitch 1994).

The Washington State Department of Agriculture can request records from anyone required to keep records. A general record call-in from a significant land area, however, is financially unfeasible unless there is significant cause. Record availability outside the agency (Washington State Department of Agriculture) may be constrained by legal requirements also. Since the basin is changing from rural to urban, a record request may not provide the type of information needed by a given plan (Fitch 1994).

5.8.2 Areas of Concern and Future Information Needs

Additional research is needed on the types and quantities of agricultural fertilizers and pesticides used in the Issaquah Creek Basin. This information would allow for a complete analysis of how agricultural activities affect ground water quality.

5.9 Residential and Golf Course Fertilizer and Pesticide Use

Residential use of fertilizers and pesticides can cause increases in the levels of nitrate in ground water in highly susceptible areas. This is especially true for cases where 1-5 acre residential lots are kept in turf and irrigated regularly in the summer months. Landscaping practices such as keeping portions of large lots in native growth can help to reduce risk of nitrate contamination from residential fertilizer use.

The one private golf course and one proposed golf course in the Issaquah Creek Valley Ground Water Management Area are the Sahalee Golf & Country Club (private, Sammamish Plateau); and the Beaver Lake Golf Course (proposed near Beaver Lake on the Sammamish Plateau). Fertilizer is used by turf applications at public golf courses.

Turf fertilizers are a source of two potential contaminants, nitrate and phosphate. Of the two, nitrate represents the greatest risk to ground water contamination because of its high water solubility and high mobility in the soil column.

Phosphates in turf fertilizers generally do not pose a significant threat to ground water for a number of reasons. First, the water solubility of phosphate is low and much of the available phosphorus will be utilized within the root zone. The pH of the turf and underlying soil is conducive to the rapid binding of phosphate with aluminum ions found in abundance in western Washington soils (Braun, 1989). The use of phosphate on turf is essentially self-limiting. Only a relatively small amount of phosphate is used by grasses and little of that is undesirable seed head growth, diminishing the aesthetic quality of the turf.

Fertilizing practices are essentially the same for most golf courses in western Washington. Nitrogen is applied to the fairways at relatively low rates, about 2 to 2.5 pounds per 1,000 square feet. The 2 to 2.5 pounds is split into two annual applications. The greens receive nitrogen at a much higher rate, about 6 pounds per 1,000 square feet, split into 10 to 12 annual applications. These application practices are generally consistent with those recommended by the Washington State University Cooperative Extension Service. The Cooperative Extension Service suggests that nitrate contamination of both ground and surface water associated with turf fertilizers can be avoided through frequent, low-level applications of no more than 4 to 6 pounds of nitrogen per 1,000 square feet per year in 0.5 pound increments. Over-watering the turf after fertilizer application should be avoided to reduce the opportunity for nitrate wash-through. Use of urea should be avoided since it converts rapidly to nitrate. Ammonia sulfate is the recommended form of nitrogen because it is assimilated quickly, becomes tied up in the organic matter of the turf, and converts slowly to nitrate. (USGS 1995)

Fertilizer use may not pose a significant threat to ground water in the GWMA. Future data collection efforts should focus on obtaining information on the types and quantities of fertilizers and pesticides used by golf courses and nurseries, and other non-agricultural businesses and monitoring ground water quality from wells in the vicinity of these establishments.

5.10 Transportation

5.10.1 Roadside Spraying

Description

Roadside spraying usually attempts to accomplish one of four objectives: (1) to control excess weed growth; (2) to limit the spread of brush and trees; (3) to protect newly planted beds from disease and insects; and (4) to control insects and weeds at specific spots (Uyeda 1988). Within the state of Washington, labeling, distribution, transportation, application, use restrictions, and disposal of pesticides are governed by Chapter 16-288 WAC. The issuance and monitoring of statewide pesticide use permits is the responsibility of the Washington State Department of Agriculture.

Three public agencies conduct roadside spraying in the Issaquah Creek Valley Ground Water Management Area: the Washington State Department of Transportation, the King County Department of Transportation, and the City of Issaquah. Each of these agencies is required by law (RCW 17.21) to record the details of each spraying event and to retain those records for a period of 7 years. Spraying records, showing specific quantities and locations of herbicidal applications in the Issaquah Creek Valley Ground Water Management Area, may be obtained from the Department of Transportation's Bellevue office, from the Road Services Division in the King County Department of Transportation, and from the City of Issaquah Department of Public Works

The State Department of Transportation is responsible for vegetation control on I-90, State Routes 18, 900, and 202. The Department of Transportation sprays weeds appearing within 2 feet of roadsides, around fire hydrants and manholes, and in drainage ditches. The amount of herbicide sprayed by the Department of Transportation fluctuates between 4 and 5 pounds per acre and is heavily diluted with water when applied. State roadsides in the Issaquah Creek Valley Ground Water Management Area are sprayed once a year, usually during the month of April, primarily using three herbicide products: Karmex, Krovar, and Roundup. (The above are trade-name formulations containing herbicides diuron, bromacil, and glyphosate.)

The King County Road Services Division of the Department of Transportation serves unincorporated portions of the Issaquah Creek Valley Ground Water Management Area. The King County Roads Division applies herbicides to control noxious weeds on right of ways and weed and grass growth on gravel shoulders and around guard rails. Either Escort or Garlon is used for broad leaf control. Oust or Roundup is used for the non-selective control on the shoulders. The use of the chemicals simazine and atrazine was discontinued after 1989 because they are water soluble and can't be used in permeable soils. All herbicides, including those not on a "restricted use," are applied by certified pesticide applicators (Matsuno 1994).

The City of Issaquah Department of Public Works does not have an active roadside spraying program. The spraying of herbicides is limited to around tanks, pump stations (not well houses), fire hydrants, and some guard rails. Roundup is the herbicide being used, except in certain areas where Arsenol is being used.

The City of Issaquah Parks Department uses herbicides to control unwanted vegetation in turf and for spot weed control in landscape beds and tree wells. Confront is used over turf areas to control broadleaf weeds. Roundup, Crossbow, some Surflan/Gallery, and very little Casaron is used for spot control of weeds in the landscaped beds and tree wells.

The Seattle-King County Health Department conducts soils and water monitoring to determine the residual levels of pesticides over time. According to the 1989 monitoring report, no residuals for simazine and atrazine were found in surface water samples. As expected, low levels of herbicide residuals were found in soil samples taken at a depth of 4 inches. The results indicate that roadside spraying does not appear to pose a significant threat to water quality. Further, the amount of herbicides applied in the area has decreased over the years through improved application methods, such as overall decreased application rates (*Issaquah Creek Basin Current/Future Conditions and Source Identification Report*, King County Surface Water Management Division, October, 1991).

Potential Ground Water Impacts

The application of herbicides for roadside plant control can threaten ground water quality in two ways: (1) chemicals may be transported by storm water into high ground water recharge areas and, (2) pesticides may percolate into shallow aquifers through fissures or dry and sandy soils. Vegetation and clay soils along roadsides in the Issaquah Creek Valley Ground Water Management Area may act to effectively absorb some pesticides before they reach ground water. Particular attention should be paid to the quantity and type of chemical applied, especially if a chemical is likely to destroy or inhibit grass growth (Horner and Mar 1982). However, the preferred method of vegetation control is the use of machinery or manual removal.

Areas of Concern and Future Information Needs

Additional information on ground water impacts from roadside chemical applications are needed in four areas:

- The location of dry and sandy soils and any exposed aquifers that may facilitate the contamination of ground water by chemicals applied at roadsides;
- The types of roadside chemicals most likely to percolate through soils to an aquifer, as well as those that inhibit grass growth;
- The quantities and locations of chemical applications;

- Reports of any accidents or improper storage, handling or transport of pesticides and herbicides used for plant control in the Issaquah Creek Valley Ground Water Management Area.

5.10.2 Highway Runoff

Description

As rain washes over a roadway, it carries away contaminants depositing them into soils and storm water systems. Runoff of this kind is likely to occur on highways and heavily traveled roads. As noted earlier, there are several major roads in the Issaquah Creek Valley Ground Water Management Area: Interstate 90, State Routes 900, 18, and 202, the Issaquah-Hobart Road, Vaughn Hill Road, and SE 56th Street. Common contaminants found in storm water runoff from roads include petroleum products, heavy metals, and soot. In areas where existing roads cross streams, untreated road runoff may be discharged directly to local streams in the Issaquah Creek Valley Ground Water Management Area. For example, untreated roadway runoff is discharged into the North Fork of Issaquah Creek at river miles 0.2 and 1.2 *(Issaquah Creek Basin Current/Future Conditions and Source Identification Report*, King County Surface Water Management Division, October, 1991). Trucks transporting waste to the Cedar Hills Landfill on the Cedar Grove and May Valley Roads may also account for significant highway runoff.

Potential Ground Water Impacts

Ground water infiltration by highway runoff is possible in very porous earth and in areas of exposed aquifer. Studies of highway runoff in Western Washington have shown that vegetation may effectively capture pollution in upper soil layers (Horner and Mar 1982). However, the precise conditions under which runoff pollutants may be contained in surface soil is not yet known. Highway runoff for Interstate 90 and other heavily traveled roads in the Issaquah Creek Valley Ground Water Management Area flows into vegetated storm water channels thus decreasing the chances of ground water contamination. However, some channels are maintained with mechanical blades that may clear soil and vegetation allowing highway runoff to infiltrate into ground water.

Areas of Concern and Future Information Needs

The most comprehensive study of highway runoff in Washington State was conducted by the Washington State Department of Transportation between 1977 and 1982 (Horner and Mar 1982). Although these reports discuss the conditions under which runoff may lead to ground water contamination, the degree and impact of potential contamination is never quantified. Since the 1982 study no comprehensive studies of highway runoff have been conducted in Washington State. However, the Washington State Department of Transportation will be conducting a highway runoff characterization and Best Management Practices effectiveness monitoring program in King County for the National

Pollutant Discharge Elimination System Permit Program and the highway runoff Rule, Chapter 173-270 WAC. Samples will be collected for a complete range of parameters including metals and priority pollutants (Schaftlein 1994).

Additional research is necessary to determine the type and quantity of contaminants that flow from road surfaces. In addition, more information is needed on storm water drainage for major roads in the study area.

5.10.3 Hazardous Material Spills

Description

The term "hazardous material" refers to "hazardous waste" as well as "hazardous substances," both generally defined as materials that pose a substantial present or potential threat to human health or the environment (Horner and Mar 1982). The majority of hazardous substances traveling on Issaquah Creek Valley Ground Water Management Area roads are petroleum products. These products are most frequently transported in the Issaquah Creek Valley Ground Water Management Area along Interstate 90, the Issaquah-Hobart Road, and State Route 18.

Potential Ground Water Impacts

The exact frequency and routes of hazardous material traffic is not yet known. Preliminary information from Ecology indicates that for the Interstate 90 portion of the Issaquah Creek Valley Ground Water Management Area there was only one hazardous material accident from January 1985 through September 1988, with no resulting spill. Future research should determine the probability of a hazardous material accident occurring in the study area and the circumstances under which such an accident would threaten ground water quality.

The Ecology office in Bellevue responds to reports of petroleum or hazardous material spills in the Issaquah Creek Valley Ground Water Management Area. A spill response team is available on a 24-hour basis to implement and monitor cleanup operations for accidents that occur on highways or roads, at manufacturing plants, or any location in the Issaquah Creek Valley Ground Water Management Area. Ecology's procedure for responding to spills depends on the substance spilled as well as on the severity and location of the accident (Baker 1990).

Areas of Concern and Future Information Needs

The goal of evaluating the risk of a hazardous material spill is to provide information to decision makers in the following areas:

- The location of accident zones where hazardous material spills are likely to occur;

- A description of sensitive areas where spills would threaten ground water quality; and,
- An estimation of the resources needed in any remediation effort resulting from a spill.

To complete this evaluation, the following research process may be followed:

- State traffic volume data will estimate the number of trucks that have used major roads in the Issaquah Creek Basin in past years;
- Accident statistics will then help to determine the probability of a truck accident occurring on these roads;
- Additional data is then needed to determine the percentage of trucks carrying hazardous materials in high physically susceptible areas in order to locate principal accident zones and the likelihood of a hazardous material accident occurring;
- Further research will indicate the number of hazardous material accidents that result in spills, as well as the quantity and substance of those spills; and
- Research is needed to estimate the probability of spilled hazardous materials reaching and contaminating ground water.

5.11 Hazardous Waste

5.11.1 Description

Hazardous waste is a material that is ignitable, corrosive, reactive, or toxic. Inadvertent or intentional discharges to storm water disposal systems represent another release mechanism. To be regulated under the state Dangerous Waste Regulations Chapter 173-303 WAC, a commercial or industrial facility must generate at least 220 pounds per month of hazardous waste; transport dangerous/hazardous waste; treat, store or dispose of dangerous/hazardous waste; or burn or blend dangerous waste fuels. Several commercial and industrial facilities located within the Issaquah Creek Valley Ground Water Management Area generate quantities of hazardous or extremely hazardous waste regulated under Resource Conservation and Recovery Act.

Small quantity generators produce less than 220 pounds of hazardous waste per month. The Local Hazardous Waste Management Program assesses how small quantity generators store, use and dispose of hazardous waste. The Seattle-King County Health Department and the King County Water and Land Resources co-staff the Local Hazardous Waste Management Program field unit that inspects any business that has the potential to generate hazardous waste. Hazardous waste spillage at small quantity generators is a high priority. Businesses where hazardous waste spillage is observed are referred to Ecology for follow-up. These businesses must still handle their waste properly according to Chapter 173-303 WAC and Title 10 of the King County Board of Health.

There is one site listed in the U.S. Environmental Protection Agency Superfund Program List within the Issaquah Creek Valley Ground Water Management Area. Queen City Farms, and industrial waste site, is currently under investigation and remediation. This site is discussed in further detail in Section 5.5.2.

5.11.2 Potential Ground Water Impacts

Hazardous waste can be introduced to the environment, including ground water, in a number of ways. If hazardous wastes are discharged to septic systems (through sinks, toilets or floor drains) the wastes discharged may contaminate soil and ground water. Any hazardous wastes that are discarded from households or businesses to the environment along with normal solid waste refuse can be placed in landfills and contributed to leachate contamination of underlying ground water. Finally, hazardous wastes that are deposited on exposed ground surfaces from traffic accidents, spills, or from improper storage can percolate into the soil and may migrate via recharging precipitation into the ground water environment.

5.11.3 Areas of Concern and Future Information Needs

Ecology maintains a record of businesses that identify themselves as generating, storing, treating or transporting hazardous waste in the state. This list (notifier's list) was reviewed to identify business that may generate hazardous waste in the Issaquah Creek Valley Ground Water Management Area. Businesses shown on Ecology's notifier's list that are also located in the Issaquah Creek Valley Ground Water Management Area are listed in Table 5.9. At least one type of hazardous waste is associated with the normal operations of each type of generator listed in Table 5.9. For example, automotive repair shops typically handle large quantities of volatile solvents and oil-based products containing organic compounds such as benzene, chlorinated ethylenes, toluene, and methylene chloride. Dry cleaners use solvents and cleaning solution containing chlorinated ethanes and ethenes, especially trichloroethane and tetrachloroethylene. Paint supply stores sell products containing heavy metals, phenols, and toluene. When these materials are discarded because their usefulness has diminished due to age or contamination (e.g., spent solvents), they will probably be classified as hazardous wastes. There are potential hazardous waste generators, including small quantity generators, that have not notified Ecology (because they don't have to) and businesses that don't generate waste now but could because they store or use hazardous materials. If hazardous waste is improperly managed, they may cause damage to the environment and/or human health. The Seattle-King County Health Department should monitor data collected by Ecology and the Local Hazardous Waste Program, regarding hazardous waste generator impacts on ground water quality.

5.12 <u>Ground Water Quantity</u>

The amount of ground water available and the amount of water available to recharge ground water is affected by precipitation, land use, population growth, and water use.

Ground water recharge is naturally affected by the amount of vegetation, soil, and surficial geologic conditions, and the topography of the potential recharge area. Vegetation decreases the velocity of stormwater runoff as water is diverted around plant stems and roots. This is a benefit to recharge because slowing the runoff increases the time available for infiltration and thereby increases infiltration. By clear-cutting the land and removing vegetation, ground water recharge can be diminished.

Soils composed of coarse-grained material such as sand and gravel are generally more porous and better for recharge than those composed of fine-grained particles such as clay. Sealing over these recharge areas with parking lots, and residential and commercial buildings reduces the amount of ground water recharge. The slope of the surface upon which precipitation falls affects the amount of precipitation that recharges into the ground. More rain tends to run off a steep slope than off a level plain.

With population growth there is an increase in the number of residential and commercial buildings, roads, and parking lots that are impervious surfaces that decrease or prohibit ground water recharge. There is also an increased demand for water. Ground water withdrawals from the aquifer, when combined with an increase in impervious surface area in a recharge area, can lead to a diminished ground water supply for drinking water purposes. Because ground water and surface water are interconnected, surface water features such as lake levels and the base flow of creeks are impacted by diminished ground water levels.

With the demands for more ground water, agencies and purveyors need to implement methods to protect this valuable finite resource. A method to retain recharge is to maintain portions of residential areas in their natural state or permit the planting of vegetation in these areas. Storm water facilities can be constructed to promote recharge of ground water provided that the storm water is first adequately treated so as not to contaminate ground water. The State of Washington is also currently investigating ways to treat and reuse wastewater.

5.13 Summary of Land Use Information Needs

From the descriptions of land use activities in the Issaquah Creek Valley Ground Water Management Area, it is clear that the effects of existing and potential water and land use activities on ground water are still uncertain. This section of the report presents information relevant to the Issaquah Creek Valley Ground Water Management Plan and points to areas where additional information will provide decision makers with a complete picture of ground water management issues in the study area. Future research priorities should address the topics discussed below:

5.13.1 Ground Water Recharge Zones

Locating those surface areas where aquifers are most heavily recharged is important to every land use activity previously described, because these are areas where surface

contamination is most likely to lead to ground water contamination. Also, ground water loss can occur if these areas are covered over by parking lots, buildings, or if other changes are made to the soil mantle.

A map of aquifer susceptibility to contamination based on three factors (surficial soils, surficial geology, and ground water depth) is presented in Figure 5.5. Efforts to minimize the possibility of contaminants reaching these areas and to prevent the paving over of these areas should be undertaken. Land use activities are relevant to ground water management only as they affect ground water quality and quantity. Surface activities described in this report will have the greatest impact on ground water when they take place in ground water recharge zones. The map (Figure 5.5) should be further refined as more information becomes available from wellhead protection studies and SEPA reviews.

5.13.2 Future Development

A detailed analysis of existing land use activities in the Issaquah Creek Valley Ground Water Management Area, together with projected residential, commercial, and industrial development trends, is needed to assess land use activities that account for ground water contamination and to determine to what extent the demand for ground water is likely to increase in the future.

5.13.3 On-Site Septic Systems

Improper discharges to on-site septic systems (e.g. industrial discharges) and the overloading and inadequate treatment of sewage in on-site septic systems threaten ground water quality and should be of particular concern whenever development occurs where sewer service is unavailable. The location of all on-site septic systems, especially those receiving improper discharges or with a history of failure and located in potential ground water recharge zones, should be tabulated and evaluated. Homeowners and businesses should be reminded to maintain their on-site septic tanks and to pump their on-site septic tank every 3 to 5 years, depending on use.

5.13.4 Sewers

Additional information is needed on existing and projected sewer quantities, and sewer line leaks. Also needed is a detailed account of future service options and system expansion plans.

5.13.5 Underground Storage Tanks

Without proper prevention or detection systems in place, there is a high risk of ground water contamination due to an underground storage tank leak or accident. Additional information on appropriate commercial underground storage tank locations and safety measures is needed to minimize this risk. Underground storage tanks research should also focus on smaller privately owned tanks, especially those installed to hold heating oil.

Although no known record of these tanks exists, parallel studies in other areas may help to estimate potential ground water threats posed by residential underground storage tanks.

An additional research priority should be to identify the extent and type of contamination from leaking underground storage tanks.

5.13.6 Stormwater

The extent to which stormwater runoff represents a threat to ground water quality should be researched, particularly in sensitive recharge areas where significant amounts of vehicular oil and grease occur in runoff.

5.13.7 Landfills

Evaluating the extent of ground water contamination from landfills is a complex process. Water quality information from ground and surface water monitoring stations at Cedar Hills Landfill and Queen City Farms would help determine the extent of ground water contamination and the effectiveness of past and current remediation efforts. A complete hydrologic analysis of the areas surrounding the landfills is also needed to measure the impact of landfill leachate on surrounding land uses. The direction of ground water flow beneath the landfills, and the depth and range of aquifers exposed to contaminants, should be evaluated.

5.13.8 Quarries and Mines

Additional information is needed on how existing operations affect ground water quality. Mines and quarries, while opening the ground surface to potential higher recharge, also increase the potential for contaminants entering the aquifer. The operation of and reclamation of quarries and mines should be evaluated for their potential impacts on ground water.

5.13.9 Hazardous Waste

It is also necessary to monitor and evaluate the impacts on ground water quality caused by hazardous waste generators. Data collected about these facilities can help with such monitoring evaluation.

5.13.10 Hazardous Material Spills

The potential catastrophic impact of a hazardous materials spill in the study area warrants further investigation. Specifying accident zones where spills are most likely to occur and estimating the severity of contamination that may result from a spill should be the two initial priorities of this research effort.

5.13.11 Plant Control

Use of pesticides and fertilizers could pose a future threat to ground water quality in the Issaquah Creek Valley Ground Water Management Area. These chemicals are applied in a broad range of activities including: residential, agriculture, the maintenance of powerline corridors, roadside clearing, and park and landscape maintenance. Additional information is needed on the quantities and applied location of chemical applications, the types of roadside chemicals most likely to percolate through soils and the location of exposed aquifers that may facilitate contamination of ground water by chemicals applied at roadsides.

6.0 WATER APPLICATIONS

This section discusses sources of water and water service providers in the Issaquah Creek Valley Ground Water Management Area, water rights, aquifer capacity, existing and potential water demand, and the need for further analysis of aquifer capacity and the combined effects of pumping on the ground water system.

6.1 Water Sources

6.1.1 Ground Water

Ground water currently provides 100 percent of the potable water supply in the Issaquah Creek Valley Ground Water Management Area. Ground water investigations to date in the lower Issaquah Creek Valley indicate the presence of what appears to be a hydraulically interconnected system of aquifers. A description of the aquifers and their primary sources of recharge is provided in Section 7.3.

New data, collected as described in the Recommendations Section of this Plan (Section 8), will help to more clearly define the ground water resource in the Issaquah Creek Valley Ground Water Management Area.

6.1.2 Surface Water

Surface water is not known to be used as a source of potable water in the Issaquah Creek Valley Ground Water Management Area. Surface water and ground water within the Issaquah Creek Basin are, however, believed to be hydraulically connected. Issaquah Creek, with its system of tributaries, and Tibbetts Creek represent the primary sources of surface water in the ground water management area. Issaquah Creek extends 17.35 miles (27.8 km) from the Hobart Plateau to Lake Sammamish. Elevations for Issaquah Creek range from 2,500 feet mean sea level at headwaters to 25 feet mean sea level at Lake Sammamish. King County rates both general water quality and habitat suitability for Issaquah Creek as good. With a length of 4.3 miles (6.8 km), Tibbetts Creek covers a comparatively smaller area than Issaquah Creek. The headwaters for Tibbetts Creek are measured at elevation 1,080 feet mean sea level, while the mouth of the creek at Lake

Sammamish is at an elevation of 25 feet mean sea level. King County lists general water quality for Tibbetts Creek as good and habitat suitability as fair (Metro 1988).

6.2 Water Services

The boundaries for all water service areas in the Issaquah Creek Valley Ground Water Management Area are shown in Figure 6.1. In addition, data from some of the major producing wells in the study area are provided in Table 6.1. Existing water rights granted to each water purveyor that provides service in the Ground Water Management Area are listed in Table 6.2. The East King County Coordinated Water System Plan (August 1989) lists all the major water suppliers (Group A) in the Issaquah Creek Valley Ground Water Management Area and the quantities of water drawn from these wells. The plan also describes future expansion plans for each water purveyor, water level depths of each Group A well, and the number of service connections for these wells. More detailed plans for expansion and additional supply can be found in individual purveyors' Water System Plans and subsequent Plan updates.

City of Issaquah

The City of Issaquah has historically relied upon ground water to meet its potable water supply needs. Recently, increased demands on the ground water resource combined with concerns of the State of Washington Department of Ecology (Ecology) about hydraulic continuity between ground water and surface water, and other issues have resulted in closure of the Issaquah Valley Aquifer to development of additional new sources of ground water (City of Issaquah, Water System Plan Update, 1996). Continued growth within the existing City limits, combined with requests for service outside the existing City limits, have prompted the need to develop strategies for providing additional supply capacity. These strategies include demand management (e.g., water conservation) and development of conventional and nonconventional supply alternatives.

The City of Issaquah water service area extends beyond the city limits to include Grand Ridge, Lake Sammamish State Park, a large portion of the Tibbetts Creek Valley, and the area around the Issaquah-Hobart Road between the City's boundary and the Mirrormont area (see Figure 6.1). However, some residences located on steep hillsides in the City of Issaquah use wells that are not included in the City's service area (Rothnie, 1989).

The City of Issaquah operates a Group A public water system. The City has five wells ranging in depth from 97 to 412 feet. These wells are located in the lower Issaquah Valley aquifer. Water rights allow water to be pumped at rates of 250 gpm to 1,200 gpm depending on which well is being pumped (Lynne 1994). However, water rights do not necessarily reflect the true capacity of the aquifer. The City of Issaquah also holds certified water rights on the Gun Club wells, which are currently inactive. These water rights may be reactivated in the future.

Sammamish Plateau Water and Sewer District

The Sammamish Plateau Water and Sewer District service area forms the northern boundary of the Issaquah Creek Valley Ground Water Management Area, as shown in Figure 6.1. Sammamish Plateau Water and Sewer District merged with Cascade View (Water District 122) in 1995. The Cascade View area is now included in the Issaquah Creek Valley Ground Water Management Area. Water provided by Sammamish Plateau Water and Sewer District serves commercial uses, light industrial activities, and residential areas. The Sammamish Plateau Water and Sewer District has 9,191 service connections. Currently the Plateau has a supply of 1.65 million gallons per day and forecasts they will exceed their supply by 0.93 million gallons per day (2.48 million gallons per day estimated) by the year 2000 (King County Comprehensive Plan, Technical Appendices, 1994). The Plateau's water source is eight groundwater wells, and they hold water rights equal to 9.28 million gallons per day or 4,936 acre feet per year. The Sammamish Plateau Water and Sewer District and Northeast Sammamish Water and Sewer District have an intertie, and they plan to intertie with Issaquah in the future (East King County Coordinated Water System Plan, 1989). The District projects that five additional aboveground storage facilities need to be constructed to serve the growing demand for water in their area. The land use in the District's area includes primarily single family residences on former timber production and agricultural lands, golf courses, parks, and equestrian trails.

Prior to merging with the Sammamish Plateau Water and Sewer District in 1995, Cascade View Water District completed a Water Comprehensive Plan in January 1992 and has water rights equal to 0.28 million gallons per day or 12 acre feet per year (East King County Coordinated Water System Plan 1989). As of March 16, 1995, Cascade View comprised 367 service connections and a population of 910 (Cox, J., Personal Communication). Cascade View Water District interties with Union Hill Water Association. Their Water Comprehensive Plan recommends significant commitment to future interties with the Union Hill and the Ames Lake water system.

Sammamish Plateau Water and Sewer District draws all of its water from wells. Wells 7, 8, and 9 operate in the Lower Issaquah Valley aquifer system and serve approximately 70 percent of the water demand of the Sammamish Plateau Water and Sewer District. Located between Interstate 90 and East Lake Sammamish Parkway, wells 7 and 8 have an actual depth of 150 feet and carry a potential capacity of 2,000 and 3,500 gpm, respectively. Well 9 is located north of Interstate 90 and east of East Lake Sammamish. It is completed to a depth of 200 feet and has a potential capacity of 3,500 gpm (Little, 1994). However, Well 9 has only been approved for supplemental winter time rights in the case where wells 7 and 8 must shut down, due to the fact that it is located in what is considered a closed basin by Ecology. Sammamish Plateau Water and Sewer District also operate wells on the Sammamish Plateau including wells 1, 2, 3, 4, 5, 6, 10, and 11-2 and in the area previously served by Cascade View (Water District 122) (wells 12 - 14).

King County Water District #90

Water District #90 operates a Group A water system serving the King County community of Newcastle. Only a small portion of this district lies within the boundaries of the Issaquah Creek Valley Ground Water Management Area. The Lake MacDonald residential area represents the largest area served by District #90 in the Issaquah Creek Valley Ground Water Management Area. No Group A source wells for this district are located in the Issaquah study area (King County Planning, 1983).

King County Water District #123

District #123 operates a Group A water system serving Preston. Only a small portion of this district falls within the boundaries of the Issaquah Creek Valley Ground Water Management Area.

Other Purveyors

The largest private Group A water system in the study area serves the Mirrormont area. Water provision in the Mirrormont area is from five Group A wells that range in depth from 209 feet to 325 feet; these wells have a combined potential capacity of 1,000 gpm (Nordie/Heintze 1994).

In addition to the purveyors listed in Table 6.1, there are numerous Group B water systems and individual wells in the Issaquah Creek Valley Ground Water Management Area.

Areas of Concern and Information Needs

Additional data are needed to complete the analysis of water users and for conservation planning in the Issaquah Creek Valley Ground Water Management Area:

- Map Group B water system locations within the ground water planning area.
- Identify the key private wells in the basin and develop an estimate of water use in the basin. Key private wells will be those wells within 1-, 5-, and 10-year time of travel of the major Group A public water supplies, and those private wells in the physically susceptible areas.

6.3 Water Rights

A water right is a purveyor's permitted right to withdraw water. A water right is specified in two ways:

- A maximum pumping rate (expressed in gallons per minute or GPM) is specified based on the capacity of the well (note that well capacity is a function of construction specifications and the pump, and not an indication of aquifer capacity).
- A maximum annual volume of ground water that can be withdrawn from the well (typically expressed as Acre Feet per Year). This volume is based upon the water needs of the population served by the well and is not a function of well or aquifer capacity.

Ecology is the state agency responsible for granting or denying a water right application. In a review of technical reports for the Issaquah Creek Basin, Ecology concluded that ground water and surface water are in direct continuity. Further, they have denied water right applications in areas where ground water is in hydraulic continuity with a closed surface water body. Because Issaquah Creek flows into Lake Sammamish, which feeds the Sammamish River and eventually Lake Washington, all wells within the Issaquah Creek drainage are assumed to be in some degree of hydraulic continuity with Lake Washington. Therefore this basin is considered to be closed by Ecology, and many water right applications have been denied with justification that pumping would decrease surface water flows.

Sammamish Plateau Water and Sewer District also operates wells above the Issaquah Valley on the Sammamish Plateau and in Cascade View (previously serviced by Water District 122), where hydraulic continuity with Issaquah Creek is not an issue. Sammamish Plateau Water and Sewer District has been granted water rights in this Plateau region. Table 6.2 lists the current water rights held by the Sammamish Plateau Water and Sewer District.

Currently, the State does not require a water rights claim for wells that withdraw less than 5000 gallons per day, or irrigate less than one-half acre. Therefore, some individual wells associated with rural residences are not accounted for by existing water right volumes. An estimation of total ground water withdrawal from wells without water rights will be necessary to allocate future ground water resources.

Table 6.2 lists the major permitted water rights in the study area. These figures represent the total amount of water a supplier is appropriated. However, they do not necessarily reflect the capacity of the aquifer.

6.4 Aquifer Capacity

The actual capacity of an aquifer to provide ground water cannot be determined without an in-depth study of cumulative impacts of pumping on the aquifer system. However, long-term water level data for the Lower Issaquah Creek Valley Aquifer indicate a downward trend in water table elevations. This declining trend in ground water elevation may indicate that the aquifer system is being pumped (cumulatively by all water users) beyond its capacity, or the trend may be a result of climatic influences. The capacity of

the aquifer systems from which the Sammamish Plateau Water and Sewer District and the City of Issaquah withdraw their water is unknown. (Lynne 1994)

A comparison of withdrawal volumes specified by water rights (Table 6.2) and annual water demand (current and projected) from each purveyor (Table 6.3) indicates that future demands may not be met by the current water right. It is unknown at this time whether actual aquifer capacity could sustain projected demands. Purveyors are beginning to use creative alternatives to maximize their current water appropriation and increase the overall annual volume of water pumped from the aquifers in the valley to accommodate accelerated growth in the area. These alternatives include aquifer storage and recovery (known as ASR) techniques and use of peak day pumping rates coupled with reservoir storage. In both cases, a greater volume of ground water will be withdrawn from the aquifers involved.

Some preliminary testing of specific wells screened in the Lower Valley Aquifer System has been performed. In September 1990, the Sammamish Plateau Wells 7 and 8 were pumped for 3 days. Analysis of pumping tests on Wells 7 and 8 indicated that the zone of influence from pumping of Well 8 extended in a northwest-southeast direction along the valley margin for a distance of 7,000 feet from the pumping wells. In July 1992, Carr & Associates conducted a 9½-day pump test of Sammamish Plateau Water and Sewer District Well 9. Extensive water level and water quality data were collected from 51 ground water monitoring sites, 15 surface water stations and two precipitation gauges. Test results suggested that pumping of Well 9 should have little impact on surface waters and only limited impact on other production wells.

6.4.1 Areas of Concern and Future Information Needs

The following water rights analysis elements will require further investigation during implementation of the Issaquah Creek Valley Ground Water Management Plan:

- Estimate the capacity of the aquifer system.
- Determine the numbers and locations of Group B and individual wells without water rights in the Issaquah Creek Valley.

6.5 Existing and Potential Water Demand

6.5.1 Major Suppliers and Water Demand

Existing and anticipated future water demand for major suppliers in the Issaquah Creek Valley Ground Water Management Area is reflected in Tables 6.3, 6.4 and 6.4A. These data show an average annual increase in water demand (between 1986 and 2000) of 3.9 percent for Issaquah, 5.1 percent for Sammamish Plateau Water and Sewer District, and 2.6 percent at Mirrormont. If this period is extended from 1986 to 2040, the average

annual increase becomes 2.5 percent in Issaquah, 3.5 percent with Sammamish Plateau Water and Sewer District, and stays at 2.6 percent for Mirrormont.

Water demand projections used in the report prepared by Economic and Engineering Services, Inc. (1988) for the East King County Coordinated Water System Plan are estimates based on variables such as individual utility data, weather projections, the price of water, and demographic data. These demand estimates are derived from base assumptions that reflect the projections most likely to occur for each category. The most significant variations from base estimates range from 20.4 percent with a low scenario to 9.8 percent using the highest possible projections.

The City of Issaquah in 1990 had a population of 7,786 within its corporate boundaries. The average annual water demand in 1990 was 1.22 million gallons per day (MGD), with a maximum day demand of 3.1 MGD (see Table 6.4A). In the year 2020, the population of the corporate area is projected to be 12,815, with the total population for the City of Issaquah, including annexation, to be 58,643. The maximum day demand in 2020 is projected to be 8.0 MGD (City of Issaquah Water System Plan Update, August 1995). The current water right for the city of Issaquah is 5.6 MGD. Use of conservation measures will slightly reduce demand figures. The Department of Ecology has closed the Issaquah Creek Basin to further water right appropriations due to the interconnection of ground water and surface water in the basin.

6.5.2 Demographic Projections for the Issaquah Creek Valley Ground Water Management Area

Demographic indicators are helpful in estimating the amount and types of increased water demand predicted for the Issaquah Creek Valley Ground Water Management Area. Small Area Zones (SAZs) are used by King County transportation planning for the purpose of transportation analysis. These SAZ numbers were used for the purpose of population forecasting in the Issaquah Creek Valley Ground Water Management Area. SAZ projections are taken from the King County Comprehensive Plan, and are current as of February of 1995. SAZ projections include only those areas that lie within unincorporated King County. Therefore, they do not include the City of Issaquah. Projections for the City of Issaquah were provided by growth target numbers taken from the City of Issaquah Comprehensive Plan.

SAZ projections were used to estimate household growth in the Issaquah Creek Valley Ground Water Management Area between 1990 and 2012. Table 6.5 indicates estimated growth between 1990 and 2012 by number of households. Data indicate that the total number of households requiring water in the Issaquah Creek Valley Ground Water Management Area was 24,820 in 1993 and projected to be 35,502 in the year 2012, reflecting a 43% increase in water demand within the Ground Water Management Area .

Another predictor of future population and development patterns in the study area is available through the Puget Sound Regional Council. Projections are presented in terms

of forecast and analysis zones. Six different forecast and analysis zones fall within the boundaries of the Issaquah Creek Valley Ground Water Management Area, these being Klahanie/Pine Lake (4605); Beaver Lake (4607); Issaquah (4300); Cougar Mountain (4225); Maple Valley/Hobart (3330); and the Renton Plateau (4230) (see Figure 6.2). All six forecast and analysis zones are not entirely within the Issaquah Creek Valley Ground Water Management Area.

6.5.3 Areas of Concern and Future Information Needs

Research in the following areas will provide a more complete understanding of existing and future water demand and supply in the Issaquah Creek Valley Ground Water Management Area:

- Future research involving the City of Issaquah and Sammamish Plateau Water and Sewer District water demand projections should focus on determining the type and magnitude of demands to be made on all sources in the Issaquah Creek Valley Ground Water Management Area.

- Assess the capacity of both the Lower Issaquah Valley Aquifer System and the Sammamish Plateau Aquifer System(s). Determine whether increased pumping to provide service to growing areas will begin to deplete the ground water resource before certificates of water availability are granted for large supply requests. Assess long term trends in ground water levels in these systems.

7.0 HYDROGEOLOGY

7.1 Geology

This section briefly describes the geology of the area using generalized geologic units appropriate for an analysis of surface and ground water movement. The geologic units of significance in the Issaquah Creek Valley Ground Water Management Area were deposited since the early Tertiary period (approximately 60 million years ago). The composition of these units is characterized by a complex history, that indicated the Issaquah Creek Valley Ground Water Management Area was related for some time to advancing and retreating oceans and glaciers. This history also included earth's internal processes of volcanism (tectonics) and mountain building (orogeny), and currently involves erosive forces from stream and rivers.

Much of the development of the Cascade mountains is due to their regional tectonic setting. This orogenic event occurred as a result of the subduction of an oceanic plate under a less dense continental plate. As a result, the topographic features in the Issaquah Creek Valley Ground Water Management Area formed from mountain building processes. The Issaquah Creek Valley Ground Water Management Area is underlain by Eocene age (approximately 40 million years old) igneous and sedimentary rocks. The

igneous rocks include magma that solidifies underground (intrusive andesite) and magma that solidifies on or near the ground surface (extrusives like volcanoclastics and lavas). The consolidated sediments (bedrock) in the Issaquah Creek Valley Ground Water Management Area consist of sedimentary rocks like sandstone, siltstone, coal, conglomerate, and shale. These formed from geologic processes characterized by shallow ocean, near shore, and estuarine environment. The rocks are exposed at the surface in the surrounding highlands of Cougar Mountain, Squak Mountain, Tiger Mountain, and Grand Ridge. Locally, they are overlain by younger sedimentary rocks, exposed mainly in the northern upland areas of the basins.

This sequence of rocks, many thousands of feet thick, has been folded along northwest-trending horizontal axes. The dominant fold here is the Lake Sammamish syncline, a pronounced downwarp that extends from Lake Sammamish through the City of Issaquah, and which is truncated by faulting east of West Tiger Mountain. The syncline is flanked on the southwest by the Newcastle Hills anticline, whose axis and corresponding bedrock uplift now separate the lower Issaquah valley from the May valley and the May Creek Basin to the southwest. On the northeast side of the Issaquah Creek Basin, rocks climb up the southwest limb of the Raging River anticline, a less pronounced fold near the eastern basin boundary.

The surface and subsurface expression of the Lake Sammamish syncline dominates the structure in the basins. Particularly in the northern third of the basin, not only the bedrock structure but also the glacial sedimentation and the surface topography follow the trend of this trough. Glacial ice has scoured out a valley in the rock, filling it with unconsolidated sediment; these sediments were again scoured to form the yet narrower valley now occupied by the south end of Lake Sammamish and the Issaquah Creek floodplain.

In the remainder of the basin, the structure of folds in the bedrock is still discernible in the rocks themselves. Yet the contact between the rocks and the later glacial and nonglacial sediments that overlie them does not follow the folds in the strata. Instead, erosion of the rock surface follows a much larger subsurface valley extending southeast out of the Issaquah Creek basin, crudely along the modern Cedar River valley, at a maximum depth of over 500 feet below ground level (Hall and Othberg 1974). The southwest part of the Issaquah Creek basin lies on the northeast flank of that valley, presumably an infilled arm of an ancestral Puget Sound (*Issaquah Creek Basin Report,* October 1991).

In the Puget Lowland, the geologic record indicates discontinuous periods of Pleistocene glacial and interglacial processes. In the basins of the Issaquah Creek Valley Ground Water Management Area, glacial deposits can be assigned to the Vashon stage of the Fraser glaciation. The effects of the glaciation lasted 2,000 years and were gone from the area about 13,000 years ago. During these glacial periods an advancing thick mass of ice inched southward for thousands of years. The mechanics of a glacier work like a giant conveyor belt. The ice sheet plucks and plows chunks of soil and rock from the

countryside and incorporates them into its mass. The effect of the glacier is to scour and scrape the landscape, then transport its load in melt water and deposit it in three typical geologic units.

In the front of the advancing glacier, water from melting glaciers deposited a sheet of sand and gravel known as advance outwash. The advance outwash was subsequently covered by the glacier, which left a deposit of compact silty-sandy gravel known as "Till." As the glacier retreated, the till was subsequently covered by sand and gravel (deposited from the meltwater stream) known as recessional outwash deposits. In some places, areas of ice-contact deposits occur. These sediments were deposited on the surface of the melting glacier and are silty sand and gravel that can resemble till.

The last glaciation left a mantle of advance outwash, till, recessional outwash, and ice-contact deposits over older glacial deposits on the uplands and in some valleys; it left thick deposits of recessional outwash in most valleys.

7.2 Soils

Knowledge of soil properties and distribution is essential to understanding relationships between ground water distribution, movement, and contamination processes. Given the diverse physical and biological nature of the Issaquah Creek Valley Ground Water Management Area, a large number of widely varying soils are present. Each presents a unique set of considerations in developing future management alternatives.

Approximately three-quarters of the Issaquah Creek Valley Ground Water Management Area, excluding the Tiger Mountain peaks complex, has been mapped (Figure 7.1A). The four main soil associations mapped in the Issaquah Creek Valley Ground Water Management Area are the Alderwood, Beausite-Alderwood, Everett and Puget-Earlmont-Snohomish Association Soil series. (There are also smaller areas of Oridia-Seattle-Woodinville and Alderwood-Kitsap-Indianola Associations - see Figure 7.1A). For more detailed information on these four soils and other soils, see Table 7.1 and Appendix A. Soils that appear in several associations are described only once. Water quality and ground water recharge factors related to soil series characteristics are also presented. These factors are interpreted from the information extensively researched and prepared by the U.S. Natural Resources Conservation Service. The Conservation Service produces maps with greater detail about the location of various soil types. The maps are too large in scale to reproduce for this report.

Alderwood Association

The Alderwood association blankets a large part of the Issaquah Creek Valley Ground Water Management Area. It is found in upland areas, including most of the Sammamish Plateau and Cedar Hills and Hobart Plateau in their entirety. It is composed of 85 percent Alderwood soils, 8 percent Everett, and 7 percent less extensive soils. In general they are

moderately well drained, variable sloped soils underlain by very low permeability glacial till at a depth of 20 to 40 inches.

Beausite-Alderwood Association

The Beausite-Alderwood association is another extensive association in the Issaquah Creek Valley Ground Water Management Area, covering primarily the mountainous areas (Cougar and Squak Mountains, Grand Ridge, and likely the mostly unmapped Tiger Mountain peak complex). Major soils represented include approximately 55 percent Beausite soils, 30 percent Alderwood soils, 10 percent Ovall soils, and 5 percent miscellaneous soils. These soils are found on rolling to very steep surfaces underlain at 20 to 40 inches depth by sandstone, shale, or dense glacial till. In general, these soils do not contribute any significant recharge to the ground water.

Everett Association

Everett association soils are found on northern upland units in the vicinity of Tradition Lake Terrace, lower Grand Ridge, and an adjacent portion of the Sammamish Plateau. A substantial portion of the City of Issaquah and the upstream valleys also consists of Everett soils. The association typically consists of 70 percent Everett soils, 15 percent Neilton soils, 7 percent Alderwood soils and 8 percent less extensive soils. The dominant soils are found on both gently undulating surfaces, and steep terrace faces. They are underlain by sand and gravel, and are exceedingly well drained.

Valley Soils

A number of soils are represented in the valleys, including: Sammamish, Bellingham, Briscot, Puyallup, Puget, Oridia, and Sultan. Most of the above soils are found in developing areas of the lower Issaquah Valley.

Although not extensively distributed elsewhere in the Issaquah Creek Valley Ground Water Management Area, these soils are significant due to the industrial, urban, and residential development that has occurred or is planned in their vicinity. Large scale development is likely to include drainage rerouting or enhancement, and substantial earth moving or placement of fill. Such activities greatly disrupt the natural drainage and permeability related properties of native soils. The number of potential contaminant sources also increases with intensive land use activities.

Puget Soils

Puget soils are formed in valley alluvium and are composed of a silty clay loam. Slopes are very flat, less than 1 percent, and permeability is low. The seasonal water table is at or near the surface. Recharge to shallow aquifers is slow, yet significant.

7.3 Ground Water

Ground water hydrology, or hydrogeology, the study of the interrelationship of geologic materials and processes with water, is both a descriptive and an analytic science (Fetter 1994). The development and management of water resources is also an important part of hydrogeology. Hydrogeology is recognized as an important part of environmental planning.

Most of the ground water in the Issaquah Creek Valley Ground Water Management Area comes from direct precipitation onto the ground surface. Precipitation that is neither evaporated, transpired by plants, nor lost rapidly by surface flow enters the ground water system. Ground water is accessible for water use or discharge to surface water bodies only where it can move freely through subsurface deposits. In the Issaquah basin, the various outwash deposits of the last glaciation form the most common aquifers. Some shallow aquifers and many major ground water recharge areas are formed in recessional outwash and ice-contact deposits. These are characterized by relatively large pore spaces and they freely transmit water (*Issaquah Creek Basin, Current/Future Conditions and Source Identification Report*, King County Surface Water Management, October, 1991).

The infiltration, movement, and storage of ground water is controlled by the characteristics of the surficial and subsurface geology. Infiltration at the surface depends on the permeability of the surface sediments and the accessibility of those sediments to precipitation. Thus outwash deposits, consisting of silt-poor sand and gravel, provide the best opportunities for infiltration. In contrast, Vashon Till has a much higher percentage of silt and clay and so offers significantly more resistance to flow. It acts as the uppermost aquitard, with rates of infiltration through the unweathered deposit of approximately 1 inch per month (Olmstead 1969). The soil layer developed on top of the till, however, has much greater infiltration, but the movement of water is largely restricted to that thin upper zone.

In the Lower Issaquah Valley, a large ice-dammed lake formed south of the retreating glacier front. Meltwater rivers flowing down to the lake formed a large delta. This delta is the eastern margin of the Lower Issaquah Valley; its coarse-grained deposits grade westward and northward into finer-grained lake deposits. The major aquifer system providing ground water to wells in the City of Issaquah and the Sammamish Plateau Sewer and Water District receives a substantial amount of recharge from these deltaic deposits (Carr/Associates 1993; Golder Associates 1993).

Subsequent to the lowering of Lake Sammamish to its present level, Issaquah Creek began flowing through the Tiger Mountain Gap and down the Lower Issaquah Valley. It eroded some of the lake and deltaic deposits and deposited a mantle of silty-sandy alluvium over the older, more permeable deposits.

7.3.1 Surficial Geologic Deposits

Geologic deposits form the basis for the different hydrogeologic units in the study area. A map of surficial geology showing post-glacial, glacial, and bedrock deposits is presented in Figure 7.1B. The deposits beginning with the most recent, are listed below:

POSTGLACIAL DEPOSITS

Recent Bog Deposits (or wetland deposits, Qw)

Bog deposits are found in both upland and valley depressions and contain organic material such as peat, muck, and decaying vegetable matter. Drainage is poor because of factors such as poor surface drainage, impervious subsoils, a discharge zone for higher gradient aquifers, or simply a depression in an unconfined aquifer with a high water table. Because of the accumulation of water, these areas could contribute to local recharge.

Bog deposits can have an important, natural influence on water quality because decaying organic materials produce humic acids, and associated geochemical conditions are highly reducing. As a result, adverse effects to local ground water quality can include:

- increased corrosivity,
- elevated concentrations of dissolved iron, manganese, hydrogen sulfide and nitrates, and,
- undesirable color, taste, and odor characteristics.

Alluvium (including Qb, Qf, Qval, and Qoal)

Alluvium consists of stream deposits ranging from cobble-sized gravel through sand to sandy silts. The deposits are found in valley fill, along stream channels, floodplains, and as alluvial fans where steep gradient streams meet lower gradient valley floors. Many wells are completed in alluvium and are capable of yielding large quantities of water. Permeability of alluvial materials varies considerably. Depending on grain size and sorting, alluvial aquifers can be perched, unconfined, and confined. Hydraulic continuity between aquifer zones varies laterally and with depth. Surface water and downslope drainage provide ample recharge to alluvium. Where thick and extensive upper aquitards are absent, alluvial aquifers are vulnerable to contamination from surface sources, or from vertical and horizontal movement of contaminated water from one aquifer to another.

Landslide Deposits (Qls and Qmw)

Landslide deposits are found along the side and base of slopes. Geologic materials are variable. These deposits are not known to be an exploitable source of ground water.

VASHON STADE GLACIAL DEPOSITS

Table 7.2 summarizes the characteristics of these deposits, and Figure 7.1B shows their locations.

Vashon Recessional Outwash (Qvr and Qvrg)

Recessional outwash is predominantly gravel, sand, and minor amounts of silt that were deposited by melt water from the retreating ice. Large delta deposits are exposed in bluffs east of Issaquah. Other similar deltaic deposits are located southwest of Cedar Hills and north of Hobart. A typical thickness of this unit is 60 feet, however, the unit can vary from a veneer overlying till to an accumulation greater than 300 feet. This coarse-grained unit can be a productive aquifer in places where relatively thick sequences of sand and gravel are saturated.

Most of the recessional outwash is highly permeable. Much of these deltaic deposits lie above the water table, but provide an important recharge medium to adjacent inter-connected aquifers. Unpredictably distributed lenses of silt intercept downward percolating ground water and redirect it laterally, creating locally perched water table zones and surface weeps. Where saturated and endowed with a good source of recharge, recessional outwash readily yields large quantities of water. In areas where the unit is thin or lies above the water table, little water is available, such as the Sammamish Plateau. In these areas, the aquifer is under water table conditions, and the wells produce moderate yields for domestic purposes.

Due to the unit's high permeability and exposure to the surface environment, recessional outwash is vulnerable to contamination. Interconnected aquifers are vulnerable to contamination transported through this unit.

Vashon Recessional Lacustrine Deposits (Qvrl)

These fine-grained materials were deposited in the ancestral Lake Sammamish. Unit materials are predominantly clay and silt, but include sand and rare occurrences of gravel. Individual textural layers such as clay, sand, or silt are probably not laterally continuous. Vertical hydraulic continuity between textural layers and more permeable deposits probably varies widely. In general, the unit likely functions as a leaky aquitard.

Vashon Ice Contact Deposits (Qvi)

Ice contact deposits are a heterogeneous (complex) mixture of till and outwash deposits. Grain size changes abruptly. Due to this physical variability, characteristics such as permeability and recharge cannot be generalized.

Vashon Till (Qvt)

Till is a massive, compact, heterogeneous mixture of silt, sand and gravel. Random sand and gravel lenses are present. Much of the upland and mountainous areas are covered with till varying in thickness from a thin veneer to 30 feet or more. The permeability of till at the surface is low and tends to decrease with depth. Downward percolation is slow.

Upper portions can contain perched and semi-perched water tables. Isolated lenses of sand and gravel yield limited quantities of water to shallow, domestic wells. Recharge to these lenses is usually slow. Seasonal fluctuations in water level occur, and some wells are vulnerable to drought or overdrafting. Shallow wells are very susceptible to contamination. Permeable areas in the till surface provide an avenue for local recharge and migration of contaminants to underlying materials.

Vashon Advance Outwash (Qva)

Advance outwash is composed principally of sand to cobble-sized gravel. Thin beds of silt are present. Materials in the advance outwash range from well sorted to poorly sorted. The unit is irregularly distributed throughout the basin, although exposed only in the north part of the Issaquah Creek Valley Ground Water Management Area. Permeability is generally high. Where saturated, the unit yields large quantities of water. Surface exposures or shallow deposits may be vulnerable to contamination.

Unconsolidated pre-Vashon Deposits (Qtb, Qpf, and Qob)

The following unconsolidated sediments are not found exposed at the surface, but local drilling records and exposures outside the Issaquah Creek Valley Ground Water Management Area confirm their presence. Some deep wells in these sediments are known to yield significant amounts of water.

Table 7.2 briefly summarizes the composition of the pre-Vashon units and general hydrogeologic properties. The unit names are informal.

Bedrock (Tsc, Tb, Ti, Tv, Tp, Tpr, Tpt, Trr, and br + Qvt)

Bedrock units present in the Issaquah Creek Valley Ground Water Management Area are not known to yield large quantities of water to wells. However, in some areas they may be the only available source for domestic supply. Descriptions of the bedrock units are summarized in Table 7.2.
Saturated thicknesses of sandstone and conglomerate have yielded usable water supplies, yet declining water levels indicate that recharge may be insufficient to sustain discharge for an extended period. The potential presence of mineralized, saline, or brackish connate water in these units diminishes their potability and usefulness for irrigation.

Fractured, porous, volcanic rocks can yield significant water; however, the volcanic rocks in the Issaquah Creek Valley Ground Water Management Area are easily weathered and decomposed along fractures. Thus, it is unlikely that any productive volcanic rock aquifers occur in the Issaquah Creek Valley Ground Water Management Area.

Low-permeability bedrock is not expected to readily transmit ground water or potential contaminants to aquifers; however, two potential contamination processes should not be overlooked:

- Contaminant migration through porous layers, joints, and fractures to wells completed in relatively shallow bedrock.
- Intrusion of poor quality (mineralized, brackish, saline) ground water from bedrock to aquifers in hydraulic continuity through pumping influences.

7.3.2 Aquifers

Information describing hydrostratigraphy, ground water movement, and the supply potential of aquifers is available only for small portions of the Issaquah Creek Valley Ground Water Management Area where major sources have been developed. Future project drilling, monitoring, data collection and analysis efforts will substantially improve the present knowledge and provide a basis for further investigations. For this discussion, aquifer systems and flow direction are described according to physiographic situation.

Mountain Aquifers

Mountain aquifers are mostly bedrock which is capable of providing only individual domestic water supplies. However, in saturated, permeable glacial sediments, small public supply wells may be possible. For example, the Mirrormont subdivision is a Group A public supply system with several wells completed in permeable glacial sediments. One Mirrormont well is reportedly capable of producing 330 gpm.

Mountain aquifers located well above the regional water table are expected to have steep ground water gradients. Where low-permeability layers laterally redirect the flow, water erupts as springs or surface weeps. Beneath the unconsolidated sediments, flow would logically follow along buried erosional surfaces, bedding planes, faults, and fractures. Shallow ground water flow that does not emerge as runoff likely recharges lower elevation upland and valley aquifers.

Upland Aquifers

Numerous domestic wells are completed in unconsolidated materials with highly varying degrees of success. There are no known large production wells completed in upland aquifers. Two wells located in and next to Cedar Hills Landfill produce 127 gpm and 50

gpm. Most upland aquifer wells are completed in unconsolidated sediments, and a few are completed in sandstone.

Deep and shallow upland aquifer flow patterns may not be in similar directions. Valley aquifers are the likely recipients of recharge from upland ground water. Deep upland aquifers may be continuous with valley aquifers in some areas.

Valley Aquifers

Drilling reports and well logs indicate that unconsolidated sediments in the Issaquah Creek valley may be present at depths of over 650 feet below ground surface (Robinson & Noble, Inc. 1986). A narrow gap in the Issaquah Creek valley south of Issaquah is bounded by bedrock. Deep unconsolidated sediments are found in the valley north and south of this gap. The degree or manner of interconnection is unknown. Some wells drilled near the valley gap encountered bedrock at relatively shallow depths. If a bedrock sill or barrier is present, it could restrict or alter deep ground water flow.

Aquifers north of the gap are hereafter referred to as lower valley aquifers and are discussed in the following sections. Those aquifers south of the gap are referred to as upper valley aquifers. In addition to the upper and lower valley aquifers (see Figure 7.2), there may be distinguishing characteristics for aquifers found in the tributary stream valleys drained by East Fork, North Fork, Mason Creek, and the unnamed drainage along the Cedar Grove Road.

In the lower valley, at least three major aquifer zones have been identified. They are informally designated A1 - Upper Zone, A2 - Lower Zone, and A3 - Deep Zone. Their known characteristics are summarized in Table 7.3.

Several high-yield production wells are completed in these zones. (Table 7.4. lists wells indicating yields and aquifer characteristics. Figure 7.2 shows the location of Sammamish Plateau Water and Sewer District and City of Issaquah Production Wells.) All three aquifer zones have been demonstrated to be in hydraulic continuity with Sammamish Plateau Water and Sewer District's Well 9. Production testing of Well 9, completed in zone A3, created drawdown interference observed in all 3 aquifer zones within 4 hours. In zones A1 and A2, wells up to 6,000 feet away had less than 1 foot of drawdown, and wells with over 1 foot of drawdown were within 3,400 feet of Well 9. One well with over 2 feet drawdown interference is located just over 3,000 feet from Well 9. The general ground water gradient is toward Lake Sammamish (Carr/Associates 1988, 1992/93).

In the upper valley there are no known high-capacity production wells. However, given the relatively sparse population of the area, there has not been an economic incentive to develop high yield wells, and so the potential productivity of ground water resources is unknown.

Flow in shallow aquifers is expected to follow in the approximate direction of surface drainage. The direction of ground water movement in deeper aquifers in the upper valley is not fully understood. There is some flow from the upper to lower valley.

7.3.3 Lower Issaquah Valley Aquifer System

Hydrogeologic Boundaries. Hydrogeologic boundaries can restrict ground water flow (e.g. bedrock boundaries) or enhance it (e.g. stream boundaries). They also constitute the ultimate source areas and discharge areas of the aquifer system. The boundaries recognized in the Lower Issaquah Valley Aquifer system are:

- The lower Issaquah valley system aquifer is bounded on the south by low-permeability bedrock, at the Tiger Mountain Gap, and by bedrock outcrops occurring in the higher elevations along the margins of the ground water basin. The assumed low permeability of the bedrock constitutes a no-flow boundary to the base of the aquifer system;
- The lower Issaquah valley aquifer system is bounded on the north by Lake Sammamish, which is a regional discharge area. All ground water flowing through the area ultimately discharges either to Lake Sammamish, the wetland area directly south of the Lake, or to Issaquah Creek which drains into Lake Sammamish;
- The uppermost boundary to the aquifer system is the most complex, consisting of wetlands, streams, lakes, open-space (recharge areas), and urbanized areas. The water entering the ground water flow system originates from precipitation within the confines of the ground water basin. Streams may "lose" water to the aquifer, "gain" water from the aquifer, or have no interaction with the aquifer. Lake Tradition likely contributes water to the lower Issaquah valley aquifers through vertical infiltration from the Tradition Lake Plateau to the lower Issaquah valley aquifer. Urbanized areas tend to reduce the natural infiltration to the ground water through stormwater collection. Undeveloped open areas and rural residential areas represent potential recharge areas (Lower Issaquah Valley Wellhead Protection Plan, Golder Associates 1993).

Ground Water Flow in the Lower Issaquah Valley. Ground water generally flows to the northwest through the lower Issaquah Creek valley area and discharges to Lake Sammamish, or the wetland area immediately south of the Lake. Ground water flow converges on the central valley area from the North Fork, East Fork and Lower Fork Subbasins of Issaquah Creek. Flow directions in the western lower Issaquah valley (near Newport Way) are not well known. The deltaic sediments of the North and East Forks readily transmit ground water downwards into the lower Issaquah valley from the upland areas, causing steep hydraulic gradients at the margins of the valley, then the gradients flatten within the delta itself. A water table contour map was constructed using water level data from selected wells and USGS topographic maps. Figure 7.2 shows the general topography of the area and the wells used for constructing the water level contour map. Figure 7.3 shows ground water levels, indicating that ground water moves from higher

elevations toward the lower valleys and lowlands in the Issaquah Creek Valley Ground Water Management Area.

Ground water flow directions in the Grand Ridge and Tradition Lake areas are less certain, owing to a lack of wells and water-level measurements. It is presumed that flow mimics topography and is primarily westward toward the Issaquah valley, with components of flow directed towards the North Fork (particularly the wetland areas) and the East Fork valleys. Near the western margins of these areas, vertical infiltration through the deltaic sediments probably dominates. Quasi-horizontal flow may occur along distinct delta strata, but the continuity of individual strata within deeper zones in the lower Issaquah valley aquifer cannot be substantiated.

Ground water elevations vary throughout the year in response to winter and spring recharge. The direction of ground water flow within the valley appears to shift from a primarily northern direction during the summer and fall, to a northwestern direction during the winter and spring (see Figure 7.4). This was noted in the Wellhead Protection Plan wells as well as the monitoring wells at the ARCO site (Geraghty and Miller 1991). This westward shift in flow direction indicates a large influx of ground water from the east during the winter and spring. This has important implications with regard to the source of recharge to the aquifers within the valley and well capture zones (*Lower Issaquah Valley Wellhead Protection Plan*, Golder Associates 1993).

A ground water pollution study of the Issaquah Plateau was conducted by the Puget Sound Power and Light Company in 1978. This study identified the existence of two standing water bodies, Lake Tradition and Round Lake, in the upper water table. The surrounding geology, the near identical lake body elevations and corresponding seasonal fluctuations of the lake's levels indicate the hydraulic continuity between the two lake systems. Test borings between the lakes encountered large quantities of ground water at depths of less than 6 feet, and deeper borings located ground water closely corresponding to the nearby lake elevations. The ground water appears to be the seasonal overflow progressing north from Lake Tradition. The study also showed that the major movement of this upper ground water table is west-southwest from Round Lake.

Surface runoff from the northwest side of Tiger Mountain and the Plateau migrates and concentrates in the Lake Tradition trough and moves westward and to some minor degree, northward. Most of the ground water movement continues west, showing up as a surface exposure in Round Lake and vicinity. From here, ground water flows in a southwest direction (*Ground Water Pollution Study*, Puget Sound Power and Light Company 1978).

Ground Water Flow through the Gap. The Tiger Mountain Gap is located in the south central part of the Issaquah Creek Valley Ground Water Management Area between Squak and Tiger Mountains (Figure 4.2). In April of 1992, resource protection well RP-1 was installed near the Tiger Mountain Gap (Carr/Associates, Inc. 1992) to determine the extent of ground water resources in this vicinity and the depth to bedrock. An aquifer

encountered between depths of 27 to 42 feet yielded a transmissivity of 30,000 gallons per day per foot (gpd/ft). Bedrock was encountered at a depth of 63 feet below ground surface.

As shown by the water level contours on Figure 7.3, the Tiger Mountain Gap appears to act as a restricting ground water conduit, limiting drainage from the southern portion of the Issaquah Creek Valley Ground Water Management Area. To quantify the effect of the Tiger Mountain Gap on ground water movement, two calculations were performed. First, to determine the amount of ground water discharge available to flow through the Tiger Mountain Gap, a water balance was calculated for the area south of it. Second, to determine how much water can potentially move through the Tiger Mountain Gap, its hydrogeological capacity was calculated using Darcy's Law. Results are discussed below.

Available Discharge (Water Balance). The ground water discharge from the upper basin (GDu) that is available to move through the Tiger Mountain Gap can be estimated from the relationship of:

$$Gdu = P - ET - (SF + BF)$$

where upper basin values are:

P	=	148 cfs (precipitation)
ET	=	47 cfs (evapotranspiration)
(SF+BF)	=	87 cfs (stream outflow)
GDu	=	14 cfs (ground water discharge)

As shown, the ground water discharge of the basin upstream from the Tiger Mountain Gap is 14 cfs. This represents about 50 percent of the total discharge from the lower Issaquah valley drainage basin (24.5 cfs), as calculated in the water budget section (Section 7.5).

Discharge Capacity (Darcy's Law). Darcy's Law was used to calculate the amount of possible ground water flow through the Tiger Mountain Gap, based on permeability (hydraulic conductivity), area, and gradient.

$$Q = K A \, dh/dx \text{ (Darcy's Law)}$$

where values for the Tiger Mountain Gap are:

K = 400 ft/day (hydraulic conductivity estimated from well RP-1; Carr/Associates, Inc. 1992)

A = 36,000 sq. ft. (area = 480 ft. wide x 75 ft. deep)

dh/dx = 0.01 (gradient)

$$Q = (400)(36{,}000)(0.1)$$
$$= 144{,}000 \text{ ft}^3/\text{day}$$
$$= 1.7 \text{ cfs (capacity for ground water discharge)}$$

This calculation indicates that the Tiger Mountain Gap's ground water discharge capacity is about 1.7 cfs of the 14 cfs of available discharge from the upper basin. These results indicate an order of magnitude difference between the available ground water and the amount that could move through the Tiger Mountain Gap. Three possible explanations for these differences are evaluated below:

Data used to calculate the water balance and hydraulic capacity were inaccurate. The water balance calculation is as reliable as that done for the entire basin. The values used in Darcy's equation are conservative and probably overestimate underflow through the Tiger Mountain Gap. The extent of the aquifer in the Tiger Mountain Gap may be underestimated. Additional monitoring wells are needed to provide better data on actual ground water flow through the Tiger Mountain Gap.

Ground water exits via paths other than the Tiger Mountain Gap. Ground water may also exit the Issaquah Creek basin via shallow valleys south of Squak Mountain. South of Cedar Hills Landfill, the ground water gradient is very flat and the flow intermittent. Here, ground water may recharge deeper sediments and flow southwest toward the Cedar River. Further investigation of the valleys north and south of the Cedar Hills landfill is needed to determine the amount of ground water leaving the Issaquah Creek Valley Ground Water Management Area. If upper basin ground water actually flows toward the Cedar River basin, then estimates of the ground water discharge to Lake Sammamish could be reduced by 50 percent.

Ground water emerges as surface water. Ground water could be forced to the surface at the Tiger Mountain Gap, flow through the Tiger Mountain Gap in Issaquah Creek, and reenter the lower valley aquifer downstream. This potential exfiltration and reinfiltration could be evaluated by additional stream monitoring stations, above, in, and below the Tiger Mountain Gap.

Ground Water Elevations. Ground water elevations (or water-table elevations) determine, in part, the rate and direction of ground water flow. Elevations are referenced to mean sea level. Ground water flows from high to lower elevations at a rate proportional to the slope of the water-table and the hydraulic characteristics of the aquifer. Ground water elevations fluctuate in a somewhat predictable fashion because of annual fluctuations in precipitation and ground water recharge. The annual high and low ground water elevations are typically used to evaluate general aquifer behavior. The high and low water-table configuration, based on observed water levels, is shown on Figure 7.4. Water level contours for both the Upper and Lower Valley are shown in Figure 7.3. Water-level elevations are extrapolated to the western portion of the valley based on

assumed conditions. There are very little data on ground water conditions in the western lower Issaquah valley.

Seasonal high ground water elevations in the lower Issaquah valley occur in February, based on 1992 data, and range from 150 to 200 feet in the South Issaquah/Hobart area to approximately 50 feet about two miles south of Lake Sammamish. Ground water elevations in the immediate vicinity of Lake Sammamish are uncertain, because no wells exist in this area. However, ground water elevations are expected to approach 25 feet near the lake, which is the average elevation of Lake Sammamish. Seasonal high ground water elevations in the central valley area, where most of the wells are located, vary from approximately 60 to 70 feet. Ground water elevations increase to the east to as much as 80 feet or higher.

Seasonal low ground water elevations occur in August and September (based on the 1992 data) and range from 150 to 160 feet in the South Issaquah/Hobart area to approximately 47 feet approximately two miles south of Lake Sammamish. Seasonal low ground water elevations in the central valley area, where most of the wells are located, vary from approximately 55 to 60 feet.

Little data are available on Grand Ridge and the Tradition Lake Plateau. Recently installed shallow wells at the proposed Grand Ridge development indicate that ground water elevations vary from about 400 feet to over 800 feet, and are likely representative of shallow perched aquifers over low-permeability bedrock or till. Ground water levels in a private well (Dean Well) located west of the proposed development are relatively constant at approximately 338 feet. This well is completed below till (*Lower Issaquah Valley Wellhead Protection Plan*, Golder Associates, 1993).

Ground Water Level Fluctuations. Fluctuations in ground water levels are often indicative of the overall behavior of the aquifer, the location of recharge/discharge areas, and the response to recharge/infiltration. In general, the lower Issaquah valley aquifer responds very quickly to precipitation events. These water-level responses are seen in both shallow and deep wells. This response suggests continuity with the ground surface and/or stream network. Additionally, the wells in the lower Issaquah valley respond to pumping of the various production wells in the area. Short-term fluctuations are clearly observed in response to the Lakeside Gravel Pit, which operates wells on an eight-hour work-day schedule. Figure 7.5 shows a hydrograph of one shallow monitoring well at the ARCO site. The hydrograph shows the short-term fluctuations in water levels caused by pumping at Lakeside, short-term and longer term declining and rising water level trends due to climate, and the effect of pumping at Sammamish Plateau Water and Sewer District's well 9. The various responses result in "noise" in long-term water-level observations caused by these short-term effects.

Within the valley area, the annual change in ground water elevations was between 7 and 10 feet in 1992. Greater annual fluctuations of up to 15 feet occurred in the vicinity of Sammamish Plateau Water and Sewer District's wells 7 and 8. The annual change in

water elevations appears to decrease to 7 feet or less north towards Lake Sammamish, while higher annual water-level fluctuations of 10 feet or more occur south and east of the central valley area (*Lower Issaquah Valley Wellhead Protection Plan*, Golder Associates 1993).

Water levels in wells are related to rainfall, however, the relationship has been modified by significant ground water withdrawals in some areas. Long term rainfall trends should be assessed with long term well water level data. Then pumping effects could be compared to water level data. Pavement as a result of urbanization has also affected this relationship due to a higher volume of rainfall lost to storm flows which have decreased ground water recharge (Liszak, 1995).

Hydraulic Gradients. Hydraulic gradients indicate the rate of ground water movement. Gradients are unitless parameters, equivalent to a slope. The average horizontal hydraulic gradient within the central valley area, based on data from 14 wells, is relatively flat at between 0.001 and 0.002. Hydraulic gradients are less well known on Grand Ridge and in the Tradition Lake area. Within the proposed Grand Ridge development, the horizontal gradient is about 0.067, 10 times higher than in the lower valley.

Vertical gradients are also important, because they indicate the upward or downward component of ground water flow. In general, downward gradients are expected in recharge areas and upward gradients are expected in discharge areas.

The vertical hydraulic gradients vary considerably throughout the lower Issaquah valley area. In general, the vertical gradient is, as expected, directed upward in the northern area near Lake Sammamish. Primarily downward vertical gradients occur in the central valley area, probably as a result of the high-volume pumping within this area. Locally, both upward and downward gradients may be created because of the completion interval of the production wells, which may induce downward leakage from above and upward leakage from below. At Sammamish Plateau Water and Sewer District's wells 7 and 8 the vertical hydraulic gradient appears to be downward from the surface to the 117-foot completion interval and upward from the deeper 177-foot completion to the 117-foot completion interval.

Vertical gradients on Grand Ridge and Tradition Plateau are unknown. However, the vertical gradient is directed upward along the flanks of the Tradition Lake area (near well WH-1, and wells COI 1 and 2). The upward gradients in this area may be the result of infiltration originating from higher elevations at a high head and discharging to the lower valley area.

In general, the vertical hydraulic gradients observed within the lower Issaquah valley in 1992 appeared to remain relatively constant throughout the year, with the exception of wells COI 1 and 2 and SPVT6. At these sites, the vertical gradient decreased between the winter/spring recharge period and summer/fall period, when the vertical gradients are at a minimum. This trend suggests that recharge to the deeper sediments during the

winter/spring may increase the upward vertical gradient in places and then decay during the ensuing dry period (*Lower Issaquah Valley Wellhead Protection Plan*, Golder Associates, 1993).

Aquifer System Characteristics. The present understanding of the aquifer system indicates the total sediment thickness ranges from over 600 feet in the central lower Issaquah valley near wells COI 4 and 5, to 300 feet at the Grand Ridge margin of the Lower Issaquah Valley (Sammamish Plateau Water and Sewer District's well 9), to 150 feet at the Lake Tradition margin of the lower Issaquah valley (well WH-1), to 63 feet at the Hobart Gap (well RP-1). Actual aquifer thicknesses are assumed to be similar to sediment thicknesses, since there is little regional geologic continuity between strata.

Production wells within the lower Issaquah valley tap highly permeable aquifers. Testing of these wells has provided data on the hydraulic characteristics of the aquifer. Carr/Associates conducted a 3-day pumping test of Sammamish Plateau Water and Sewer District's wells 7 and 8 between September 12 and 15, 1990. The wells were pumped at a combined rate of 5,600 gpm. During the test, water-levels were monitored in 17 wells and at 6 surface water stations. The 17 monitoring wells included 11 piezometers and 6 production wells. During the test, water-levels in the observation wells were drawn down between 1 and 3 feet, and the cone of depression extended a distance of approximately 7,000 feet from the pumping wells. Analysis of the pumping test was complicated to some degree by interference resulting from the pumping of other production wells, and by the complex hydrogeology of the valley. Based on the test, a transmissivity of approximately 67,000 ft^2/d was calculated (Carr/Associates 1990). Assuming an aquifer thickness of between 200 and 300 feet, a bulk hydraulic conductivity of between 220 and 330 ft/day for the aquifer is estimated. The calculated storativity varied from 0.2 to 1 x 10^{-4}. During the test, the Reid Pond, located over 1,300 feet to the northwest of the pumping wells, demonstrated over 1½ feet of drawdown interference due to pumping (Liszak, 1995).

A long-term pumping test of Sammamish Plateau Water and Sewer District's well 9 was conducted at a rate of 2,340 gpm for about 9.5 days by Carr/Associates in July 1992. During the test, water-levels were monitored in 55 observation wells. In addition, 15 surface water monitoring stations were established and monitored. The test was designed to minimize interference from surrounding, pumping wells and attempt to achieve steady-state conditions in the aquifer through an extended test length. Analysis of the well 9 test (Carr Associates 1993) suggests the following:

- Well 9 is completed in a thin (50-foot) isolated aquifer zone (termed Zone C), with a high transmissivity, separated from the overlying sediments by a leaky aquitard;
- Pumping of Well 9 caused drawdowns of between 1.4 and 0.2 feet in shallower zones of the aquifer;
- Flow paths towards Well 9 do not intersect the known contamination at the ARCO site;

- Steady-state conditions were not achieved;
- Transmissivity of the aquifer as a whole is similar to that observed at Sammamish Plateau Water and Sewer District's wells 7 and 8 at 70,000 ft^2/day based on a late-time drawdown analysis of all wells monitored; and
- Strong, downward vertical gradients are established from the water table towards the deeper portions of the aquifer.

In July 1992, Golder Associates conducted a series of slug tests in the monitoring wells. The tests were analyzed using the Bouwer/Rice (1967) method and the method of Van der Kamp (1976). The hydraulic conductivity calculated from the tests ranged from 100 to 470 ft/day, which is consistent with the pumping test results (*Lower Issaquah Valley Wellhead Protection Plan*, Golder Associates 1993).

Stream/Aquifer Interaction. Stream-aquifer interaction is important in an aquifer system and can be a source of recharge to the ground water. It is often difficult to measure the "hydraulic continuity" between a stream and aquifer and, in most cases, indirect assessments of stream-aquifer interaction are necessary. The parameters controlling stream-aquifer interaction are:

- The elevation difference between the stream and the ground water; and
- The hydraulic characteristics of the streambed.

Three major streams traverse the lower Issaquah valley (Figure 4.1). The North Fork and East Fork Issaquah Creek descend from elevated upland areas into the lower Issaquah valley, losing more than 200 feet of elevation over a relatively short distance. The Lower Fork of Issaquah Creek gradually descends through the lower Issaquah valley from the Hobart Gap to Lake Sammamish, losing about 100 feet of elevation. From a hydraulics standpoint, it is expected that the steep sections of the North and East Forks of Issaquah Creek would provide coarser bedload (sands and gravels), and have a higher hydraulic conductance. When the stream enters the lower Issaquah valley, its gradient decreases and finer sediments (sands and silts) are deposited, potentially reducing the hydraulic connection between the streambed and the underlying aquifer.

Stream gauging was performed in March 1992 on the North Fork and East Fork of Issaquah Creek. On the North Fork, three stations were gauged between the McDonald Well and 60th Street (approximately 1,000 feet apart). On the East Fork, two stations were gauged (approximately 1,000 feet apart) near the Sunset Overpass of I-90. The objective of the stream gauging was to determine whether significant stream/aquifer interaction was occurring at the edge of the upland areas surrounding the lower Issaquah valley. The accuracy of the survey is estimated at +/- 1 cfs, due to the shallow stream depth and low velocity of water flowing through the stream. On the North Fork, measured streamflow decreased from 3.3 cfs upstream of the McDonald well to 2.8 cfs downstream of the McDonald well, and then increased to 4.1 cfs below the 60th Street

bridge farther downstream. These results do not indicate large streamflow losses or gains and are within the accuracy of the survey.

At that streamflow, stream/aquifer interaction of less than 1 cfs per 1,000 feet of streambed was estimated along the North Fork at its confluence with the valley floor. Along the East Fork, a similar conclusion was reached. Streamflows measured upstream and downstream of the Sunset overpass were 9.8 and 9.3 cfs, respectively. These values are within the accuracy of the survey and are consistent with streamflows used by King County Surface Water Management. Thus, stream/aquifer interaction along the East Fork between the Sunset overpass and confluence with the Lower Fork Issaquah Creek is estimated at less than 1 cfs per 1,000 feet of streambed. Because of the limited extent of stream gauging, these streamflow relationships may not be representative for all seasons or flow regimes. Additional stream gauging data are needed to fully characterize stream/aquifer interaction along the edge of the lower Issaquah valley.

Mini-piezometers were installed at six locations in the lower Issaquah valley (four on the Lower Fork and two on the North Fork) in June 1991. These piezometers were placed in or directly adjacent to the streambed to a depth of 5 to 8 feet. They measure the relative water levels in the stream and underlying shallow ground water. The results at four of the six locations indicated that stream water levels were "perched" 1 to 3 feet above the ground water level, indicating little interaction between the stream and aquifer. At two of the stations, ground water levels were equal to or higher than the stream water level, suggesting continuity between the systems.

Monitoring of streamflow and shallow ground water levels during the pumping test at Sammamish Plateau Water and Sewer District's Well 9 also indicated limited hydraulic continuity with the streams. The cone of depression created by the 9-day pumping test extended over nearly two square miles, and the drawdowns observed at the water-table (based on a hand-contoured drawdown map) can account for over 80 percent of the water pumped from the aquifer during the test assuming a bulk porosity of 20 percent. If stream infiltration provided a significant contribution to the water pumped from the well, drawdowns in distant observation wells would be much less. Thus, infiltration from the stream to the aquifer is interpreted to be a minor component of the water drawn to the well when it is pumped. There is still a long-term impact to surface waters during pumping, but this impact occurs at the discharge areas (i.e. the wetlands directly adjacent to Lake Sammamish) of the ground water system because there is less ground water moving through the aquifer as a result of pumping *(Lower Issaquah Valley Wellhead Protection Plan*, Golder Associates, 1993).

Data Sources. Data for generating hydrostratigraphic cross sections were obtained from copies of Ecology's well logs supplied by King County, well logs from Carr/Associates and other consultants' project files, and the Issaquah Creek Valley Ground Water Management Area well log database file. Issaquah Creek Valley Ground Water Management Area database incorporates data from all these sources and includes files for water levels, well construction data, and lithologic logs. Most of the well logs were

originally recorded by the well drillers. This information was entered into the database by Seattle-King County Health Department personnel as part of this project. Selected well logs are included in Appendix E (available upon request). The locations of wells included in the database are shown in Figure 7.2.

Hydrostratigraphic Units. The lithologies described in the well logs were categorized into three hydrostratigraphic units. These units are described in Table 7.5 and illustrated in cross sections as Figures 7.6 through 7.9. The location of each cross section is shown in Figure 7.10.

Extent and Significance of Hydrostratigraphic Units. To illustrate the extent and significance of these hydrostratigraphic units, four hydrogeologic cross sections were generated from the well logs. The locations of the four cross sections are shown on Figure 7.10. Cross sections A-A' and A'-A" (see Figures 7.6 and 7.7) parallel the main stem of Issaquah Creek from Lake Sammamish south to Hobart. Cross section B-B' (see Figure 7.8) begins in the Tibbetts Creek Valley, crosses Lower Issaquah Valley, extends up the North Fork of Issaquah Creek, and ends on the south flank of the Sammamish Plateau. Cross section C-C' (see Figure 7.9) begins at the City of Issaquah's Gun Club Well (34F03), bisects the Lake Tradition Plateau, and follows the East Fork of Issaquah Creek toward the town of Preston.

The well numbers (i.e., 34F03) for each well used in the sections are shown on the map (Figure 7.10) and the cross sections (see Figures 7.6 through 7.9). Logs for all wells used in the cross sections are included in Appendix E (available upon request). Some wells near the cross sections with duplicative, incomplete, or inadequate logs were not included in the figures.

The extensive topographic relief in the study required use of relatively high vertical exaggeration (28x) on the cross sections. This exaggeration makes some bedrock and sedimentary shapes appear very steep and unnatural. For example, the steep chevron-shaped aquifer in cross section A-A' (see Figure 7.6) looks unlikely. However, this correlation accurately depicts coarse-grained aquitard sediments, deposited at about 10 degrees, opposite flanks of the ancestral North Fork delta. Hydrostratigraphic relationships in the Lower Issaquah Valley were confirmed by water levels and drawdown interference measured during recent extensive aquifer tests (Carr/Associates, Inc. 1990 and 1993).

Cross Section A-A'-A." Cross section A-A'-A" is segmented into north (A-A') and south (A'-A") illustrations (see Figures 7.6 and 7.7). The section shows significant changes in depth to bedrock along the main valley of Issaquah Creek. Wells located near the southern end of Lake Sammamish, where the modern delta of Issaquah Creek is forming, have the lowest ground surface elevations and exhibit flowing artesian conditions (i.e., water levels above ground surface).

Multiple aquifer zones of high permeability sand and gravel were encountered by numerous Lower Issaquah wells, such as 28A06, 27E03, and 27E04. These include a shallow aquifer zone (depth less than 60 feet below ground surface), a middle aquifer zone (depth 80 to 170 feet), and a deep aquifer zone (depth 195 to 220 feet). These major aquifer zones are used by production wells of the Sammamish Plateau Water and Sewer District and the City of Issaquah. At Sammamish Plateau Water and Sewer District's Well 9 (27E03) a substantial layer of silt separates the middle and deep aquifer zones. The deeper sediments logged at well 34F03, east of Issaquah High School, may be related to these sediments of the lower Issaquah valley.

At well 27E03, bedrock was encountered at a depth of 301 feet. Most other lower valley wells were not drilled deep enough to encounter bedrock. Bedrock was found at a depth of 18 feet below ground surface at well 15P02. The ground surface elevation at this well is 330 feet above sea level. Within the Section 15 area, the depth to bedrock is highly variable ranging from 18 feet to 194 (Well 15A02) feet below ground surface. At monitoring Well 15E08, bedrock is encountered at 65 feet below ground surface.

South of the Tiger Mountain Gap (see Figure 7.10), the bedrock basement deepens at well 26B02 and then rises sharply at well 05N03 near Hobart. Limited available data indicated that aquifers south of the Gap are less productive than the permeable deltaic sands and gravels in the lower Issaquah valley. Lacustrine silt and clay aquitards occur both north and south of the Tiger Mountain Gap and, where present, impede the vertical migration of ground water.

Cross Section B-B'. Cross section B-B' illustrates the sediments southwest to northeast from Tibbetts Creek up the North Fork of Issaquah Creek. As shown in Figure 7.8, a series of deltaic sands and gravel was deposited from the North Fork of Issaquah Creek into ancestral Lake Sammamish. Test drilling at City of Issaquah well 5 (28B04) showed the presence of shallow aquifer zones and a deep silty-sand aquifer.

The upland east of the lower Issaquah valley consists of bedrock mantled by glacial deposits. Although numerous wells are shown along the North Fork Valley (see Figure 7.10), few of them encounter extensive aquifers.

Cross sections through the deltaic deposits south of the North Fork appear in reports by Carr/Associates 1993 and Golder Associates 1993.

Cross Section C-C'. Cross section C-C' (see Figure 7.9) shows the bedrock that is beneath Lake Tradition Plateau and that is overlain by about 100 feet of sediments in the upper East Fork Valley. Relatively permeable aquifers separated by silty aquitards are present in the upper East Fork Valley and in Issaquah Valley at wells 27P02 and 34A01. In the eastern part of the East Fork Valley, the more productive wells are completed in these aquifers. Shallow bedrock penetrated by wells 25P01, 25J01, and 30L01 contains shale with some coal seams. This bedrock provides limited water to a few domestic wells.

Data Limitations. In the Issaquah Creek Valley Ground Water Management Area, the quality and quantity of reliable data are extremely varied. Ground water resources of the lower Issaquah valley have been explored extensively and evaluated professionally on several projects, including the Lower Issaquah Valley Wellhead Protection Plan (November 1993). By contrast, very little ground water exploration or professional evaluation has occurred in upstream parts of the Issaquah Creek Valley Ground Water Management Area (the Upper Valley) other than at the Cedar Hills Landfill. In the remaining parts of the Issaquah Creek Valley Ground Water Management Area where development can occur, domestic wells drilled only as deep as necessary have been installed. As a result, limited geologic data are available in areas where shallow aquifers are adequate (typically in the valleys), and geologic data are abundant where shallow aquifers are inadequate (typically in the foothills).

Drillers' and geologists' descriptions of sedimentary units are subjective and can produce inconsistencies in descriptions of similar units. For example, soft shale bedrock has been mistakenly identified as "silt" or "clay." The three hydrostratigraphic units used in this report accommodate some of these potential problems. However, future, more detailed analysis should recognize the potential differences in nomenclature.

The locations of some of the wells shown in the cross sections have been verified. However, other wells may be mislocated by the incorrect entry of a quarter-quarter section. More than one-third of the wells used in the cross sections have been accurately surveyed to provide locations and elevations. For other wells, Seattle-King County Health Department personnel entered the estimated elevations and locations with the designated 40-acre quarter-quarter section. Consequently, some locations may not be accurate, and well elevations for non-surveyed wells may be inaccurate.

Cross sections illustrating hydrostratigraphy generally are not impaired by imprecise elevations as long as reasonable values are used. However, evaluation of ground water gradients based on inaccurate elevations is not appropriate. In addition, many of the test wells have different water levels for each zone of completion, and seasonal changes of more than 10 feet are not reflected by water levels measured only once when the well was completed.

Future analysis could benefit from greater detail on wellhead and surface water elevations. These data would help refine the surface/ground water relationships in various parts of the study area. Moreover, the location of wells should be verified and noted in latitude and longitude coordinates to facilitate entry into computerized data banks.

7.3.4 Sammamish Plateau Aquifer System

The USGS reported on the Sammamish Plateau aquifer system in the *Geohydrology and Ground Water Quality of East King County, Washington* (USGS 1995) and in the 1995

draft of the *East King County Ground Water Management Plan.* The following discussion is from those reports.

Ground water in the upland area of the Sammamish Plateau moves vertically downward and laterally to discharge points (such as Lake Sammamish). The amount of time required for an individual molecule of water to travel through the system is roughly proportional to the permeability of the unit and amount of precipitation that reaches the unit. Flow into and out of the study area can be qualitatively assessed by evaluating the ground water conditions along the study boundaries. Along the Lake Sammamish boundary, ground water flows out of the study area to the west and in some areas deeper ground water flow may be to the west also. Confirmation of these hypotheses require additional investigation and a phased approach to additional investigation is recommended.

The USGS identified individual aquifers in the Sammamish Plateau: Vashon advance outwash (Qva); upper coarse grained unit (Q(A)c); bog and alluvium (Qal-Qvr); lower coarse grained unit (Q(B)c); oldest unconsolidated unit (Qc); and bedrock (Br). These are described below.

Vashon advance outwash (Qva): These deposits are labeled on geologic maps as Vashon advance (Qva) and typically consist of well-graded gravelly sand to fine-grained sand. The Vashon advance coarsens upward through the sequence; in other words, the particle grain size is larger in the upper-part of the formation than in the bottom. The meltwater from the encroaching ice mass increased in velocity in the study area during the deposition of the Vashon advance. As a result, the formation is configured by a basal unit (lacustrine silt, clay, and very fine sand), a medium sand and sandy, cobbly gravel (characteristic of a high energy environment), and an ice marginal deposit (interbedded sands, silt, and gravels) (Snoqualmie Ridge Project, February 1995).

Ground water flow in Qva is toward Patterson Creek from the eastern Sammamish Plateau and Ames Lake areas. Flow from the western Sammamish Plateau is toward Lake Sammamish. The flatter gradients are less than 100 feet/mile in areas such as the Sammamish. Steeper gradients in excess of 500 feet/mile are present near Patterson Creek (USGS, 1995).

Upper coarse-grained unit (Q(A)c): Underlying the upper-fine grained unit, but discontinuous in the study area, is the upper-coarse grained unit (Q(A)c). This unit consists of interglacial sand and gravel from the pre-Fraser (Qpf) unit, including strongly oxidized sand and gravel. The average thickness of the unit is approximately 140 feet (Plate 1, U.S. Geological Survey, 1995). The top of the unit varies from 300 feet below to 700 feet above sea level (Plate 2, U.S. Geological Survey, 1995).

In Q(A)c, ground water flow is is determined by a ground water divide in the Sammamish Plateau, with ground water in the western part flowing to Lake Sammamish and ground water in the eastern part flowing toward the Snoqualmie River. Gradients in the river

valley and east of the Sammamish Plateau are less than 50 feet/mile in some places (USGS, 1995).

Bog and alluvium (Qal-Qvr): The youngest geologic units in the study area are bog deposits (Qb), and alluvium (Qal). Flow within this unit on the Sammamish Plateau is not well defined because of a lack of data points and because much of the unit is completely unsaturated there. Vertical flow directions are difficult to ascertain because the Qal-Qvr and Qva are discontinuous, and in some areas the heads are similar from one unit to the next. In general, vertical flow is downward in upland areas. This is apparently the case in the Sammamish Plateau, where heads in Qva are generally larger than those in the underlying Q(A)c. Water level elevations in a set of five piezometers on the Plateau decreased with piezometer depth, also indicating downward flow. The data are from wells 24N/06E-09A11 through 09A15, and are listed in Table 7.6 B.

Lower coarse-grained and oldest unconsolidated units (Q(B)c, Q(C)): Little information exists about the productivity and extent of the lower coarse-grained unit (Q(B)c) and the oldest unconsolidated units (Q(C)). The lower coarse-grained unit consists of sand and gravel with minor percentages of clay and silt. The unit, though saturated, is rarely used as a ground water source. The ground water in this unit is probably confined.

Bedrock (Br): Most of the consolidated rocks that make up the bedrock (Br) consist of andesite with minor amounts of basalt and diorite. The consolidated Tertiary and pre-Tertiary rocks that constitute the bedrock contain small quantities of water in fractures and joints that are probably more numerous near the top of the unit. In general, however, the bedrock is an unreliable source of ground water, and many wells drilled into that unit yield insufficient or poor-quality water. In areas where the aquifer used is bedrock, bedrock is either exposed at land surface or is covered by a thin, low water bearing layer of unconsolidated deposits. Where the bedrock is exposed at land surface, the ground water is likely to be under water-table conditions; where the bedrock is covered by a significant thickness of unconsolidated deposits, especially clays and silts, the ground water is likely to be confined.

The lowest median hydraulic conductivity (0.88 ft/day) was for the Br unit. Because ground water in bedrock is present primarily in the fractures, a low median hydraulic conductivity suggests that the Br unit generally is not fractured enough to produce large quantities of water. This low hydraulic conductivity is the primary reason the bedrock is generally a poor source of water.

For all of the upland aquifers, the presence of downward vertical flows indicates that some water may be moving into the deeper regional geohydrologic system, possibly even the bedrock (USGS, 1995). Although this water would probably tend to flow north and west, it would also flow within the deeper geohydrologic units not mapped, such as Q(B)c, Qc, and possibly Br. The ground water in these units could easily flow beneath surface waters such as Lake Sammamish, and ultimately flow to surface water bodies

(such as Puget Sound) outside the study area. The results of a seepage study conducted in September 1991 showed that an estimated 3.3 feet^3/second discharges from the Sammamish Plateau to Lake Sammamish. (USGS, 1995).

Ground Water Withdrawals

More than 98 percent, or 1,110 acre-ft, of the total ground water withdrawals in the Sammamish Plateau went to public supply systems, reflecting the area's suburban nature. Although most of the water withdrawn for public supply is used for individual households, undetermined quantities are used for commercial, institutional, industrial, or municipal uses. Also, a significant quantity of water can be lost through leakage from distribution systems. There is a marked seasonal variation in the demand for, and therefore withdrawal of, water for public supply purposes. The greatest demand is in late summer and early fall, when temperatures are high, precipitation is at a minimum, and ground water levels are relatively low (USGS, 1995).

7.3.5 Data Collection Activities for Hydrogeologic Characterization

Water Level Measuring. Water level measurement data are critical to both ground water flow patterns and to trend analysis of impacts of climate, water use, and regional growth on the aquifer system.

Water levels in wells were monitored on a monthly basis between 1989 and 1992 at 48 well sites. The data were collected by personnel from the City of Issaquah, Sammamish Plateau Water and Sewer District, the Seattle-King County Health Department and Carr and Associates. Water level data collected between 1989 and 1992 are listed in Appendix F (available upon request).

On the Sammamish Plateau, water level information was collected by the USGS and the Seattle-King County Health Department. The USGS interpreted water quantity information from a collection of well logs and springs on the Sammamish Plateau, as part of the data collection for the East King County Ground Water Management Program. (See Table 7.6 B) The data collection effort of USGS was based on field data collection activities described in the *Data Collection and Analysis Plan for East King County, Washington, Ground Water Management Area Study*, July 1, 1991. The USGS Technical Report (1995) identified the Sammamish Plateau as one of three areas with data gaps in the East King County Ground Water Management Area. Subsequently, ground water levels were measured monthly at 10 well sites by Seattle-King County Health Department personnel (Figure 7.3). The Seattle-King County Health Department continued the data collection the USGS began, and used equivalent methodology as the US Geological Survey.

The well sites were selected based on the following criteria:

- Hydrogeologic Significance - Appropriate location for defining ground water flow directions, gradient, divides, as well as water level trends.
- Representative - The water level measurements are representative of a single aquifer (i.e., well is not completed over several aquifer zones).
- Well Log - The well has a complete and reliable well log.
- Locatable - The well can be located in the field and verified with the well log.
- Easily Measurable - the well is accessible with a sounder.
- Non-Pumping Water Levels - The well should have limited use to facilitate obtaining static water level measurements.

Selection of monitoring wells was restricted to wells having geologic logs and well completion information. The process for site selection included the following:

- The project database was queried for all wells having geologic logs, and a well summary table and well location map were prepared.
- General areas where additional hydrogeologic data were needed were identified on the well location map.
- Field surveys and interviews were conducted by the project consultants to locate wells that satisfy the above criteria and whose owner agreed to allow access for periodic measurements.
- The selected sites were reviewed by the Issaquah Creek Valley Ground Water Advisory Committee.

Well construction and hydrogeologic information has been entered into the database for all monitoring wells. All monitoring wells were surveyed in 1991. Water levels from wells included in the Issaquah Creek Valley Ground Water Management Area monthly monitoring program were plotted to view seasonal water level trends. Figure 7.11 shows the monitoring wells included in the monitoring program, and Figures 7.12A through 7.12H show the water level changes in these wells. The apparent variations in water level may arise from seasonality in precipitation and the effects of prior pumping. Thus, general trends should be sought without undue emphasis on small variations.

As indicated in Figures 7.12A through 7.12H, high water levels occur during the months of February through May, while low water levels occur from September through December. Water levels can fluctuate seasonally as much as 15 feet. Because high precipitation periods generally occur during the months of November through February, a time lag of two to four months is presumed to occur for ground water recharge. The length of this lag period depends on the depth to ground water and the type of overlying sedimentary material.

Long term data collection from these 48 wells is needed to determine ground water level trends. The City of Issaquah Wells #1 and #2 monitored as part of the well network have data available from 1981 to 1994 (Appendix F, available upon request). The water level in Well #2 has declined 3 feet between 1981 and 1994 (Liszak, J. 1995).

The water level in one of the deep wells, 24N/06E - 09A15, declined from 1982 to 1986. The National Oceanic Atmospheric Administration has historic records for rainfall in the Puget Sound region. Although there is no site specific information, the available historic information indicates for years 1982 - 84, 1986, 1988, and 1990 rainfall was above the average, so the decline was not likely related to precipitation. Pumping may be a factor, as this well is located on the Sammamish Plateau where the population is rapidly increasing. In contrast, the shallow ground water in another well on the Sammamish Plateau, showed little year-to-year variation (USGS, 1995).

Exploratory/Test Wells. An electrical resistivity survey was conducted in the lower Issaquah valley (Carr/Associates November 1989) to make a preliminary evaluation of the ground water potential of the area, and to help select sites where test drilling would have the greatest opportunity for success. Electrical resistivity surveying is a geophysical technique for measuring electrical properties of subsurface geologic materials. By measuring these electrical properties, subsurface hydrogeologic features can be identified. The Wenner Array resistivity method was used.

Results of resistivity surveying in the lower Issaquah valley showed permeable sediments present as isolated lenses and short channel segments. Less permeable, fine sediments are widely distributed and increase in dominance to the west and north.

The recommendations from the survey were for the Sammamish Plateau Water and Sewer District to drill five 8-inch-diameter test wells of approximately 200 feet deep. The five test sites recommended were:

- One well site in the vacant lot immediately north of the Meadow Creek Office Park.
- Two wells in the I-90 Corporate Park greenbelt.
- One well in the I-90 Corporate Park "tailpiece property."
- One well in the pastures east of 230th Avenue South East.

The three new exploratory/test wells were installed in 1990 and one in 1992 to provide additional information with which to evaluate hydrostratigraphy, ground water flow, and water quality. The three wells VT-1, VT-2 and VT-3 drilled in 1990 were based on the 1989 Carr/Associates resistivity recommendations and the criteria below.

The criteria used to select the test well sites include the following:

- Hydrogeologic Significance - Aquifers, ground water flow directions and water quality are of interest and satisfy the program objectives.
- Property Accessibility - The property is accessible to heavy drilling equipment and access for long-term monitoring is available.
- Property Availability - The property is publicly owned or the owner is agreeable to terms of drilling and long-term monitoring at no cost.

- Site integrity - The site is secure from vandalism and free from contamination or any disturbance from future land use activities (e.g., road construction, gravel pit expansion, etc.).

Three of the new wells (VT-1, 2, 3) were drilled, using the cable tool method for the City of Issaquah and Sammamish Plateau Water and Sewer District as part of their ongoing efforts to characterize and manage the ground water resources within their local service areas (Sections 21 and 27, Township 24 North, Range 6 East). These sites lie in the lower Issaquah valley. The wells have a casing depth of 160 feet (well VT-1), 79 feet (well VT-2) and 158 feet (well VT-3), respectively.

These three wells were drilled to:

- Determine the potential of the alluvium for 1,000 to 3000 gallons per minute production well (VT-1).
- Determine aquifer characteristics and install piezometers for future water level monitoring. The results of the drilling and testing were used to evaluate the suitability of the site for a future production well. The exploration also provided additional information on the relationship between the shallow aquifer system and the aquifer penetrated by the City of Issaquah's deep well 5 (VT-2).
- Determine the suitability of well VT-3 site for construction of one or more high-yield production wells.

The fourth site (RP-1) lies in the Squak/Tiger Mountain Gap area and within Section 10 of Township 23 North, Range 6 East. The new well was drilled using the air rotary method to a depth of 80 feet. Bedrock was encountered at 63 feet below ground surface. Two piezometers of 2-inch and 4-inch diameter were installed to 59 feet (2 inches) and 39 feet (4 inches), respectively. The gap area represents a narrow constriction between the upper Issaquah Creek Valley and the lower Issaquah Creek Valley. Data collected from this well will help evaluate horizontal and vertical ground water gradients, seasonal and long-term ground water trends, and ground water quality relationships in the valley. An access agreement for long-term water level and water quality monitoring was established for a period of 10 years by Seattle-King County Health Department.

The wells were installed in accordance with Ecology's guidelines for "Data Collection from Wells used in the Ground Water Management Area Program, May 1989" as well as according to "Standards for the Construction and Maintenance of Wells, Chapter 173-160 WAC."

The results of the drilling of these four wells were:

- Drilling at the VT-1 site revealed a permeable aquifer which is used by the Sammamish Plateau Water and Sewer District wells 7 and 8. This production well is capable of producing 2,000 to 3,000 gallons of potable water per minute.

- At the VT-2 site, the low permeability of the aquifer zones limits the productivity of any future productions wells. The maximum yield of such wells probably would not exceed 200 gallons per minute.

The high iron and manganese content of the water from the shallow aquifer zone has been observed in other shallow aquifer zones in the valley. Most of these occurrences are associated with wetlands.

These water level and water quality relationships suggest a lack of continuity between the shallow and deep ground water. The VT-2 site will be useful for water level and water quality monitoring.

The RP-1 well is screened in a thin, water-bearing zone consisting of gravel and sand. This zone is not considered a major water-bearing zone, with production limited to about 25 gallons per minute. The upper 4-inch piezometer installed to a depth of 39 feet is hydraulically connected to the 2-inch deeper piezometer, installed to a depth of 59 feet. The hydraulic relationship between this well and the nearby Hayes Nursery well cannot be determined because the Hayes well was pumping during the testing of this well. Available data suggest complex hydrogeologic relationships between existing wells and surface water features in the vicinity of the RP-1 well.

Water chemistry results indicate that the water samples for this well meet the state drinking water standards, with the exception of manganese. Manganese is a secondary health constituent which has an undesirable taste and discolors water. Manganese occurs naturally in the ground. It is an essential trace element for humans. Manganese toxicity from drinking water has not been reported. (Drinking Water and Health National Academy of Sciences, Washington D. C. 1977).

Wells VT-1 and VT-2 are being monitored for water levels by the Sammamish Plateau Water and Sewer District, and data are forwarded to Seattle-King County Health Department for inclusion in the Issaquah Creek Valley Ground Water Management Area database (Table 7.6).

7.4 Aquifer Recharge and Protection

This section summarizes ground water recharge in the Issaquah Creek Valley Ground Water Management Area. It describes the source of ground water and how it enters the system, compares the relative physical susceptibility of ground water to contamination in various parts of the basin, provides an estimate of the amount of recharge, and evaluates the vulnerability of the ground water resource to various potential sources of contamination.

This information is important for developing an effective program of ground water management in the basin. The ground water recharge described here considers the water

which reaches the water table. The deeper aquifers generally are recharged from shallow aquifers. However, deep aquifer recharge is more complex and merits further investigation.

7.4.1 Sources of Ground Water

The available information indicates that all ground water in the Issaquah Creek basin originates as precipitation on the basin. In perimeter areas where data are sparse, some contribution may occur from outside the topographic basin which forms the boundary of the study area. Precipitation falling on the basin's land surfaces above the water table infiltrates the unsaturated zone to the saturated zone and then moves downgradient. Once infiltrated, ground water may re-emerge to form springs and streams or enter other surface water bodies. Part of the infiltrated water also may migrate through deeper sediments to underlying aquifers. The ground water in the lower basin discharges to Issaquah Creek, Tibbetts Creek, and finally to Lake Sammamish. Ground water in the upper basin may discharge to the lower basin through the Tiger Mountain Gap or to the Cedar River.

7.4.2 Recharge and Aquifer Susceptibility

The potential for ground water recharge varies from one part of the Issaquah Creek basin to another. Ground water recharge occurs when precipitation infiltrates and reaches the water table of the uppermost aquifer. This process is influenced by many factors, including land use, precipitation, vegetation, topography, soil permeability and moisture, and the permeability of geologic materials between the ground surface and the water table. Some of these factors have been incorporated into ranking schemes that estimate relative recharge potential, such as those used in the Vashon/Maury Island Water Resource Study (Carr/Associates 1983), the Redmond Ground Water Management Report (EMCON 1992), and the DRASTIC method (USEPA/600-2-85/018).

A map of infiltration potential for the Issaquah Creek Valley Ground Water Management Area was created and presented in the December 1994 Draft Issaquah Creek Valley-GWMP. The physical parameters (criterion) used to prepare this map included soils, slope and geology. Subsequent to the December 1994 Draft, a county-wide methodology was adopted to define and rank areas that are physically susceptible to ground water contamination (King County Department of Development and Environmental Services, August, 1995). The county map of physically susceptible ground water supersedes the previous infiltration potential map. The King County Department of Natural Resources has plans to develop a county-wide map of critical ground water recharge areas based on the strategies used to rank areas in the ground water susceptibility mapping process coupled with precipitation data and impervious surface coverage.

The county wide map of physically susceptible ground water areas is shown in Figure 5.5. This map shows areas where ground water is ranked by its relative susceptibility to contamination. Areas are ranked as being of high, medium, and low susceptibility to

ground water contamination. The map, initially published in the 1994 King County Comprehensive Plan, was created under requirements of the Growth Management Act. Since the initial map was published, a revised county wide map has been created using criteria specifying surficial geology, soils and depth to ground water. Each criteria was rated individually as high, moderate, or low according to the protocols listed in Tables 7.7 through 7.9. The three individual scores were combined to yield an overall rating of aquifer susceptibility. It should be noted that soils were assigned one-quarter of the weight assigned to geology and depth to ground water because their occurrence is a result of the physical and chemical weathering processes of surficial geology. A full rating for soils would duplicate surficial geology in the mapping equation.

Soils that are excessively drained or are somewhat excessively drained are rated highly susceptible; soils that are well drained or moderately well drained are rated moderately susceptible; and soils that are somewhat poorly drained, poorly drained or very poorly drained are rated low in susceptibility. Table 7.7 indicates the susceptibility ranking of the USDA, NRCS soil units.

For surficial geology, a clean sand and/or gravel were rated as highly susceptible, tight silt or clay were rated low, and materials (mixtures of and, silt or clay) that fall between the two categories were rated as moderate. Table 7.8 indicates the susceptibility ranking of the USGS geologic units.

The data used to determine depth to ground water was obtained from well logs from the Department of Ecology. Only wells with water levels less than or equal to 100 feet were used in constructing water level contour maps. This reflects the assumption that where depth to water was greater than 100 feet, a relatively impermeable layer would likely exist above the water table. The susceptibility ranking for the depth to ground water criterion is presented in Table 7.9.

Precipitation and land use are not considered in this study of physical susceptibility, but should be considered at a later date in the determination of critical aquifer recharge areas. The Issaquah Creek Valley Ground Water Management Area, ranked by the physical susceptibility of the aquifer, is shown schematically in Figure 5.5.

The areas where ground water is most physically susceptible to contamination in the Issaquah Creek Valley Ground Water Management Area are those areas of soils with very high permeability. They overlie sand and gravel, which were deposited by meltwaters from the receding Vashon glacier. Here, the topography is generally level, although occasionally it is hummocky or steeply sloping, as on the scarps of terraces. In these high-infiltration areas, most surplus water recharges ground water, as little surface runoff occurs. The most important of these areas lies east of the City of Issaquah on the uplands between the East and North Forks of Issaquah Creek.

Most areas mantled with Vashon Till have a low potential for infiltration, and hence, ground water recharge. The local till is a dense mixture of sediment sizes with low

permeability. Some water infiltrating the till's surface layer, which has a slightly higher permeability, percolates downslope on the top of the unweathered till to discharge into wetlands. Some of the water in the soil slowly percolates through the till or along scattered fractures in the till to deeper zones. The till is usually underlain by outwash sand and gravel, which forms an important aquifer in the area. Over large areas, the slow recharge through the till can provide substantial quantities of water to the deeper aquifers. Till-covered areas probably provide most of the recharge in the southwestern portion of the Issaquah Creek Valley Ground Water Management Area.

Areas of steep bedrock slopes probably have a low potential for infiltration. Many of the soils in this area have a high permeability, which promotes infiltration. Below the soil, the water encounters low-permeability bedrock, which sheds the water downslope along the bedrock surface to the valleys where it either enters streams or recharges the valley aquifers. Some of the percolating water may enter fractures to recharge deeper bedrock aquifers of limited extent and importance.

The valley floors are underlain by diverse sediments ranging from fine sand and silt to coarse sand and gravel. These deposits are oftentimes overlain by silt and muck, which seal them from surface infiltration. Some areas with coarser-grained surface deposits and a water table below the land surface receive local recharge. In most of the lower valley, a high water table and fine-grained surface deposits located above underlying aquifers prevent local recharge.

Land use, both current and historic, influences actual recharge. Precipitation also affects the actual quantity of recharge. These effects were not included in determination of physically susceptible ground waters (see Figure 5.5). These criterion will be included in critical aquifer recharge maps for King County which are expected to be produced using the physical susceptibility maps in conjunction with land use information and precipitation data.

7.4.3 Ground Water Vulnerability

Aquifer vulnerability is a composite of susceptibility and contaminant loading. Susceptibility refers to the ease with which contaminants can move from the land surface to the ground water. The greater the susceptibility, the more readily a contaminant can reach the water table. Contaminant loading refers to the actual presence of activities with the potential to contaminate. Thus, a vulnerable aquifer is one under an area with high susceptibility which has a high contaminant loading, without an upper confining layer.

Aquifer susceptibility is assessed by the same factors that were used to delineate potential recharge areas: soils, geology, and ground water levels. Areas with high recharge potential are highly susceptible because the recharging water may transport contaminants to the water table.

A map showing potential sites where contaminant loading may occur is shown in Figure 5.4. These maps show where contamination sources have occurred in the basin to 1991.

Activities with the potential to contaminate are listed in Table 7.10. Appropriate mitigation should be associated with these activities. These activities should be discouraged in sensitive aquifer recharge areas, as should activities which reduce recharge (Table 7.11).

Lower Issaquah Creek Valley

Lower valley aquifers are a productive source of ground water used for the Issaquah Creek Valley Ground Water Management Area's major public supply systems. Soils in the area are subject to fluctuating high water table conditions. The degree of hydraulic continuity between the surface and aquifer zones is largely unknown. On the east side of the lower valley, there is evidence that the upper aquifer zone A1 recharges the lower A2 zone under pumping conditions, thus raising concerns that surface contaminants may have hydraulic access to lower aquifer zones.

Several potential contaminant sources are present in the City of Issaquah and surrounding areas. These potential contaminant sources, such as underground storage tanks, are likely to increase in number due to growing development pressures. Most large supply wells are located near major transportation corridors and in the vicinity of high-intensity land uses. The potential impact to water quality from upstream contaminant sources in the upper Issaquah Creek valley and Cedar Hills area is unknown. Monitoring of on-site and off-site wells and springs between the Cedar Hills Landfill and Issaquah Creek is conducted by King County. This is discussed in detail in Section 5.5 of this report (Landfills and Industrial Waste Sites).

During the period of this study, several spills and related events have occurred in the lower Issaquah Creek Valley. These events have threatened the water quality in some existing high-capacity production wells. The actual impact of these spills has been lessened by rapid remedial response and modified withdrawal patterns from the potentially affected wells.

At the present time, the lower Issaquah Creek valley is probably the most vulnerable part of the ground water resource. In this area, high-capacity wells have been completed at relatively shallow depths in coarse-grained sediments that generally are not separated from the surface by impermeable sediments.

Upper Issaquah Creek Valley

Upper valley aquifers are used primarily for small community and domestic supply systems. Soils and geologic materials vary greatly in permeability and properties affecting vulnerability to contamination. Water tables are high in some areas and the extent of surface water and ground water interconnection is not documented.

Septic tank systems, animal keeping, isolated commercial and industrial sites, and transportation corridors represent the more obvious potential sources of ground water contamination. Development activities in the area are likely to result in introduction of a number of additional contaminant sources. Upgradient contaminant sources such as Cedar Hills Landfill and Queen City Farms Superfund Site are also a potential threat to water quality.

Upland and Mountain Areas

With the exception of Mirrormont, water is provided by Group B public water systems and individual domestic wells. Contamination of a mountain or upland aquifer would result in serious problems for rural residents because alternative water supply sources are not readily available. Here too, the incidence of ground water contamination is less likely to be discovered because water quality monitoring is not routinely performed.

Upland and mountain aquifers vary greatly in their susceptibility to contamination. Mountain soils and some upland soils are typically thin, steeply sloping, and poorly suited for septic tank systems. In general, wells completed in shallow aquifers are subject to contamination, especially from septic tank systems and animal-keeping practices. Many mountain and upland wells are completed in shallow, relatively unprotected aquifers.

Residential development in these areas is expected to intensify; thus, the number and density of potential contaminant sources will increase. The Cedar Hills Landfill and the Queen City Farms Superfund sites represent contaminant sources with potential for great impact upon the water quality of shallow and lower aquifers in the Cedar Hills area.

7.5 Water Budget

Ground water used in the Issaquah Creek Valley Ground Water Management Area is only replenished by precipitation. The following sections describe processes influencing the Issaquah Creek Valley Ground Water Management Area hydrologic cycle. A water budget was prepared to put these processes into a quantified relationship with each other.

This budget is a hydrologic accounting tool used for estimating the annual quantity, availability and movement of water entering and exiting a basin. Components of the budget include precipitation, evapotranspiration, storm runoff and baseflow, ground water basin transfers, ground water discharge, and change in storage. These processes are in reality far more complex than the variables represented in the water budget equation. Values used in the equation are derived from estimates and imperfect data, but nonetheless are useful for developing a general sense of the water regime. Future investigations and ground water management decision-making should be mindful of the limitations of these estimates.

A simplified equation for this budget is: Inflow = Outflow + Change in Storage

The water balance equation can be expressed in greater detail by the following equation:

$$P = ET + SF + BF + GT + GD + dS \quad (1)$$

where:

P	=	Precipitation
ET	=	Evapotranspiration
SF	=	Storm Runoff
BF	=	Baseflow
GT	=	Ground Water Basin Transfers
GD	=	Ground Water Discharge
dS	=	Change in Storage

7.5.1 Precipitation

Precipitation data, a critical component in all water balance calculations, are available for 18 local monitoring stations within or near the study area and for six regional monitoring stations. The local monitoring stations include four Department of Natural Resources sites, five King County Surface Water Management sites, eight sites that were established through the Issaquah Creek Valley Ground Water Management Area program, and King County's Cedar Hills Landfill station. The four Department of Natural Resources sites are Fifteen Mile Creek, Tiger Mountain, Preston and the Issaquah Fish Hatchery. Data have been collected at these sites since 1986. The five King County Surface Water Management sites set up in 1988 are located at upper Tibbetts Creek, Grand Ridge, East Fork of Issaquah Creek, McDonald Creek and Holder Creek. The eight sites established in 1989 by Seattle-King County Health Department are Francis Lake, LeRoux, Rothnie, Maple Hills Park, Cougar Mountain, Grand Ridge, High Valley and Issaquah. These sites were selected to provide additional coverage within the planning area. The precipitation measurements at these sites are collected by volunteers. Locations of the rain gages are depicted on the map in Figure 7.13. The list of the location of precipitation and stream gaging stations, numbered in Figure 7.13, can be found in Table 7.12. The criteria used to select precipitation gauging sites include:

- Site Distribution - Establish sites in areas where data are not presently being collected. Focus data collection on higher elevation sites where existing data are limited.
- Representative - The site is not obstructed in a 45 degree cone projecting from the orifice of the gauge, shielded from nearby ground turbulence, and is offset from roof spray and gutter splash.
- Orographic Significance - Establish sites where terrain and seasonal storm directions are likely to influence precipitation patterns.
- Accessibility - The site is easy to measure on a regular basis (e.g. backyard, work place, or routine checkpoint).

- Security - The site is protected from vandalism, animals, and accidental damage.
- Permanency - The location of the gauge is not likely to change.
- Commitment and Responsibility - The data collectors must be committed to collecting data for the term of the project.

Data for these stations are presented in Appendix G (available upon request). The regional monitoring stations include SeaTac Airport, Kent, Cedar Lake, Snoqualmie Falls, Sand Point, and Landsburg.

The Cedar Hills station has the longest period of record in the project area (1974 to present). The average annual precipitation at this station is 54.44 inches per year (in/yr). Because precipitation for 1988 was very close to the long-term average conditions (98 percent of normal), this period was selected to assess the distribution of average precipitation within the study area. Precipitation data were available for all local and regional stations during 1988 with the exception of the Issaquah Creek Valley Ground Water Management Area monitoring stations established in 1989. Estimates of 1988 precipitation for Issaquah Creek Valley Ground Water Management Area sites were derived by normalizing 1990 values by the ratio of 1988 to 1990 values available from other sites.

A contouring program (Surfer) was used to generate a precipitation isohyetal map showing lines of equal precipitation for the area. The results of this analysis are presented in Figure 7.14, along with the station locations and 1988 precipitation totals.

Precipitation inflow within the Issaquah Creek Valley Ground Water Management Area was calculated by adding the amounts of precipitation in each precipitation interval and averaged over a year. Based on this analysis, the total precipitation inflow for 1988 is 244.4 cfs. The adjusted precipitation inflow for a normal year is 249.4 cfs.

7.5.2 Evapotranspiration

Evaporation and transpiration, collectively referred to as evapotranspiration, represent a loss of liquid water from the water budget through its transformation to vapor. Transpiration is performed by living plants (such as trees) when water is taken up through the roots, processed and released as vapor through tissue cells in the leaves and bark. Evaporation includes the vaporization of water from the soil, parking lots and rooftops, forest canopies and plant surfaces, or open water such as lakes and streams.

This component was estimated using the Blaney-Criddle method (USSCS 1970). This method uses crop, latitude, and temperature to calculate potential evapotranspiration. A simple water balance within the soil, based on rainfall and potential evapotranspiration, was then used to relate potential evapotranspiration to actual evapotranspiration. In this balance, actual evapotranspiration equals potential evapotranspiration as long as

precipitation is sufficient to keep the soil moist enough to provide plants with water. When the soil is drier, actual evapotranspiration is less than the potential rate.

For this analysis, the soil mass balance procedure has been computerized to calculate the actual evapotranspiration rate on a weekly basis. In this analysis, monthly data (rainfall and temperature) are distributed evenly over four weeks of the month.

When precipitation was equal to or greater than potential evapotranspiration:

$$AET = PET$$

When precipitation was less than potential evapotranspiration:

$$AET = PET \text{ (when } SM/SMC \geq 0.75)$$

or

$$AET = PET * 1.333 * (SM/SMC) \text{ (when } SM/SMC < 0.75)$$

where:

AET	=	Actual evapotranspiration (in/yr)
PET	=	Potential evapotranspiration (in/yr), calculated by the Blaney-Criddle method
SM	=	Soil moisture content from the previous week (in)
SMC	=	Soil moisture holding capacity (in)

This linear function of the ratio of actual water content to soil moisture holding capacity is one of at least five methods used to relate actual evapotranspiration to potential evapotranspiration, reported in Dunne and Leopold (1978). The soil moisture holding capacity over the project area varies and is not accurately known. This analysis assumes a soil moisture holding capacity of six inches.

The choice of values for representative evaporation and transpiration estimates related to crops is problematical. It is related to variable climatic conditions and the amount of sunlight received and soil moisture utilized by vegetation over an annual year. Figures for crops in eastern Washington will be higher than those in western Washington. It is expected that conifers in western Washington will produce more evapotranspiration than most crops under unirrigated conditions. This is because the conifers will intercept more precipitation and evaporate it away than conventional crops in our geographic location, and because their rooting depth is generally greater than most grass crops. This allows for greater moisture extraction during low moisture conditions. In addition, conifers are capable of transpiring some moisture during periods of relatively low sunlight. This grass crop factor was used in this analysis because of the availability of the data from eastern Washington studies. Comparison of this data with US weather service information on evapotranspiration that is 40 years old is similar. Updated information on evapotranspiration is needed. (Martin, W., Fisher, J., DeBell, D., and Handson, J., personal communications, and Kelliher and Lenning, *Evaporation and Canopy Characteristics of Conifer Forests and Grasslands,* US Weather Bureau, *Normals of Precipitation and Evaporation, and* Dunne, Leopold, *Water in Environmental Planning.*)

Based on the above-stated methods and assumptions, the average calculated evapotranspiration rate for the basin is 18.8 in/yr. Based on Issaquah Creek's total basin drainage area of 56.6 square miles, the total evapotranspiration outflow from the system is 78.3 cfs based over one year.

7.5.3 Storm Runoff and Baseflow

Stream flow data are critical elements in evaluating a water balance relationship and when providing an insight into possible hydrogeologic impacts related to ground water development. The interrelationship of ground water and surface water is a crucial concept in the management of these resources. This is particularly true to maintaining streamflow and wetlands given that ground water development can reduce inflow to these features.

Historical stream flow data are available for 17 gauging stations within or near the study area. The gauging stations include four Department of Natural Resources sites, seven King County Surface Water Management sites, and six United States Geological Survey sites. Continuous recording data loggers are used to record stage data at most of the sites. The United States Geological Survey sites generally provide the longest period of recorded data. The Surface Water Management stations were installed in 1988. The stream gauging stations are summarized in Table 7.13, and station locations are shown on Figure 7.13. Data for these stations are presented in Appendix G (available upon request).

Storm runoff and baseflow quantities were evaluated using the stream gauging data for USGS Station 121216. This station is located near the mouth of Issaquah Creek just upstream from Lake Sammamish. All surface water runoff for the Issaquah Creek basin discharges through this point. The total drainage area above the gauge is 56.6 square miles.

A 3-year hydrograph for Station 121216 is presented in Figure 7.15. Included on the hydrograph is the baseflow curve that reflects the ground water discharge input to the stream. Storm runoff is the difference between the total stream flow and the baseflow curves. A portion of this baseflow is a diversion of the Cedar River watershed.
Average stream flow (total flow) from 1988 through 1990 was 115.2 cfs. Baseflow for this same period was 79 cfs, or about 69 percent of the total average stream flow. The average storm runoff during this period was 36.2 cfs, or about 31 percent of the total.

7.5.4 Interbasin Transfers - Imports and Exports

Imports of water to the Issaquah Creek Valley Ground Water Management Area are not thoroughly identified or quantified. USGS stream records indicate that flow from 1.9 square miles of the upper Rock Creek watershed (Cedar River drainage), south of the Issaquah Creek Valley Ground Water Management Area, is diverted into Issaquah Creek.

How this diversion takes place is beyond the scope of this study. However, Issaquah Creek basin discharge calculations already take into account contributions from the upper Rock Creek watershed.

Some public water supply systems on the periphery of the Issaquah Creek Valley Ground Water Management Area are importing relatively small quantities. King County Water District No. 90 serves residential development in the May Valley area and near Lake McDonald with water purchased from the Seattle Water Department. The water originates in the Cedar River Watershed.

Export of water from the Issaquah Creek Valley Ground Water Management Area basin is significant. The City of Issaquah, Sammamish Plateau Water and Sewer District, Darigold Dairy, and various small public supply systems use a supply entirely derived from ground water. After use for water supply purposes, most of this water becomes wastewater. Wastewater from these areas, where sewered, is pumped out of the Issaquah Creek Valley Ground Water Management Area to King County Department of Natural Resources, Wastewater Treatment Division's Renton sewage treatment plant. The remaining percentage is lost to consumption as evapotranspiration, runoff, or system leakage (see Table 7.14).

Infiltration and inflow into sewer systems within the City of Issaquah and Sammamish Plateau service areas also represent potential export losses. Another export is the leachate collected at Cedar Hills Landfill and sent to King County Department of Natural Resources, Wastewater Treatment Division's Renton treatment plant (see Table 7.14 for estimated exports based on King County Department of Natural Resources, Wastewater Treatment Division and water use records). Table. 7.14 includes only the most significant exports.

7.5.5 Intrabasin Translocation

Intrabasin translocation is water artificially moved from one hydrologic location to another or the distribution of ground water to areas not in direct hydraulic continuity with their source. For example, the provision of drinking water to distant homes and the subsequent disposal of this water through on-site septic tank systems may result in loss of water from one aquifer system, and artificial recharge to another shallow aquifer.

Except for losses to consumption or runoff, the net effect on the basin is minor. Intrabasin translocations are not computed in the basin water budget because they are not sufficiently known. Although they are suspected not to be significant overall, nonetheless they should be recognized as a potential local ground water management concern.

7.5.6 Change in Storage

Analysis of short-term water level trends (see Figures 7.12A through 7.12H) indicates that water levels within the basin are stable at this time. It appears that present ground water withdrawals are not causing significant changes in storage. Thus, changes in basin storage are assumed to be zero in the water balance assessment. However, long term collection of water level data is needed to determine water levels trends in the basin.

7.5.7 Ground Water Discharge

Ground water discharge (GD) consists of the subsurface underflow that exits the Issaquah basin. It is estimated by the residual or unaccounted for portion of the water balance and is calculated from Equation 1 as follows:

$$GD = P - ET - SF - BF - GT - ds \quad (2), \text{ or}$$
$$GD = 249.4 - 78.3 - 42.9 - 96.2 - 7.5 - 0 = 24.5$$

Based on the above analysis, the calculated ground water discharge from the system is 24.5 cfs. This discharge is to Lake Sammamish and possibly the Cedar River.

7.6 Water Quality

Historical ground water quality was compiled from the Washington Department of Health, the U.S. Environmental Protection Agency, and the Department of Ecology data sources. Little long-term data are available for the area. Monitoring of organic compounds is almost non-existent outside the limits of the Cedar Hills Landfill and Queen City Farms.

Data collection efforts were directed towards achieving the following:

- Long-term trend data
- Identification of potential sources of contamination
- Baseline organic and inorganic ground water chemistry for the project area
- Water quality of shallow ground water systems
- Assessing water chemistry of public water supplies as it relates to primary maximum contamination limits.

The monitoring network's purpose was to provide adequate background data to assess the impacts of land use activities on ground water quality. The type of land use activity can have a direct impact on water quality parameters found in ground water. For example, measuring a trend of increasing nitrate, chloride, or conductivity levels may indicate the failure of on-site sewage facilities. Likewise, detecting a pesticide in ground water quality samples would imply the possibility of nearby agricultural activity.

Group A sampling and analysis is oriented towards definition of the general inorganic ground water chemistry within the project vicinity. Monitoring for Group A parameters was carried out in 19 wells (see Table 7.6). The King County Department of Natural Resources, Solid Waste Division samples four wells for Group A and B parameters at the Cedar Hills landfill and Queen City Farms. The Seattle-King County Health Department Solid Waste Division samples seven wells for Group A and B parameters around the Cedar Hills landfill and Queen City. A listing of the Group A parameters is presented in Table 7.15.

The process for site selection was similar to that used to select water level monitoring sites. The criteria used in site selection included the following:

- Site Distribution - Establish sites in areas where data are not presently being collected.
- Hydrogeologic Significance - Appropriate location/depths for defining horizontal/vertical variability of ground water chemistry.
- Sampling Access - Select sites where a sampling tap exists or can be easily installed.
- Well Log - The well has a complete and reliable well log.
- Locatable - The well can be located in the field and verified with the well log.

Three sampling rounds for Group A parameters were collected in March 1990, June 1990, and December 1990.

Group B sampling and analysis is oriented towards detection of ground water contamination in the project area and the evaluation of the extent to which land use patterns affect ground water quality. Monitoring for Group B parameters was carried out in eight wells. The list of Program B water quality monitoring sites is presented in Table 7.6. The locations of the sampling wells are shown on Figure 7.16. A list of the Group B parameters is presented in Table 7.16 (volatiles), Table 7.17 (semi-volatiles), Table 7.18 (pesticides, PCBs) and Table 7.19 (priority pollutants).

The criteria used in the Program B site selection was similar to that used for Program A, with the exception that new sites (i.e., in addition to the on-going Program B monitoring in vicinity of Cedar Hills Landfill and Queen City Farms) were primarily located in the northern portion of the study area where urbanization and land use activities pose the greatest threat to water quality. Additional Group B sampling sites were not selected in the vicinity of the Cedar Hills Landfill or Queen City Farms because water quality monitoring is currently being conducted by King County Solid Waste Division and Seattle-King County Health Department.

Group B (volatiles) samples were collected from eight wells in March 1990 and December 1990. Samples were collected in accordance with the procedures listed in the Issaquah Creek Valley Ground Water Management Plan, Quality Assurance Project Plan, March 1990. Samples collected were analyzed by AmTest, a laboratory certified by the

Washington Department of Health. Samples results and laboratory procedures were validated by the Pacific Ground Water Group.

On the Sammamish Plateau, water quality sampling and analysis was carried out under the East King County Ground Water Management program. Sources for water quality data include samples collected by the USGS in July and August 1991 and samples collected by the Seattle-King County Health Department from June 1994 through May 1995.

The USGS study included the one-time collection and analysis of samples from 121 wells and 3 springs during July and August 1991. The samples from all these sites were analyzed for bacteria, metals, inorganics, and physical characteristics. A subset of 11 sites were sampled for volatile organic compounds and another subset of 12 for selected pesticides. Other subsets were tested for boron, dissolved organic carbon, methylene blue active substances and radon.

Based on the USGS recommendations, the Seattle-King County Health Department collected samples from a 23-well network. Five quarterly rounds of samples were collected, beginning in June 1994 and ending in May 1995. All these wells were tested for bacteria, metals, physical and inorganic parameters. A subset of 9 wells were tested in June 1994 for volatiles and semi-volatiles. Eleven wells were sampled for pesticides, polychlorinated biphenyls, and herbicides in June and December 1994. The wells tested for organic compounds were chosen based on location and potential for certain types of contamination.

The criteria used by the Seattle-King County Health Department followed the USGS criteria for site selection, which included the following:

- availability and access permission by well owner;
- practicality and feasibility of collecting samples from wellhead;
- wells previously sampled by the U. S. Geological Survey that were out of compliance with State Board of Health Drinking Water Quality Standards for arsenic, fecal coliform, and pesticides;
- wells where contamination is present from other sampling efforts;
- areas of potential contamination;
- wells that are used for municipal, irrigation and domestic purposes and that have been previously inventoried;
- areal distribution; and
- the geohydrologic unit in which the well is completed.

Samples from the Sammamish Plateau wells were collected in accordance with the procedures listed in the *East King County Ground Water Management Plan, Quality Assurance Project Plan/Data Collection and Analysis Plan*, December 1994. Samples were analyzed by AmTest Laboratory which is certified by the Washington State

Department of Health. Sample results and laboratory procedures were validated by the Seattle-King County Health Department.

Water quality data collected during the course of this study and available from earlier analyses indicate that the ground water quality in the Issaquah Creek Valley Ground Water Management Area basin is generally excellent. The ground water generally meets all State of Washington Department of Health standards for public drinking water supplies. The iron and manganese results from a few wells exceeded the Washington Department of Health Standards. However, manganese and iron are naturally occurring elements which effect taste and cause fixture staining. They are only a health concern in that they can interfere with the treatment of drinking water.

7.6.1 Organic Compound Results

Of the 130 volatile and semi-volatile organic, pesticide, and PCB compounds analyzed, only two, acetone and methylene chloride, showed concentrations which were slightly above detection limits. Reported concentrations near detection limits are difficult to interpret because such results can be influenced by other sources, such as laboratory or other errors. Data from other sources have shown the presence of hydrocarbon compounds in shallow ground water at some locations in lower Issaquah Creek valley (Geraghty & Miller March 1991 and 1992; Applied Geotechnology 1989; Rittenhouse-Zieman & Associates 1990; EA Engineering 1990; Kleinfelder 1991). These contaminants are present as a result of spills and leaks which have occurred at local service stations. To date, no such compounds have been identified in production wells in the lower valley. The real potential for similar, future incidents mandates continued monitoring and analysis for volatile and semi-volatile organic compounds.

7.6.2 Inorganic Compound Results

The inorganic analyses showed the presence of ions characteristic to Puget lowland ground water. These include inorganic compounds, such as iron and manganese, which can occur naturally in local ground water. Such metals are present in the soils and sediments of the basin and can be dissolved by contact with ground water. Key inorganic indicators have been evaluated during this testing period, as shown in Figures 7.17 through 7.23.

Figure 7.16 shows the locations of sampled wells by number and owner name. The key inorganic indicators evaluated here include:

- Total Dissolved Solids Sodium
- Total Hardness Nitrate
- Calcium Chloride
- Magnesium Arsenic

These parameters represent some of the important ions and indicators of dissolved constituents. Total dissolved solids, hardness, calcium, and magnesium are indicators of the amount of time ground water has been in contact with the sediments. Sodium also can be an indicator of residence time, sea water intrusion, or contamination by septic effluent. Nitrate and chloride can be indicators of effluent contamination. Arsenic occurs in some similar settings in the Cascade foothills and merits more detailed analysis in the Issaquah Creek Valley Ground Water Management Area.

7.6.3 General Discussion of Water Quality

As ground water infiltrates through the soil and moves through sediments and rocks, its quality changes. These changes result from the exchange of gases, such as oxygen and carbon dioxide, and the solution of minerals from surrounding rocks. The type(s) and degree(s) of change are effected by differences in geology and residence time. Geologic differences can produce different ionic ratios, such as the calcium to potassium ratio and the chloride to sulfate ratio.

Concentrations generally increase with residence time, because the longer the ground water is in contact with mineral matter, the greater the opportunity for dissolution to occur. Ground water that has moved over a long distance, or to great depths, or traveled more slowly will have higher concentrations of dissolved minerals than ground water which has flowed only a short distance, to shallow depths, or at high rates.

These influences can be assessed by comparing water quality in wells located in different parts of the basin and those completed at different depths and in different materials. In the study area, these influences were analyzed using the results from three sampling episodes for selected wells. These results are illustrated in Figures 7.17 through 7.23. The data are presented in Appendix H (available upon request).

Comparison of water quality data is complicated by temporal variations of some parameters that are larger than the differences between wells. For instance, the variation in concentration between sampling episodes for total dissolved solids (TDS) ranges from 30 to 200 mg/L. For hardness, the temporal variation is 40 mg/L, and for sodium, it is 20 mg/L. These variations may reflect the influence of seasonal recharge patterns or other causes. The duration of the sampling period was too short to fully evaluate seasonal water quality variation.

However, some generalizations are possible. Water from wells completed in bedrock tends to have higher concentrations of sodium and lower concentrations of calcium than those of water from wells completed in sand and gravel. The Agnew, Mitchell, and Preston wells are completed in bedrock. Water analyses show the sodium concentration in two of them (Agnew and Mitchell) exceeds 80 mg/L, and the calcium is less than 20 mg/L. The Adams, Greening, Overdale, and Pommer wells are completed in sand and gravel, and analyses of water samples show sodium concentrations below 20 mg/L and calcium concentrations above 20 mg/L. Some exceptions exist. Samples from the

Preston well, completed in bedrock, show only 4 to 6 mg/L sodium and 10 to 30 mg/L of calcium. Samples from the Pommer Well, completed in sand and gravel, show over 30 mg/L sodium and less than 20 mg/L calcium. These differences in sodium probably result from the weathering of sodium-rich minerals in the igneous rocks.

The available water quality data show no spatial variations. No definitive changes in water quality are apparent in the downstream direction. The water quality of water from the Greening and Adams wells in the southern portion of the basin is similar to the water quality of the Overdale well in the northern portion of the basin.

In the Issaquah Creek Valley Ground Water Management Area, local land use can influence water quality. Slightly elevated concentrations of nitrate and chloride in the Greening Well (see Figure 7.19) may be related to septic tank effluent or runoff from livestock pens. As shown in Appendix H (available upon request), similarly elevated concentrations of nitrate appear in several other sampled wells, including Leroy, 23N/6E-33; Jackson, 23N/6E-27C01; Hall, 23N/6E-03K02; Zetech, 24N/6E-28F02; and others.

In the March 1990 sampling event, nitrate levels were detected in 19 of the 24 wells sampled. The nitrate results ranged from 0.10 to 2.5 mg/l.

In the June 1990 sampling event, no nitrate levels were above the 0.2 mg/l detection level in the 19 wells sampled. As nitrates were not detected in the June 1990 sampling event, this suggests that winter conditions, due to precipitation, may allow local nitrates to infiltrate the aquifer while summer conditions, due to a lack of precipitation, arrest infiltration. In the December, 1990 sampling event, 7 of the 19 wells sampled were above the nitrate detection level with results ranging from 0.96 to 2.1 mg/l.

The wells where nitrate levels were detected are scattered throughout the Issaquah Creek Valley Ground Water Management Area. Further monitoring of these wells to assess and determine the nitrate source(s) is necessary. Table 7.10 shows the causal linkage between land use activities and potential resultant contaminants.

Ground water contamination investigations have been conducted by the U.S. Environmental Protection Agency at the Queen City Farms Superfund Site. Studies have also been conducted by Ecology at sites in and outside the City of Issaquah where underground storage tanks were discovered leaking. Surface water quality studies have been performed by Ecology, King County Department of Natural Resources, Water and Land Resources Division, and King County Surface Water Management. King County Solid Waste Division has an extensive water quality data base for Cedar Hills landfill.

7.6.4 Wellhead Protection Study

As part of the Lower Issaquah Valley Wellhead Protection Plan (Golder Associates 1993) three rounds of water quality samples were taken from wells located throughout the lower Issaquah valley between May 1992 and April 1993, as summarized on Table 7.20. The

samples were analyzed for various constituents, including the major anions and cations, priority pollutant metals, iron and manganese, nitrate, turbidity, volatile organics, pesticides, herbicides, and PCBs. Additionally, water quality sampling was performed between 1990 and 1992 (Geraghty and Miller 1992) in 18 monitoring wells around the ARCO Station at the corner of Gilman Blvd. and Front Street after a leak in one of the underground storage tanks was detected. These data were provided to the Wellhead Protection Plan study. The Department of Ecology also performed sampling at six sites in Issaquah and analyzed for lead and organic compounds (The Department of Ecology 1992).

Four of the eleven City of Issaquah and Sammamish Plateau Water and Sewer District's wells monitored in the Issaquah Creek Valley Ground Water Management Area program were monitored for water quality parameters in the Wellhead Protection Study (see Table 7.21). The remaining seven wells monitored in the ground water study were monitored for water levels only in the wellhead protection study (see Table 7.21).

The ground water within the lower Issaquah valley generally contains few dissolved solids, and is classified as a calcium bicarbonate type of water. In general, the ground water quality from production wells within the lower Issaquah valley is excellent, with only slightly elevated iron and manganese concentrations. Pesticides or PCBs were not detected within the lower Issaquah valley, and priority pollutant metals are below regulated limits. The pesticides sampled for were the same as those listed in Table 7.18. Shallow ground water contamination from volatile organic compounds associated with underground gasoline storage tanks has been documented above drinking water standards in shallow monitoring wells in the lower Issaquah valley. The organic compounds (benzene, toluene, ethylbenzene, and xylene) have been detected in other monitoring wells and are discussed in the City of Issaquah's and the Sammamish Plateau Water and Sewer District's Wellhead Protection Plan (Golder Associates 1993).

Surface water quality in the lower Issaquah valley is important to ground water quality since it is often indicative of the quality of storm water runoff, which may reach ground water through direct infiltration. Stream water quality is summarized briefly below, with an emphasis on drinking water constituents rather than toxicity to fish or riparian habitat.

During baseflow conditions, King County Department of Natural Resources, Water and Land Resources Division monitors several sites within the watershed on a monthly basis. The monitoring is part of its annual quality of local lakes and streams program. Three sites on Issaquah Creek and one site on Tibbetts Creek are monitored. In addition, King County Department of Natural Resources, Water and Land Resources Division has collected grab samples during high flows and storms since 1987 from one site on Issaquah Creek. King County Department of Natural Resources, Water and Land Resources Division further collected five samples from five sites within the Issaquah basin during 1989 and 1990 as part of a storm water quality sampling program.

Between 1989 and 1990 dry season fecal coliform geometric means of four of the five stream locations exceeded state water-quality standards. The East Fork Issaquah Creek location did not exceed the standard. Yearly geometric means exceeded state standards in three of the five sites, while the wet-season state standard was exceeded in only Tibbetts Creek. An evaluation of baseflow metal concentrations indicated that copper, chromium, iron, nickel, and zinc concentrations were below their respective aquatic standards, and cadmium, mercury, and lead concentrations were below detection limits. There is hydraulic continuity between surface and ground water, with ground water providing the baseflow for streams during periods of low or no rainfall. Constituents found in streams can infiltrate into the ground and may impact ground water quality.

Two fish kills occurred on the North Fork Issaquah Creek in March and April, 1990. Water and tissue samples indicated the fish kill was due to a combination of elevated metal, ammonia, sulfides, 1,2 benzenedicarboxylic acid, and diisonyl ester along with low hardness (Lower Issaquah Valley Wellhead Protection Plan, Golder Associates 1993).

7.7 Conclusions

The results presented in this report are based on previously existing data, data collected as part of the Lower Issaquah Valley Wellhead Protection Plan, (Golder Associates 1993) and data collected during the course of this Ground Water Management area study. Current regional planning suggests that ground water resources of the Issaquah Valley will remain a primary source of subregional public and private domestic water supplies for the foreseeable future. Maintenance and enhancement of the existing quantity and quality of water will require careful management of the resource. The findings of this project have resulted in the following conclusions:

1. Precipitation inflow within the Issaquah Creek Valley Ground Water Management Area was calculated by adding the amounts of precipitation in each precipitation interval. The precipitation inflow for 1988 was 244.4 cfs. The adjusted precipitation inflow for a normal year is 249.4 cfs.

2. The average stream flow (total flow) from 1988 through 1990 was 115.2 cfs. Baseflow for this same period was 79 cfs, or about 69 percent of the total average stream flow. The average storm runoff during this period was 36.2 cfs, or about 31 percent of the total.

3. The average stream flow from 1988 through 1990 (115.2 cfs) was 82 percent of normal conditions (140.7 cfs). Therefore, the storm runoff and baseflow quantities were adjusted to reflect long-term average conditions. Assuming that the ratio of baseflow to total runoff remains constant over time, the normalized storm runoff and baseflow quantities are 42.9 cfs and 96.3 cfs, respectively.

4. The 56.6 square-mile Issaquah Creek drainage basin produces an estimated ground water discharge of 25 cfs (not including baseflow). The actual discharge may be less than this estimated amount if drainage from the upper basin above the Tiger Mountain Gap is being naturally diverted toward the Cedar River drainage.

5. The basin has three distinct hydrostratigraphic units. These are bedrock, aquitard and the aquifer as described in Table 7.5. Local bedrock forms a basement aquitard which retards ground water movement from the basin. The bedrock's structural features, coupled with its recent glacial erosion, have created a highly variable bedrock surface.

6. The major aquifers of the basin are present as deltaic and alluvial sediments and are located adjacent to the valleys. In the lower valley, these aquifers are capable of supplying in excess of 1,000 gallons per minute to properly constructed wells. Other parts of the basin with less permeable aquifers allow development of wells capable of producing 5 to 100 gallons per minute.

7. In most parts of the basin, the major aquifers are separated by discontinuous aquitards of silt and clay and low-permeability, glacial sediments.

8. Water quality in the basin is generally excellent. Volatile organic compounds have been found in shallow ground water at spill sites in the lower valley. To date no volatile organic compounds have been found in major aquifers or wells. Analyses of inorganic ions show the presence of parameters characteristic to those of Puget Sound area ground waters. At some locations, iron, manganese, and other naturally occurring contaminants occur in excess of the secondary maximum contaminant levels. Water quality in the bedrock is typically inferior to water quality in the unconsolidated aquifers. Some seasonal variation in water quality has been noted. Local land use activities appear to influence local water quality and could impair it.

9. The basin has areas of low, medium, and high infiltration potential. Most of the ground water recharge occurs in high infiltration potential areas. These areas are present along permeable outwash slopes of the lower valley and in areas of coarse-grained deltaic sediments in the upper and lower parts of the basin. The total ground water recharge in the basin is estimated to be between 21 and 51 cubic feet per second (13 to 33 million gallons per day), normalized over a one year period.

10. From well logs, cross sections A-A'-A", B-B' and C-C' were constructed to define the distribution and extent of aquifers and aquitards. These cross sections show some of the geology and extent of the aquifers. New wells drilled will further refine the geology, the extent of aquifers and directional flow of ground water.

11. The four wells drilled in the Issaquah Creek Valley Ground Water Management Area in 1990 and 1992 provide data on aquifer permeability, quality and the hydraulic connection between aquifers. Two wells were drilled in permeable zones, while two wells were drilled in zones not considered major water-bearing zones.

12. Two wells had manganese levels above the maximum contamination level and one well had iron levels above the maximum contamination level. In one well there was a lack of continuity between the shallow and deep aquifers while in another well the peizometers were hydraulically connected.

13. The results of drilling these four wells show the complexity and diversity of the ground water resource and geology in the Issaquah Creek Valley Ground Water Management Area. More data from these wells and new monitoring wells drilled in the Issaquah Creek Valley Ground Water Management Area will further refine the characterization of the aquifers in the Issaquah Creek Valley Ground Water Management Area.

14. The well water levels monitored monthly from forty-eight well sites in the Issaquah Creek Valley Ground Water Management Area had variations resulting from seasonal fluctuations and the effects of pumping of the aquifer. Monitoring of water levels for trends over a long period to assess the impacts of recharge, pumping, and population growth on the ground water resource, is needed.

The Lower Issaquah Valley Wellhead Protection Plan study by Golder Associates in 1993 concluded that:

1. The stratigraphy within the lower Issaquah valley is highly complex, consisting of shallow alluvium, recessional outwash, delta, till, lacustrine, and undifferentiated glacial deposits. The delta deposits are highly permeable and are the most important source of ground water within the lower Issaquah valley. Recessional outwash is also highly permeable, and occurs in the eastern higher elevations providing an important media for ground water recharge. The shallow alluvial deposits vary in permeability, and may or may not be fully saturated. The other hydrogeologic units are less permeable, and may provide local aquitards within the lower Issaquah valley.

2. The lower Issaquah valley hydrogeologic system is bounded at depth and along the border of the ground water basin by low-permeability bedrock; on the south by the Tiger Mountain gap, which allows only a limited quantity of ground water to pass from the upper Issaquah valley; on the north by Lake Sammamish where the ground water within the lower Issaquah valley discharges; and at the surface by streams, lakes, and permeable and impermeable areas.

3. Ground water elevations within the lower Issaquah valley vary from about 25 feet mean sea level near Lake Sammamish to about 200 feet mean sea level in the Tiger Mountain Gap. In the central valley area, ground water elevations are generally between 50 and 70 feet. In the Grand Ridge area ground water elevations vary from 400 to over 800 feet.

4. Ground water levels fluctuate annually between 7 and 15 feet within the lower Issaquah valley. The timing and magnitude of the fluctuations is the same for shallow zones and deeper zones. Ground water levels respond rapidly to precipitation events.

5. The direction of ground water flow within the lower Issaquah valley is generally northwestward toward Lake Sammamish, but varies annually within the central valley area from a northwestern direction during periods of high ground water levels to a more northern direction during periods of low ground water levels.

6. Within the central valley area of the lower Issaquah valley, the horizontal hydraulic gradient is relatively flat at between 0.001 and 0.002 ft/ft. Vertical hydraulic gradients are generally directed upwards except in the vicinity of the City of Issaquah's and Sammamish Plateau Water and Sewer District's production wells (COI 4/5, and wells 7/8). On Grand Ridge the horizontal hydraulic gradient is 0.067 ft/ft. A steep vertical hydraulic gradient exists between the Grand Ridge terrain and the valley floor.

7. Transmissivity in the lower Issaquah valley is estimated at 67,000 to 70,000 ft^2/d, based on two long-term pumping tests. Average hydraulic conductivity is estimated at between 200 and 300 ft/day.

8. Streams are a minor source of water to the wells in the central portion of the lower Issaquah valley.

9. The average annual recharge to the lower Issaquah valley aquifer system is between 20 and 25 cubic feet per second. The eastern plateau areas (Grand Ridge and Lake Tradition) may provide up to 30 percent of the direct recharge to the lower Issaquah valley, with the remainder occurring within the main valley. Average annual discharge to Lake Sammamish and the adjacent wetland area is between 10 and 20 cubic feet per second.

10. There appears to be little stream/aquifer interaction in the central lower Issaquah valley area. Stream gauging, mini-piezometer installations and pumping test results suggest limited hydraulic continuity between surface and ground water within the central valley area. Additional stream gauging data are needed to further assess hydraulic continuity with the central lower Issaquah valley.

11. Analysis of pumping tests and long-term water-level fluctuations indicates that ground water withdrawals in the lower Issaquah valley affect shallow ground water levels and cause downward vertical gradients from the water-table toward the completion zones of the wells.

12. The lower Issaquah valley aquifer system behaves as an unconfined to locally semi-confined aquifer. Analyses of pumping tests, water-levels, and hydraulic

gradients do not suggest that significant regional confining layers are present within the aquifer system. As such, the aquifer is highly vulnerable to contamination from surface sources.

13. The ground water sampled from wells by the City of Issaquah and Sammamish Plateau Water and Sewer District as part of the Lower Issaquah valley Wellhead Protection Plan were generally excellent with only slightly elevated iron and manganese concentrations. Herbicides, pesticides and PCBs were not detected and priority pollutants were below the regulated limits.

8.0 RECOMMENDATIONS

Future ground water management of the Issaquah Creek Valley Ground Water Management Area needs reliable data on ground water quality and quantity impacts. Information on ground water quantity can be used to determine aquifer recharge, ground water/surface water continuity and source capacity. Information on ground water quality can be used to determine appropriate land use and, if needed, remediation priorities. Information on both ground water quality and quantity can be used to better manage the ground water resource in the Issaquah Creek Valley Ground Water Management Area and to educate the public in protecting this valuable finite resource.

Additional ground water quantity information will require an expanded monitoring program and additional test and monitoring wells. These should be cooperative endeavors between the Seattle-King County Health Department, King County Surface Water Management Division, the Washington State Department of Natural Resources, Washington State Department of Ecology, Washington State Department of Health, particularly its Wellhead Protection Program, the City of Issaquah, the Sammamish Plateau Water and Sewer District, and private interests. A monitoring program is expensive, and care should be taken to select stations that provide the most useful data.

Ground water quantity determination relies on information on precipitation, ground water levels, stream discharge, and water levels in selected lakes and wetlands, as well as information from existing wells.

8.1 Precipitation Stations

The meteorological monitoring network provided by the existing Washington State Department of Natural Resources and King County Water and Land Resources Division stations appears adequate to define precipitation variations within the area. Additional data should be obtained from stations maintained by the water purveyors and the City of Issaquah, King County, and the Washington State Highway Department. The eight sites monitored by volunteers for Seattle-King County Health Department should be provided with automatic data logger rain gauges.

8.2 Surface Water Monitoring

The stream gauging stations within the Issaquah Creek Valley Ground Water Management Area are maintained and operated by others and, with one exception, provide adequate coverage. Data are lacking for the Tiger Mountain Gap, where three additional stations are required upgradient from, within, and downgradient from the Gap.

The Lower Issaquah Valley Wellhead Protection Plan recommends additional stream gauges be installed in the central lower Issaquah valley to determine the hydraulic conformity between surface and ground water.

Water level monitoring stations should be considered for selected wetlands and lakes. Data collected from these stations will allow assessment of the long-term combined impact of climatic variations and ground and surface water utilization. These stations should be located in the southern and northern portions of the basin.

The continuity between ground water and surface water should be evaluated by identifying gaining and losing stretches of streams, and the role of the ground water system, through the interpretation of nearby ground water levels.

8.3 Ground Water Monitoring Network

Additional monitoring wells are required in several areas, particularly along Tibbets, Fifteen Mile, and Holder creeks; along the divide between the Cedar River and Issaquah Creek drainage basins in the southern portion of T23N; and in the Tiger Mountain Gap. In most of these localities, wells exist and could be used if long-term permission to measure can be obtained. The latter two localities are critical. Here, new monitoring wells may need to be installed to define the ground water flow and the extent of aquifers. They should be located in areas with transmissive sediments, as indicated by a resistivity survey. The criteria used to select wells in this study phase shall be the basis used for well selection.

- Tiger Mountain Gap: Two to three additional monitoring wells should be located along a north-south line with an existing Issaquah Creek Valley Ground Water Management Area monitoring well to determine the stratigraphy, transmissivity, and hydraulic gradient of the sediments within the Gap. These data are required to assess the potential ground water contribution of the southern portion of the Issaquah Creek Basin to the northern portion.
- Cedar River - Issaquah Creek Divide: Further exploration should be done in sections 17, 18, 28 and 33 (T23N, R6E) to determine whether ground water is discharging from the Issaquah Creek Basin into the Cedar River Basin.
- The degree to which Lake Sammamish serves as a recharge reservoir to lower valley aquifers should be further evaluated through the interpretation of hydraulic gradients and conductivities in the lake vicinity.

- Additional research is required of water purveyors' wells about the types of activities the wells support (i.e., residential commercial, industrial or agricultural).
- Future research on the Sammamish Plateau Water and Sewer District's water demand projection should focus on determining the type and amount of demands to be made on all sources in the Issaquah Creek Valley Ground Water Management Area, whether or not those demands come from within Issaquah Creek Valley Ground Water Management Area boundaries.
- Information on the number and location of individual wells presently without water rights and metering of individual wells is necessary to more accurately determine actual withdrawals from source aquifers.

8.4 Ground Water Quality

Ground water quality information should be obtained from existing and new data sources. The existing monitoring network of wells and new wells drilled should be sampled twice yearly (wet and dry seasons) for inorganic and where necessary for organic, pesticide, and PCB parameters pertaining to relevant land use activities; to establish ground water quality trends and to provide data of potential contamination sources.

All the wells within the monitoring network should be accurately located and have accurate elevations located using the Global Positioning System. Most of the existing monitoring wells have surveyed elevations, but these have not been located with equal accuracy.

- The location of all septic tank failures in the Issaquah Creek Valley Ground Water Management Area should be researched to determine the ground water quality impacts.
- The water quality of stormwater outlets during storm events should be monitored where these outlets discharge to ground water and creeks.
- The water quality (and water quantity) of ground water at and around sand and gravel mines should be monitored.
- The water quality data collected from wells at and surrounding the Cedar Hills Landfill and Queen City Farms by King County Solid Waste Division and Seattle-King County Health Department Solid Waste Section should be assessed and entered into the Seattle-King County Health Department database. The shallow and deep aquifers should be assessed to see whether they are interconnected and whether ground water quality is being impacted.
- The location of commercial and residential underground storage tanks needs to be identified to determine the extent and type of ground water contamination.
- The types and quantities of fertilizer and pesticide applications, including roadside spraying, need to be monitored for their impacts on ground water quality.
- Hazardous material spills, particularly transportation spills, need to be monitored for their impacts on ground water.

- Data collated by the Department of Ecology, the Seattle-King County Health Department Local Hazardous Waste Management Program, and King County Department of Natural Resources, Water and Land Resources Division on hazardous waste generators' impacts on ground water quality needs to be monitored.

8.5 Use of Data Analysis

The results of future ground water and surface water quality monitoring should be analyzed periodically as data become available to determine whether ground water contamination has occurred or is occurring. If any contamination is discovered, recommendations should be made as to what modifications and/or additions to the monitoring system would enable increased definition of the extent of contamination. Also, the natural geochemistry of the water sample analyses should be analyzed to determine the water quality characteristics of specific aquifers and areas where ground water exchange or mixing may be occurring. These data should be entered into the Seattle-King County Health Department database.

- An aquifer susceptibility map for the Issaquah Creek Valley Ground Water Management Area has been produced based on the physical factors of soils, slope, and geology. A recharge map should be produced and updated periodically for the Issaquah Creek Valley Ground Water Management Area based on the spatial distribution of factors such as potentially hazardous land use activities, depth to ground water, precipitation, recharge potential and well head protection data studies by purveyors in the Issaquah Creek Valley Ground Water Management Area. Determination of recharge areas within the drainage basin will be accomplished by comparative weighing and ranking of these factors. The vulnerability assessment could be further refined through use of contamination scenarios and risk assessments.
- The aquifer recharge map, susceptibility map, a water level contour map, and the estimates of total ground water recharge should be updated as new information becomes available.
- Future data collection should also focus on the characterization of, and recharge to, the deep aquifers in the Issaquah Creek Valley Ground Water Management Area.
- The management plan should include efforts to evaluate the impacts of continued development on the ground water resources. The ground water recharge areas in the Issaquah Basin are located on the uplands, with the area of highest potential recharge being in the northeast portion of the Issaquah Creek Valley Ground Water Management Area along the East Fork. This is the area currently undergoing extensive development and designated for continued development under the Growth Management Act. An extensive ground water monitoring program should be established to guide evaluation of the future impacts. These

monitoring results could be used to assess the potential impacts of much larger developments.

- The Issaquah Creek Valley Ground Water Management Area aquifer source capacities should be estimated. This information is necessary for water right evaluation and land use planning.
- Maximum (aquifer-specific) water source capacity data are necessary for all future water sources in the Issaquah Creek Valley Ground Water Management Area. Water rights capacities must be derived from the same data used to determine maximum water source capacities.
- Peak usage requirements for water suppliers would also help to determine their ability to deliver water under existing water rights and source capacities.

8.6 Public Awareness

The ground water resources of the Issaquah Creek Valley Ground Water Management Area are limited. Although the estimated total discharge from the basin appears large, this water is not available everywhere, and some areas have insufficient ground water resources. The ground water management program should include an extensive education program to encourage water conservation and protection.

City officials, government agencies, businesses, purveyors, schoolchildren and the public need to be educated about protecting the ground water resources from contamination and depletion. Moreover, the protection strategies should be updated regularly as new information becomes available.

References

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9.0 REFERENCES

Allen, Mark. Seattle-King County Health Department, On-site Program. Information on on-site sewage systems. 1994.

Anderberg, Janet. Seattle-King County Health Department, Environmental Health Division. Discussion of on-site septic systems. 1991.

Associated Earth Sciences, Inc., Snoqualmie Ridge Project, *Hydrogeology and Ground Water Resource Impact Assessment of the Lake Alice Plateau*, February 1995, prepared for Weyerhaeuser Real Estate Company as Appendix F in the *Draft Supplemental Environmental Impact Statement for Snoqualmie Ridge Mixed Use Final Plan*, City of Snoqualmie. April 1995.

Bishop, R. Department of Ecology. Personal communication, April 25, 1994.

Booth, Derek. King County Department of Natural Resources, Surface Water Management Division, Information on Stormwater and Highway Runoff. 1994.

Braun, 1989.

Burnette, D. City of Issaquah. Data on building permits. 1994.

Canty, Dave. King County Department of Natural Resources, Surface Water Management Division. Information on the Issaquah Creek Basin and Surface Water Management's role. 1994.

Carr/Associates. *Volume I, Draft Status Report, Description of Test and Presentation of Data on Well 9 Pumping Test.* Consultant report for Sammamish Plateau Water and Sewer District. 1992.

Carr/Associates. *Volume II, Evaluation and Interpretation of Well 9 Pumping Test.* Consultant report for Sammamish Plateau Water and Sewer District. 1993.

Carr/Associates. *Report on Impacts of Increased Pumping from Wells 7 and 8.* Prepared for Sammamish Plateau Water and Sewer District. December 7, 1990.

Carr/Associates. *Issaquah Creek Valley Ground Water Management Plan.* Task 5: Hydrogeological Report. September 15, 1993.

City of Issaquah Natural Resources Department. *City of Issaquah Water System Plan Update.* August 1995.

Cox, Gerald. Personal communication regarding water systems in East King County Ground Water Management Area, March 1995.

DeBell, D., US Forest Service. Personal communication on evapotranspiration, 1995.

Dunne and Leopold. *Water in Environmental Planning.* Chapter 5, Water Use by Vegetation. 1978.

Ecology, Washington Department of. (Knowlton, Doug). Information on underground storage tanks.

Economic and Engineering Services, Inc. *East King County Coordinated Water System Plan.* August 1989.

Fetter, C. W. *Applied Hydrogeology*, Third Edition. 1994.

Fisher, J. State Department of Natural Resources. Personal communication on evapotranspiration, 1995.

Fitch, Lyle. King Conservation District. Information on agriculture. 1994.

Golder Associates in Association with Carr/Associates and the Barton Group. *Lower Issaquah Valley Wellhead Protection Plan.* For Sammamish Plateau Water and Sewer District and the City of Issaquah. November 1993.

Handson., J. US Forest Service. Personal communication on evapotranspiration, 1995.

Heintze, Dick. Interlake Associates. Personal communication of January 27, 1994.

Hickok, Dave. Seattle-King County Health Department, Solid Waste Division. Information on Cedar Hills landfill. 1994.

Kelliher, F. M., Lenning, R., Schulze, E. D. *Evaporation and Canopy Characteristics of Coniferous Forests and Grasslands.* 1993

King County Department of Development and Environmental Services and Seattle-King County Health Department, *Mapping Aquifer Susceptibility to Contamination in King County*, August 1995.

King County Department of Natural Resources. *Draft East King County Ground Water Management Plan,* July 1996.

King County Surface Water Management Division, *Issaquah Creek Basin Current/Future Conditions and Source Identification Report*, October 1991.

Komorita, J. King County Department of Natural Resources, Solid Waste Division. Information on the Cedar Hills landfill and the Queen City Farms site. 1994.

Lewine, J. City of Issaquah, Planning Department. Information on the City of Issaquah's Comprehensive Plan and Sub-Area Plans. 1995.

Liszak, Jerry. Department of Ecology. Information on ground water level fluctuations, aquifer system characteristics, and water level measuring. 1995.

Little, Ron. Sammamish Plateau Water and Sewer District. Information on water withdrawals, sewer system and basin exports. 1993.

Lynne, Sheldon. City of Issaquah. Information on the Comprehensive Plan, ground water policies, commercial land industrial trends, water use, aquifer capacity, sewers and roadside spraying. 1994.

Martin, T. University of Washington Department of Forestry. Personal communication on evapotranspiration, 1995.

Matsuno, R. King County Department of Works, Roads and Engineering Division. Information on roadside spraying. 1994.

McPhillips, L. U.S. Environmental Protection Agency. Personal communication on Queen City Farms, 1995.

Misko, D. Department of Ecology. Information on contaminated underground storage tank sites. 1994.

National Academy of Sciences. *Drinking Water and Health,* Washington, D. C. 1977.

Nordie, G. Personal communication of January 1994.

Orlean, H. U.S. Environmental Protection Agency. Information on Cedar Hills landfill and Queen City Farms. 1994.

Pacific Groundwater Group, Inc., Carr Associates, Inc.; Parametrix, Inc. *Data Collection and Analysis Plan, Issaquah Creek Valley Ground Water Management Program.* 1992.

Parametrix, Inc./Carr Associates. *Area Characterization Report. Issaquah Creek Valley Ground Water Management Plan for Seattle-King County Health Department.* December 1991.

Petrovich, B. Department of Ecology. Personal communication of January 24, 1994.

Phillips, 1989.

Pierce, D. Washington State Department of Natural Resources. Information on quarries and mines. 1994.

Portman, J. Darigold, Inc. Personal communication of December 30, 1993.

Regenstreif, Jay. Sammamish Plateau Water and Sewer District. Personal communication of April 25, 1994.

Reid, J. King County Planning and Community Development Division. Information on the King County Comprehensive Plan, community plans, development trends and land use forecasts. 1994.

Schaftlein, S. State Department of Transportation. Personal communication of May 3, 1994.

Seattle-King County Health Department, *East King County Ground Water Management Plan, Quality Assurance Project Plan/Data Collection and Analysis Plan,* December 1994.

Seattle-King County Health Department. *Data Collection and Analysis Plan for East King County, Washington, Ground Water Management Area Study*, July 1, 1991.

Slagle, Kitty. Seattle-King County Health Department. Information on illegal dumping, 1995.

U.S. Geological Survey. *Geohydrology and Ground-Water Quality of East King County, Washington.* Water-Resources Investigations Report 94-4082. 1995

US Weather Bureau. *Normals of Precipitation and Evapotranspiration (Inches).* State of Washington.

Glossary

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10.0 GLOSSARY

ALLUVIAL. Pertaining to or composed of alluvium or deposited by a stream or running water.

ALLUVIUM. A general term for clay, silt, sand, gravel, or similar unconsolidated material deposited during comparatively recent geologic time by a stream or other body of running water as a sorted or semisorted sediment in the bed of the stream or on its floodplain or delta, or as a cone or fan at the base of a mountain slope.

AQUIFER. A soil or geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield economical quantities of water to wells and springs.

AQUIFER SYSTEM. A body of permeable and relatively impermeable materials that functions regionally as a water-yielding unit. It comprises two or more permeable units separate at least locally by confining units that impede groundwater movement but do not greatly affect the regional hydraulic continuity of the system. The permeable materials can include both saturated and unsaturated sections.

AQUIFER TEST. A test involving the withdrawal of measured quantities of water from or addition of water to a well, and the measurement of resulting changes in head in the aquifer both during and after the period of discharge or addition, e.g., a bailer or pump test. (These are withdrawal tests)

AQUITARD. An essentially impermeable geologic formation, group of formations, or part of a formation through which virtually no water moves.

AREA OF INFLUENCE. Area surrounding a pumping well within which the water table or potentiometric surface has been changed due to the well's pumping or recharge.

ARTESIAN WELL. A well deriving its water from a confined aquifer in which the hydraulic water level stands above the ground surface; synonymous with flowing artesian well.

ATTENUATION. The general process of reducing the amount and concentration of contaminants in water. Includes physical, chemical and biological processes as well as dilution.

BASALT. A general term for dark-colored iron- and magnesium-rich igneous rocks. It is the principal rock type making up the ocean floor and is easily seen in exposed cliffs in Eastern Washington.

BASE FLOW. That part of stream discharge not attributable to direct runoff from precipitation or snowmelt, usually sustained by ground water discharge.

BEDROCK. A general term for the rock, usually solid, that underlies soil or other unconsolidated material.

BENTONITE. A colloidal clay, largely made up of the mineral sodium montmorillonite, [a hydrated aluminum silicate] used in sealing the annular space to create a surface or sanitary seal.

CAPILLARY ACTION. The movement of water within the interstices of a porous medium due to the forces of adhesion, cohesion, and surface tension acting in a liquid that is in contact with a solid.

CAPILLARY FRINGE. The zone at the bottom of the vadose zone where groundwater is drawn upward by capillary force.

CARBONATE. A sediment formed by the organic of inorganic precipitation from aqueous solution of carbonates of calcium, magnesium, or iron.

CHLORIDE. A compound of chlorine with one other positive element or radical.

CLEAN WATER ACT. Basic federal legislation regulating surface water quality.

COLIFORM BACTERIA. Bacteria (*E. coli*) associated with human and warm-blooded animal waste.

CONE OF DEPRESSION. A depression in the groundwater table or potentiometric surface that has the shape of an inverted cone and develops around a well from which water is being withdrawn. It defines the area of influence of a well.

CONFINED AQUIFER. A formation in which the groundwater is isolated from the atmosphere at the point of discharge by impermeable geologic formations; confined groundwater is generally subject to pressure greater than atmospheric.

CONFINING BED. A geologic unit with low permeability (hydraulic conductivity) which restricts movement of water into or out of the aquifer. See also aquiclude, aquitard.

CONTAMINATION. The degradation of natural water quality as a result of anthropogenic activities.

CROSS-SECTION. A schematic representation of geologic layers as seen in a side view.

DISCHARGE. Ground water that flows out of an aquifer into an adjacent aquifer or to the surface into a spring or river.

DISCHARGE AREA. An area in which there are upward components of hydraulic head in the aquifer. In the discharge area ground water flows toward the surface, and may escape as a spring, seep, or base flow, or by evaporation and transpiration.

DISPERSION. The spreading and mixing of chemical constituents in groundwater caused by diffusion and mixing due to microscopic variations in velocities within and between pores.

DRAINAGE BASIN. The land area from which surface runoff drains into a stream channel or system of channels, or to a lake, reservoir, or other body of water.

DRAWDOWN. The distance between the static water level and the top surface of the cone of depression during pumping of a well.

DRILLERS LOG. A record of the geologic and aquifer conditions encountered by a driller during drilling of a water supply well. The State of Washington requires that a log be completed for each well.

DRINKING WATER STANDARDS. Federal or state water quality regulations that limit the contaminant levels of certain compounds for drinking water.

DYNAMIC EQUILIBRIUM. A condition of which the amount of recharge to an aquifer equals the amount of natural discharge.

EFFLUENT. Liquid waste discharged from a manufacturing or treatment process, in its natural state or partially or completely treated, that discharges into the environment.

EROSION. The general process or group of processes whereby the materials of the Earth's crust are moved from one place to another by running water (including rainfall), waves and currents, glacier ice, or wind.

EVAPOTRANSPIRATION. Loss of water from a land area through transpiration of plants and evaporation from the soil.

FLOODPLAIN. The surface or strip of relatively smooth land adjacent to a river channel, constructed by the present river and covered with water when the river overflows its banks. It is built of alluvium carried by the river during floods and deposited in the sluggish water beyond the influence of the swiftest current.

FLOW LINES. On a hydraulic gradient diagram, the lines indicating the direction followed by groundwater toward points of discharge. Flow lines are perpendicular to equipotential lines.

FLOW RATE. The volume of flow per time (e.g., gallons per minute).

FLOWING ARTESIAN WELLS. Wells which tap confined aquifers which flow at ground surface without the necessity of pumping.

GEOLOGIC MAP. A map showing the aerial distribution of geologic units and the altitude or structure of those units.

GLACIAL DRIFT. A general term for unconsolidated sediment transported by glaciers and deposited directly on land or in the sea.

GLACIOFLUVIAL. Pertaining to the meltwater streams flowing from melting glacier ice and especially to the deposits and landforms produced by such streams.

GLACIOLACUSTRINE. Deposits created in lake environments from glacial silts and clays.

GROUND WATER. All water that is located below the ground surface; more specifically, subsurface water below the water table.

GROUND WATER DIVIDE. A ridge in the water table, or potentiometric surface, from which ground water moves away at right angles in both directions.

GROUND WATER MODEL. A simplified conceptual or mathematical image of a ground water system, describing the feature essential to the purpose for which the model was developed and including various assumptions pertinent to the system. Mathematical ground water models can include numerical and analytical models.

GROUNDWATER TABLE. The surface between the zone of saturation and the zone of aeration; the surface of an unconfined aquifer.

HARDNESS. A property of water causing formation of an insoluble residue when the water is used with soap. It is primarily caused by calcium and magnesium ions.

HAZARDOUS WASTE. Federally regulated man-made waste that is ignitable, corrosive, reactive, or toxic.

HYDRAULIC CONDUCTIVITY. The rate of flow of water in gallons per day through a cross section of one square foot under a unit hydraulic gradient, at the prevailing temperature (gpd/ft).

HYDRAULIC CONNECTION. The condition in which two water-bearing layers or bodies may freely transmit water between them.

HYDROGEOLOGIC. Those factors that deal with subsurface waters and related geologic aspects of surface water.

HYDROLOGIC CYCLE. The cyclical movement of water from the oceans to atmosphere to the land and back to the oceans.

HYDROSPHERE. All waters of the Earth, as distinguished from the rocks (lithosphere), living things (biosphere), and the air (atmosphere).

HYDROSTRATIGRAPHY. The assemblage of layers of aquifers and aquitards.

IGNEOUS. A type of rock solidified from molten material.

IMPERMEABLE. An adjective used to describe rock, soils, or sediments that impede the flow of water.
INFILTRATION. The downward movement of rain water or surface water into soil.

LACUSTRINE. Referring to a lake environment.

LAMINATED. The layering or thin bedding in sedimentary rocks.

LANDFILL. A general term indicating a disposal site of refuse, and dirt from excavations.

LEACHATE. The liquid that has percolated through solid waste and dissolved soluble components.

MAXIMUM CONTAMINANT LEVEL (MCL). The maximum permissible level as required by the Safe Drinking Water Act regulations, of a contaminant in water that is delivered to the users of a public water system.

METAMORPHIC. A rock that has been physically and/or chemically changed from an original texture and/or composition, usually by very high temperatures or pressures below the earth's surface.

MG/L. Milligrams per liter; a unit of concentration in water equivalent to a part per million or 0.0001 percent.

MICROORGANISMS. Microscopic organisms such as any of the bacteria, protozoans, or viruses.

NITRATE. A compound commonly associated with domestic and agricultural waste, and formed by nitrogen.

OUTWASH. Stratified sand and gravel removed or washed out from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of an active glacier. The coarser material is deposited nearer to the ice.

OUTWASH PLAIN. A broad, gently sloping sheet of outwash.

PEAT. A non-compacted deposit of organic material commonly developed from bogs or swamps.

PERCOLATE. The act of water seeping or filtering through soil without a defined channel.

PERMEABILITY. The property or capacity of a porous rock, sediment, or soil for transmitting a fluid; it is a measure of the relative ease of fluid flow under unequal pressure.

pH. A measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. Originally stood for "potential of hydrogen".

PLUME. A contaminated portion of an aquifer extending from the original contaminant source.

POLLUTION. When the contamination concentration levels restrict the potential use of groundwater.

POROSITY. The percentage of the bulk volume of a rock or soil that is occupied by interstices, whether isolated or connected.

POTABILITY. Ability to be used as drinking water.

POTENTIOMETRIC SURFACE. The surface to which water will rise in an aquifer under hydrostatic pressure.

PPM. Parts/per million. A unit of concentration equivalent to 0.0001 percent.

RECHARGE. The addition of water to the zone of saturation; also, the amount of water added.

RECHARGE AREA. Area in which water reaches the zone of saturation by surface infiltration.

RUNOFF. That part of precipitation flowing overland to surface streams.

SANDSTONE. A sedimentary rock composed of abundant rounded or angular fragments of sand set in a fine-grained matrix (silt or clay) and more or less firmly united by a cementing material.

SEAWATER INTRUSION. The entry of seawater into a fresh water aquifer.

SEDIMENTARY ROCKS. Rocks resulting from the consolidation of loose sediment that has accumulated in layers.

SHALE. A fine-grained sedimentary rock, formed by the consolidation of clay, silt, or mud. It is characterized by finely laminated structure and will not fall apart on wetting.

STORAGE COEFFICIENT. The volume of water released from storage per unit-volume of porous medium per unit change in head.

STRATIGRAPHIC. Pertaining to the composition and position of layers of rock or sediment.

TERTIARY. A period of earth's history estimated to have occurred between 65 and 2 million years ago.

TILL. Predominantly unsorted and unstratified drift, generally unconsolidated, deposited directly by and underneath a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, and boulders ranging widely in size and shape.

TOPOGRAPHIC. Pertaining to the general configuration of a land surface.

TOTAL DISSOLVED SOLIDS (TDS). A term that expresses the quantity of dissolved material in a sample of water, either the residue on evaporation, dried at 356°F (180°C), or, for many waters that contain more than about 1,000 mg/l, the sum of the chemical constituents.

TRANSMISSIVITY. The rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. Transmissivity values are given in gallons per minutes through a vertical section of an aquifer one foot wide and extending the full saturated height of an aquifer under a hydraulic gradient of 1 in the English Engineering system; in the International System, transmissivity is given in cubic meters per day through a vertical section of an aquifer one meter wide and extending the full saturated height of an aquifer under a hydraulic gradient of 1.

TRANSPIRATION. The process by which water absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface.

TURBULENT FLOW. Water flow in which the flow lines are confused and heterogeneously mixed. It is typical of flow in surface-water bodies.

UNCONFINED AQUIFER. An aquifer where the water table is exposed to the atmosphere through openings in the overlying materials.

UNSATURATED ZONE. The subsurface zone containing both water and air. The lower part of the unsaturated zone (capillary fringe) does not actually contain air, but is saturated with water held by suction at less than atmospheric pressure.

VADOSE ZONE. The zone containing water under pressure less than that of the atmosphere, including soil water, intermediate vadose water, and capillary water. This zone is limited above by the land surface and below by the surface of the zone of saturation, that is, the water table.

VISCOSITY. The property of a substance to offer internal resistance to flow. Specifically, the ratio of the shear stress to the rate of shear strain.

WATER TABLE. The surface between the vadose zone and the groundwater, where the pressure is equal to that of the atmosphere.

WEATHERING. The destructive process(es) by which the atmosphere and surface water chemically change the character of a rock.

ZONE OF CONTRIBUTION. The area surrounding a pumping well that encompasses all areas or features that supply ground water recharge to the well.

ZONE OF INFLUENCE. The area surrounding a pumping well within which the water table or potentiometric surfaces have been changed due to ground water withdrawal.

Sources:

Driscoll, F., *Groundwater Wells*, Johnson Division, 1986.

Groundwater Resource Protection, King County Planning and Washington State Department of Ecology.

Redmond-Bear Creek Ground Water Management Program, *Draft Hydrogeologic Characterization Report*, prepared by EMCON Northwest, Inc., November, 1992.

Northern Thurston County Ground Water Management Plan, February, 1992.

Appendices

Appendix A Soil Association Descriptions

The following Appendices are available from King County Department of Natural Resources, Water & Land Resources Division:

Appendix B	**Hydrostratigraphy**
Appendix C	**Well Water Level Measurements, 1989 - 1992**
Appendix D	**Summary of Precipitation Data**
Appendix E	**Water Quality**
Appendix F	**Related Documents:**

- **Data Collection and Analysis Plan**
- **Data Management Plan**
- **Quality Assurance Project Plan**
- **Public Involvement Plan**
- **Area Characterization Plan**
- **Data Analysis Report**

Appendix G Guidelines for the Development of Ground Water Management Areas and Programs (Chapter 173-100 WAC)

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Appendix A

Soil Association Descriptions

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APPENDIX A

SOIL ASSOCIATION DESCRIPTIONS

ALDERWOOD ASSOCIATION

The Alderwood association blankets over one-fourth of the Issaquah Creek Valley Ground Water Management Area. It is found in upland areas, including the southeast portion of the Sammamish Plateau, and Cedar Hills and Hobart Plateau in their entirety. It is composed of 85 percent Alderwood soils, 8 percent Everett and 7 percent less extensive soils. In general, they are moderately well drained, variably sloped soils underlain by very low permeability glacial till at a depth of 20 to 40 inches.

The Alderwood series is one of the most commonly found soils throughout the Issaquah Creek Valley Ground Water Management Area. These soils are gravelly sandy loams and are typically found on slopes ranging from 6 to 35 percent. A 75 percent Alderwood and 25 percent Kitsap soil unit is found on steep (25 to 75 percent) slopes. This Alderwood and Kitsap mix also contains pockets of deep, moderate to coarse textured soils.

Runoff is slow to medium on 6 to 15 percent slopes, and medium to very rapid on steeper slopes.. Permeability is moderately high in the surface layer. During saturated winter conditions, infiltrated water encounters the dense substratum and moves laterally downgradient.

These soils are severely limiting to septic tank filter fields. Water quality degradation could result where site conditions are inappropriate for septic tank systems. Vertical recharge is probably slow, except along fractures in the till. Lateral subsurface movement to more permeable zones or windows in the substratum could contribute substantially to recharge. The extent and location of these more permeable zones in largely unknown.

BEAUSITE-ALDERWOOD ASSOCIATION

The Beausite-Alderwood association is the most extensive association in the Issaquah Creek Valley Ground Water Management Area, covering primarily the mountainous area (Cougar and Squak Mountains, Grand Ridge, and likely the mostly unmapped Tiger Mountain peak complex). Major soils represented include approximately 55 percent Beausite soils, 30 percent Alderwood soils, 10 percent Ovall soils, and 5 percent miscellaneous soils. These soils are found on rolling to very steep surfaces underlain at 20 to 40 inches depth by sandstone, shale, or dense glacial till. In general, these soils are moderate to well drained.

BEAUSITE SOILS

Beausite soils are gravelly, sandy loams formed in glacial materials. These soils are underlain by fractured sandstone at a depth of about 20 to 40 inches. Rock outcrops are exposed at many locations.

Beausite soils are situated on rolling to very steep slopes (6 to 75 percent). On the east side of Squak Mountain, and north side of Tiger Mountain, slopes greater than 50 percent are common. On 6 to 15 percent slopes, runoff is moderate. On greater slopes, runoff is rapid to very rapid. Permeability is moderately high. Sandstone is not considered a primary aquifer material, so recharge is probably not significant. However, lateral movement of water in saturated soils might play a significant role in adjacent recharge zones.

Due to the thinness of the soils over bedrock, and steep slope conditions, these soils are severely limiting to on-site sewage disposal. Contaminants introduced to the soil surface could enter bedrock fractures and affect local domestic wells. Large contaminant releases would be rapidly transported by shallow subsurface flow and streams, and could impact water quality downgradient.

OVALL SOILS

Ovall soils are gravelly loams formed in thin glacial deposits. They are underlain by weathered, andesite breccia at a depth of 20 to 40 inches. The soils are found on rolling to very steep hills with 15 to 75 percent slopes within the Issaquah Creek Valley Ground Water Management Area. Runoff ranges from moderately rapid to very rapid. Permeability is moderate. Recharge is likely insignificant. Subsurface flow and surface runoff could contribute recharge to more permeable areas downgradient. Due to the shallow presence of bedrock and the steepness of slopes, the soils are severely limiting to on-site waste disposal. Rapid runoff of surface contaminants is likely.

EVERETT ASSOCIATION

Everett association soils are found on northern upland units in the vicinity of Tradition Lake Terrace, lower Grand Ridge, and an adjacent portion of the Sammamish Plateau. A substantial portion the city of Issaquah and the upstream valleys also consists of Everett soils. The association typically consists of 70 percent Everett soils, 15 percent Neilton soils, 7 percent Alderwood soils and 8 percent less extensive soils. The dominant soils are found on both gently undulating surfaces, and steep terrace faces. They are underlain by sand and gravel, and are exceedingly well drained.

EVERETT SOILS

Everett soils are composed of gravelly, sandy loam, underlain by gravelly sand at a depth of 18 to 36 inches. The soils were formed on glacial outwash, and are found on terraces and terrace fronts. At depth, there are unpredictably distributed lenses of low permeability silt. Slopes vary from 0 to 30 percent. Runoff is slow to medium on 0 to 15 percent slopes, medium to rapid on 15 to 30 percent slopes. Permeability is rapid and recharge is likely significant.

Everett soils offer very little protection to ground water quality. This is due to the highly permeable nature of the soils and substrata. The presence of silt lenses or low permeability strata could result in unpredictable lateral movement of ground water.

NEILTON SOILS

Neilton soils are composed of gravelly, loamy sand, and are underlain by stratified glacial outwash. This outwash contains layers of materials that vary greatly in permeability. The soils are found on rolling, undulating terrace slopes of 2 to 15 percent. Runoff is slow to medium. Permeability is very high. Recharge is likely significant. As in the case of Everett soils, Neilton soils offer limited protection to ground water quality.

VALLEY SOILS

There are a number of soils represented in the valleys. A partial listing of these soils includes: Sammamish, Bellingham, Briscot, Puyallup, Puget, Oridia and Sultan. Most of these soils are found in developing areas of the lower Issaquah Creek Valley.

Although not extensively distributed elsewhere in the Issaquah Creek Valley Ground Water Management Area, these soils are significant due to the industrial, urban, and residential development that has occurred or is planned in their vicinity. Large-scale development is likely to include drainage rerouting or enhancement, and substantial earth moving or placement of fill. Such activities greatly disrupt the natural drainage and permeability properties of native soils. The number of potential contaminant sources also increases with intensive land use activities.

SAMMAMISH SOILS

Sammamish soils consist of silt loams stratified with fine sand and clay. The soils exist in alluvium and are found in stream valleys on level 0 to 2 percent slopes. Runoff is slow. Permeability is moderately slow. There is a seasonal high water table at 1 to 2 feet depth. Flooding is a hazard. Recharge is probably slow, but could be significant in those areas underlain by shallow aquifers.

These soils offer limited protection to underlying shallow aquifers. Flooding and the seasonal high water table prevent operation of effective septic tank drainfields. It is logical to assume underground storage tanks or holding pits would face similar high water table constraints.

BELLINGHAM SOILS

Bellingham soils are composed of silt loams with varying amounts of sand and clay in the subsoil. These soils formed in alluvium on level valley areas and upland depressions. Both runoff and permeability are slow. During the rainy season, the water table is at or near the surface. Recharge is probably slow, but it is likely significant for shallow aquifers.

The soil probably offers limited protection to shallow aquifers. Underground storage tanks, holding pits, and properly functioning septic tanks systems are severely constrained by the season high water table. Slow permeability is also a constraint to septic tank systems.

BRISCOT SOILS

The Briscot soils are composed of a silt loam stratified with fine sand. The soils were formed in river valley alluvium and lie on less than 2 percent slopes. Runoff is slow and permeability is moderate. There is high water table in the winter at 1 to 2 feet below the surface. Stream overflow is a moderate hazard. Recharge to shallow, unconfined aquifers is likely significant.

Contamination to shallow unconfined aquifers is possible. Construction of septic tank systems is severely limited due to flooding and high water table conditions. Underground storage tanks or holding pits likely face similar constraints.

PUYALLUP SOILS

Puyallup soils are composed of fine sandy loams and were formed in alluvium on natural stream levees and valleys. Slopes are slightly convex and less than 2 percent. Runoff is slow and permeability moderately high. There is a seasonal high water table at a depth of 4 to 5 feet. Flooding potential is slight to severe. Recharge to shallow aquifers is probably significant. Due to moderately high permeability, shallow depth to a seasonal high water table, and proximity to streams and shallow aquifers, this soil probably offers very limited protection to water quality.

PUGET SOILS

Puget soils formed in valley alluvium and are composed of a silty clay loam. Slopes are flat, less than 1 percent. Runoff is slow to ponded. Permeability is slow. The seasonal water table is at or near the surface. Stream overflow is a severe problem. Recharge to shallow aquifers is likely slow, yet significant.

The high water table severely limits the use of septic tank systems. Underground storage tanks and holding pits are similarly faced with high water table problems. These soils are probably in close proximity to shallow aquifers and offer limited protection.

ORIDIA SOILS

Oridia soils are composed of silt loam, interspersed with fine sand and clay at depth. They formed in alluvium on less than 2 percent slopes. Runoff is slow. Permeability is moderate to moderately slow. The seasonal high water table is at 1 to 2 feet below the surface. There is a moderate flood hazard. Recharge to shallow aquifers is likely significant. The soils offer little protection to shallow aquifers. Due to the presence of a high water table, septic tanks systems cannot be expected to function properly. Underground storage tanks and holding pits are also severely limited by these conditions.

SULTAN SOILS

Sultan soils consist of silt loam with clayey and sandy zones at depth. The soils are formed in alluvium on gently undulating valley floors with less than 2 percent slopes. Runoff is slow and permeability is moderate. There is a seasonal water table at 2 to 3 feet below the surface. In some areas, there is a severe flood hazard. Recharge is probably relatively slow, but significant to underlying shallow aquifers.

The ability of the soil to protect ground water quality is diminished by the presence of shallow aquifers and high water table conditions. The presence of a high water table severely limits the use of septic tank systems. Underground storage tanks and holding pits are also confronted with this limitation.

Appendixes B - F are available From the King County Department of Natural Resources, Water and Land Resources Division:

APPENDIX B HYDROSTRATIGRAPHY

APPENDIX C WELL WATER LEVEL MEASUREMENTS, 1989-1992

APPENDIX D SUMMARY OF PRECIPITATION DATA

APPENDIX E WATER QUALITY

APPENDIX F RELATED DOCUMENTS:

- Data Collection and Analysis Plan
- Data Management Plan
- Quality Assurance Project Plan
- Public Involvement Plan
- Area Characterization Plan
- Data Analysis Report

Appendix G

Guidelines for the Development of Ground Water Management Area and Programs (Chapter 173-100 WAC)

Issaquah Creek Valley
Ground Water Management Plan

March 1999

WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Guidelines for Development of Ground Water Management Areas and Programs

CHAPTER 173-100 WAC

August 1988
86-2

Development of Ground Water Management Areas and Programs

In response to growing concern about Washington State's ground water resources, the 1985 legislature passed landmark legislation to assist state and local governments in effectively managing the public's ground water. Substitute House Bill 232 directed the Department of Ecology to establish a process for the identification and designation of ground water management areas and for the development of comprehensive ground water management programs. This process is described in *Chapter 173-100 WAC* of the state administrative code, entitled *"Ground Water Management Areas and Programs."* A copy of these regulations, which became effective on January 17, 1986, are included in this booklet.

There are several advantages to local agencies and user groups in using the process described in Ground Water Management Areas and Programs. The process is designed so that a ground water management program can be initiated and developed on the local level while at the same time be supported by state legislation and regulations. Development of these ground water management programs is intended to be a team planning effort utilizing resources from interested user groups and various local and state agencies. Chapter 173-100 WAC establishes a well defined process which allows for issues, concerns and opportunities from all interested groups and agencies to be incorporated into the planning process in an effective and efficient manner. This coordination should facilitate a wider acceptance of the program and also provide a broader authority to implement and enforce the program. In addition, passage of the Clean Water Bill (ESSB 4519) by the 1986 Legislature will allow Ecology to contribute up to 50 percent in matching funds for the development of ground water management programs which follow this process.

This booklet is intended to assist local governments and water user groups in understanding Chapter 173-100 WAC and to serve as a guide for those who are interested in developing ground water management programs in their area. This booklet is designed to answer general questions about the process. For more detailed requirements and procedures leading to designation of ground water management areas and development of ground water management programs, Chapter 173-100 WAC should be reviewed.

The following questions and answers will provide information for developing a ground water management program.

What is a "ground water management area?"

A ground water management area is a specific geographic area which encloses one or more aquifers and in which there exists a justifiable concern for the quality and/or quantity of the ground water. The purposes of designating a ground water management area are to:

1. Protect the quality and quantity of ground water.
2. Meet future water needs while recognizing existing water rights.
3. Provide for effective and coordinated management of the ground water resource.

The regulation states that an area must first be designated by Ecology as a ground water management area before an advisory committee can be established to develop a ground water program.

Reference: WAC 173-100-050

What does Ecology consider a "justifiable concern?"

A list of concerns to help guide in the identification of probable ground water management areas is included in WAC 173-100-050 of the regulations. The following is a summary of that list:

1. Geographic areas where ground water quality is threatened or is susceptible to contamination. This includes contamination from land use activities and seawater intrusion.

2. Aquifers that are declining due to restricted recharge or over use. This includes aquifers which have the potential for over use based on projected future demands.

3. Aquifers that have been over appropriated and adjudications of water rights have not been completed.

4. Aquifers designated as "sole source aquifers" by the Environmental Protection Agency. Only three aquifers in the state have been designated as sole source. They are Whidbey, Camano and the Spokane-Rathdrum aquifers.

5. Aquifers identified as the primary source of a public water supply.

6. Aquifers where an approved coordinated water system plan has identified a need for a ground water management program.

What is a "ground water management program?"

A ground water management program is a comprehensive program designed to protect ground water quality and assure ground water quantity for current and future uses.

A water user group or local government agency is interested in developing a ground water management program in their area. What is their first step?

The first step is to develop a request for designation of the proposed area as a probable ground water management area. Development of a request requires several steps in itself, the most important one being coordination with local agencies and water user groups. Early involvement of all interested agencies and groups will help avoid problems later in the process. Coordination with the local county or counties is required so that written concurrence by the county or counties for appointment of a lead agency can be included in the request for designation.

Probable ground water management areas may be proposed for designation at any time by Ecology upon its own motion or at the request of other state agencies, local governments or ground water user groups.

What is involved in developing a request for designation of a ground water management area?

Developing a request for area designation will involve agency and user group coordination, information gathering and a minimum of one public meeting for public comment and review. The request should be in the form of a concise, factual report and contain the following:

1. A general description of and rationale for the proposed ground water management area boundary.

2. A list of concerns along with supporting documentation to substantiate those concerns. Utilizing available data from federal, state and local sources may help justify your concerns. Information from completed ground water studies, land use and water use records, local soils, geology and hydrology conditions and local expertise would be valuable as supporting documentation. Reference should be made as to how the information justifies your particular concern.

3. Goals and objectives for the proposed ground water management area.

4. An estimated cost of developing the ground water management program and potential funding sources.

5. Recommendations for agencies, organizations and groups to be represented on the advisory committee. The advisory committee will oversee and review the development of the ground water program. Membership of the advisory committee should represent

a broad spectrum of the public. A list of potential committee members and the responsibilities of the committee is described in WAC 173-100-090.

6. A recommendation for the lead agency, taking into consideration the responsibilities contained in WAC 173-100-080. Either Ecology or a local government agency may be the lead agency. The recommendation for lead agency shall first be submitted to the county or counties with jurisdiction over the proposed ground water management area. Written concurrence by the county or counties for lead agency should be submitted along with the request for designation. If the proposed area is entirely within one county, that county has the option to be lead agency if it so desires.

7. A list of those who have participated in the development of the request through public meetings, mailing lists and other interaction. The request should specifically address the extent of coordination and involvement by government agencies and user groups.

The request should then be submitted to Ecology, Water Resources Planning and Management, and also to other interested agencies and groups for their review and comments. These groups should be instructed to submit comments directly to Ecology. A list of those to whom copies of the request have been mailed should be sent to Ecology.

Reference: WAC 173-100-050

What happens after a request is submitted to Ecology?

When a request is received by Ecology it will be reviewed to make sure it complies with the intent and requirements of Chapter 173-100 WAC. Ecology will review the request on the following basis:

1. Do the proposed area boundaries constitute a logical groundwater management area based on the local hydrogeology?

2. Does the request contain all of the required components including justifiable concerns, goals and objectives, cost estimates and funding sources and a general description and rationale for the proposed area?

3. Have other interested agencies and groups been involved in formulation of the request? What level of coordination has gone into the development of this request?

4. Has at least one public meeting been held for review and comments? Was a broad spectrum of the public represented at this meeting?

5. Has a recommendation for the lead agency and advisory committee members been made? Has written concurrence for lead agency from the appropriate county or counties been included?

6. Has local government shown a willingness to cooperatively develop a comprehensive ground water management program?

If Ecology determines that the request meets the intent and criteria of WAC 173-100-050, Ecology will identify the proposed area as a probable ground water management area, establish the general planning boundaries and appoint a lead agency. Ecology will also begin to seek nominations for the advisory committee and evaluate the request for ranking on the General Schedule.

How does the General Schedule work?

Ecology intends to designate a ground water management area as soon as possible after a request is received and it is placed on the General Schedule. The General Schedule guides Ecology in the order of designation of ground water management areas and also in the allocation of Ecology's available funding and staffing. The schedule will rank the relative priority of each probable ground water area based on:

1. The urgency of the problems or potential problems as described in the request for identification. Highest priority will be given to those areas where water quality is imminently threatened.

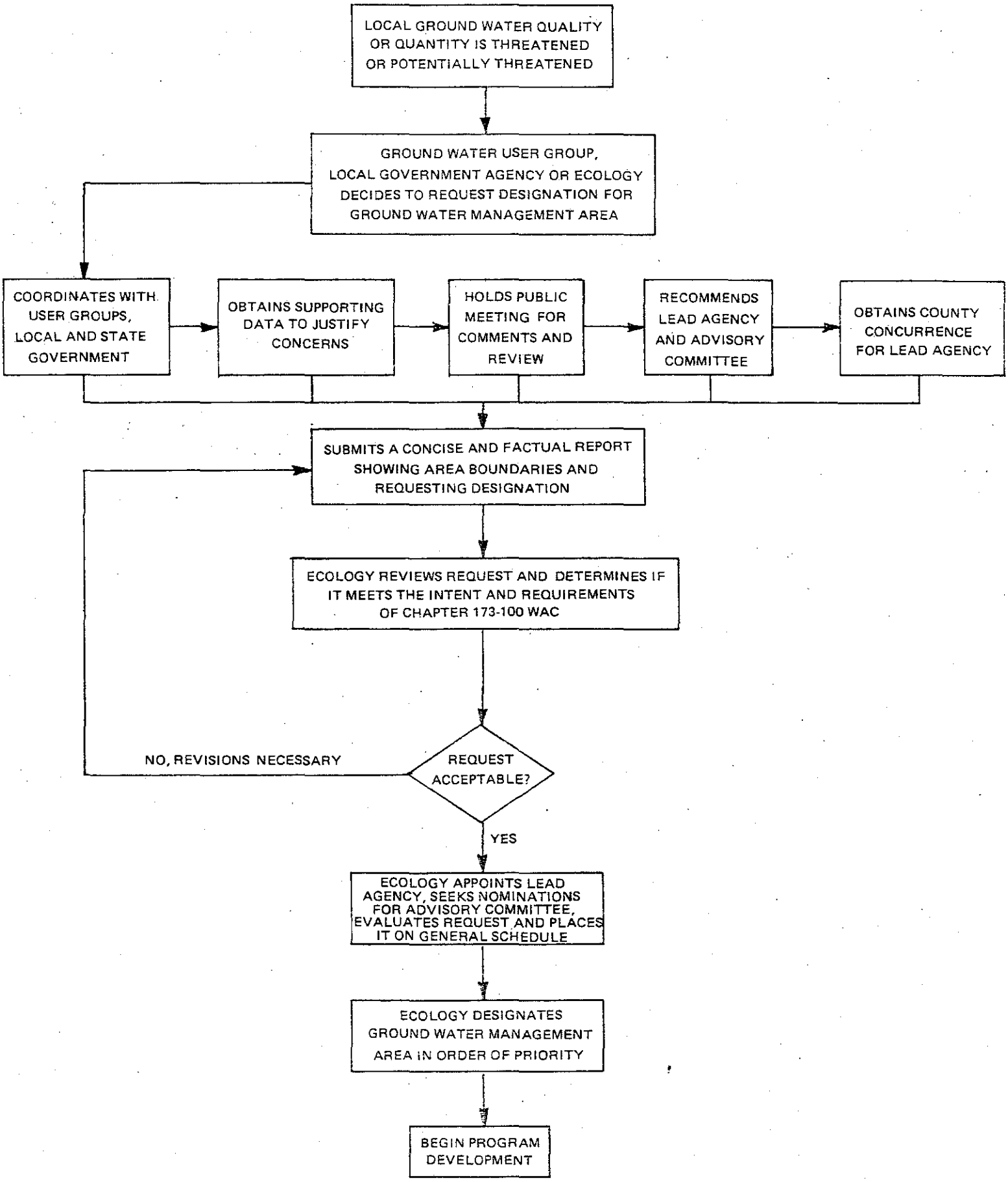
2. The availability of funding and staff on a local or state level to develop and implement a ground water management program.

As stated above, passage of the Clean Water Bill (ESSB 4519) will allow Ecology to contribute up to 50 percent in matching funds to public bodies for the development of ground water management programs. The ability and willingness at the local level to fund their share of the program will be a significant factor in determining priority.

Although Ecology will make every effort to avoid a delay in designation, a situation may arise where the number of requests for designation is so great that Ecology does not have the funding or staffing to handle all requests. In this case the higher priority areas will be designated first and the lower priority areas later. All requests which are put on the General Schedule will be designated as soon as state resources are available to do so.

Ecology may update and revise the General Schedule at anytime as needed. Ecology will notify the public of revisions through the news media and the Washington State Register. A public hearing will be held during June of each year for public comment on the General Schedule. Although requests may be submitted at any time, Ecology recommends that requests be submitted by April 1 of each year. This will allow time for Ecology to review the requests and place them on the General Schedule prior to the annual public hearing.

REQUEST FOR GROUND WATER MANAGEMENT AREA DESIGNATION



Prior to designation of a ground water management area, Ecology will hold a public hearing within the local area for comments and review of the proposal. Upon designation, Ecology will issue an order which contains a general description of the planning boundary and documents the intent to develop a ground water management program for that area. It should be noted that the proposed boundary is only a planning boundary at this stage and may be modified as data is collected during program development.

Reference: WAC 173-100-060 and WAC 173-100-070

Once the area is designated as a ground water management area, what is the next step?

After the area is designated the lead agency will be eligible to apply for grant funding and program development can begin. Ecology will appoint the ground water advisory committee in cooperation with the local governments and interested user groups. The lead agency shall hold the first meeting of the ground water advisory committee within 60 days of the appointment of the committee.

The lead agency shall be responsible for coordination and undertaking the activities necessary for development of the ground water management program. This includes preparation of a work plan, coordinating data collection and scheduling advisory committee meetings. The lead agency may delegate the development of various elements of the ground water management program to other committee members or it may choose to hire a consultant to complete some tasks.

The advisory committee is responsible for overseeing the development of the ground water management program and assuring it is both technically and functionally sound. The committee will give final approval to the program before it is submitted to Ecology for certification. Ecology will participate on the advisory committee along with other state and local government agencies and ground water user group members.

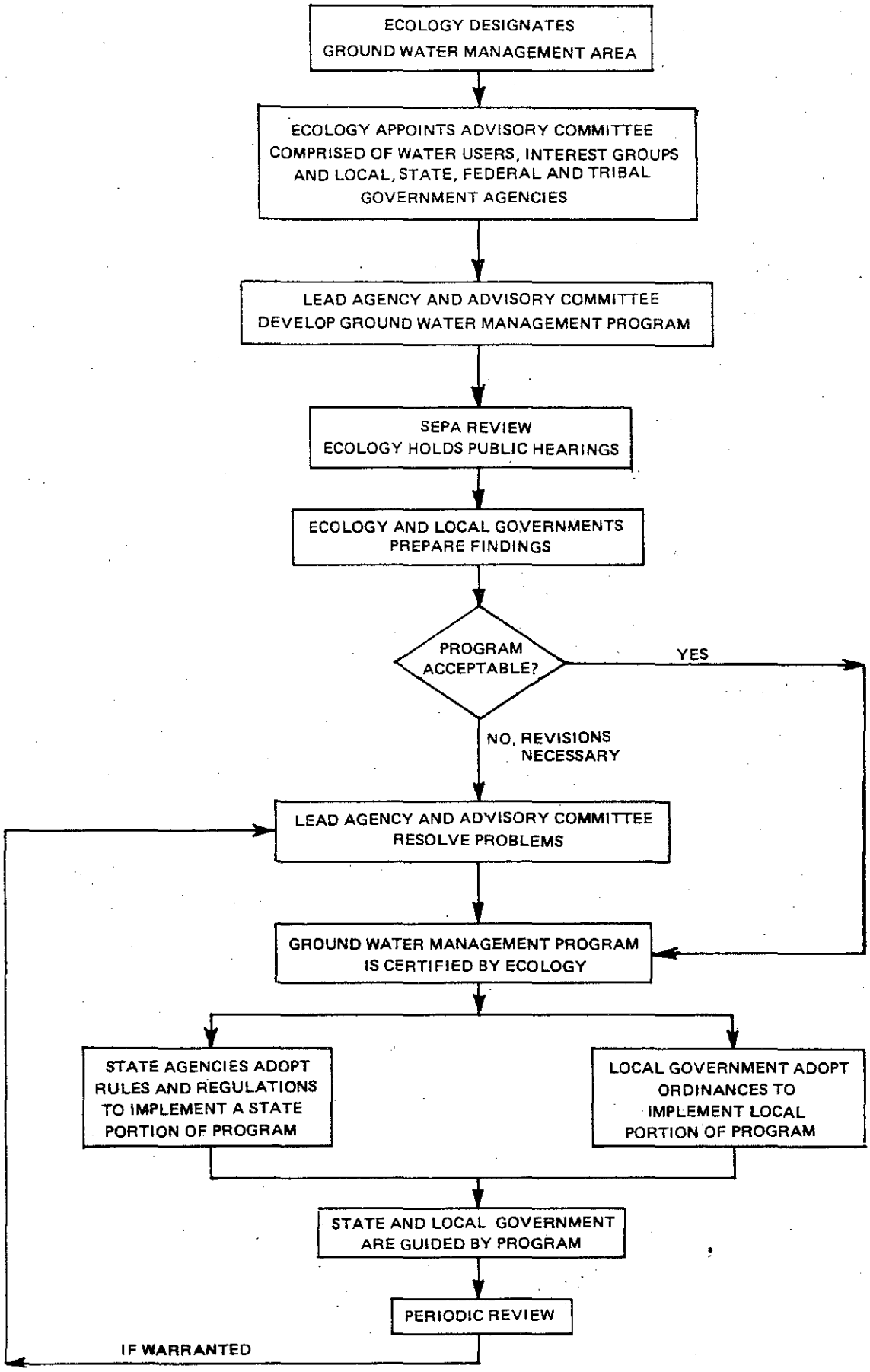
Reference: WAC 173-100-080 and WAC 173-100-090

What should be included in a "ground water management program?"

The program for each management area will be tailored to the specific conditions of that area. Each ground water management program should include the following:

1. A section describing the collection and analysis of data, the area's hydrogeological characteristics, historical and projected ground water usage and jurisdictional boundaries and responsibilities.

GROUND WATER MANAGEMENT PROGRAM DEVELOPMENT



2. A discussion of the type and extent of land use activities potentially affecting ground water quality and quantity.

3. Identification of water quantity and quality goals and objectives.

4. An alternatives section which outlines and evaluates various land and water use management strategies.

5. A section recommending specific management strategies for implementation.

6. An implementation plan including a detailed work plan, model ordinances and a monitoring plan and system for program review to assure goals and objectives are being met.

The time frame for program development will depend on each areas complexity both geologically and politically. Ecology feels an average of two to three years for program completion is a reasonable estimate at this time.

Reference: WAC 173-100-100

What is Ecology's role after the ground water management program is completed?

Upon completion, the proposed ground water management program shall be subject to review pursuant to the State Environmental Policy Act (SEPA). Ecology will hold a local public hearing for comment and review of the program. Following the hearing, the department and each local agency and user group will have 90 days to evaluate the program and submit their findings containing their concurrence or nonconcurrence with the program. Statements of nonconcurrence shall be resolved by the advisory committee, using mediation techniques if necessary. If the program is found to be consistent with the intent of Chapter 173-100 WAC, Ecology will certify the program. Following certification, affected state agencies and local governments shall adopt or amend regulations and policies for implementation of the ground water management program.

Reference: WAC 173-100-120

All correspondence involving ground water management area designation or ground water management program development should be sent to:

Department of Ecology
Water Resources Planning and Management
PO Box 47600
Olympia, WA 98504-7600
(360) 407-6600

SUMMARY OF RESPONSIBILITIES

INITIATOR OF REQUEST ---------- (user group, Ecology or local government)	Coordination with local government, user groups with state government Develop request for designation Recommend lead agency and GWAC Hold public meeting on request for area designation Submit request to Ecology
Provide written concurrence on lead agency recommendation Member of GWAC	----------COUNTY GOVERNMENT
LEAD AGENCY ----------	Coordinate development of GWMP Prepares workplan, schedule, budget for GWMP Schedule GWAC meetings Delegate activities to GWAC Coordinate SEPA review
Oversees development of GWMP reviews workplan, schedule and budget for GWMP Final review of GWMP before submittal to Ecology Coordinates public review	----------ADVISORY COMMITTEE
ECOLOGY ----------	Places request for area designation on general schedule Holds public hearing on request for area designation Designates GWMA Appoints lead agency and GWAC Participates on GWAC Holds public meeting upon plan completion Certifies GWMP

GWMA - Ground Water Management Area
GWMP - Ground Water Management Program
GWAC - Ground Water Advisory Committee

Chapter 173-100 WAC
GROUND WATER MANAGEMENT AREAS AND PROGRAMS

WAC
173-100-010 Purpose.
173-100-020 Authority.
173-100-030 Overview.
173-100-040 Definitions.
173-100-050 Probable ground water management areas.
173-100-060 General schedule.
173-100-070 Designation of ground water management areas for program planning purposes.
173-100-080 Lead agency responsibilities.
173-100-090 Ground water advisory committee.
173-100-100 Ground water management program content.
173-100-110 SEPA review.
173-100-120 Hearings and implementation.
173-100-130 Designation of ground water areas.
173-100-140 Intergovernmental agreements.
173-100-150 Appeals.
173-100-160 Regulation review.

WAC 173-100-010 Purpose.
The purpose of this chapter is to establish guidelines, criteria, and procedures for the designation of ground water management areas, subareas or zones and to set forth a process for the development of ground water management programs for such areas, subareas, or zones, in order to protect ground water quality, to assure ground water quantity, and to provide for efficient management of water resources for meeting future needs while recognizing existing water rights. The intent of this chapter is to forge a partnership between a diversity of local, state, tribal and federal interests in cooperatively protecting the state's ground water resources.
[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-010, filed 12/20/85.]

WAC 173-100-020 Authority.
This chapter is promulgated by the department of ecology pursuant to RCW 90.44.400, 90.44.410, 90.44.420, 90.44.430 and 90.44.440.
[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-020, filed 12/20/85.]

WAC 173-100-030 Overview.
This regulation establishes a process for the identification and designation of ground water management areas and for the development of comprehensive ground water management programs. From a general schedule of probable ground water management

areas, the department of ecology in cooperation with local government will designate specific ground water management areas, subareas, or depth zones within such areas and will appoint a lead agency to develop a ground water management program and an advisory committee to oversee the development of the program for each designated area. Following completion of the program and a public hearing to be held by the department of ecology, the program must be certified to be consistent with the intent of this chapter. The program will then be implemented through state regulations and local ordinances. The programs must thereafter be periodically reviewed.
[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-030, filed 12/20/85.]

WAC 173-100-040 Definitions.
For the purposes of this chapter the following definitions shall apply:

(1) "Aquifer" means a geologic formation, group of formations or part of a formation capable of yielding a significant amount of ground water to wells or springs.

(2) "Department" means the Washington state department of ecology.

(3) "Ground water" means all waters that exist beneath the land surface or beneath the bed of any stream, lake or reservoir, or other body of surface water, whatever may be the geological formation or structure in which such water stands or flows, percolates or otherwise moves.

(4) "Ground water advisory committee" means a committee appointed by the department to assist in the development of a ground water management program.

(5) "Ground water area or subarea" means a geographic area designated pursuant to RCW 90.44.130.

(6) "Ground water management area" means a specific geographic area or subarea designated pursuant to this chapter for which a ground water management program is required.

(7) "Ground water management program" means a comprehensive program designed to protect ground water quality, to assure ground water quantity and to provide for efficient management of water resources while recognizing existing ground water rights and meeting future needs consistent with local and state objectives, policies and authorities within a designated ground water management area or subarea and developed pursuant to this chapter.

(8) "Ground water management zone" means any depth or stratigraphic zone separately designated by the department in cooperation with local government for ground water management purposes within a ground water management area. Ground water management zones may consist of a specific geologic formation or formations or other reasonable bounds determined by the department consistent with the purposes of this chapter.

(9) "Ground water right" means an authorization to use ground water established pursuant to chapter 90.44 RCW, state common or statutory law existing prior to the enactment of chapter 90.44 RCW, or federal law.

(10) "Ground water user group" means an established association of holders of ground water rights located within a proposed or designated ground water management area.

(11) "Lead agency" means the agency appointed by the department to coordinate and undertake the activities necessary for the development of a ground water management program. Either the department or an agency of local government may be the lead agency.

(12) "Local government" means any county, city, town, or any other entity having its own incorporated government for local affairs including, but not limited to, a metropolitan municipal corporation, public utility district, water district, irrigation district, and/or sewer district.

(13) "Local government legislative authority" means the city or town council, board of county commissioners, special district commission, or that body assigned such duties by a city, county or district charter as enacting ordinances, passing resolutions, and appropriating funds for expenditure.

(14) "Probable ground water management area" means a specific geographic area identified by the department, in cooperation with other state agencies, local government and ground water user groups, as a candidate area for designation as a ground water management area pursuant to this chapter.

[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-040, filed 12/20/85.]

WAC 173-100-050 Probable ground water management areas.

The department in cooperation with local government and ground water user groups shall identify probable ground water management areas.

(1) Probable ground water management areas may be proposed for identification at any time by the department upon its own motion or at the request of other state agencies, local government or ground water user groups.

(2) Probable ground water management area boundaries shall be delineated so as to enclose one or more distinct bodies of public ground water as nearly as known facts permit. Probable ground water management subareas shall be delineated so as to enclose all or any part of a distinct body of public ground water. Boundaries shall be based on hydrogeologic properties such as limits to lateral extent of aquifers, major perennial rivers, and regional ground water divides or as deemed appropriate by the department to most effectively accomplish the purposes of this chapter.

(3) The criteria to guide identification of probable ground water management areas shall include, but not be limited to, the following:

(a) Geographic areas where ground water quality is threatened;

(b) Aquifers that are declining due to restricted recharge or over-utilization;

(c) Aquifers in which over-appropriation may have occurred and adjudication of water rights has not yet been completed;

(d) Aquifers reserved or being considered for water supply reservation under chapter 90.54 RCW for future beneficial uses;

(e) Aquifers identified as the primary source of supply for public water supply systems;

(f) Aquifers underlying a critical water supply service area where the coordinated water system plan established pursuant to chapter 70.116 RCW has identified a need for a ground water management program;

(g) Aquifers designated as sole source aquifers by the federal Environmental Protection Agency;

(h) Geographic areas where the ground water is susceptible to contamination or degradation resulting from land use activities;

(i) Aquifers threatened by seawater intrusion; or

(j) Aquifers from which major ground water withdrawals have been proposed or appear imminent.

(4) The state agency, local government or ground water user group requesting probable ground water management area identification shall provide sufficient information for the department to determine if the area should be so identified. The department and other affected state and local governments and user groups may cooperate in preparing the request for identification.

(a) The request for identification shall be presented in a concise, factual report form and shall consider the guidelines and criteria set forth in subsections (2) and (3) of this section as they relate to the proposed area. It shall also contain: (i) Supporting data as to the need for such identification; (ii) a general description of and rationale for the proposed ground water management area boundary; (iii) goals and objectives for the proposed ground water management area; (iv) an estimated cost of developing the ground water management program and potential funding sources; (v) recommendations for agencies, organizations and groups to be represented on the ground water management area advisory committee; and (vi) a recommendation for the lead agency, taking into consideration the responsibilities contained in WAC 173-100-080.

(b) The recommendation for lead agency shall first be submitted to the county or counties with jurisdiction for written concurrence. Such written concurrence shall be included with the information required in (a) of this subsection. If such concurrence cannot be obtained, the department shall attempt to mediate an agreement between the parties.

(c) The agency or ground water user group initiating the request for identification shall hold at least one public meeting for the purpose of receiving comments from the public, affected local, state and tribal agencies and ground water user groups.

(d) Upon completion, the request for identification shall be submitted to the department and other affected state and local agencies and ground water user groups for their review and comment. Comments shall be submitted to the department.

(5) If the department is proposing an area for identification, the department shall prepare a report containing the information in subsection (4)(a) of this section, hold a public meeting, and submit the report to affected state and local agencies and ground water user groups for their review and comment.

(6) Based upon review of the request for identification together with any comments received and a finding that the proposed area meets the guidelines and criteria of subsections (2) and (3) of this section, the department shall identify the proposed area as a probable ground water management area, establish the general planning boundaries and appoint a lead agency. When a probable ground water management area is included within only one county and that county indicates its desire to assume lead agency status, the department shall appoint the county as lead agency. The department shall notify

affected state and local agencies, ground water user groups, tribal governments and local news media of such identification.
[Statutory Authority: Chapters 43.27A and 90.44 RCW. 88-13-037 (Order 88-11), § 173-100-050, filed 6/9/88. Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-050, filed 12/20/85.]

WAC 173-100-060 General schedule.
The department shall establish a general schedule for the designation of specific ground water management areas. The general schedule shall guide the department in the designation of specific ground water management areas and in the allocation of the department's available water resources funding and staffing.

(1) The general schedule for designation of ground water management areas shall identify the relative priority of each of the probable ground water management areas. The relative priority of the probable ground water management areas shall be based upon:

(a) The availability of local or state agency resources to develop and implement a ground water management program;
(b) The significance, severity or urgency of the problems or potential problems described in the request for identification submitted for each area, with the highest priority given to areas where the water quality is imminently threatened;
(2) The department shall revise the general schedule as needed to comply with the intent of this chapter. After each revision the general schedule shall be published in the news media and the Washington State Register. A public hearing will be held in June of each year to receive public comment on the general schedule.
[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-060, filed 12/20/85.]

WAC 173-100-070 Designation of ground water management areas for program planning purposes.
The department shall designate ground water management areas by order of the department in accordance with the general schedule. The department shall hold a public hearing within the county or counties containing the probable ground water management area prior to such designation. The order shall be issued to the lead agency as well as the agency or ground water user group originally requesting identification of the areas, with copies sent to other affected state agencies, local governments, tribal governments and those parties recommended for ground water advisory committee membership. Copies of the order shall be published by the department in newspapers of general circulation within the area. The order shall contain a general description of the planning boundary for the ground water management area and shall state that the department, in cooperation with the lead agency and local government, intends to appoint a ground water advisory committee to oversee the development of a ground water management program for the area.
[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-070, filed 12/20/85.]

WAC 173-100-080 Lead agency responsibilities.
The lead agency shall be responsible for coordinating and undertaking the activities necessary for development of the ground water management program. These activities shall include collecting data and conducting studies related to hydrogeology, water quality, water use, land use, and population projections; scheduling and coordinating advisory committee meetings; presenting draft materials to the committee for review; responding to comments from the committee; coordinating SEPA review; executing inter-local agreements or other contracts; and other duties as may be necessary. The lead agency shall also prepare a work plan, schedule, and budget for the development of the program that shows the responsibilities and roles of each of the advisory committee members as agreed upon by the committee. Data collection, data analysis and other elements of the program development may be delegated by the lead agency to other advisory committee members.
[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-080, filed 12/20/85.]

WAC 173-100-090 Ground water advisory committee.
(1) The ground water advisory committee shall be responsible for overseeing the development of the ground water management program; reviewing the work plan, schedule and budget for the development of the program; assuring that the program is technically and functionally sound; verifying that the program is consistent with this chapter and with the respective authorities of the affected agencies; and formulating and implementing a public involvement plan.

(2) The membership of each ground water advisory committee shall represent a broad spectrum of the public in order to ensure that the ground water is protected and utilized for the greatest benefit to the people of the state. The committee shall include, but not be limited to, representation from the following groups:

(a) Local government legislative authorities within the designated area;

(b) Planning agencies having jurisdiction within the designated area;

(c) Health agencies having jurisdiction within the designated area;

(d) Ground water user groups within the designated area, including domestic well owners;

(e) The department;

(f) Department of social and health services;

(g) Other local, state, and federal agencies as determined to be appropriate by the department;

(h) Tribal governments, where a ground water management program may affect tribal waters;

(i) Public and special interest groups such as agricultural, well drilling, forestry, environmental, business and/or industrial groups within the area, as determined to be appropriate by the department.

(3) The department shall appoint, by letter, members and alternates to the ground water advisory committee after seeking nominations from the groups listed above. Members and alternates shall serve until the ground water management program for the

area is certified. The department may appoint replacement members or alternates upon request of the appointee or the ground water advisory committee.

(4) The lead agency shall hold the first meeting of the ground water advisory committee within sixty days of the appointment of the committee. Public notice shall be given for each meeting. The lead agency shall chair the first meeting, during which the advisory committee shall determine, by general agreement, rules for conducting business, including voting procedures, and the chairperson of the advisory committee.
[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-090, filed 12/20/85.]

WAC 173-100-100 Ground water management program content.
The program for each ground water management area will be tailored to the specific conditions of the area. The following guidelines on program content are intended to serve as a general framework for the program, to be adapted to the particular needs of each area. Each program shall include, as appropriate, the following:

(1) An area characterization section comprised of:

(a) A delineation of the ground water area, subarea or depth zone boundaries and the rationale for those boundaries;

(b) A map showing the jurisdictional boundaries of all state, local, tribal, and federal governments within the ground water management area;

(c) Land and water use management authorities, policies, goals and responsibilities of state, local, tribal, and federal governments that may affect the area's ground water quality and quantity;

(d) A general description of the locale, including a brief description of the topography, geology, climate, population, land use, water use and water resources;

(e) A description of the area's hydrogeology, including the delineation of aquifers, aquitards, hydrogeologic cross-sections, porosity and horizontal and vertical permeability estimates, direction and quantity of ground water flow, water-table contour and potentiometric maps by aquifer, locations of wells, perennial streams and springs, the locations of aquifer recharge and discharge areas, and the distribution and quantity of natural and man-induced aquifer recharge and discharge;

(f) Characterization of the historical and existing ground water quality;

(g) Estimates of the historical and current rates of ground water use and purposes of such use within the area;

(h) Projections of ground water supply needs and rates of withdrawal based upon alternative population and land use projections;

(i) References including sources of data, methods and accuracy of measurements, quality control used in data collection and measurement programs, and documentation for and construction details of any computer models used.

(2) A problem definition section that discusses land and water use activities potentially affecting the ground water quality or quantity of the area. These activities may include but are not limited to:

- Commercial, municipal, and industrial discharges
- Underground or surface storage of harmful materials in containers susceptible to leakage

- Accidental spills
-Waste disposal, including liquid, solid, and hazardous waste
-Storm water disposal
-Mining activities
-Application and storage of roadway deicing chemicals
-Agricultural activities
-Artificial recharge of the aquifer by injection wells, seepage ponds, land spreading, or irrigation
-Aquifer over-utilization causing seawater intrusion, other contamination, water table declines or depletion of surface waters
-Improperly constructed or abandoned wells
-Confined animal feeding activities

The discussion should define the extent of the ground water problems caused or potentially caused by each activity, including effects which may extend across ground water management area boundaries, supported by as much documentation as possible. The section should analyze historical trends in water quality in terms of their likely causes, document declining water table levels and other water use conflicts, establish the relationship between water withdrawal distribution and rates and water level changes within each aquifer or zone, and predict the likelihood of future problems and conflicts if no action is taken. The discussion should also identify land and water use management policies that affect ground water quality and quantity in the area. Areas where insufficient data exists to define the nature and extent of existing or potential ground water problems shall be documented.

(3) A section identifying water quantity and quality goals and objectives for the area which (a) recognize existing and future uses of the aquifer, (b) are in accordance with water quality standards of the department, the department of social and health services, and the federal environmental protection agency, and (c) recognize annual variations in aquifer recharge and other significant hydrogeologic factors;

(4) An alternatives section outlining various land and water use management strategies for reaching the program's goals and objectives that address each of the ground water problems discussed in the problem definition section. If necessary, alternative data collection and analysis programs shall be defined to enable better characterization of the ground water and potential quality and quantity problems. Each of the alternative strategies shall be evaluated in terms of feasibility, effectiveness, cost, time and difficulty to implement, and degree of consistency with local comprehensive plans and water management programs such as the coordinated water system plan, the water supply reservation program, and others. The alternative management strategies shall address water conservation, conflicts with existing water rights and minimum instream flow requirements, programs to resolve such conflicts, and long-term policies and construction practices necessary to protect existing water rights and subsequent facilities installed in accordance with the ground water management area program and/or other water right procedures.

(5) A recommendations section containing those management strategies chosen from the alternatives section that are recommended for implementation. The rationale for choosing these strategies as opposed to the other alternatives identified shall be given;

(6) An implementation section comprised of:

(a) A detailed work plan for implementing each aspect of the ground water management strategies as presented in the recommendations section. For each recommended management action, the parties responsible for initiating the action and a schedule for implementation shall be identified. Where possible, the implementation plan should include specifically worded statements such as model ordinances, recommended governmental policy statements, interagency agreements, proposed legislative changes, and proposed amendments to local comprehensive plans, coordinated water system plans, basin management programs, and others as appropriate;

(b) A monitoring system for evaluating the effectiveness of the program;

(c) A process for the periodic review and revision of the ground water management program.

[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-100, filed 12/20/85.]

WAC 173-100-110 SEPA review.

The proposed ground water management program shall be subject to review pursuant to the State Environmental Policy Act, chapter 43.21C RCW, as required under the applicable implementing regulations.

[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-110, filed 12/20/85.]

WAC 173-100-120 Hearings and implementation.

(1) Upon completion of the ground water area management program, the department shall hold a public hearing within the designated ground water management area for the purpose of taking public testimony on the proposed program. Local governments are encouraged to hold joint hearings with the department to hear testimony on the proposed management program. Following the public hearing, the department and each affected local government shall prepare findings on the ground water management program within ninety days. This period may be extended by the department for an additional ninety days. The findings shall evaluate the program's technical soundness, economic feasibility, and consistency with the intent of this chapter and other federal, state and local laws. The findings shall identify any revisions necessary before the program can be certified and shall contain a statement of the agency's concurrence, indicating its intent to adopt implementing policies, ordinances and programs if required, or a statement of nonconcurrence with the program if such be the case.

(2) The lead agency will consolidate the findings and present them to the advisory committee. Statements of nonconcurrence shall be resolved by the committee and the program revised if necessary.

(3) The program shall then be submitted by the ground water advisory committee to the department which shall certify that the program is consistent with the intent of this chapter.

(4) Following such certification, state agencies and affected local governments shall adopt or amend regulations, ordinances, and/or programs for implementing those provisions of the ground water management program which are within their respective jurisdictional authorities.

(5) The department, the department of social and health services and affected local governments shall be guided by the adopted program when reviewing and considering approval of all studies, plans and facilities that may utilize or impact the implementation of the ground water management program.

[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-120, filed 12/20/85.]

WAC 173-100-130 Designation of ground water areas.

The procedures provided in RCW 90.44.130 may be utilized by the department to designate ground water areas, subareas, or zones for the purposes described therein either in conjunction with the procedures of this chapter or independently thereof.

[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-130, filed 12/20/85.]

WAC 173-100-140 Intergovernmental agreements.

In order to fully implement this chapter, the department may negotiate and enter into cooperative agreements with Indian tribal governments, adjacent states and Canadian governmental agencies when a ground water management area is contiguous with or affects lands under their jurisdiction. Such cooperative agreements shall not affect the jurisdiction over any civil or criminal matters that may be exercised by any party to such an agreement. Intergovernmental agreements shall further the purposes of this chapter, and shall serve to establish a framework for intergovernmental coordination, minimize duplication, and efficiently utilize program resources to protect ground water resources.

[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-140, filed 12/20/85.]

WAC 173-100-150 Appeals.

All final written decisions of the department pertaining to designation of ground water management areas, certification of ground water management programs, permits, regulatory orders, and related decisions pursuant to this chapter shall be subject to review by the pollution control hearings board under chapter 43.21B RCW.

[Statutory Authority: RCW 90.44.400. 86-02-004 (Order DE 85-24), § 173-100-150, filed 12/20/85.]

WAC 173-100-160 Regulation review.

The department of ecology shall initiate a review of the rules established in this chapter whenever new information, changing conditions, or statutory modifications make it necessary to consider revisions.

[Statutory Authority: Chapters 43.27A and 90.44 RCW. 88-13-037 (Order 88-11), § 173-100-160, filed 6/9/88.]

Tables

Issaquah Creek Valley
Ground Water Management Plan

March 1999

Table 5.1 New Lots In Recorded Formal and Short Plats in the Issaquah Ground Water Management Area

	North of I-90		Issaquah		South of I-90		
	Formal	Short	Formal	Short	Formal	Short	Total
1984	0	0	92	0	90	27	209
1985	20	7	100	0	13	72	212
1986	136	4	29	0	41	55	265
1987	107	13	0	4	2	35	161
1988	32	1	8	0	0	18	59
1989	296*	0	31	0	0	14	341*
1990	309*	128	0	0	0	15	452*
1991	256*	14	27	0	0	13*	73*
1992	21*	6	30	3	0	13*	73*
Total	1177*	173	317	7	146	252*	2072
84/85 % of change	2000	700	8.7	0	-85.6	166.7	1.4
85/86 % of change	580	-42.9	-71.0	0	215.4	-23.6	25.0
86/87 % of change	-21.3	225.0	-2900	400	-95.1	-36.4	-39.3
87/88 % of change	-70.1	-92.3	800	-400	-200	-48.6	-63.4

Source: KC/LDIS, Annual Growth Reports 1985-1989
1989-1992: King County Land Development Information System 1994

* These are approximate numbers as the Issaquah Ground Water Management Area boundary dissects certain sections. These are approximate numbers for these sections and does not include recorded plats on the Plateau.

Table 5.2 Permit Applications for the City of Issaquah

	1985	1986	1987	1988	1989	1990	1991	1992	1993	Total
Single-Family Res.	85	80	61	32	20	7	29	41	81	436
Multi-Family Res.	7	5	3	5	3	1	5	5	8	42
Commercial	9	7	7	3	6	5	7	8	11	63
SF/Additions	2	12	20	18	18	36	32	51	54	270
MF/Additions	5	4	0	2	0	3	2	5	6	27
Comm/Additions	54	37	62	44	58	46	36	53	53	443
Total	189	145	153	104	105	98	111	163	213	1,281

Source: City of Issaquah 1989 (1985 to 1988).
City of Issaquah 1994 (1989 to 1993).

Table 5.3 Ecology's Toxic Clean-Up Program

Site Name	Address	Affected Media	Contaminant Status	Site Status	Comments
Bakamus Truck Repair/Rowley	1500 19th Ave. NW, Issaquah 98027	Ground Water Soil	Suspected Confirmed	Remedial Action Conducted by Ecology. Residual contamination left on site.	Final Independent Remedial Action Report received by Ecology.
Bell-Fair Aluminum & Steel Inc.	1480 19th Ave. NW, Issaquah 98027	Ground Water Soil Surface Water Air	Suspected Confirmed Suspected Suspected	Independent Remedial Action	Release Report received by Ecology. Awaiting Assessment by potentially liable party.
FOUR TEK Industries	228 Ave. SE; N of Cedar Grove Rd., Issaquah 98027	Ground Water Soil Surface Water	Suspected Suspected Suspected	Awaiting assessment by Ecology	
General Fabrication & Design	1590 NW Maple St., Issaquah 98027	Ground Water Soil Surface Water Air	Suspected Confirmed Suspected Suspected	Independent Remedial Action	Release Report received by Ecology; Awaiting assessment by potentially liable party
Issaquah Tire Service/Rowley	1860 NW Mall St., Issaquah 98027	Ground Water Soil Surface Water	Suspected Confirmed Suspected	Awaiting assessment by Ecology	
Northwest Pipeline/Issaquah	22339 SE 56th, Issaquah 98027	Soil Air Sediment	Confirmed Suspected Suspected	Awaiting assessment by Ecology	

Table 5.3 Ecology's Toxic Clean-Up Program

Site Name	Address	Affected Media	Contaminant Status	Site Status	Comments
Queen City Farms A (4 Tek)	22420 SE 168th Wy., Issaquah 98027	Ground Water Soil	Confirmed Confirmed	Remedial Action in progress	
Queen City Farms A (Buried Drum)	22420 SE 168th Wy., Issaquah 98027 *	Ground Water Soil	Confirmed Confirmed	Remedial action in progress	
Queen City Farms A	22420 SE 168th Wy., Issaquah 98027	Ground Water Soil	Confirmed Confirmed	Remedial action in progress	

Source: Department of Ecology, Bellevue. List dated October 13, 1993. (Feb. 1994)

Table 5.4 Operational Underground Storage Tanks Reported in the Issaquah Ground Water Management Area

Site Name/Address	Substance	Size	Age (yr)
Warren Iverson/Hobart 20250 276 SE/Box 250	Unleaded Gas	5000-9999	14
Warren Iverson/Hobart 20250 276 SE/Box 250	Diesel Fuel	1101-2000	3
Warren Iverson/Hobart 20250 276 SE/Box 250	Leaded Gas	10000-19999	9
Warren Iverson/Hobart 20250 276 SE/Box 250	Unleaded Gas	10000-19999	9
Preston Maintenance Facility 29726 SE Preston Way	Unleaded Gas	2001-4999	2
Preston Maintenance Facility 29726 SE Preston Way	Diesel Fuel	2001-4999	2
Preston Maintenance Facility 29726 SE Preston Way	Diesel Fuel	2001-4999	2
Preston General Store 30365 SE High Point Way	Leaded Gas	5000-9999	6
Preston General Store 30365 SE High Point Way	Diesel Fuel	5000-9999	6
Preston General Store 30365 SE High Point Way	Unleaded Gas	10000-19999	6
Preston General Store 30365 SE High Point Way	Unleaded Gas	10000-19999	6
Arco 6162 1403 NW Lk. Sammamish Rd.	Unleaded Gas	10000-19999	20
Arco 6162 1403 NW Lk. Sammamish Rd.	Leaded Gas	10000-19999	20
Arco 6162 1403 NW Lk. Sammamish Rd.	Unleaded Gas	10000-19999	20
Tiger Mt. Country Store 14331 Issaquah-Hobart Rd.	Alcohol Blend	10000-19999	11
Tiger Mt. Country Store 14331 Issaquah-Hobart Rd.	Alcohol Blend	10000-19999	11
Tiger Mt. Country Store 14331 Issaquah-Hobart Rd.	Diesel Fuel	10000-19999	11
Tiger Mt. Country Store 14331 Issaquah-Hobart Rd.	Alcohol Blend	10000-19999	11
Grange Supply Inc.	Alcohol Blend	10000-19999	20

Table 5.4 Operational Underground Storage Tanks Reported in the Issaquah Ground Water Management Area

Site Name/Address	Substance	Size	Age (yr)
145 NE Gilman Blvd.			
Grange Supply Inc. 145 NE Gilman Blvd.	Unleaded Gas	10000-19999	20
Grange Supply Inc. 145 NE Gilman Blvd.	Diesel Fuel	10000-19999	20
Grange Supply Inc. 145 NE Gilman Blvd.	Kerosene	5000-9999	20
Grange Supply Inc. 145 NE Gilman Blvd.	Diesel Fuel	10000-19999	20
Grange Supply Inc. 145 NE Gilman Blvd.	Alcohol Blend	10000-19999	20
Grange Supply Inc. 145 NE Gilman Blvd.	Diesel Fuel	5000-9999	20
Texaco Station 15 East Sunset Way	Unleaded Gas	5000-9999	7
Texaco Station 15 East Sunset Way	Unleaded Gas	10000-19999	7
Texaco Station 15 East Sunset Way	Leaded Gas	10000-19999	7
Texaco 63-232-0499 1605 NW Gilman Blvd.	Unleaded Gas	10000-19999	29
Texaco 63-232-0499 1605 NW Gilman Blvd.	Unleaded Gas	10000-19999	21
Texaco 63-232-0499 1605 NW Gilman Blvd.	Leaded Gas	10000-19999	29
Texaco 63-232-0499 1605 NW Gilman Blvd.	Unleaded Gas	5000-9999	21
Texaco 63-232-0499 1605 NW Gilman Blvd.	Leaded Gas	10000-19999	21
Texaco 63-232-0499 1605 NW Gilman Blvd.	Diesel Fuel	10000-19999	29
Texaco 63-232-0499 1605 NW Gilman Blvd.	Unleaded Gas	10000-19999	29
Plateau Texaco 2936 228th Ave SE	Leaded Gas Unleaded Gas Unleaded Gas	10000-19999 10000-19999 10000-19999	29 29 29
King County Water District 1510 228th Ave SE	Unleaded Gas Diesel Fuel	111-1100 111-1100	15 15

Table 5.4 Operational Underground Storage Tanks Reported in the Issaquah Ground Water Management Area

Site Name/Address	Substance	Size	Age (yr)
Fire Station 109 3425 Issaquah Pine Lake Rd.	Diesel Fuel	2001-4999	3
Fedderly Marion Freightlines 1740 NW Maple	Unleaded Gas	2001-4999	7
Maintenance Shops 20500 SE 56th St.	Diesel Fuel	2001-4999	29
Maintenance Shops 20500 SE 56th	Unleaded Gas	2001-4999	29
Maintenance Shops 20500 SE 56th	Used Oil/Waste Oil	111-1100	29
Brown Bear Car Wash 22121 SE 56th	Leaded Gas	5000-9999	1
Brown Bear Car Wash 22121 SE 56th	Unleaded Gas	10000-19999	1
Brown Bear Car Wash 22121 SE 56th	Diesel Fuel	5000-9999	1
Brown Bear Car Wash 22121 SE 56th	Unleaded Gas	10000-19999	1
Chevron 95399 25 NW Gilman Blvd.	Leaded Gas	10000-19999	3
Chevron 95399 25 NW Gilman Blvd.	Unleaded Gas	10000-19999	3
Chevron 95399 25 NW Gilman Blvd.	Unleaded Gas	10000-19999	3
The Southland Corp. 3302 E Lake Sammamish Pkwy.	Unleaded Gas	10000-19999	8
The Southland Corp. 3302 E Lake Sammamish Pkwy.	Unleaded Gas	10000-19999	8
The Southland Corp. 3302 E Lake Sammamish Pkwy.	Leaded Gas	10000-19999	8
James Perry 470 Front St. N		111-1100	45
Issaquah BP 55 NW Gilman Blvd.	Leaded Gas	10000-19999	15
Issaquah BP 55 NW Gilman Blvd.	Diesel Fuel	5000-9999	15
Issaquah BP 55 NW Gilman Blvd.	Unleaded Gas	10000-19999	6

Table 5.4 Operational Underground Storage Tanks Reported in the Issaquah Ground Water Management Area

Site Name/Address	Substance	Size	Age (yr)
Issaquah BP 55 NW Gilman Blvd.	Unleaded Gas	10000-19999	6
Darigold Inc. 611 Front St.	Diesel Fuel	10000-19999	32
Darigold Inc. 611 Front St.	Diesel Fuel	10000-19999	25
Darigold Inc. 611 Front St.	Diesel Fuel	10000-19999	25
Issaquah 070584	Diesel Fuel	111-1100	17
Issaquah 7340	Unleaded Gas	10000-19999	5
Issaquah 7340	Used Oil/Waste Oil	111-1100	5
Issaquah 7340	Unleaded Gas	10000-19999	5
Lakeside Sand & Gravel Co.	Diesel Fuel	10000-19999	5
Lakeside Sand & Gravel Co.	Diesel Fuel	10000-19999	5
Lakeside Sand & Gravel Co.	Leaded Gas	5000-9999	5
Lakeside Sand & Gravel Co.	Used Oil/Waste Oil	5000-9999	6
Harold J. Ruby ARCO 4466	Used Oil/Waste Oil	111-1100	3
Harold J. Ruby ARCO 4466	Leaded Gas	10000-19999	2
Harold J. Ruby ARCO 4466	Unleaded Gas	10000-19999	2
Harold J. Ruby ARCO 4466	Unleaded Gas	10000-19999	2
Harold J. Ruby ARCO 4466	Unleaded Gas	10000-19999	2
Transportation	Unleaded Gas	10000-19999	2
Transportation	Diesel Fuel	10000-19999	2
Transportation	Leaded Gas	10000-19999	2
Bethel Clark	Leaded Gas	10000-19999	10
Bethel Clark	Diesel Fuel	10000-19999	10
Bethel Clark	Unleaded Gas	10000-19999	10
Bethel Clark	Unleaded Gas	10000-19999	10
Kbog N Tiger Mtn/1500	Diesel Fuel	1101-2000	3

Source: Department of Ecology, October 8, 1993.

Table 5.5 Age of Underground Storage Tanks In Operation in the Issaquah Ground Water Management Area

Age (year)	Number of Tanks
1-2	14
3-5	13
6-10	20
11-15	9
16-20	11
21-30	15
Greater than 30	2
Total	**84**

Source: Ecology 1994.

Table 5.6 Substances Contained in Underground Storage Tanks in Operation in the Issaquah Ground Water Management Area

Substance	Number of Tanks
Leaded gas	15
Unleaded gas	35
Diesel fuel	23
Kerosene	1
Used/waste oil	4
Alcohol Blend	5
Unknown	1
Total	**84**

Source: Ecology 1994.

Table 5.7 Size of Underground Storage Tanks in Operation in the Issaquah Ground Water Management Area

Size (gallons	Number of Tanks
111-1,100	8
1,101-2,000	1
2,001-4,999	7
5,000-9,999	12
10,000-19,999	56
Total	**84**

Source: Ecology 1994.

Table 5.8 Ecology Current and Former Contaminated Underground Storage Tank Sites in the Issaquah Ground Water Management Area - January 7, 1994

Site Name	Address	City	Zip Code	Cleanup Status[a]	Media[b]
Texaco Station #004481	825 Front Street North	Issaquah	98027-2508	Awaiting	D
Grange Supply	145 NE Gilman Blvd	Issaquah	98027-2904	Conducted	D
King County Fire District #10	175 Newport Way NW	Issaquah	98027-3104	Conducted	D
Issaquah Feed Service	232 Front St. N	Issaquah	98027-3232	Conducted	D
Shell Station Issaquah	1605 NW Gilman Blvd	Issaquah	98027-5329	In Progress	A,D
Fedderly Marion Freight Lines	1740 NW Maple	Issaquah	98027-8977	In Progress	D
Car Wash Ent Issaquah Landfa	22121 SE 56th St	Issaquah	98027-9237	Conducted	D
Southland 7-11 Station #26056	3302 Sammamish Pkwy	Issaquah	98027-9649	Awaiting	A,D
US West Issaquah Soc #01086	1200 12th NW	Issaquah	98027	Monitoring	A,D
ARCO Station #6162	1403 NW Lake Sammamish Rd	Issaquah	98027	Awaiting	D
Dept. of Transportation Newport Way Exit	SR 901 West Bound On-ramp	Issaquah	98027	In Progress	D
King County Issaquah Public Works	23240 SE 74th	Issaquah	98027	Conducted	D
BP Oil Station Issaquah	55 NW Gilman Blvd	Issaquah	98027-2427	In Progress	A
Chevron Station #9-5399	25 NW Gilman Blvd	Issaquah	98027-2427	Conducted	A,D
ARCO Station #4466	800 Front Street N	Issaquah	98027-2507	In Progress	A,D
Mobil Station #10-d6r	30 West Sunset Way	Issaquah	98027-3811	Monitoring	A,D
Texaco Station #0244	15 East Sunset Way	Issaquah	98027-3826	In Progress	A,D
Issaquah School District Bus Garage	805 2nd Avenue SE	Issaquah	98027-4312	Conducted	D
Southland 7-11 Station #26056	3302 E. Lake Sammamish Par	Issaquah	98027-9649	Waiting	A,D

Table 5.9 Hazardous Waste Generators in the Issaquah Ground Water Management Area

Business Name	Address (Issaquah)	RCRA Type Generator[a]
Captain's Cleaners	1025 Gilman Blvd.	3
Quantum Medical Systems, Inc.	1040 12th Ave. NW	2
Ecology's RAS Issaquah	1145 12th Ave. NE, Bldg. C.	2
USWCOM Issaquah	1200 12th Ave. NW	3
ZETEC	1370 NW Mall	3
Silicon Designs Inc.	1445 NW Mall St.	3
Auto Works Two	145 NW Gilman Blvd.	2
Texaco SS 63 232 0280	15 E. Sunset Way	2
Evergreen Ford	1500 18th Ave. NW	2
Bakamus Truck Repair Co.	1500 19th Ave. NW	2
ZETEC Machine Shop 2	1505 NW Mall St.	3
Circuit Partners Inc.	1575 NW Mall St., Bldg. C	1
Autoworks of Issaquah	1590 NW Mall	2
Texaco SS 6323499	1605 Gilman Blvd.	2
United Autobody	1650 NW Mall	2
Midas Muffler & Brake Shop	1655 NW Mall St.	2
Express Tune	1655 NW Mall St., Suite C.	3
Issaquah Honda Kubota	1875 NW Poplar Way	2
Ecology's NRO May Valley Drug Lab	19523 May Valley Rd.	2
Baxter Healthcare Bartels Div.	2005 NW Sammamish Rd.	1
WP & R Maintenance	20500 SE 56th St.	2
Gilman Auto Body	220 NE Gilman Blvd.	2
Brown Bear Car Wash	22121 SE 56th St.	3
Lawson Disposal	22819 SE 64th	2
Dirk's Fine Drycleaning	240 NW Gilman Blvd.	2
Chevron USA Inc. 95399	25 NW Gilman Blvd.	2
City of Issaquah	525 1st Ave. NW	1
CA Carey Corp.	537 NW Locust	2
Stone Dry Cleaners	5614 E. Lk. Sammamish Pky. SE	3
All Tech Collision Ctr.	6018 221st Pl. SE	2
Cadman Premix Co., Inc.	6600 230th Ave. SE	1
Lakeside Ind. Issaquah Div.	6600 230th Ave. SE	2
Daniells Cleaners	730C NW Gilman Blvd., Suite 105	3
Texaco SS 63231468	825 Front St.	2

Source: Department of Ecology, Bellevue. February 1994.

[a]Generator Type Legend:

1 = Generates or accumulates >2,200 lbs. (large quantity generator)
2 = Generates or accumulates <2,200 but >220 lbs.(medium quantity generator)
3 = Generates or accumulates <220 lbs. (small quantity generators)

Table 6.1 Preliminary Data On Major Producing Wells in the Issaquah Ground Water Management Area

Well Owner	Well No.	Yield/Drawdown (gpm/Dd-ft)	Static Water (ft)	Aquifer Material	Aquifer Transmissivity (gpd/ft)
City of Issaquah	1	1000/11.6	67	sand & gravel	NA
	2	NA	67	sand & gravel	NA
	3	275/15.7	33[1]	sand & gravel	NA
	4	225/51	54.5	sand & gravel	25,000
	5	1000/120	52.5	fine sand	50,000
SPW&SD	7	2000/38	64	sand & gravel	110,000
	8	2000/22	64	sand & gravel	150,000
Overdale Water Association	S21J 1	190/NA	flows	sand & gravel	NA
Darigold	S28J 1	400/10	70[1]	sand & gravel	NA
Lakeside Sand & Gravel	S27D 1	650/5	60[1]	sand & gravel	NA
Reid Sand & Gravel	S21R 1	500/NA	62[1]	sand & gravel	NA

Source: Department of Social and Health Services 1989.
[1] not screened entire length
NA = not available
Note: Static water is the level at which water stands in a well or unconfined aquifer when no water is being removed from the aquifer either by pumping or free flow. It is generally expressed as the distance from the ground surface (or from a measuring point near the ground surface) to the water level in the well.

Table 6.2 Existing Water Rights for the Issaquah Ground Water Management Area[1]

Purveyor	Use	Gallons Per Minute (GPM)	Millions of Gallons Per Day (MGD)	Acre Feet Per Year (AF/YR)
Mirrormont	D[2]	110	0.16	118
Four Lakes	D	150	0.22	82
First City Development Corporation	D	800	1.16	260
Overdale	D	190	.27	30
WA St. Parks	D	150	.22	18
Issaquah[3]	D	3,880	5.6	2,800
SPW & SD[6]	D	8,350	9.5	7,442
Consolidated Dairy	C/I[4]	1,100	1.58	1,232
Lakeside Gravel	D/C/I[5]	1,500	2.16	566

Source: Economic and Engineering Services, Inc. 1988, unless otherwise noted.

[1] Public water systems work in million gallons per day.
GPM in this table reflect the sustained yield of a well during a 24-hour pump test.
MGD is calculated based upon GPM. For example, Mirrormont MGD = 110 gpm x 1,440 minutes/day divided by a millions gallons = 0.16 MGD. AF/YR is not based upon GPM.
Acre feet per year is the maximum amount of water that a well can pump in one year under water rights which are determined by the Department of Ecology based upon the population served by the water system and the rate of use by gallons per person per day.

[2] Domestic

[3] Source: Sheldon Lynne, City of Issaquah, personal communication

[4] Commercial/Industrial

[5] Domestic/Commercial/Industrial

[6] Source: Sammamish Plateau Water and Sewer District, does not include SPWSD wells with conditional or supplemental rights

Table 6.3 Annual Water Demand By Use/Forecast By Use In Acre-Feet

Year	Single Family	Multi-Family	Commercial Industrial	Government Education	Total	Total with Conservation	Total with Losses of 15%
[a]City of Issaquah							
1986	420	580	145	50	1195	1195	1374
1990	451	802	188	54	1746	1480	1702
2000	649	1136	298	78	2160	2042	2348
2010	814	1416	390	98	2718	2591	2980
2020	1019	1761	510	122	3413	3282	3774
2030	1238	2127	639	149	4152	3995	4595
2040	1457	2493	767	175	4892	4709	5415
[a]Sammamish Plateau Water and Sewer District							
1986	1141	23	78	13	1255	1255	1443
1990	1440	51	99	16	1605	1583	1821
2000	2353	117	161	26	2658	2512	2889
2010	3247	287	223	36	3793	3616	4158
2020	4478	610	307	49	5445	5236	6022
2030	5823	934	399	64	7221	6980	8027
2040	7168	1258	476	77	8978	8706	10,012
[b]Mirrormont Services							
1986	0.138		0.092		0.413	0.002	0.445
1990	0.185		0.076		0.458	0.002	0.490
2000	0.343		0.074		0.824	0.003	0.907
2006	0.491		0.074		1.179	0.003	1.296

[a]Source: Economic and Engineering Services, Inc. 1988. CWSP.
Notes:
Classes shown as zero may be grouped in other classes.
Conservation Program started in 1990.
[b]Source: Interlake Associates 1994.
Notes:
Classes shown as zero may be grouped in other classes.
Conservation Program started in 1990.

Table 6.4A Population Projections Versus Forecast Demand - City of Issaquah

YEAR	Corporate Area Population	Potential Annexation Area Population	Total Population	Average Annual Demand (MGD)	Maximum Day Demand (MGD)
1990	7,786	16,880	24,666	1.22	3.10
2000	9,492	28,915	38,407	2.60	4.50
2020	12,815	45,828	58,643	4.50	8.00

Source: City of Issaquah Water System Plan Update. City of Issaquah Natural Resources Department, August 1995.

MGD = Million gallons per day

Table 6.4 Total Annual Water Demand Forecast in Acre-Feet

Year	Issaquah	Mirrormont	SPW&SD
1986	1374	0.445	1443
1990	1702	0.490	1821
2000	2348	0.907	2889
2010	2980	1.296	4158
2020	3774	1.296	6022
2030	4595	1.296	8027
2040	5415	1.296	10,012

Source: Economic and Engineering Services, Inc. 1988.
Interlake Associates 1994 (for Mirrormont only).

Table 6.5 Population Forecasts Using SAZ Data

GWMA	Acreage	Jurisdiction	Estimated Growth[a] 1990-2012	1993[a] Population	2012[a] Population
Issaquah	45,672	King County	7988	20,755	28,743
		City of Issaquah	2,694	4,065	6,759
			Total 10,682	24,820	35,502

[a]Population in number of household

Table 7.1 Summary of Soil Characteristics

Name	Type	Location	Important Characteristics
Alderwood Association			
Alderwood soils	Gravelly sandy loams	Common throughout Issaquah Ground Water Management Area on 6% to 35% slopes; 75% Alderwood - 25% Kitsap soil unit occurs on 25% to 75% slopes	Vertical recharge probably slow except that lateral subsurface movement to permeable zones could contribute substantially to recharge; severely limiting to septic tank filter fields; runoff slow to medium (6-15% slopes) to rapid (steep slopes)
Beausite-Alderwood Association			
Beausite soils	Gravelly sandy loams	Concentrated in central portion of Issaquah Ground Water Management Area on 6% to 75% slopes	Underlain by fractured sandstone; recharge probably not significant although lateral movement to permeable zones may contribute substantially to recharge; severely limiting to septic tank filter fields; runoff moderate to very rapid
Ovall Soils	Gravelly loams	Similar location as Beausite	Underlain by weathered andesite breccia; other characteristics same as Beausite
Everett Association			
Everett Soils	Gravelly sandy loam underlain by gravelly sand	South Sammamish Plateau on 0% to 30% slopes	Rapid permeability; recharge is probably significant; few limitations to septic tank filter fields, although these soils offer little protection to ground water quality; runoff slow to rapid; excessively well drained
Neilton Soils	Gravelly loamy sand underlain by stratified glacial drift	Similar location as Everett on 2% to 15% slopes	Runoff slow to medium; other characteristics same as Everett
Valley Soils			
Sammamish Soils	Silt loams stratified with fine sand and clay	Lower Issaquah Creek valley on 0% to 2% slopes	Moderately slow permeability; recharge probably slow, but may be significant in areas underlain by shallow aquifers; severe limitations to septic tank filter fields; seasonal high water table; flooding is a hazard; offers limited protection to underlying shallow aquifers

Table 7.1 Summary of Soil Characteristics

Name	Type	Location	Important Characteristics
Bellingham Soils	Similar to Sammamish	Similar to Sammamish	Similar to Sammamish
Briscot Soils	Silt loam stratified with fine sand	Similar to Sammamish	Moderate permeability; recharge to shallow unconfined aquifers is likely significant; otherwise similar to Sammamish
Puyallup Soils	Fine sandy loams	Similar to Sammamish on slightly convex slopes	Moderately rapid permeability; recharge to shallow aquifers is likely significant; severe limitations to septic tank filter fields; seasonal high water table; flooding potential slight to severe; offers limited protection to water quality
Puget Soils	Silty clay loam	Similar to Sammamish	Similar to, but even more severely limiting than Sammamish
Oridia Soils	Silt loam interspersed with fine sand and clay at depth	Similar to Sammamish	Similar to Sammamish
Sultan Soils	Silt loam with clayey and sandy zones at depth	Similar to Sammamish	Similar to Sammamish

Table 7.2 Characteristics of Geohydrologic Units in the Issaquah Ground Water Management Area

Geohydrologic Unit	Geohydrologic Unit Label	Characteristics
Vashon Stage Glacial Deposits		
Recessional Outwash Deposits	Qvr	Predominantly gravel, sand and minor amounts of silt. Where available it is a good source of recharge that can yield large quantities of water.
Recessional Lacustrinal Deposits	Qvrl	Predominantly clay and silt, with some sand and rarely gravel. Functions as a leaky aquitard.
Ice Contact Deposits	Qvl	A heterogeneous mixture of till and outwash deposits. These units have considerable hydrogeologic variability.
Till	Qvt	A massive heterogeneous mixture of silt, sand and gravel. The upper positions of these units can contain perched and semi-perched water tables. The isolated sand and gravel lenses yield limited quantities of water. Recharge of these lenses is usually slow.
Advance Outwash	Qva	Primary sand to cobble-size gravel with thin beds of silt. Where saturated, this unit yields large quantities of water.
Pre-Vashon Units		
Unnamed Sand		Chiefly well-sorted medium grade sand, lenses of gravel, silt and clay.Yields water to wells where saturated.
Upper Clay Unit		Massive silt and clay, peat beds: probably functions as an aquitard. Lenses of sand and gravel yield water for domestic supplies.
Unnamed Gravel		Cobble gravel, pebbles and sand which is a very permeable, productive aquifer material.
Lower Clay Unit		Almost entirely clay and silt with discontinuous beds of till and peat. Units have an impermeable bottom to upper units and a confining layer to lower aquifers.
Older Unconsolidated Deposits		Interbedded sand, silt, clay, minor gravel, till, volcanic ash with some high yield wells. The incidence of objectionable chloride reported.
Bedrock		
Unnamed Volcanic Rock	Tv	Volcaniclastic sandstone and siltstone which conglomerates with marine fossils. Unit has poor water-bearing potential.

Table 7.2 Characteristics of Geohydrologic Units in the Issaquah Ground Water Management Area

Geohydrologic Unit	Geohydrologic Unit Label	Characteristics
Blakely (?) Formation	Tb	Marine sediments, predominately sandstone and conglomerate which have poor water-bearing potential.
Renton Formation	Tr	Non-marine sandstone, claystone and coal with poor water-bearing potential.
Tukwila Formation	Tt	Volcaniclastic rocks and lava flows with poor water-bearing potential.
Tiger Mountain Formation	Tim	Non-marine arkosic sandstone, siltstone and coal with poor water-bearing potential.
Raging River Formation	Trr	Volcaniclastic sandstone and siltstone which conglomerate with marine fossils. Unit has poor water-bearing potential.
Intrusive Rocks	Ti	Andesites and basalts injected as dikes. Unit has poor water-bearing potential.

Table 7.3 Lower Issaquah Creek Valley Aquifer Characteristics

Aquifer Designation	Elevation (meters (ft))	Material	Transmissivity (m^2/day (gpd/ft))
A1 - upper fluvial sediments	-6.1 to -15.2 (-20 to 50)	Sand and gravel	372.7 (30,000)
A2 - lower glacio-fluvial sediments	-12.2 to -33.6 (-40 to -110)	Lenses of sand and gravel	2484.4 (200,000)
A3 - deep alluvial sediments	-61.0 to -106.7 (-200 to -350)	Sand	496.9 (40,000)

Source: Carr/Associates 1988.

Table 7.4 Selected Lower Valley Wells

Well Owner	Well No.	Zone Completed	Yield (m^3/day (gpm))	Specific Cap. (gpm/ft)	Transmissivity (m^2/day (gpd/ft))
Darigold	2	A1	2180 (400)	40	NA
Reid S&G	21R1	A1	2726 (500)	NA	NA
Lakeside S&G	27D1	A1	3543 (650)	130	NA
SPWD	7-1S	A1	409 (75)	7	508 (41,000)
SPWD	7-1D	A2	2726 (500)	25	2740 (221,000)
SPWD	7-3	A2	1199 (220)	33	1637 (132,000)
SPWD	7	A2	10,629 (1950)	52	3757 (303,000)
SPWD	8	A2	19,081 (3500)	90	2232 (180,000)
SPWD[1]	9	A3	no yield	unknown	unknown
Overdale W.A.	21H	A2	954 (175)	2	1141 (92,000)
City of Iss.	1	A1?	5451 (1000)	86	NA
City of Iss.	2	A1?	5451 (1000)	86	NA
City of Iss.	4	A1	1308 (240)	5	260 (21,000)
City of Iss.	5	A3	5451 (1000)	8	503 (40,600)

Sources: Carr/Associates 1983, 1984, 1988; Robinson & Noble 1986; Washington State Water Well Reports.
Note: Values are measured or reported rates during testing.
NA= Data not available
[1]SPWD is awaiting water rights from the Department of Ecology for well No. 9.

Table 7.5 Hydrostratigraphic Units

Unit	Permeability	Description
Bedrock	Low	Consolidated sedimentary and volcanic sediments including: sandstone, shale (sometimes with coal), andesite, and volcanic tuff. Can provide limited amounts of water to wells.
Aquitard	Low to Moderate	Unconsolidated ice-contact and marginal deposits of very silty sand and gravel, including till, alluvial and lake clay, silt, and fine silty sand.
Aquifer	Moderate to High	Unconsolidated ice-contact, deltaic, and alluvial deposits of sand; sand and gravel, and sand, gravel, and cobbles. All relatively free of silt and clay.

Source: Hydrogeological Report Carr/Associates, Sept. 1993.

Table 7.6 Issaquah Ground Water Management Area Water Level and Water Quality Monitoring Site List

Location No.	Site ID	Owner ID	System Name	Street Address	Altitude	Well Depth	Hole Depth	Diameter of Casing	Water Level	Date (Y-M-D) Measured
22N/07E-05N01	472745121570401	13274B	Crawford Michael	29212 SE 208th Street	746.17	101.00	101.00	6.00	35.00	19920316
22N/07E-06J02	472515121572501	59504E	Rahal Joann	28611 204th Street	591.62	125.00	125.00	6.00	51.78	19920316
22N/07E-07D05	472451121581101		Fire District 43	27605 SE 208th Street	575.25	79.00	79.00	6.00	7.25	19920316
22N/07E-07H02	472438121571601	30125A	Raub Ruth	29004 SE 216th Street	710.25	181.00	181.00	6.00	137.02	19920316
23N/06E-03A02	473049122005701		Allison Ron	10124 238th Way	268.24	144.00	147.00	6.00	111.78	19911108
23N/06E-03B04	473049122011602		Erickson Eric	10029 Issaquah-Hobart Road	158.65	42.00	49.00	6.00	23.20	19911108
23N/06E-03G02	473040122011801		Foothill Baptist Church	10120 Issaquah-Hobart Road	187.03	86.00	86.00	6.00	38.02	19911108
23N/06E-03H05	473039122005801	22777H	Young Ted	10124 238th Way	228.60	99.00	99.00	6.00	77.13	19911108
23N/06E-03K02	473027122011701		Hall Don	10805 Issaquah-Hobart Road	182.77	58.00	58.00	6.00	25.26	19900214
23N/06E-10K03	473023122012201		Brown Lawrence	12123 Issaquah-Hobart Road	184.25	33.00	33.00	6.00	6.62	19911108
23N/06E-10Q05	472924122011503		Hayes Nursery	12504 Issaquah-Hobart Road	194.81	68.00	68.00	6.00	11.13	19911108
23N/06E-15C04	472910122013902		Watson Joan	13116 223rd Street	223.33	53.00	53.00	6.00	10.10	19911108
23N/06E-15L04	472845122013604		Adams Richard	13915 233rd Way SE	298.43	88.00	88.00	6.00	47.00	19911108
23N/06E-15M02	472843122012601	227404	Four Creeks Ranch Water Assoc.	13728 229th SE	250.	133.00	133.00	10	8	19880615
23N/06E-15P03	472831122013702		Cook Jim	14116 233 Place SE	323.95	185.00	185.00	6.00	63.00	19911108
23N/06E-15R03	472830122010102		Jepsky Norm	24266 SE Tiger Mountain Road	419.24	108.00	108.00	8.00	80.00	19920316
23N/06E-16R01	472831122021801		Peek James	13728 229th Avenue SE	500.00	258.00	258.00	6.00	246.67	19860718
23N/06E-17G01	472857122035401		Verschaeve Hector	21207 SE May Valley Road	327.11	60.00	62.00	6.00	10.15	19911108
23N/06E-17H03	472854122034301		Hawes Don	21130 SE May Valley Road	392.35	132.00	132.00	8.00	97.20	19911108
23N/06E-22C01	472816122025401		Mooney Dee	14545 Cedar Grove Road SE	335.20	192.00	192.00	6.00	57.03	19911108
23N/06E-22M01	472750122015801		Stanley Ron Co. (Gene Lyle Comm)	15313 230th SE	420.00	160.00	160.00	8.00	141.00	19731017
23N/06E-22N01	472739122015801	54681R	Miller Dick W		510.00	400.00	405.00	6.00	327.00	19880615
23N/06E-22P03	472703122013301	80810J	Sneva	15729 Cedar Grove Road SE	325.00	85.00	87.00	6.00	10.00	19830311
23N/06E-24R01	472736121582701		Agnew Randy	27241 SE 156th Street	1070.49	271.00	271.00	8.00	8.21	19920316
23N/06E-26E05	472715122003901		Hayes Larry Well #1	16610 246th Place SE	439.04	152.00	152.00	6.00	80.13	19911108
23N/06E-26H01	472710122593801		Hines Donald	16604 Issaquah-Hobart Road	403.12	106.00	109.00	6.00	24.98	19911108
23N/06E-27A02	472720122011202		Greening Jackie	24223 SE 164th Street	388.51	117.00	117.00	6.00	65.81	19920316
23N/06E-27C01	472729122014101		Jackson Gary	16121 Cedar Grove Road	387.81	93.00	93.00	6.00	38.33	19911108
23N/06E-27E03	472720122020301	02996P	Cedar Acres (John Conner Well #1)	230th Ave SE & Cedar Grove Rd	390.00	200.00	200.00	6.00	100.00	19791101
23N/06E-27F02	472714122014101		Mitchell Robert	16231 Cedar Grove Road SE	400.00	360.00	360.00	6.00	77.00	19730411
23N/06E-27R01	472645122005501	52118T	Mazama Woods (Verco)	16918 240th Avenue SE	610.85	155.00	205.00	8.00	88.48	19920316
23N/06E-28B03	472725122023801	119301	Cedar Hills Landfill		580.00	347.00	347.00	8.00	314.00	19660000

Location No.	Site ID	Owner ID	System Name	Street Address	Altitude	Well Depth	Hole Depth	Diameter of Casing	Water Level	Date (Y-M-D) Measured
23N/06E-28Q01	472646122024201	264611	PW-1 / G-1 Cedar Grove Airport		370.00	250.00	250.00	8.00	0.00	
23N/06E-35B06	472636122000101		Brown Dave	25410 178th Street	672.93	320.00	360.00	6.00	74.88	19920316
24N/06E-14K01	473352122000001		Caldwell Laureita	25237 SE Issaquah-Fall City Rd	444.61	94.00	94.00	6.00	60.33	19920316
24N/06E-21J01	473258122022101	65000H	Overdale Park Water Assoc Primary		53.45	150.00	150.00	6.00	-0.0	19920316
24N/06E-21Q01	473243122023301		SPWSD/City of Issaquah Vt-2.1 Test	130 East Sunset Way	59.67	24.00	24.00	2.00		
24N/06E-22A01	473329122010101	65000H	Overdale Park Water Assoc Deep		569.66	510.00	510.00	12.00	112.75	19920316
24N/06E-22J02	473301122005602		Dean James	24109 SE Black Nugget Road	419.04	97.00	97.00	6.00	80.58	19920316
24N/06E-23C01	473322122001401		Matteson Marie	25045 SE Black Nugget Road	434.38	100.00	0.00	6.00	44.68	19920316
24N/06E-25P01	473153121590101		Foster Herb	26415 SE 79th	529.98	136.00	136.00	6.00	114.56	19920316
24N/06E-27D05	473227122020001		SPWD/City of Issaquah Vt-1 Test	130 East Sunset Way	85.95	160.00	187.00	8.00	6.15	19900129
24N/06E-27M01	473205122014101	363505	City of Issaquah Risdon Well #1		92.57	107.00	107.00	12.00	35.70	19911108
24N/06E-27M02	473206122014201	363505	City of Issaquah Risdon Well #2		93.06	97.00	200.00	12.00	34.80	19911108
24N/06E-28A03	473234122021502		SPWD Production Well #7		70.19	151.00	151.00	16.00	9.50	19920316
24N/06E-28A05	473234122021401	409009	Sammamish Plateau SWD #8		73.94	189.00	190.00	16.00	12.16	19920316
24N/06E-28A06	473234122021403		Sammamish Plateau SWD 7-1(D)		72.30	219.50	295.00	8.00	10.50	19920316
24N/06E-28A07	473234122021402		Sammamish Plateau SWD 7-1(S)		72.30	100.00	295.00	8.00	9.98	19920316
24N/06E-28A08	473236122021501		Sammamish Plateau SWD 7-3(D)		70.10	150.00	0.00	8.00	8.99	19920316
24N/06E-28B01	473237122023501	363505	City of Issaquah #4		66.97	112.00	200.00	16.00	6.40	19920113
24N/06E-28B02	473237122023502	363505	City of Issaquah #5		66.96	412.00	412.00	16.00	6.60	19920113
24N/06E-28B03	473236122023101	363505	City of Issaquah Test Well		67.09	450.00	650.00	6.00	12.45	19911108
24N/06E-28B04	473215122024901		Zetec		55.67	78.00	78.00	6.00	-2.00	19821015
24N/06E-29R01	473158122033301		Pommer James	7600 Renton-Issaquah Road	148.82	127.00	127.00	6.00	13.18	19920316
24N/07E-29Q01	473147121561601	188791	Preston Industrial # 2		520.48	50.00	50.00	6.00	20.38	19920316
24N/07E-29Q02	473154121562801	188791	Preston Industrial # 3		505.72	49.00	49.00	8.00	6.40	19920316
24N/07E-32A02	473134121560101	188791	Preston Industrial # 1r		523.40	48.00	83.00	8.00	23.95	19920316
24N/07E-32D03	473141121565703		Pendell Arthur J	29510 SE 82nd Street	607.83	156.00	156.00	6.00	106.50	19920316

Table 7.6B Issaquah Ground Water Management Area Water Level and Water Quality Monitoring Site List -- Sammamish Plateau Area†

Local well number	Latitude (degrees/ minutes/ seconds)	Longitude (degrees/ minutes/ seconds)	Geo-hydrologic unit	Land Surface elevation (feet above sea level)	Depth of well below land surface (feet)	Surface casing diameter (inches)	Use of water	Water level below land surface (feet)	Date of water level measure-ment (month/ day/year)	Hydraulic conductivity (feet per day)	Remarks
24N/06E-02E01	473551	1220042	Qvt	530	40	6	P	11.84	07-09-90	220	LMS
24N/06E-02P01	473520	1220010	--	420	110	10	U	--	--	--	--
24N/06E-02P02	473518	1220011	--	420	100	6	U	--	--	--	--
24N/06E-03E01	473547	1220200	Qva	560.44	176	6	P	--	--	--	L
24N/06E-03P01	473529	1220136	Qva	380	68	6	U	26.68	07-10-90	28	L
24N/06E-03P02	473522	1220142	Qva	375	97	6	H	--	--	63	L
24N/06E-03R01	473519	1220054	Qvr	385	12	30	U	--	--	--	--
24N/06E-04J01	473533	1220220	Qvt	412.65	31.5	1.25	U	12.14	07-10-90	--	L
24N/06E-04K01	473533	1220235	Qvr	426.77	17	72	U	4.82	07-10-90	--	W
24N/06E-04N01	473527	1220302	Q(A)c	449	300	10	U	--	--	--	L
24N/06E-04N01P1	473527	1220302	Q(A)c	449	300	10	U	187.11	09-14-90	--	L
24N/06E-04N02	473527	1220303	Q(A)c	449	346	12	U	--	--	84	L
24N/06E-04N02P1	473527	1220303	Q(A)c	449	316	12	U	191.95	09-14-90	--	L
24N/06E-04N02P2	473527	1220303	Q(A)c	449	265	12	U	187.66	09-14-90	--	L
24N/06E-04P02	473519	1220257	Qvt	406.24	54.1	1.25	U	18.61	07-06-90	--	L
24N/06E-05D01	473606	1220416	Qal	130	6.5	36	U	3.61	07-13-90	--	--
24N/06E-05D02	473605	1220420	Qal	135	12	30	H	9.66	07-13-90	--	--
24N/06E-05H01	473551	1220324	Qva	350	153	6	H	--	--	--	L
24N/06E-08F01	473459	1220413	Q(A)c	355	342	6	H	--	--	--	L
24N/06E-08J01	473451	1220329	Qvt	384.32	25	84	Z	--	--	--	--
24N/06E-08K02	473450	1220343	Qvt	410	47	36	U	24.21	07-19-90	--	--
24N/06E-08P02	473433	1220409	Q(A)f	110	185	8	Z	--	--	--	L
24N/06E-09A07	473511	1220208	Qva	402.27	110	6	H	85.07	07-11-90	--	--
24N/06E-09A09	473517	1220205	Qvr	417.22	29.2	1.25	U	8.71	07-06-90	--	L
24N/06E-09A10	473517	1220214	Qvt	401.19	47.5	1.25	U	31.98	07-06-90	--	L
24N/06E-09A11	473518	1220214	Q(B)f	401.68	424	2	U	158.77	07-06-90	--	LW
24N/06E-09A12	473518	1220214	Qva	401.70	123	2	U	72.81	07-06-90	--	W
24N/06E-09A13	473518	1220214	Q(A)f	401.87	231	2	U	87.96	07-06-90	--	W
24N/06E-09A14	473518	1220214	Qva	401.69	203	2	U	86.16	07-06-90	--	W

Local well number	Latitude (degrees/ minutes/ seconds)	Longitude (degrees/ minutes/ seconds)	Geo-hydrologic unit	Land Surface elevation (feet above sea level)	Depth of well below land surface (feet)	Surface casing diameter (inches)	Use of water	Water level below land surface (feet)	Date of water level measure-ment (month/ day/year)	Hydraulic conductivity (feet per day)	Remarks
24N/06E-09A15	473518	1220214	Qva	401.51	170	2	U	85.34	07-09-90	--	W
24N/06E-09E03	473503	1220306	Qva	385	251	6	H	120.78	07-06-90	4.1	LM
24N/06E-09E04	473504	1220306	Q(A)f	386.27	420	2	U	75.23	07-06-90	--	L
24N/06E-09H02	473502	1220212	Qva	403.53	101	6	H	87.54	07-11-90	--	L
24N/06E-09J01	473449	1220205	Qva	430	130	12	C	115.72 S	07-12-90	3,400	L
24N/06E-09J02	473449	1220207	Qva	430	132.5	12	C	119.20 R	07-12-90	6,100	L
24N/06E-09N02	473429	1220302	Qva	310	199	6	H	99.40	07-11-90	10	LWM
24N/06E-09N03	473428	1220313	Q(A)f	350	202	6	H	99.08	07-11-90	32	L
24N/06E-10C01	473513	1220127	--	370	20	30	Z	--	--	--	--
24N/06E-10D01	473517	1220159	Qvr	387.12	31.7	1.25	U	6.17	07-13-90	--	L
24N/06E-10H01	473502	1220059	Qva	455	150	12	U	119.79	08-22-90	930	L
24N/06E-10H02	473501	1220059	Qva	455	155.2	16	P	120.96	08-22-90	1,400	LMVPS
24N/06E-10H03	473503	1220058	Qva	455	169	8	U	121.29	09-14-90	1,300	L
24N/06E-10L02	473441	1220128	Qvt	360	109	6	U	43.48	07-16-90	32	L
24N/06E-10P02	473430	1220124	Qva	355	72	6	H	--	--	46	LMS
24N/06E-11B01	473506	1215956	Qva	440	92	6	Z	--	--	--	--
24N/06E-11K01	473448	1215954	Qva	430	116	12	P	63.95	08-22-90	200	L
24N/06E-11L01P1	473439	1220016	Qva	420	135	8	U	65.18	09-14-90	--	LW
24N/06E-11L01P2	473439	1220016	Qva	420	95	8	U	66.45	09-14-90	--	LW
24N/06E-11L01P3	473439	1220016	Qvt	420	25	8	U	23.05	09-14-90	--	L
24N/06E-12B01	473510	1215845	Q(A)c	430	160	6	H	119.67	08-10-90	92	LM
24N/06E-12L01	473439	1215909	Q(A)f	440	362	6	H	--	--	12	LM
24N/06E-12N02	473425	1215915	Q(A)c	450	208	6	H	--	--	11	L
24N/06E-12R01	473429	1215819	Qva	450	108	8	P	80.10	07-16-90	1,100	L
24N/06E-13D01	473411	1215918	Qva	475	155	6	H	136.20	07-16-90	310	L
24N/06E-14H02	473410	1215943	Qva	480	124	6	H	91.13	07-16-90	540	L
24N/06E-14N01	473341	1220032	Multiple	460	198	6	U	111.93	07-17-90	--	L
24N/06E-14N02	473337	1220045	Qvr	470	146	6	Z	--	--	230	L
24N/06E-15C01	473420	1220137	Qva	355	79	6	H	19.69	07-17-90	9.6	L
24N/06E-15F01	473403	1220128	Qvt	370	156	6	H	F	07-17-90	.04	L
24N/06E-15N01	473334	1220148	Br	450	160	6	H	--	--	.72	L
24N/06E-16E01	473410	1220312	Q(A)c	125	196	6	H	54.06	09-26-90	--	L
24N/06E-16E02	473406	1220310	--	60	10	48	Z	--	--	--	L

Local well number	Latitude (degrees/ minutes/ seconds)	Longitude (degrees/ minutes/ seconds)	Geo-hydrologic unit	Land Surface elevation (feet above sea level)	Depth of well below land surface (feet)	Surface casing diameter (inches)	Use of water	Water level below land surface (feet)	Date of water level measure-ment (month/ day/year)	Hydraulic conductivity (feet per day)	Remarks
24N/06E-16L02	473354	1220301	--	55	84	6	H	-0.52 F	07-19-90	--	L
24N/06E-21A01	473328	1220216	Br	425	120	8	U	40.87	07-19-90	1.4	L
24N/06E-21B01	473332	1220231	Br	390	200	8	H	63.49	07-19-90	28	L
24N/06E-21J01	473306	1220221	Qva	55	150	6	P	F	10-30-90	150	L
24N/06E-22A02	473327	1220059	Qvt	450	85	6	I	49.53	08-10-90	61	L
24N/06E-22C01	473332	1220133	Br	420	240	6	H	51.90	08-09-90	.21	L
24N/06E-22F01	473319	1220136	Br	555	510	12	P	112.74	10-30-90	--	L
24N/06E-22H02	473311	1220105	Qvr	425	86	6	H	62.38	08-09-90	8.7	LM
25N/06E-20E01	473819	1220427	Q(B)c	70	122	6	H	24.97	05-10-90	--	LWM
25N/06E-26A02	473748	1215945	Qal	115	60	8	H	10.73	06-29-90	1.7	L
25N/06E-26P01	473712	1220020	Qvr	345	63	6	H	8.88	09-14-90	11	L
25N/06E-27J01	473718	1220056	Qvr	405	152	6	P	128.58 R	09-19-90	26	L
25N/06E-27K01	473719	1220108	Qvr	370	150	6	P	87.34	09-19-90	8.3	L
25N/06E-27N01	473712	1220145	Qvr	425	238	6	H	229.93	08-08-90	--	LW
25N/06E-28H01	473728	1220207	Qvr	425	47	6	H	11.26	07-03-90	24	LM
25N/06E-29C01	473742	1220407	Q(B)c	100	178	8	H	F	06-28-90	97	L
25N/06E-32F03	473645	1220403	Q(A)c	50	116	6	H	F	06-28-90	31	LM
25N/06E-32L02	473626	1220406	Q(A)c	100	101	12	H	F	06-28-90	--	L
25N/06E-33K01	473623	1220239	Q(A)c	480	337	6	H	273.72	12-12-90	--	L
25N/06E-33N03	473616	1220310	Qva	410	200	6	H	163.27	08-07-90	--	L
25N/06E-34D01	473659	1220148	Qva	360	214	6	H	174.35 P	07-03-90	860	LMS
25N/06E-34E02	473634	1220144	Q(B)c	370	714	20	P	--	--	37	LM
25N/06E-34M01	473633	1220150	Q(B)c	360	717	12	P	237.15	08-22-90	--	L

Explanation of Terms:

[-- - not determined]

Geohydrologic Unit:

- Qal - alluvium
- Qvr - Vashon recessional outwash
- Qvt - Vashon till
- Qva - Vashon advance outwash
- Q(A)f - Upper fine-grained unit
- Q(A)c - Upper coarse-grained unit
- Q(B)f - Lower fine-grained unit

Water Level (status of well at time of visit):

- F - flowing
- P - pumping
- R - recently pumping
- S - nearby well pumping
- T - nearby well recently pumping

Q(B)c - Lower coarse-grained unit
Br - Bedrock

Use of Water:
C - commercial
H - domestic
I - irrigation
N - industrial
P - public supply
R - recreational
S - stock
T - institutional
U - unused

Remarks:
L - driller's (lithologic) log available
W - project observation well for water level
M - sampled for major ions, bacteria, trace metals and field parameters
V - sampled for volatile organic compounds
P - sampled for pesticides
S - sampled for detergents, boron and dissolved organic carbon

†Source: USGS, *Geohydrology and Ground-Water Quality of East King County, Washington*, Water Resources Investigations Report 94-4082, 1995.

Table 7.7 Susceptibility Ranking of NRCS Soil Units

NRCS Map Symbol	NRCS Soil Unit Name	Relative Physical Susceptibility
EvB	Everett	high
EvC	Everett	high
EvD	Everett	high
InA	Indianola	high
InC	Indianola	high
Pc	Pilchuck	high
RdC	Ragnar-Indianola	high
Re	Renton	high
AgC	Alderwood	moderate
AgD	Alderwood	moderate
AkF	Alderwood	moderate
AmC	Arents	moderate
Br	Briscot	moderate
Ea	Earlmont	moderate
KpB	Kitsap	moderate
KpD	Kitsap	moderate
No	Norma	moderate
Os	Oridia	moderate
So	Snohomish	moderate
Su	Sultan	moderate
Sk	Seattle muck	moderate
Tu	Tuckwila muck	moderate
Bh	Bellingham	moderate
Pu	Puget	low

Table 7.8 Susceptibility Ranking of USGS Geologic Units

Geologic Symbol	Geologic Unit Name	Relative Physical Susceptibility
Qaf	Alluvial fan deposits	high
Qual	Older alluvium	high
Qvr	Recessional outwash	high
Qvrb	Recessional outwash	high
Qvrd	Redmond Delta	high
Qvro	Older recessional outwash	high
Qvry	Recessional outwash	high
Qva	Advance outwash	high
Qc	Colluvium	moderate
Qls	Landslide deposits	moderate
Qmw	Mass wasting deposits	moderate
Qob	Olympia beds	moderate
Qyal	Younger alluvium	moderate
Qsw	Swamp deposits	low
Qtb	Transitional beds	low
Qvrc	Clay	low
Qvt	Glacial till	low

Table 7.9 Susceptibility Ranking for Depth to Water Criteria

DEPTH TO WATER Depth Below Ground Surface (feet)	Relative Physical Susceptibility
0-25	high
>25-75	moderate
>75	low

Table 7.10 Causal Relationship Between Land Use Activities and Water Quality

Contaminant Source	Cause	Potential Contaminants
Public Infrastructure and Utility Services		
Septic tank effluent	Improper site selection, design, construction and/or maintenance	Pathogens, nitrates, chlorides, sodium, inorganic chemicals, hazardous substances (cleaning compounds, solvents, pesticides, petroleum products, organic chemicals, heavy metal(s)
Leaking sewer lines	Improper design, construction and/or maintenance	Same as for septic tank effluent above
Hazardous substance use, storage and disposal (domestic, commercial and industrial)	Improper use, inadequate containment, improper disposal, assimilative capacity of application site exceeded, spills, lack of practical disposal facilities or methods	Hazardous substances (solvents, petroleum products, heavy metals, organic and inorganic chemicals, pesticides)
Pumping-induced ground water contamination	Natural and altered aquifer hydrogeochemical conditions, well location and depth, pumping patterns and rates, alteration of recharge area hydrology, overpumping, inadequate well construction or seals	Iron, manganese and hydrogen sulfide, highly mineralized, saline or brackish water
Introduction of wastes through wells	Improper abandonment of wells, use of wells for waste disposal or injection, use of dry wells for surface drainage	Uncontrolled introduction of hazardous substances and pathogens
Mortuary and cemetery operations and maintenance	Inadequate disposal of wastes, improperly located graveyards, over-fertilization of grounds	Pathogens, organic chemicals, heavy metals, nitrate
Transportation spills of hazardous chemicals	Improper emergency response and cleanup of accidental releases	Hazardous substances (petroleum products, organic chemicals, solvents, pesticides, concentrated toxins, caustics, heavy metals, radioactive materials, pathogens
Vegetation control for right-of-way maintenance	Application of herbicides in excess of surface assimilative capacity	Pesticides
Provision and transmission of electrical power	Leakage of insulating fluids	Organic chemicals (PCBs)

Table 7.10 Causal Relationship Between Land Use Activities and Water Quality

Contaminant Source	Cause	Potential Contaminants
Storm water drainage	Conveyance and infiltration of transportation-related wastes deposited on roadways and streets	Petroleum products, organic chemicals (tire rubber), heavy metals (lead)
Landfill leachate	Inadequate or improper siting, design, construction, operation and closure of facilities, uncontrolled acceptance of hazardous substances for disposal	Pathogens, nitrate, iron and manganese, hazardous substances (organic and inorganic chemicals, pesticides, solvents, petroleum products, caustics, heavy metals and radioactive materials)
Parks, golf courses and landscaping	Over-application of fertilizers and pesticides, leaking fertilizer and pesticide storage containers	Nitrate, pesticides
Commercial Agriculture and Hobby Farms		
Animal feedlots, pens, waste storage	Improper siting, animal density exceeds natural waste assimilative capacity of soils, inadequate waste collection, storage, treatment and disposal, lack of fencing through creeks	Nitrate and pathogens
Nurseries, commercial crops	Leakage from inadequate containers, improper storage practices, over-application of fertilizers and pesticides	Pesticides, nitrates, petroleum products, hazardous substances
Introduction of hazardous substances and wastes through wells	Lack of adequate backwash prevention valves for chemigation and manurigation, improper abandonment of wells, use of wells for waste disposal or injection, use of dry wells for surface drainage	Nitrate, pesticides, pathogens, hazardous substances
Sand and Gravel Mining		
Open pits in or above aquifers	Improper abandonment and filling with unsuitable wastes	Petroleum products, hazardous wastes, pathogens, iron, metals
Equipment fuel tank leakage	Inadequate containment, vandalism	Petroleum products
Illegal "midnight" dumping in excavated pits	Criminal behavior and moral turpitude, inadequate security for active operations and inadequate closure practices or law	Uncontrolled varied wastes - hazardous wastes (sludges, organic and inorganic chemicals) from industrial, agricultural, commercial

Table 7.10 Causal Relationship Between Land Use Activities and Water Quality

Contaminant Source	Cause	Potential Contaminants
	enforcement for abandoned sites	and domestic sources, pathogens and nitrates from septage, animal carcasses and vermin
Timber Harvesting		
Fuel and pesticide storage	Inadequate containment	Petroleum products and pesticides
Control of weeds and pests, fertilization of seedlings	Improper application	Pesticides and nitrates
Removal of timber and vegetation	Stimulated vegetative nutrient release through plant death, combustion and decay	Nitrates

Table 7.11 Potential Impacts To Quantity

Activity	Impact
Residential and Commercial Development	
Using private supply water wells	Increased discharge & translocation of ground water
Using on-site septic tank sewage disposal system effluent	Formation of shallow ground water recharge mounds
Constructing impermeable surfaces (rooftops, pavement, parking lots, drainage systems)	Increased runoff; decreased infiltration & recharge
Excavating cut slopes & fill additions	Altered evapotranspiration, surface drainage, infiltration & recharge; increased discharge for irrigation
Operating & Maintaining cemeteries	Altered percolation of ground water; increased discharge for irrigation
Public Infrastructure and Utilities Services	
Excavating utilities & pipelines	Altered percolation of ground water
Installing grounded bed borings for pipelines & structures	Interconnection of surface drainage & aquifer systems
Constructing streets & roads, highway interchanges, parking lots, facilities with impermeable surfaces & rooftops	Increased runoff; decreased infiltration & recharge; increased ponding & flooding with possible erosion downstream from collection points
Controlling vegetation in rights-of-way	Increased runoff; decreased infiltration & recharge
Constructing storm drainages	Increased runoff; decreased infiltration & recharge; increased ponding & flooding with possible erosion downstream from collection points
Constructing sanitary sewers	Translocation water; increased shallow ground water recharge along leaks; possible ground water infiltration into sewer pipes
Constructing public water supply systems	Translocation of water
Constructing, operating & closing landfills	Altered infiltration, surface drainages, ground water percolation, aquifer interconnections, &

Table 7.11 Potential Impacts To Quantity

Activity	Impact
	recharge mounding
Maintaining vegetation along utility corridors & transportation rights-of-ways	Increased discharge for irrigation; translocation of water; varied evapotranspiration; infiltration & recharge
Commercial Agriculture and Hobby Farms	
High-Density animal husbandry	Increased surface runoff; decreased infiltration & recharge
Irrigation & stock watering	Translocation of ground & surface water; shallow recharge mounding
Field preparation & crop cultivation	Varied evapotranspiration; increased runoff; decreased infiltration & recharge
Operations (removal of overburden, sand & gravel, excavation site dewatering)	Decreased physical aquifer capacity, increased discharge of ground water to surface; altered surface drainage; interconnected aquifer systems
Abandonment of operations	Varied local ground water recharge of discharge; translocation of aquifer water; altered surface drainage
Timber Harvesting	
Tree & vegetation removal	Increased runoff; decreased infiltration & recharge; varied disruption of evapotranspiration processes
Access road construction	Increased surface runoff; decreased infiltration & recharge

Table 7.12 Precipitation and Stream Gauging Stations as Numbered in Figure 7.13

Precipitation Station Number	Stream Gauging Station Number	Site Location	Address	Reporting Agency
71		Upper Tibbets Creek	SE 182	SWM
72		North side of Grand Ridge		SWM
73		East Fork of Issaquah Creek		SWM
74		McDonald Creek		SWM
75		Holder Creek	276 Ave SE	SWM
7		Hobart	PO Box 55	Seattle-King County Health Department - Iverson
8		Francis Lake	23436 SE 192 St.	Seattle-King County Health Department - Short
10		Laughing Jacobs Lake	22905 SE 40 St.	Seattle-King County Health Department - Rothie
15		High Valley/Eastside Squak Mt.	12234 210 Pl. SE	Seattle-King County Health Department - Merrill
16		Issaquah	9506 240th Ave SE	Seattle-King County Health Department - Kees
17		Fifteen Mile Creek		DNR
18		Tiger Mt.		DNR
19		Preston		DNR
20		Issaquah Fish Hatchery		DNR
21		Cedar Hills		King County
22		Mirrormont area	25440 SE 184 St.	Seattle-King County Health Department - Leroux

Table 7.12 Precipitation and Stream Gauging Stations as Numbered in Figure 7.13

Precipitation Station Number	Stream Gauging Station Number	Site Location	Address	Reporting Agency
23		Fire Station 106/Maple Hills Park	20505 SE 152 Ave.	Seattle-King County Health Department - Massena
24		Grand Ridge area	28404 SE 58 St.	Seattle-King County Health Department - Weckwerth
25		Cougar Mt. area	17640 SE Cougar Mt. Rd	Seattle-King County Health Department - Leake
	52	Laughing Jacobs Lake near Lk. Sammamish		USGS
	53	Issaquah Creek near Issaquah	NW Sammamish Rd. Bridge	USGS
	54	Tibbets Creek at Lk. Sammamish State Park	Lake Sammamish ranger station	SWM
	55	Upper Tibbets Creek	Newport Way crossing	USGS
	56	North Fork Issaquah Creek	SE 66 St. bridge	SWM
	57	East Fork Issaquah Creek at Issaquah		SWM
	57	East Fork Issaquah Creek at Issaquah	1st Ave NW	USGS
	58	Fifteen Mile Creek near Issaquah Creek	May Valley Rd. Bridge	SWM
	59	Issaquah Creek above Fifteen Mile Creek		USGS

Table 7.12 Precipitation and Stream Gauging Stations as Numbered in Figure 7.13

Precipitation Station Number	Stream Gauging Station Number	Site Location	Address	Reporting Agency
	60	McDonald Creek	229 Dr. SE	SWM
	61	Carey Creek	Issaquah - Hobart Rd.	SWM
	62	Holder Creek	Issaquah - Hobart Rd.	SWM
	63	Upper Fifteen Mile Creek		WADNR
	64	Issaquah Creek		WADNR
	65	Unnamed stream near Raging River		WADNR
	66	Holder Creek		WADNR
	67	Issaquah Creek	252 Ave SE Bridge	USGS

Table 7.13 Summary of Stream Gauging Stations in the Issaquah Ground Water Management Area

Site Number	Map Ref. Number	T-R-S Location	Site Location	Period of Record	Reporting Agency
12121720	52	T24N-R6E-16M	Laughing Jacobs Cr. near Lake Sammamish	1987-1988	USGS[a]
12121600	53	T24N-R6E-21E	Issaquah Cr. near Issaquah NW Sammamish Rd. Bridge	1963-	USGS
67A SWM	54	T24N-463-20G	Tibbetts Cr. @ Lk. Sammamish State Park, Lake Sammamish Ranger Station	1988-	SWM[b]
12121700	55	T24N-R6E-29G	Upper Tibbetts Cr. Newport Way Crossing	1963-1968; 1971-1976	USGS
46A SWM	56	TW4N-R63-27D	North Fork Issaquah Cr. SE 66th St. Bridge	1988-	SWM
12121510	57	T24N-R6E-28J	East Fork Issaquah Cr. @ Issaquah	1975-1981	USGS
14A SWM	57	T24N-R63-28L	East Fork Issaquah Cr. @ Issaquah 1st Avenue NW	1988-	SWM
25C SWM	58	T23N-R6E-15E	Fifteenmile Cr. near Issaquah Cr. May Valley Rd. Bridge	1988-	SWM
12121000	59	T23N-R6E-15E	Issaquah Cr. above Fifteenmile Cr.	1945-1964	USGS
25D SWM	60	T23N-R6E-15M	McDonald Cr. 229th Dr. SE	1988-	SWM
25F SWM	61	T23N-R6E-25N	Carey Cr. Issaquah-Hobart Rd.		SWM
25E SWM	62	T23N-R6E-25N	Holder Cr. Issaquah-Hobart Rd.	1988-	SWM
	63	T23N-R6E-14J	Upper Fifteenmile Cr.	1987-	DNR[c]
	64	T23N-R7E-22K	Issaquah Cr.	1987-	DNR
	65	T24N-R7E-33M	Unnamed Stream near Raging River	1987-	DNR
	66	T23N-R7E-19R	Holder Cr.	1987-	DNR
12120600	67	T23N-R6E-26B	Issaquah Creek 252nd Avenue S. Bridge	1986-	USGS

[a]U.S. Geological Survey.
[b]King County Department of Natural Resources, Surface Water Management Division
[c]Washington State Department of Natural Resources.

Note: Does not include Sammamish Plateau Stream Gauging Stations

Table 7.14 1988 Estimated Issaquah Ground Water Management Area Major Basin Exports Of Water

Exporter	Form	Quantity m^3/y (MGY)	Basin-mm (Basin-in)
City of Issaquah[a]	waste water	1,362,604 (359.7)	7.9 (0.31)
Darigold	waste water	202,652 (53.5)	1.3 (0.05)
SPWD	water supply	1,515,152 (400)	8.6 (0.34)
Cedar Hills Landfill[b]	leachate	650,000 (171)	3.0 (0.12)

Source: Metro 1988

[a] City of Issaquah estimates are for 1989.

[b] Cedar Hills Landfill estimates are for 1992.

Table 7.15 Group A Parameters

Parameter	Unit	Detection Limit	Preferred Method
Biological Parameters, Group A-1			
Total Coliforms	MPN/100ml	<2.2	EPA (5-tube)[a]
Fecal Coliforms	MPN/100ml	<2.2	EPA (5-tube)[a]
Physical Parameters, Group A-2			
Total Dissolved Solids	mg/L	1	EPA 160.1
Total Hardness, $CaCO_3$	mg/L	1	EPA 130.2
Alkalinity			
Bicarbonate	mg/L	1	EPA 310.1
Carbonate	mg/L	1	EPA 310.1
Inorganic Parameters, Group A-3			
Calcium	mg/L	.5	EPA 215.2
Iron	mg/L	.03	EPA 236.1
Manganese	mg/L	.01	EPA 243.1
Magnesium	mg/L	.5	EPA 242.1
Potassium	mg/L	.5	EPA 258.1
Sodium	mg/L	.5	EPA 273.1
Chloride	mg/L	1	EPA 325.1,.2,.3
Nitrate-N	mg/L	1	EPA 352.1
Silica	mg/L	2	EPA 370.1
Sulfate	mg/L	5	EPA 375.2,.3,.4
Zinc	mg/L	.02	EPA 289.1
Silver	mg/L	.01	EPA 272.1
Selenium	mg/L	.005	EPA 270.2,.3
Mercury	mg/L	.0002	EPA 245.1,.2
Fluoride	mg/L	.1	EPA 340.1,.2,.3
Barium	mg/L	.2	EPA 208.1
Copper	mg/L	.1	EPA 220.1
Cadmium	mg/L	.001	EPA 213.2
Lead	mg/L	.005	EPA 239.2
Chromium	mg/L	.005	EPA 218.2,.3,.5

Table 7.16 Volatiles'Group B-1 Parameters'EPA Method 624

Volatiles	Detection Level µg/L
Acrolein	5
Acrylonitrile	5
Chloromethane	1
Bromomethane	1
Vinyl Chloride	1
Chloroethane	1
Methylene Chloride	1
Acetone	1
Carbon Disulfide	1
1,1-Dichloroethene	1
1,1-Dichloroethane	1
Trans-1,2-Dichloroethane	1
Chloroform	1
1,2-Dichloroethane	1
2-Butanone	1
1,1,1-Trichloroethane	1
Carbon Tetrachloride	1
Vinyl Acetate	1
Bromodichloromethane	1
1,2-Dichloropropane	1
Trans-1,3-Dichloropropene	1
Trichloroethene	1
Dibromochloromethane	1
1,1,2-Trichloroethane	1
Benzene	1
cis-1,3-Dichloropropene	1
2-Chloroethylvinylether	1
Bromoform	1
4-Methyl-2-Pentanone	1
2-Hexanone	1
Tetrachloroethene	1
1,1,2,2-Tetrachloroethane	1
Toluene	1
Chlorobenzene	1
Ethylbenzene	1
Styrene	1
Total xylenes	1

Table 7.17 Semi-Volatiles·Group B-2 Parameters·EPA Method 625

Semi-Volatiles	Detection Level µg/L
N-Nitrosodimethylamine	2
Phenol	2
Aniline	2
bis(-2-Chloroethyl)Ether	2
2-Chlorophenol	2
1,3-Dichlorobenzene	2
1,4-Dichlorobenzene	2
Benzyl Alcohol	2
1,2-Dichlorobenzene	2
2-Methylphenol	2
bis(2-chloroisopropyl)Ether	2
4-Methylphenol	2
N-Nitroso-Di-n-propylamine	2
Hexachloroethane	2
Nitrobenzene	2
Isophorone	2
2-Nitrophenol	2
2,4-Dimethylphenol	2
Benzoic Acid	2
bis(2-Chloroethoxy)Methane	2
2,4-Dichlorophenol	2
1,2,4-Trichlorobenzene	2
Naphthalene	2
4-Chloroaniline	2
Hexachlorobutadiene	2
4-Chloro-3-Methylphenol	2
2-Methylnaphthalene	2
Hexachlorocyclopentadiene	2
2,4,6-Trichlorophenol	2
2,4,5-Trichlorophenol	2
2-Chloronaphthalene	2
2-Nitroaniline	2
Dimethyl Phthalate	2
Acenaphthylene	2
3-Nitroaniline	2
Acenaphthene	2
2,4-Dinitrophenol	2
Dibenzofuran	2

Table 7.17 Semi-Volatiles·Group B-2 Parameters·EPA Method 625

Semi-Volatiles	Detection Level µg/L
2,4-Dinitrotoluene	2
2,6-Dinitrotoluene	2
Diethylphthalate	2
4-Chlorophenyl-phenylether	2
Fluorene	2
4-Nitroaniline	2
4,6-Dinitro-2-Methylphenol	2
N-nitrosodiphenylamine (1)	2
4-Bromophyenyl-phenylether	2
Hexachlorobenzene	2
Pentachlorophenol	2
Phenanthrene	2
Anthracene	2
Di-n-Butylphthalate	2
Fluoranthene	2
Benzidine	2
Pyrene	2
Butylbenzylphthalate	2
3,3-Dichlorobenzidine	2
Benzo(a)anthracene	2
bis(2-Ethylhexyl)Phthalate	2
Chrysene	2
Di-n-OctylPhthalate	2
Benzo(b)Fluoranthene	2
Benzo(k)Fluroranthene	2
Benzo(a)Pyrene	2
Indeno(1,2,3-cd)Pyrene	2
Dibenz(a,h)Anthracene	2
Benzo(g,n,i)Perylene	2
1,2 Dipheneylhydrazine	2

Table 7.18 Pesticides/PCBs·Group B-3 Parameters·EPA Method 608

Pesticides	Detection Level µg/L
Alpha-BHC	0.05
Beta-BHC	0.05
Delta-BHC	0.05
Gamma-BHC (Lindane)	0.05
Heptachlor	0.05
Aldrin	0.05
Heptachlor Epoxide	0.05
Endosulfan I	0.05
Dieldrin	0.10
4-4 DDE	0.10
Endrin	0.10
Endosulfan II	0.10
4-4 DDD	0.10
Endosulfan Sulfate	0.10
4-4 DDT	0.10
Methoxychlor	0.50
Endrin Ketone	0.10
Chlordane	0.50
Toxaphene	1.00
Aroclor-1016	0.50
Aroclor-1221	0.50
Aroclor-1232	0.50
Aroclor-1242	0.50
Aroclor-1248	0.50
Aroclor-1254	1.00
Aroclor-1260	1.00

Table 7.19 EPA Priority Pollutant Metals Group B-4 Parameters

Element	CAS#	Detection Level mg/L	Preferred Method
Total Antimony	7440-36-0	.06	EPA 204.2
Total Arsenic	7440-38-2	.005	EPA 206.2,.3
Total Beryllium	7440-41-7	.005	EPA 210.2
Total Cadmium	7440-43-9	.001	EPA 213.2
Total Chromium	7440-47-3	.005	EPA 218.2
Total Copper	7440-50-8	.025	EPA 220.1,.2
Total Lead	439-92-1	.005	EPA 239.2
Total Mercury	7439-97-6	.0002	EPA 245.1,.2
Total Nickel	7440-02-0	.04	EPA 249.2
Total Selenium	7789-49-2	.005	EPA 270.2,.3
Total Silver	7440-22-4	.01	EPA 272.1
Total Thallium	7440-26-0	.005	EPA 279.2
Total Zinc	7440-66-6	.02	EPA 289.1

Table 7.20 Summary of Water Quality Monitoring in the Lower Issaquah Valley Wellhead Protection Plan

Well Name	Basic Inorganic			Priority Metals (EPA 7000-Series)			Turbidity			Iron and Manganese			Nitrate			Volatile Organics (EPA 524.2)			Pesticides & PCBs (EPA 8080)			Herbicides EPA (8150)			BTEX			Dissolved Oxygen (Field meas.)		
	May 92	Oct 92	Apr 93	May 92	Oct 92	Apr 93	May 92	Oct 92	Apr 93	May 92	Oct 92	Apr 93	May 92	Oct 92	Apr 93	May 92	Oct 92	Apr 93	May 92	Oct 92	Apr 93	May 92	Oct 92	Apr 93	May 92	Oct 92	Apr 93	May 92	Oct 92	Apr 93
SP7-1	X			X		X	X		X				X					X	X		X			X						X
SP7-2	X						X						X																	
SPVT1-1	X	X		X		X	X	X			X		X	X		X		X	X		X			X		X				X
SPVT1-3	X						X						X																	
SPVT2-1	X			X	X		X						X			X	X		X											
SPVT2-2		X	X			X		X	X		X	X		X	X		X							X		X				X
SPVT2-3	X						X						X																	
SPVT5-1	X	X	X	X		X	X	X	X		X	X	X	X	X	X	X	X	X		X			X		X				X
SPVT5-2		X						X			X			X																
SPVT6-2	X						X						X																	
SPVT7-4		X			X			X			X			X												X				
SPVT8-1	X	X		X			X	X			X		X			X										X				
SPVT8-4		X						X			X			X			X									X				
SPVT3			X			X			X			X			X			X			X			X						X
SP7																		X												X
WH-1		X	X		X			X	X		X	X		X	X		X						X							X
WH2-1		X				X		X			X			X				X		X	X			X		X				X
WH2-2		X						X			X			X			X			X	X			X		X				X
WH-3-1		X			X	X		X			X			X			X	X		X	X			X		X				X
WH-3-2		X						X			X			X				X								X				X
Lakeside-New		X			X			X			X		X	X												X				
Lakeside-BPW	X						X					X																		
Caldwell		X						X						X																
Bell	X						X						X																	
Darout	X						X						X																	

Source: Golder Associates, 1993

Table 7.21 Issaquah Ground Water Management Area Wells Monitored During the Wellhead Protection Study

Seattle-King County Health Department Database (Issaquah Ground Water Management Area Wells)	Wellhead Protection Wells (Golder Associates)
City of Issaquah Risdon Well #1	COI-1 Water levels only
City of Issaquah Risdon Well #2	COI-2 Water levels only
City of Issaquah Test Well	COI TW Water levels only
City of Issaquah Test #4	COI-4 Water levels only
City of Issaquah Test #5	COI-5 Water levels only
Sammamish Plateau SWD #8	SP8 Water levels only
Sammamish Plateau SWD 7-1 (D)	SP7-2 Water Quality Table 2.6.17.
Sammamish Plateau SWD 7-1 (S)	SP7-1 Water Quality Table 2.6.17.
Sammamish Plateau SWD 7-3 (D)	SP7-3 (Table 1 not shown) Water levels only
SPWD/City of Issaquah VT-1 Test	SPVT 1-1 Water Quality Table 2.6.17.
SPWD/City of Issaquah VT-2.1 Test	SPVT 2-1 Water Quality Table 2.6.17.

Figure 2.1

Issaquah Creek Valley Ground Water Management Area Boundary

Issaquah Creek Valley Ground Water Management Area

REDMOND
BELLEVUE
Lake Sammamish
CARNATION
SNOQUALMIE
ISSAQUAH
Sikes Lake
Ames Lake
Langlois Lake
Pine Lake
Beaver Lake
Laughing Jacobs Lake
Yellow Lake
Rutherford Slough
Lake Alice
Lake Borst
Our Lake
Echo Lake
Lake Kathleen
Lake McDonald
Lake Desire
Spring Lake
Lake Youngs
Walsh Lake
Issaquah Creek
Redmond Wy
Redmond - Fall City Rd NE
Cahalee Wy NE
Duvall Rd NE
Fall City - Carnation Rd SE
228th Ave SE
Issaquah - Hobart Rd
SE May Valley Rd
Renton - Maple Valley Rd
Petrovitsky Rd
Renton - Issaquah Rd
Preston - Fall City Rd SE
Fall City - Snoqualmie Rd
SE 128th St
520
202
90
900
169
18
203

Stream/Lake

Groundwater Management Area

Incorporated Area

N

0 1 2 Miles

March 1999

File name: 9903 IssGWbase21 wg

Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

KING COUNTY
Department of Natural Resources

Figure 2.2

Vicinity Map

Issaquah Creek Valley Ground Water Management Area

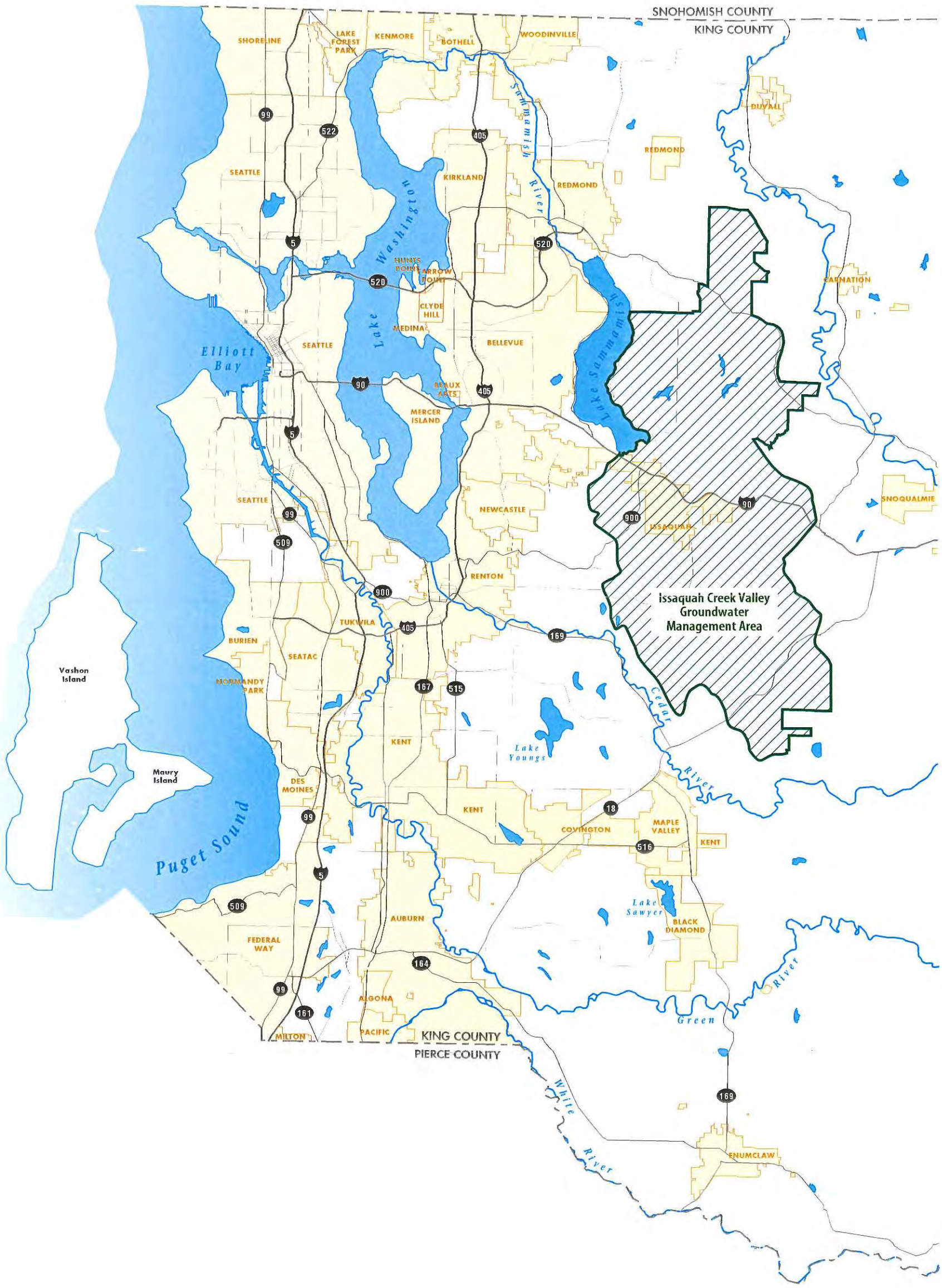
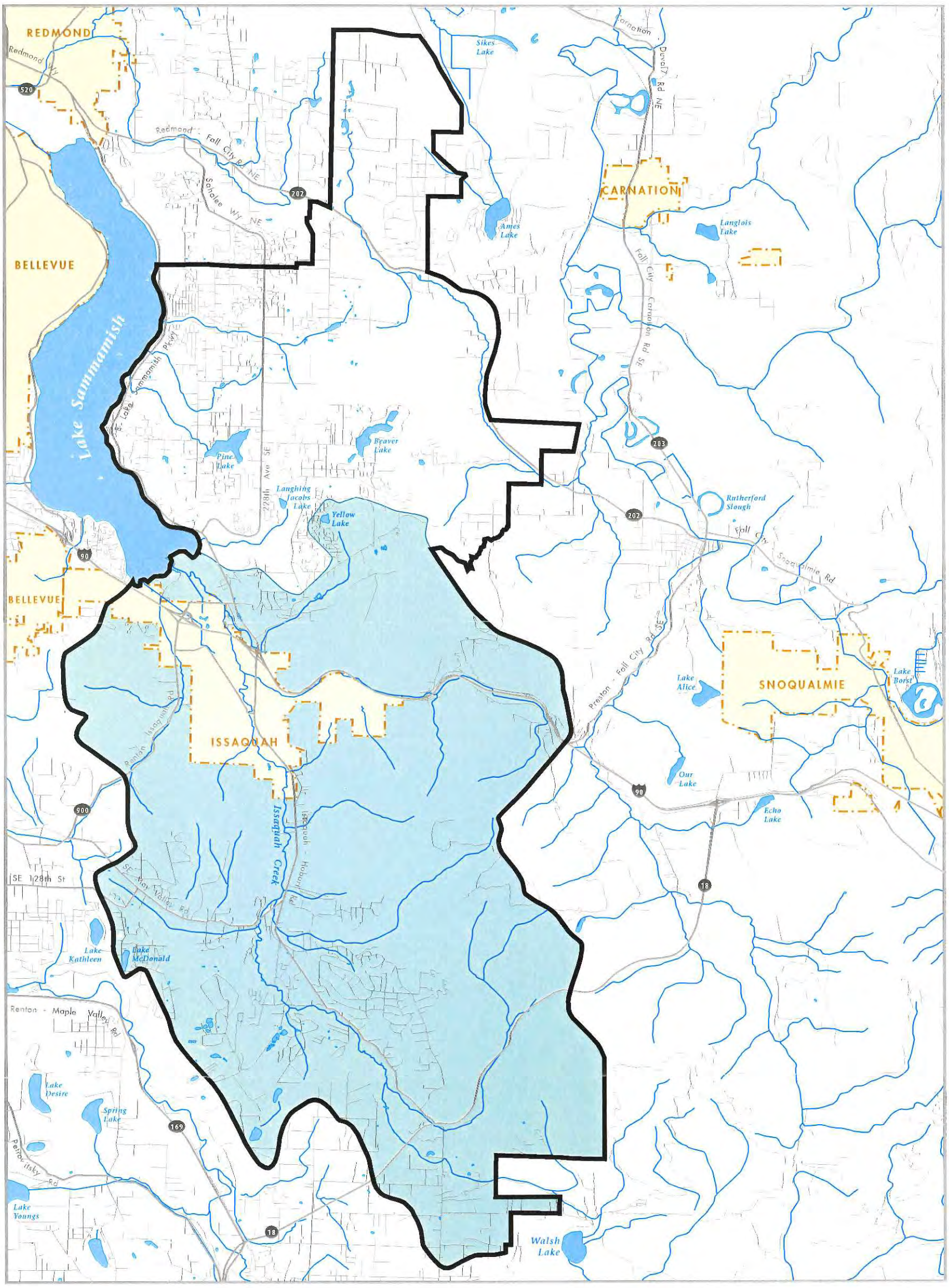


Figure 2.3

Ground Water Management Planning Area Boundary Change

Issaquah Creek Valley Ground Water Management Area



Old Issaquah Creek Valley Groundwater Management Area (pre-1996)

New Issaquah Creek Valley Groundwater Management Area Boundary

Incorporated Area

Stream/Lake

N

0 1 2 Miles

March 1999

File name: 9903 IssGWbndryCOMP23 wg

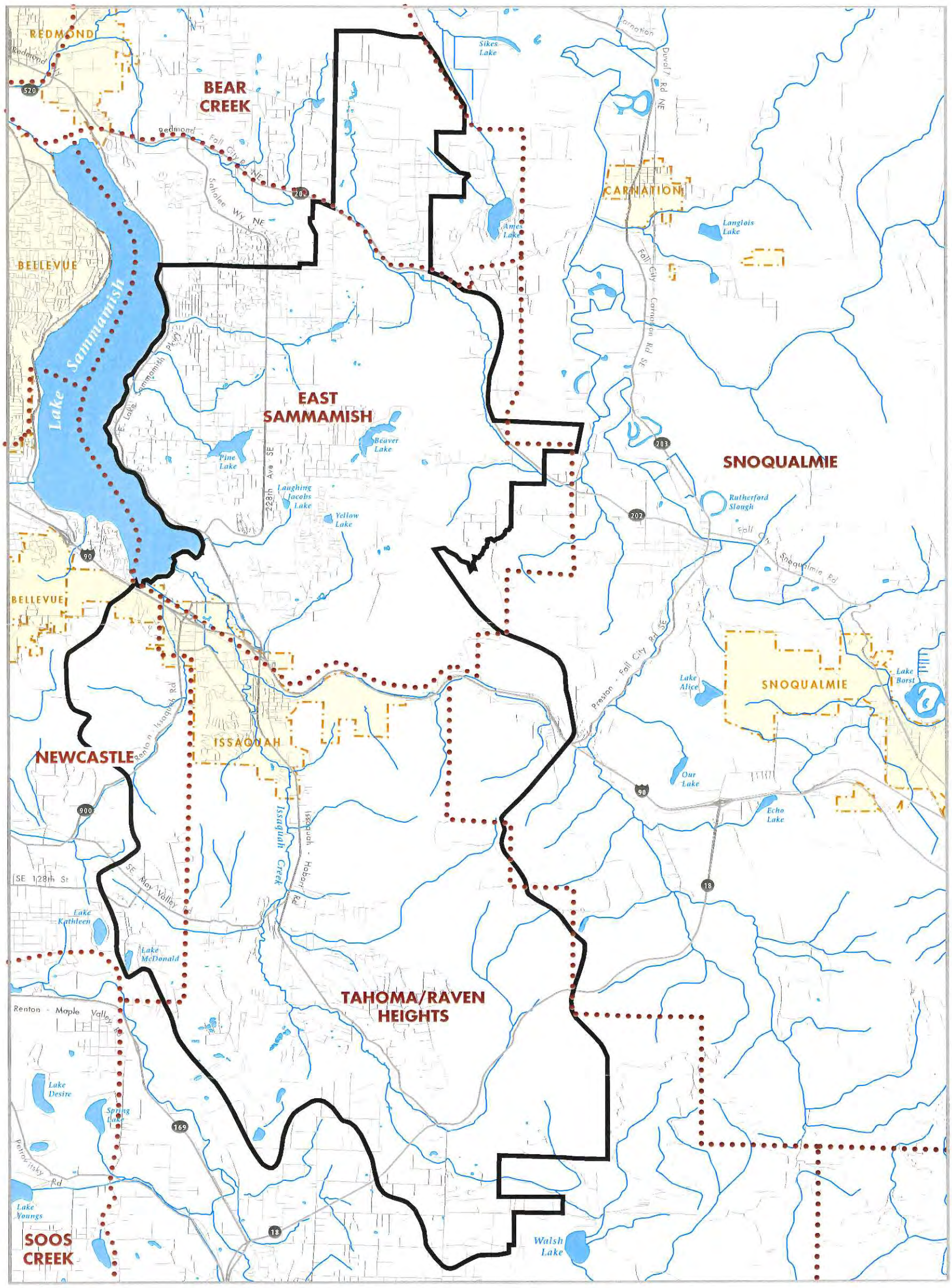
Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

King County
Department of Natural Resources

Figure 3.1

Community Planning Areas

Issaquah Creek Valley Ground Water Management Area



Community Planning Area Boundary

Stream/Lake

Groundwater Management Area

Incorporated Area

N

0 1 2 Miles

March 1999

File name: 9903 IssGWcommPLAN31 wg

Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

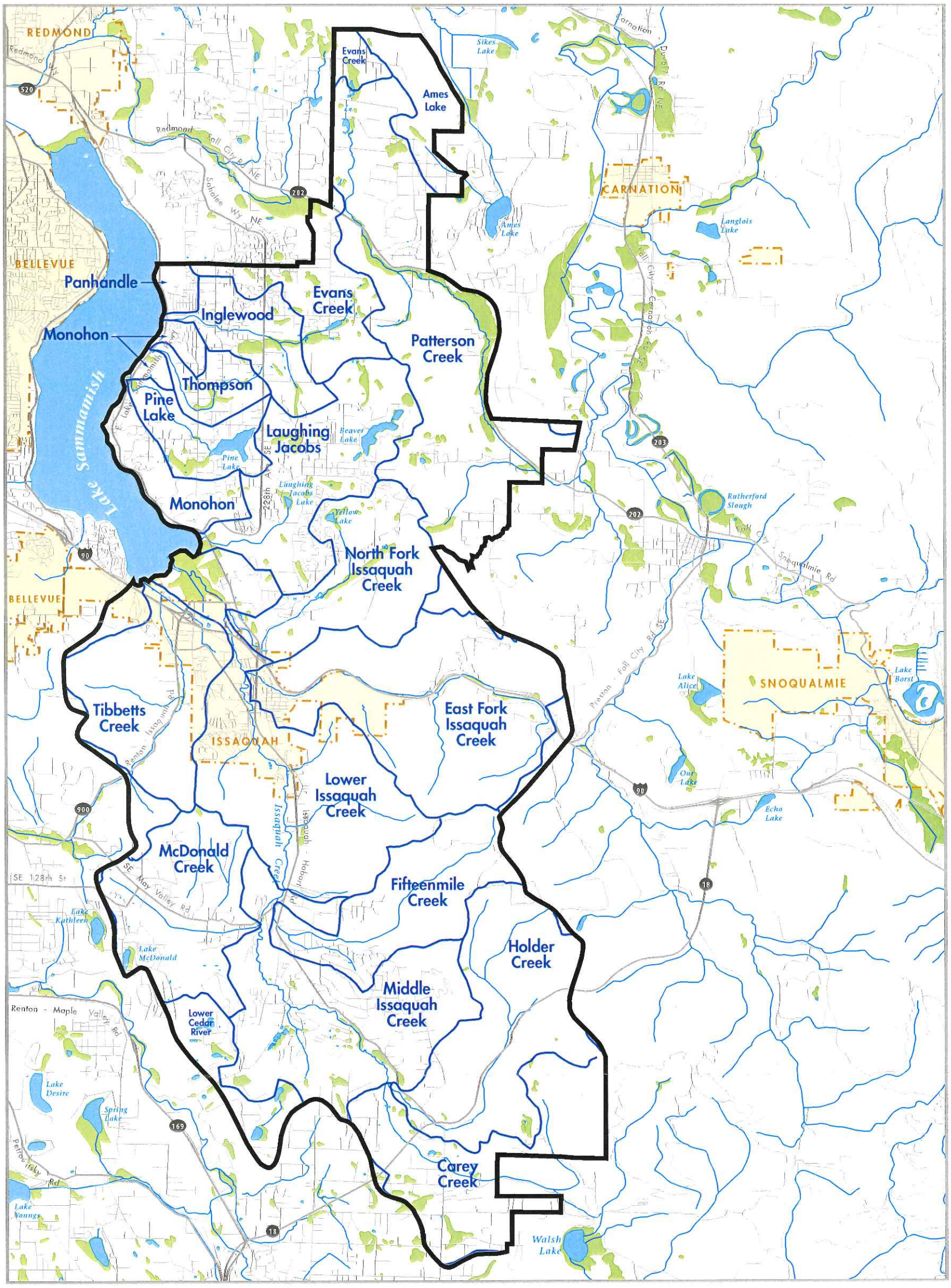
Source: King County Community Planning Area Index, DDES GIS

King County
Department of Natural Resources

Figure 4.1

Surface Water Hydrology

Issaquah Creek Valley Ground Water Management Area



File name: 9903 IssGWsurfaceHYDR041 wg

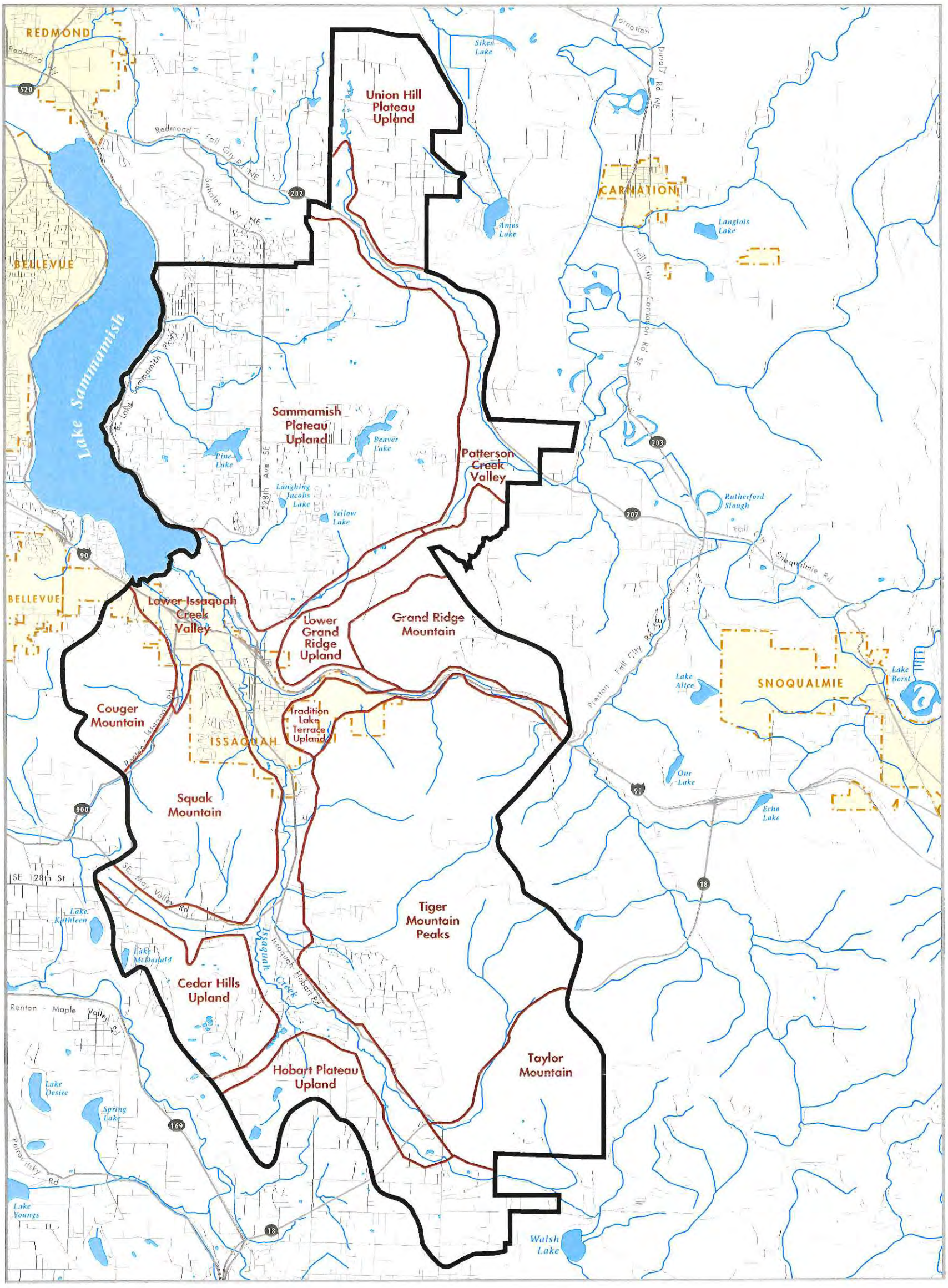
Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

King County
Department of Natural Resources

Figure 4.2

Physiographic Map

Issaquah Creek Valley Ground Water Management Area



Physiographic Boundary

Stream/Lake

Groundwater Management Area

Incorporated Area

N

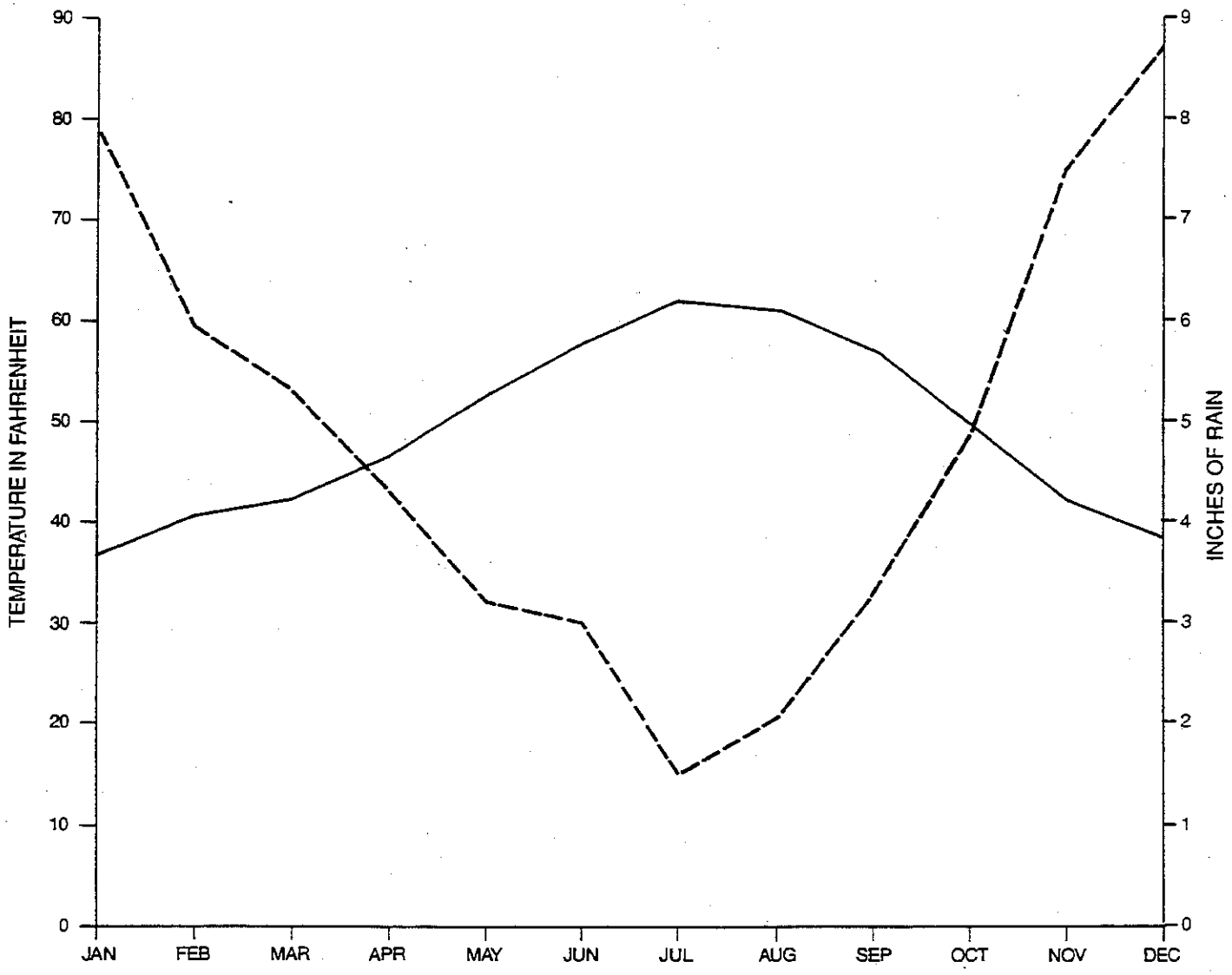
0 1 2 Miles

March 1999

File name: 9903 IssGWphysiographic42 wg

Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

King County
Department of Natural Resources



Note: Compiled from data collected from 1968-1988.

Source: NOAA 1988

Temperature

Precipitation

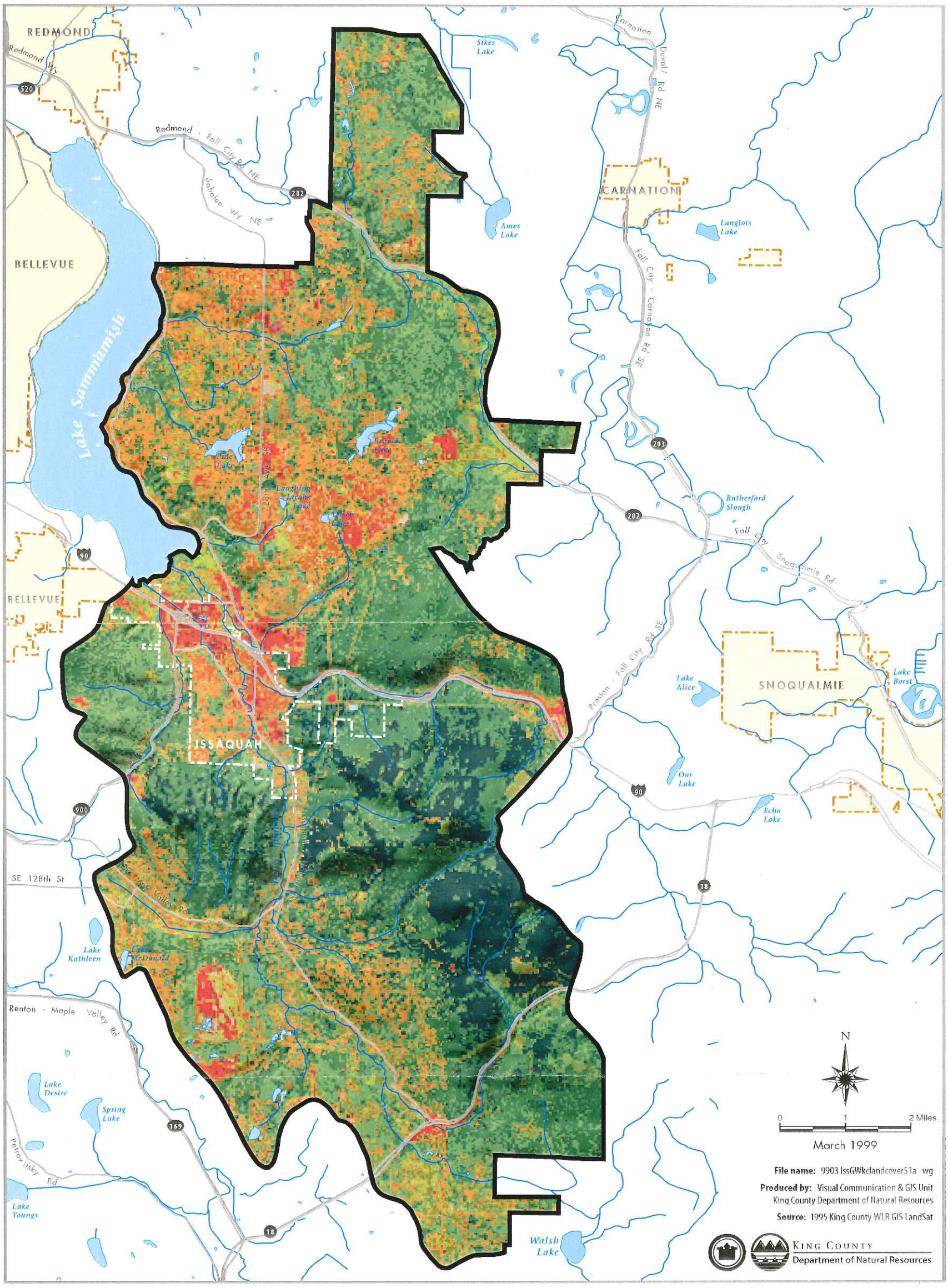
Fig. 4.3 Climograph for Landsburg

Figure 5.1A

Existing Land Use

Based on 1995 LandSat Landcover Imagery

Issaquah Creek Valley Ground Water Management Area



Developed Areas
- City Center & Industrial
- Industrial & Commercial
- High Density Urban
- Medium Density Urban & Suburban
- Recent Clearcut

Vegetation
- Grass
- Scrub & Shrub
- Deciduous Forest
- Mixed Forest
- Conifer Forest

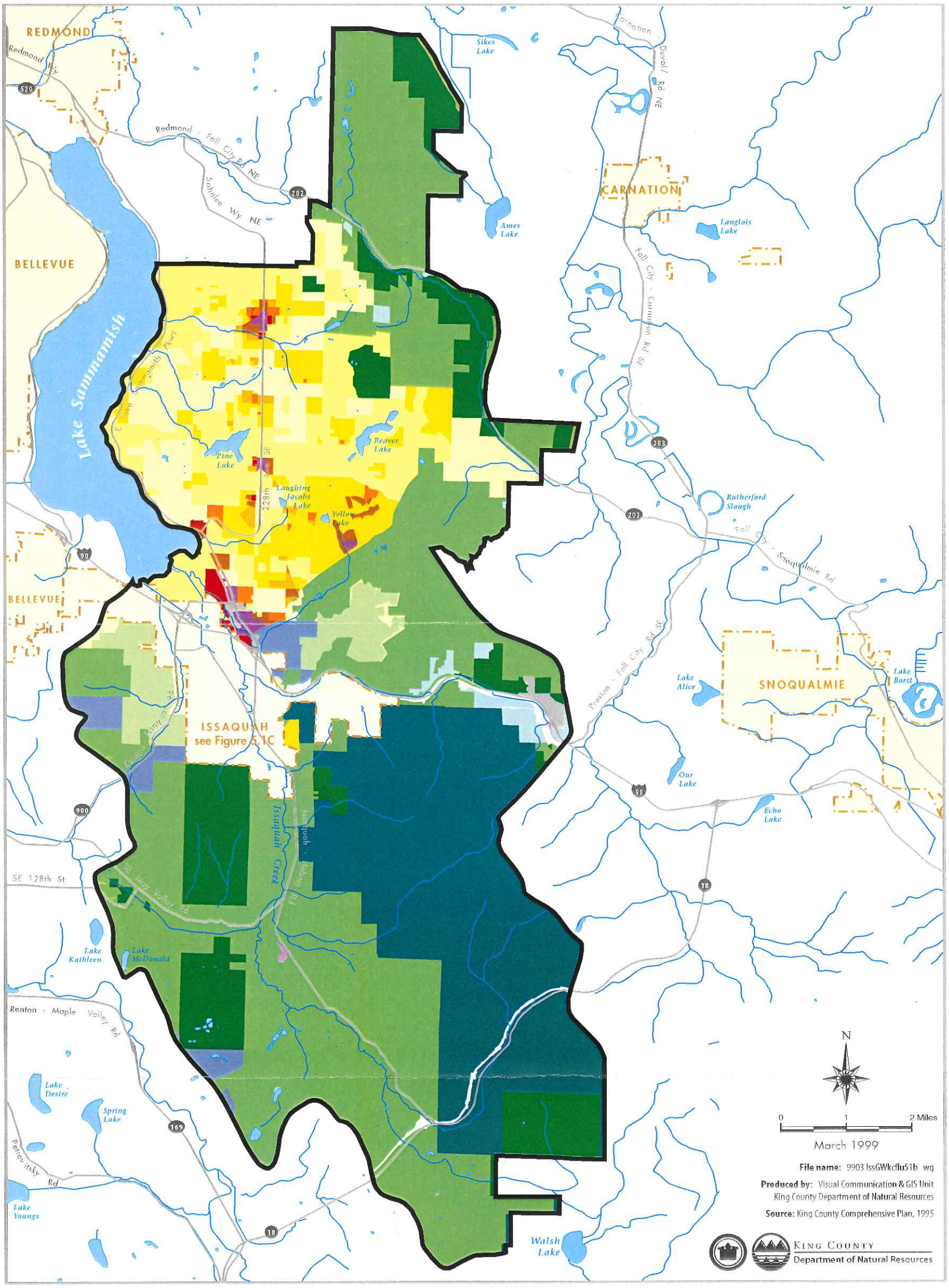
Other
- Bare Rock
- Shadow

- Stream/Lake
- Groundwater Management Area
- Incorporated Area

Figure 5.1B

King County Proposed Future Land Use

Issaquah Creek Valley Ground Water Management Area

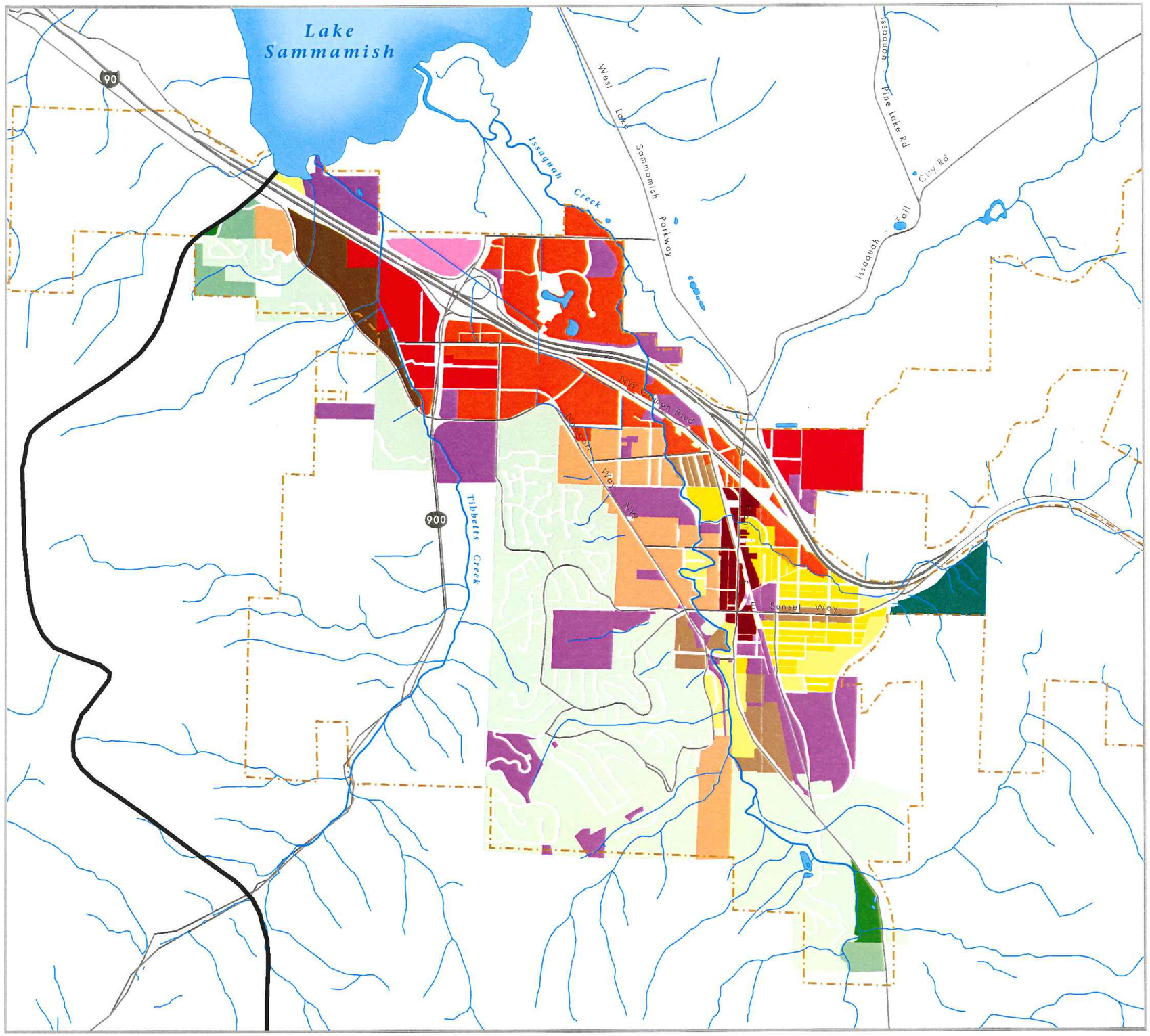


- Agricultural, 1 DU/10 Acres
- Agricultural, 1 DU/35 Acres
- Forest
- Mineral
- Rural Area, 1 DU/2.5 Acres
- Rural Area, 1 DU/5 Acres
- Rural Area, 1 DU/10 Acres
- Residential, 1 DU/Acre
- Residential, 4 DU/Acre
- Residential, 6 DU/Acre
- Residential, 8 DU/Acre
- Residential, 12 DU/Acre
- Residential, 18 DU/Acre
- Residential, 24 DU/Acre
- Residential,48 DU/Acre
- Neighborhood Business
- Community Business
- Regional Business
- Office
- Industrial
- Stream/Lake
- Groundwater Management Area
- Incorporated Area (See Figure 5.1C)

Figure 5.1C

Proposed Future Land Use for the City of Issaquah

Issaquah Creek Valley
Ground Water Management Area



- Stream/Lake
- Groundwater Management Area
- Incorporated Area (as of 3/5/99)
- Cultural and Business District
- Intensive Commercial
- Retail
- Community Facilities
- Professional Office
- Multifamily High Mixed Use (28 du/acre)
- Multifamily High (28 du/acre)
- Multifamily Medium Mixed Use (14.62 du/acre)
- Multifamily Medium (14.62 du/acre)
- Mixed Residential Established SF Duplex (7.26 du/acre)
- Mixed Residential (7.26 du/acre)
- Single Family Suburban (4.5 du/acre)
- Single Family Estates (1.24 du/acre)
- Conservancy Residential 1 du/5 acres)
- Tradition Plateau (NR Conservation Area)

N

0 1/2 1 Mile

March 1999

File name: 9903 IssGWbase-IssLU 51C lp

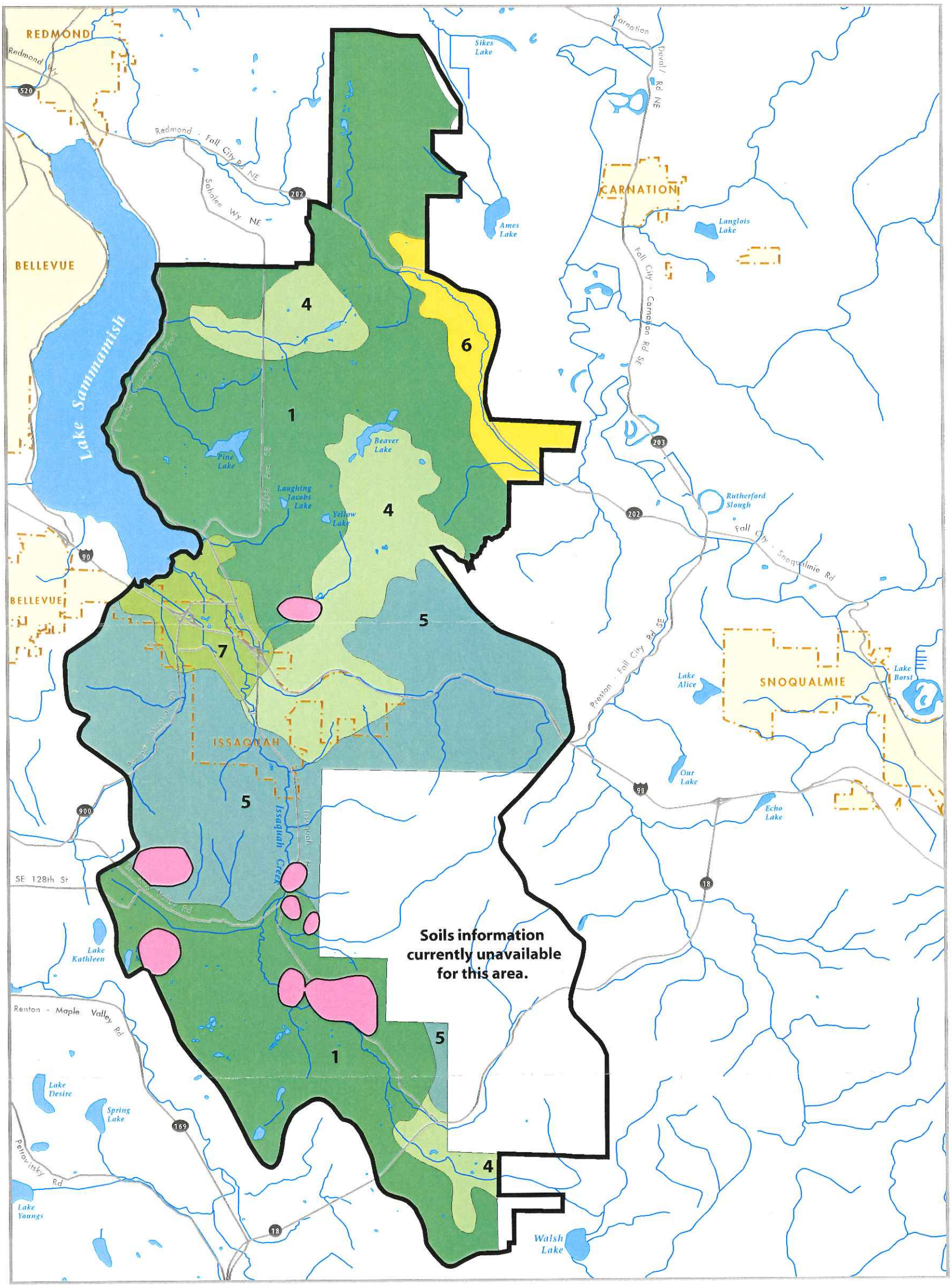
Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources
Source: City of Issaquah Comprehensive Plan, Land Use data

King County
Department of Natural Resources

Figure 5.2

Areas of Septic System Failure

Issaquah Creek Valley Ground Water Management Area



Areas of Septic System Failure (only available within old Issaquah Creek Valley GWMP Area)

1 Alderwood association

4 Everett association

5 Beausite-Alderwood association

6 Alderwood-Kitsap-Indianola association

7 Puget-Earlmont-Snohomish association

Stream/Lake

Groundwater Management Area

Incorporated Area

N

0 1 2 Miles

March 1999

File name: 9903 IssGWspticFAILURE52 wg

Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

Sources: Anderberg, 1991
USDA General Soil Map, 1972

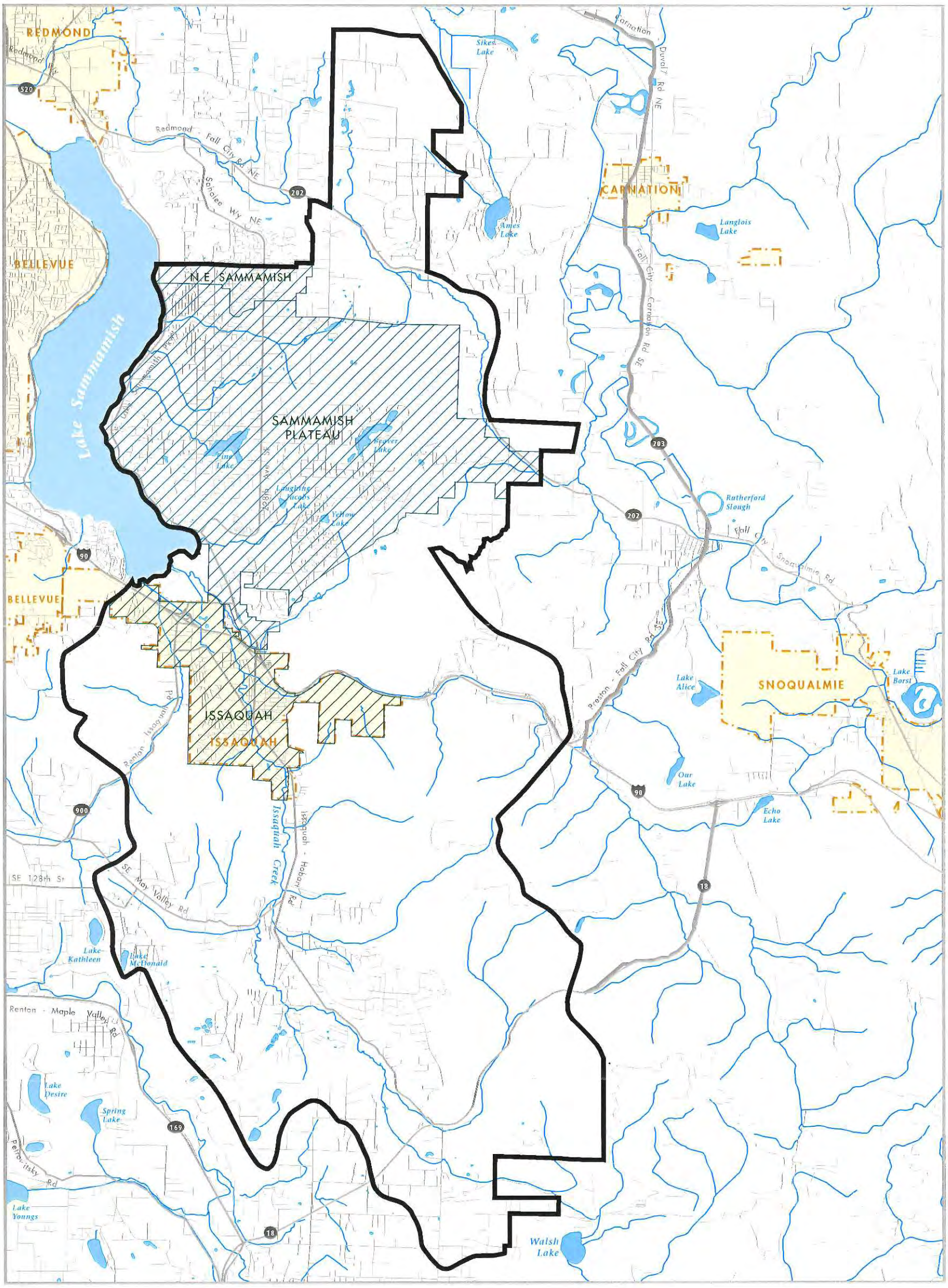
King County
Department of Natural Resources

Figure 5.3

Sewer District Service Areas

Issaquah Creek Valley Ground Water Management Area

Location Map



Sewer District Service Areas

Stream/Lake

Groundwater Management Area

Incorporated Area

N

0 1 2 Miles

March 1999

File name: 9903 IssGWsewerDIST53 wg

Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

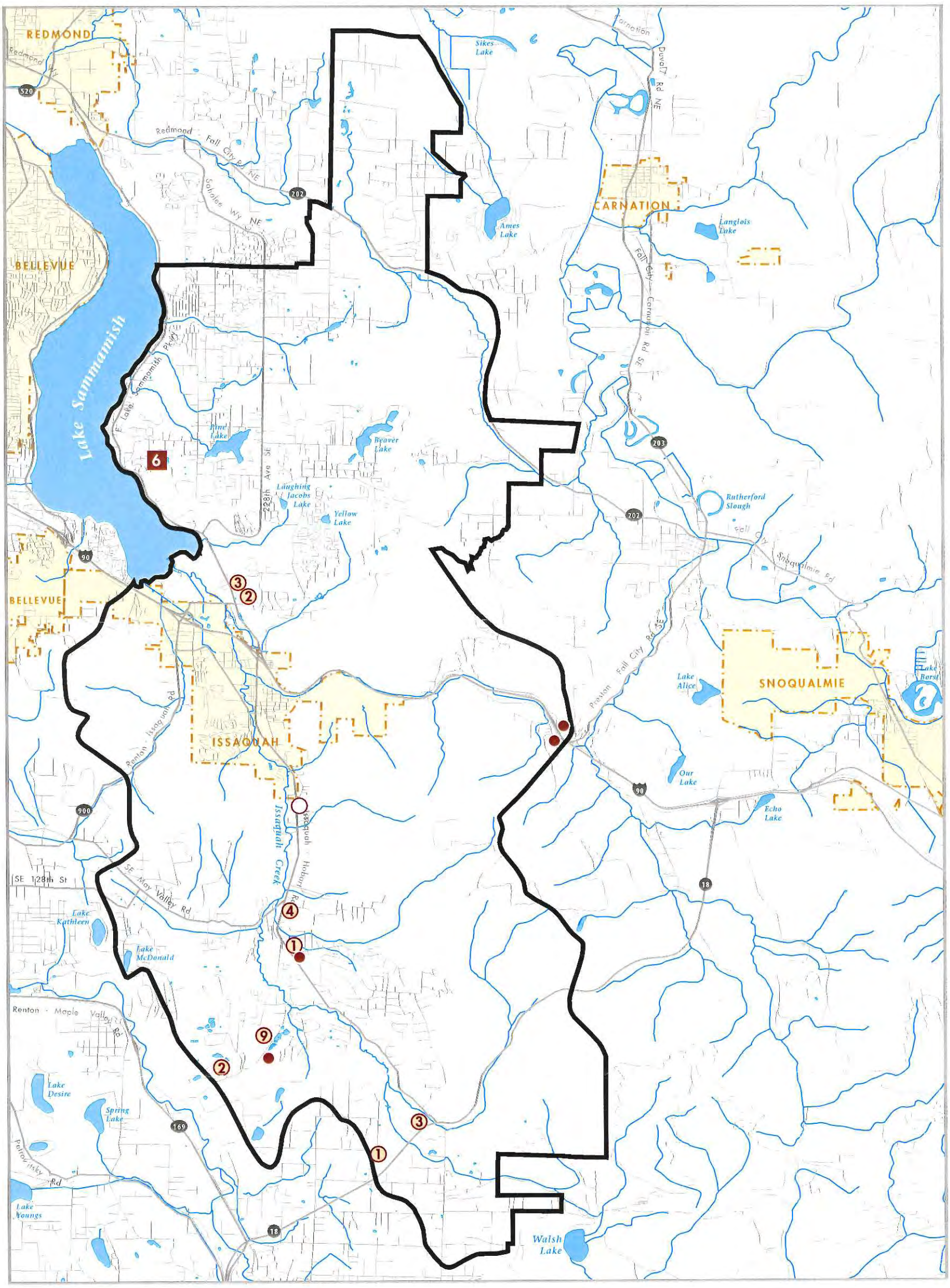
Source: 9711countySEWERutil.ai

King County
Department of Natural Resources

Figure 5.4

Potential Point Contamination Sites

Issaquah Creek Valley Ground Water Management Area



7 Leaking Underground Storage Tank and Number Present On-Site

① Underground Storage Tank and Number Present On-Site

Gas Station, Oil and Fuel Supplier

Manufacturing Plant

Stream/Lake

Groundwater Management Area

Incorporated Area

N

0 1 2 Miles

March 1999

File name: 9903 IssGWpointCONTAM54 wg

Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

Source: WA State Department of Ecology, 1994

King County
Department of Natural Resources

Figure 5.5

Aquifer Susceptibility to Contamination

Issaquah Creek Valley Ground Water Management Area

Location Map

REDMOND
BELLEVUE
Lake Sammamish
ISSAQUAH
CARNATION
SNOQUALMIE
Redmond Wy
Redmond - Fall City Rd NE
Sahalee Wy NE
Sikes Lake
Ames Lake
Langlois Lake
Carnation - Duvall Rd NE
Fall City - Carnation Rd SE
Rutherford Slough
Fall City - Snoqualmie Rd
Preston - Fall City Rd SE
Lake Alice
Lake Borst
Our Lake
Echo Lake
Pine Lake
Beaver Lake
Langlois Jacobs Lake
Yellow Lake
228th Ave SE
Issaquah Creek
Issaquah - Hobart Rd
Renton - Issaquah Rd
SE 128th St
SE May Valley Rd
Lake Kathleen
Lake McDonald
Renton - Maple Valley Rd
Lake Desire
Spring Lake
Petrovitsky Rd
Lake Youngs
Walsh Lake

Low Susceptibility to Aquifer Contamination

Medium Susceptibility to Aquifer Contamination

High Susceptibility to Aquifer Contamination

Stream/Lake

Groundwater Management Area

Incorporated Area

N

0 1 2 Miles

March 1999

File name: 9903 IssGWaquiferSUSC55 wg

Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

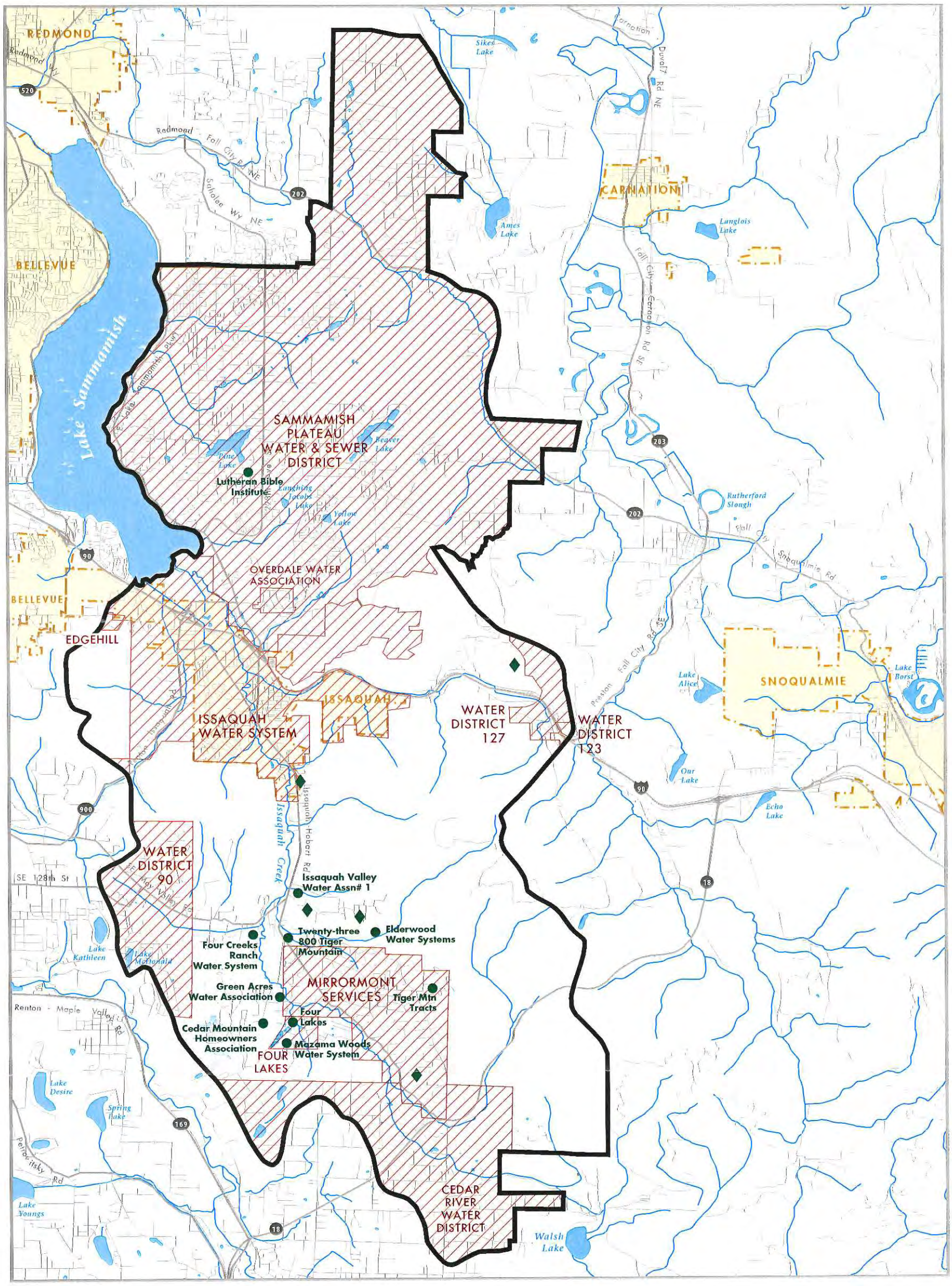
Source: WLRgis: IssRechg95.shp

KING COUNTY
Department of Natural Resources

Figure 6.1

Water District Service Areas

Issaquah Creek Valley Ground Water Management Area



Water District Service Areas

Group A Community Public Water Systems

Concentration of Group B Public Water Systems

Stream/Lake

Groundwater Management Area

Incorporated Area

N

0 1 2 Miles

March 1999

File name: 9903 IssGWwaterDIST61 wg

Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

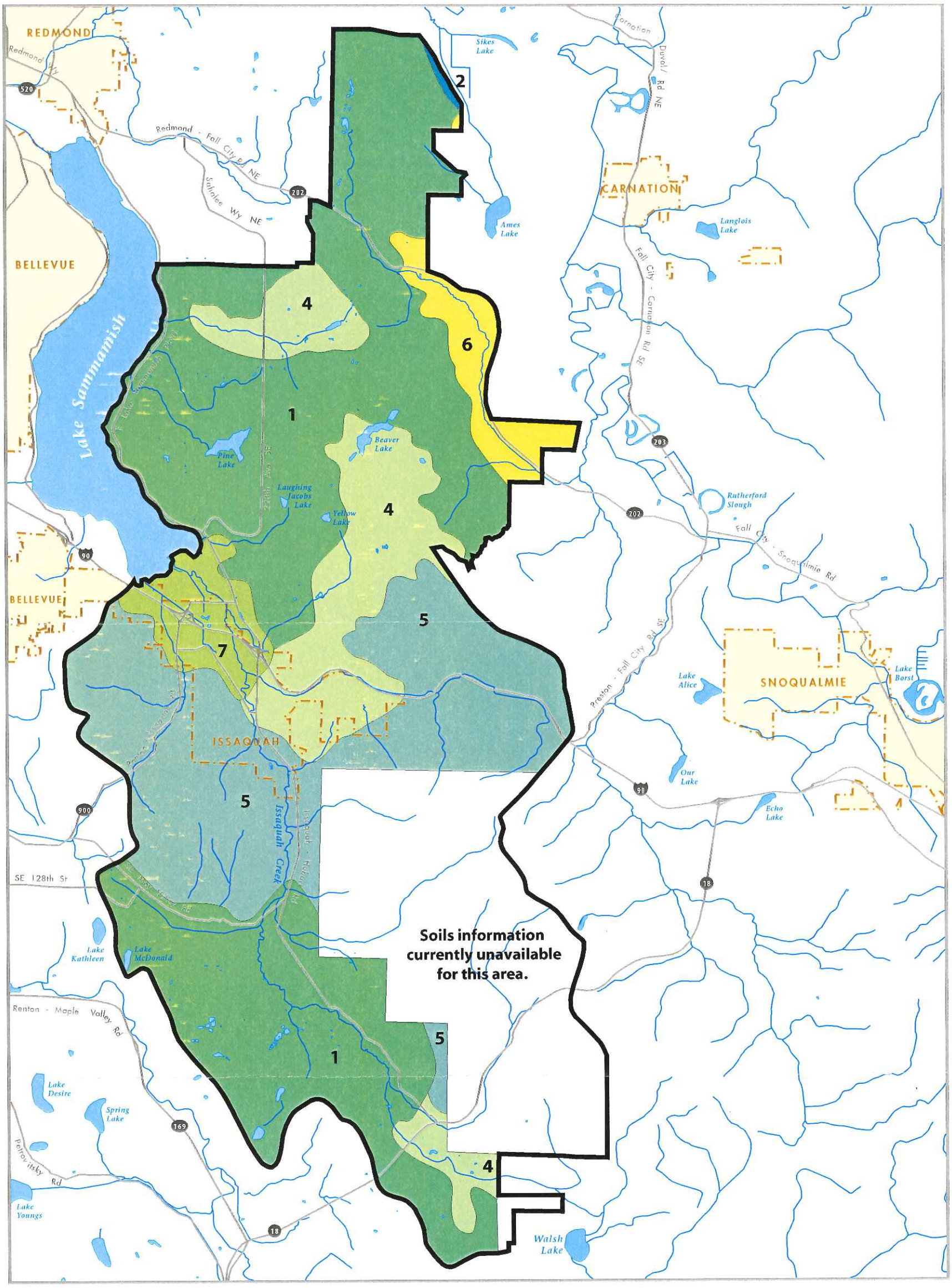
Sources: 9801countyWATERserviceAREAS.ai
1996 Issaquah Creek Valley GWMP

King County
Department of Natural Resources

Figure 7.1A

Generalized Soil Associations

Issaquah Creek Valley Ground Water Management Area



1 Alderwood association
2 Oridia-Seattle-Woodinville association
4 Everett association
5 Beausite-Alderwood association
6 Alderwood-Kitsap-Indianola association
7 Puget-Earlmont-Snohomish association

Stream/Lake
Groundwater Management Area
Incorporated Area

N

0 1 2 Miles

March 1999

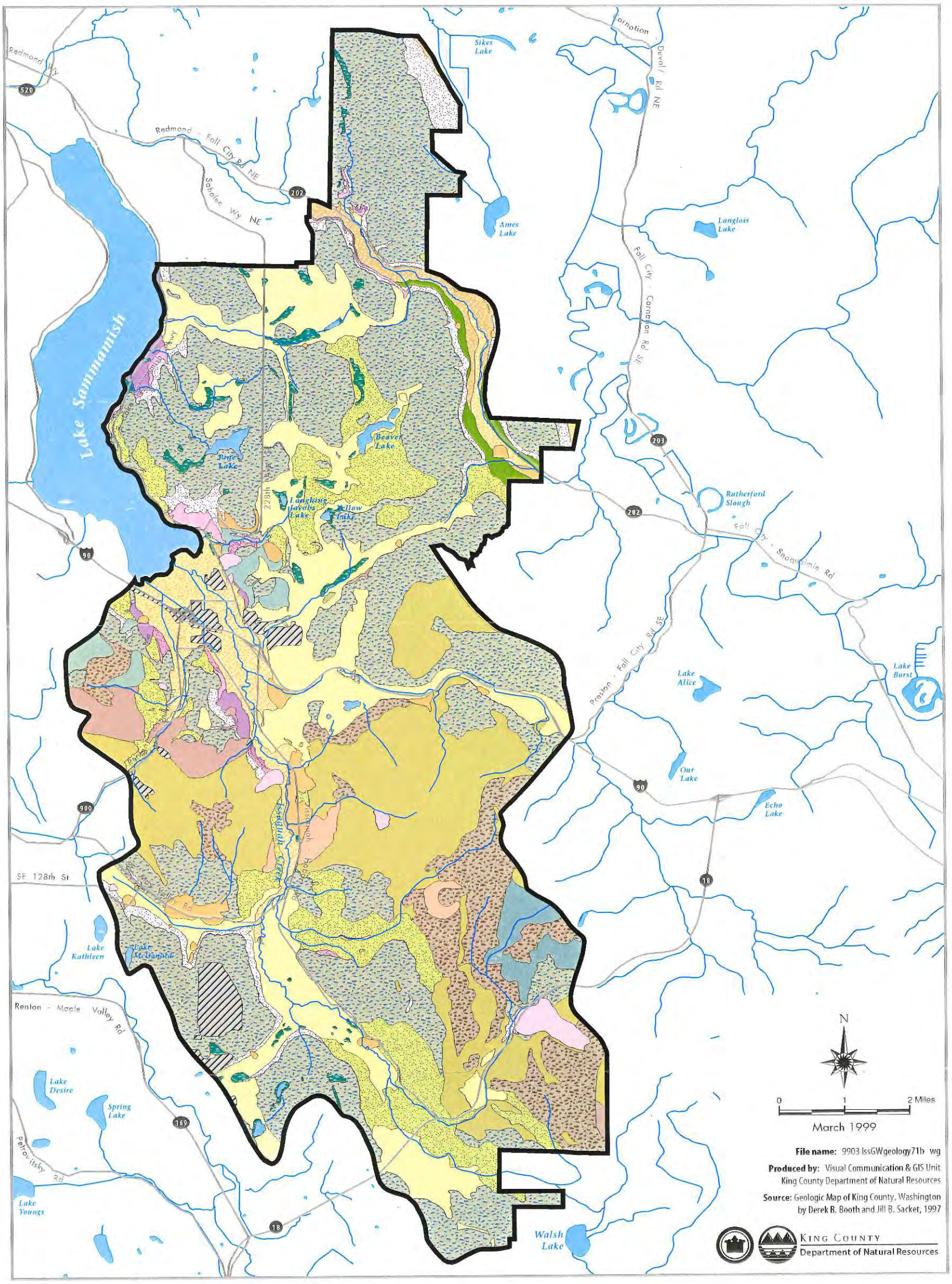
File name: 9903 IssGWsoils71a wg
Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources
Source: USDA General Soil Map, 1972

King County
Department of Natural Resources

Figure 7.1B

Surficial Geology

Issaquah Creek Valley Ground Water Management Area



Postglacial Deposits
- m modified
- Qw Wetland deposits
- Qb Beach deposits
- Qf Alluvial fan deposits
- Qyal Younger alluvium
- Qoal Older alluvium
- Qls Landslides
- Qmw Mass Wastage Deposits

Glacial and Nonglacial Deposits
- Qvt Till
- Qva Advanced outwash
- Qtb Transitional beds
- Qpf Sedimentary deposits from pre-Fraser glaciation
- Qob Olympia beds

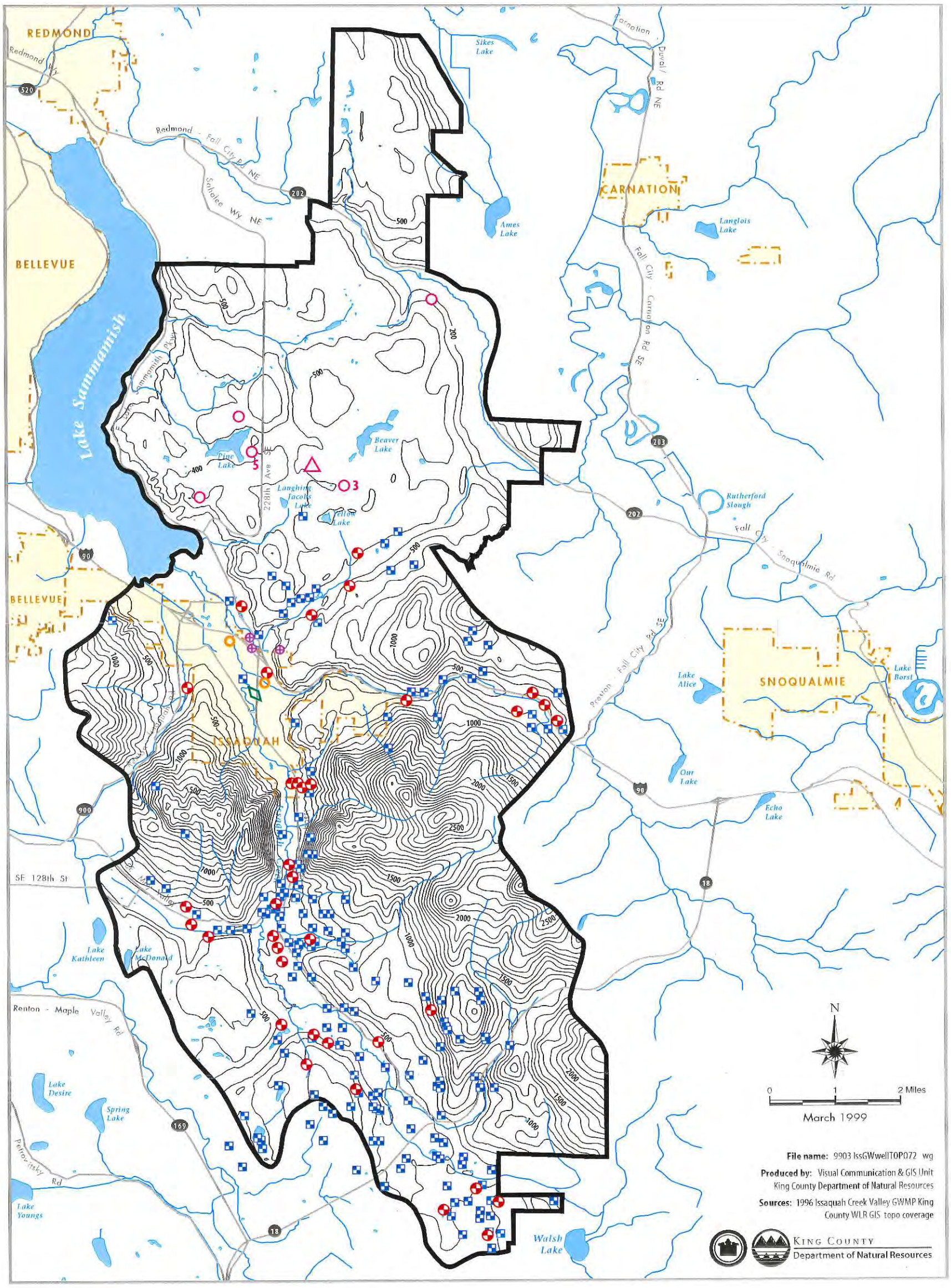
Recessional and Outwash Deposits
- Qvi Ice-contact deposits
- Qvr Recessional outwash
- Qvrg Gravel-dominated recessional outwash
- Qvrl -Lowland lacustrine-dominated recessional outwash

Bedrock
- Tsc Granite of Mount Hinman
- Tb Blakely Formation
- Ti Intrusive rocks
- Tv Volcanic rocks
- Tp Puget Group
- Tpr Renton Formation
- Tpt Tukwila Formation
- Trr Raging River Formation
- br+Qvt Bedrock with Till

Figure 7.2

Well Location and Topographic Map

Issaquah Creek Valley Ground Water Management Area



Monitoring Wells in Issaquah Creek Valley GWMP Original Area

- Arco Service Station LUST Site
- City of Issaquah Water Wells
- Sammamish Plateau Water Wells
- Well Included in Monthly Monitoring
- Well Location Obtained from Well Logs

Monitoring Wells in Sammamish Plateau Area

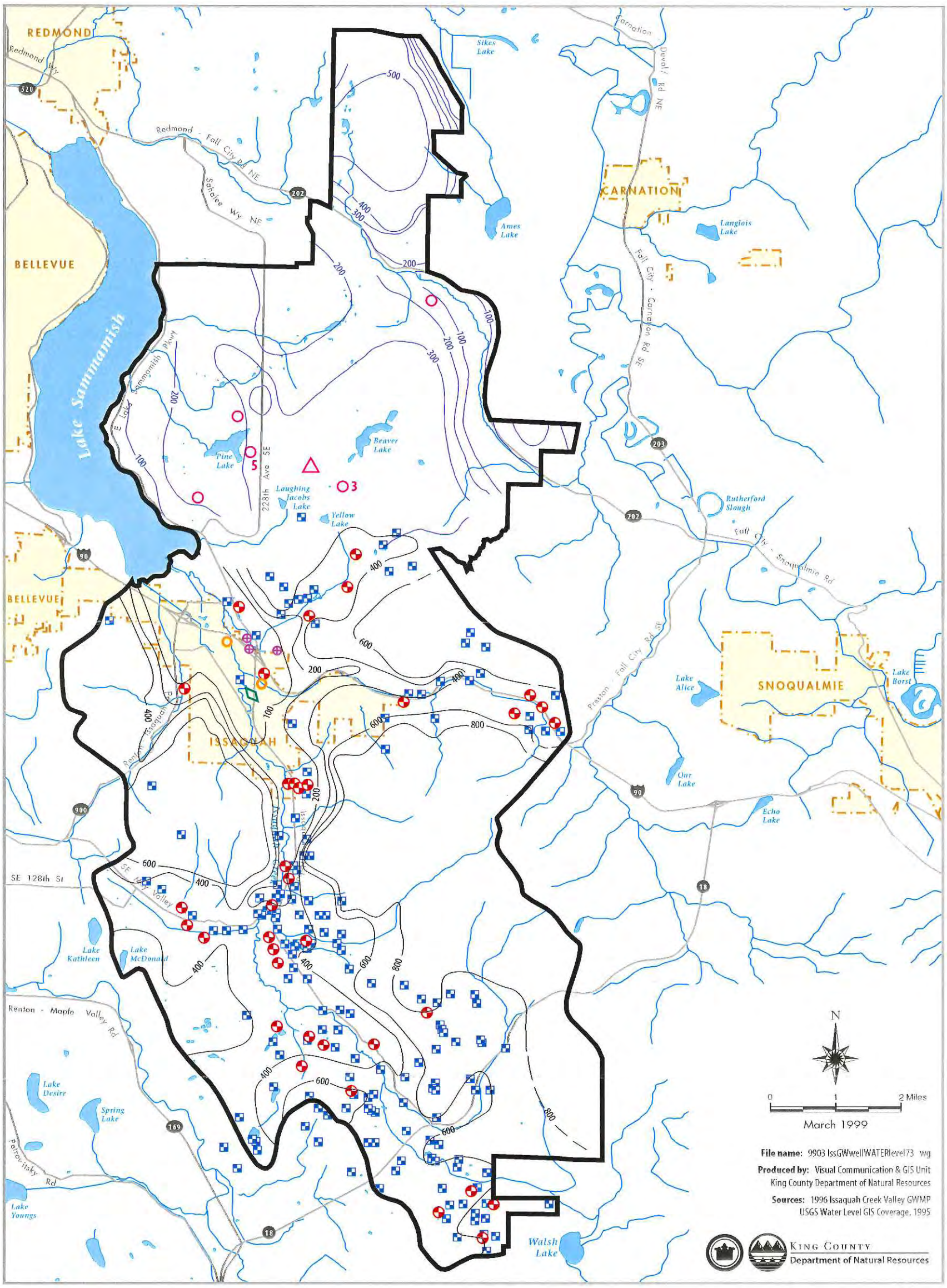
- Water Level Monitoring Site
- Water Quality Monitoring Site
- 3 Number of Wells Monitored in Area

- 100 Foot Contour
- Stream/Lake
- Groundwater Management Area
- Incorporated Area

Figure 7.3

Well Location-Water Level Map

Issaquah Creek Valley Ground Water Management Area



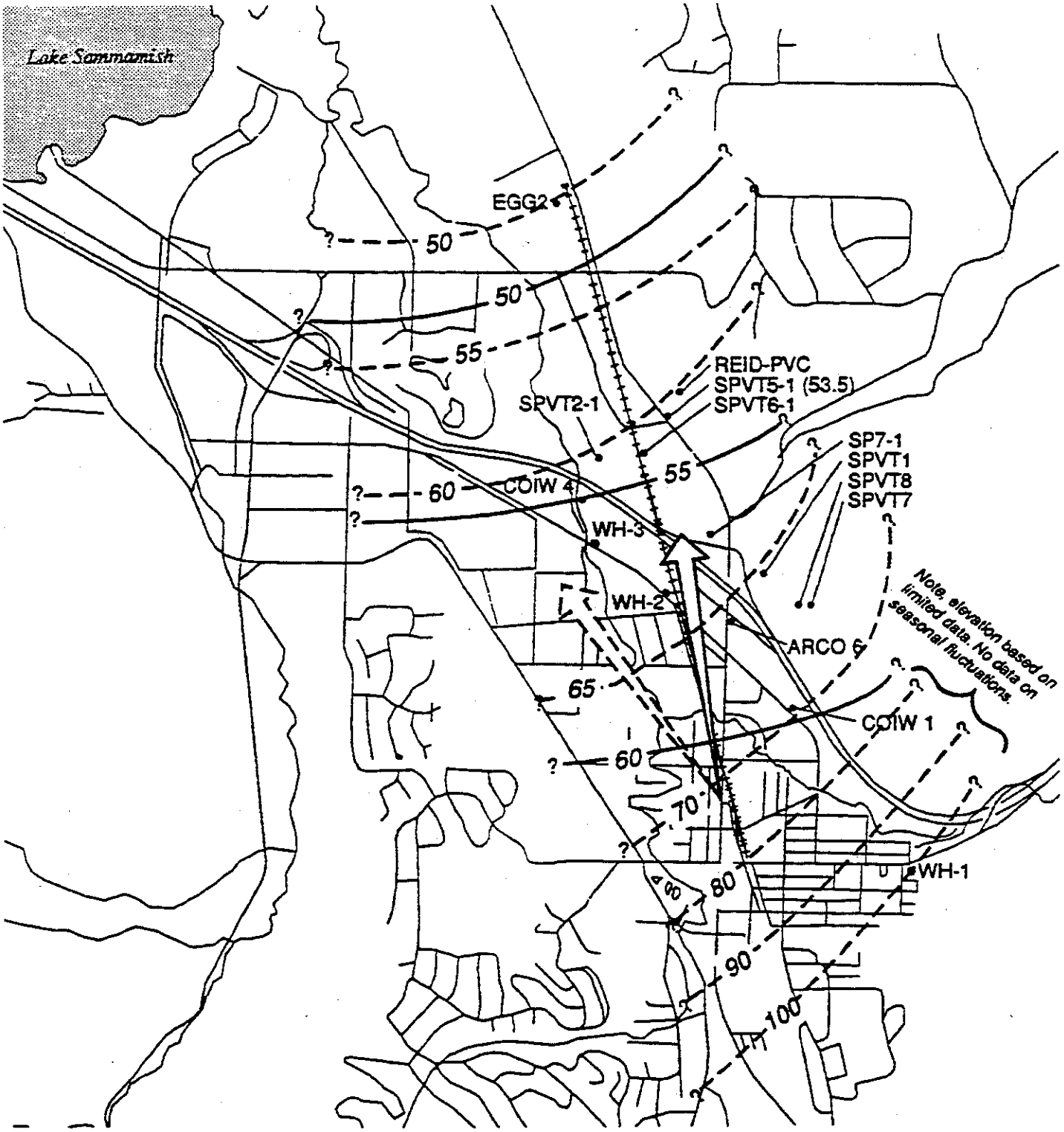
Monitoring Wells in Issaquah Creek Valley GWMP Original Area

- Arco Service Station LUST Site
- City of Issaquah Water Wells
- Sammamish Plateau Water Wells
- Well Included in Monthly Monitoring
- Well Location Obtained from Well Logs

Monitoring Wells in Sammamish Plateau Area

- Water Level Monitoring Site
- Water Quality Monitoring Site
- 3 Number of Wells Monitored in Area

- Water Level Contour (in feet) from 1996 Issaquah Creek Valley GWMP
- Water Level Contour (in feet) from 1995 USGS Water Level GIS Coverage
- Stream/Lake
- Groundwater Management Area
- Incorporated Area



Note: Groundwater levels are approximate based on hand-smoothed 1992 hydrographs. A complete year of data are not available for WH-1, WH-2 and WH-3.

Source: Wellhead Protection Study
Golder Associates 1993

Low flow (September)
Groundwater elevation contour (feet msl)

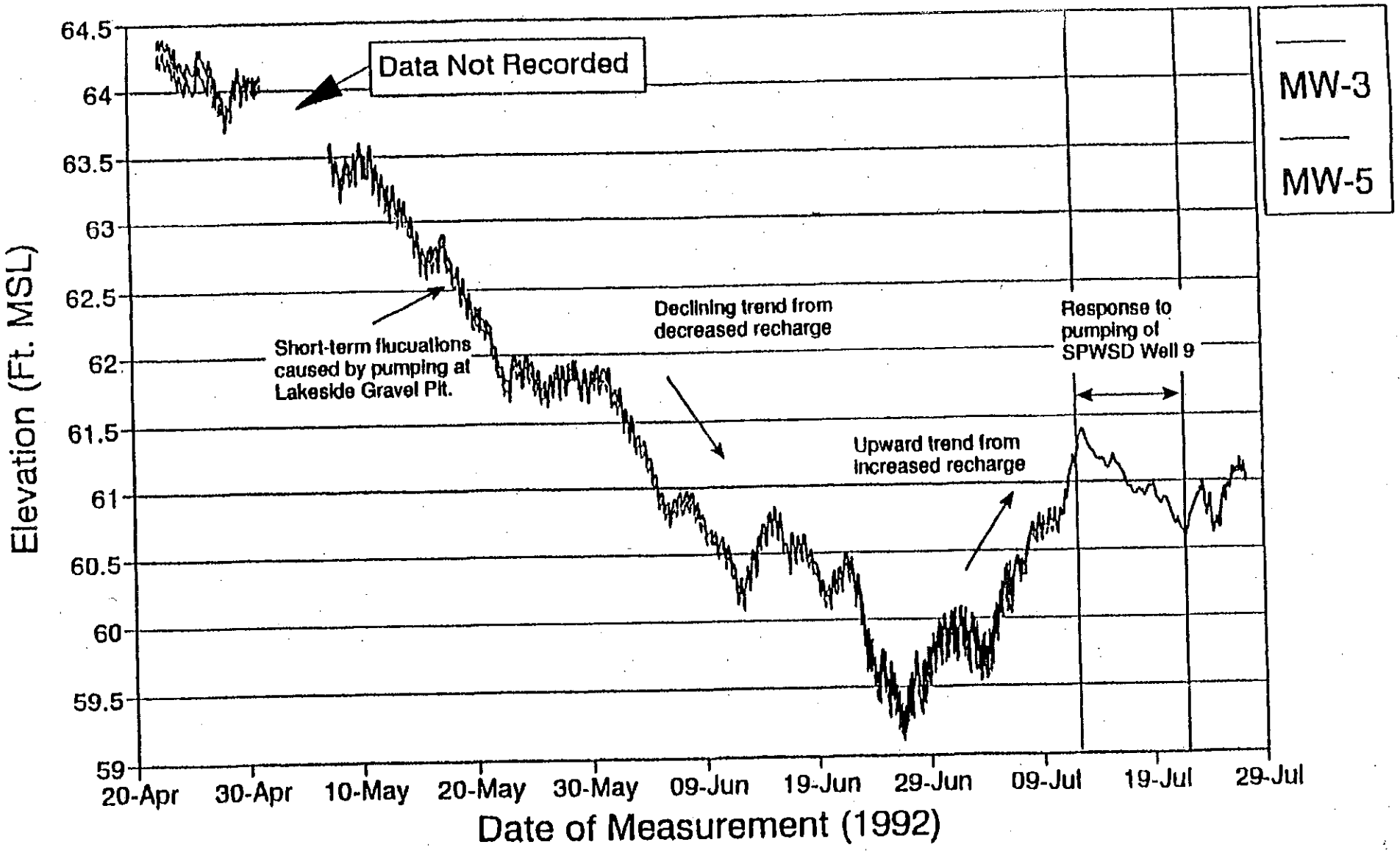
High flow (February)
Groundwater elevation contour (feet msl)

Direction of groundwater flow

SCALE IN FEET
0 1000 2000

N

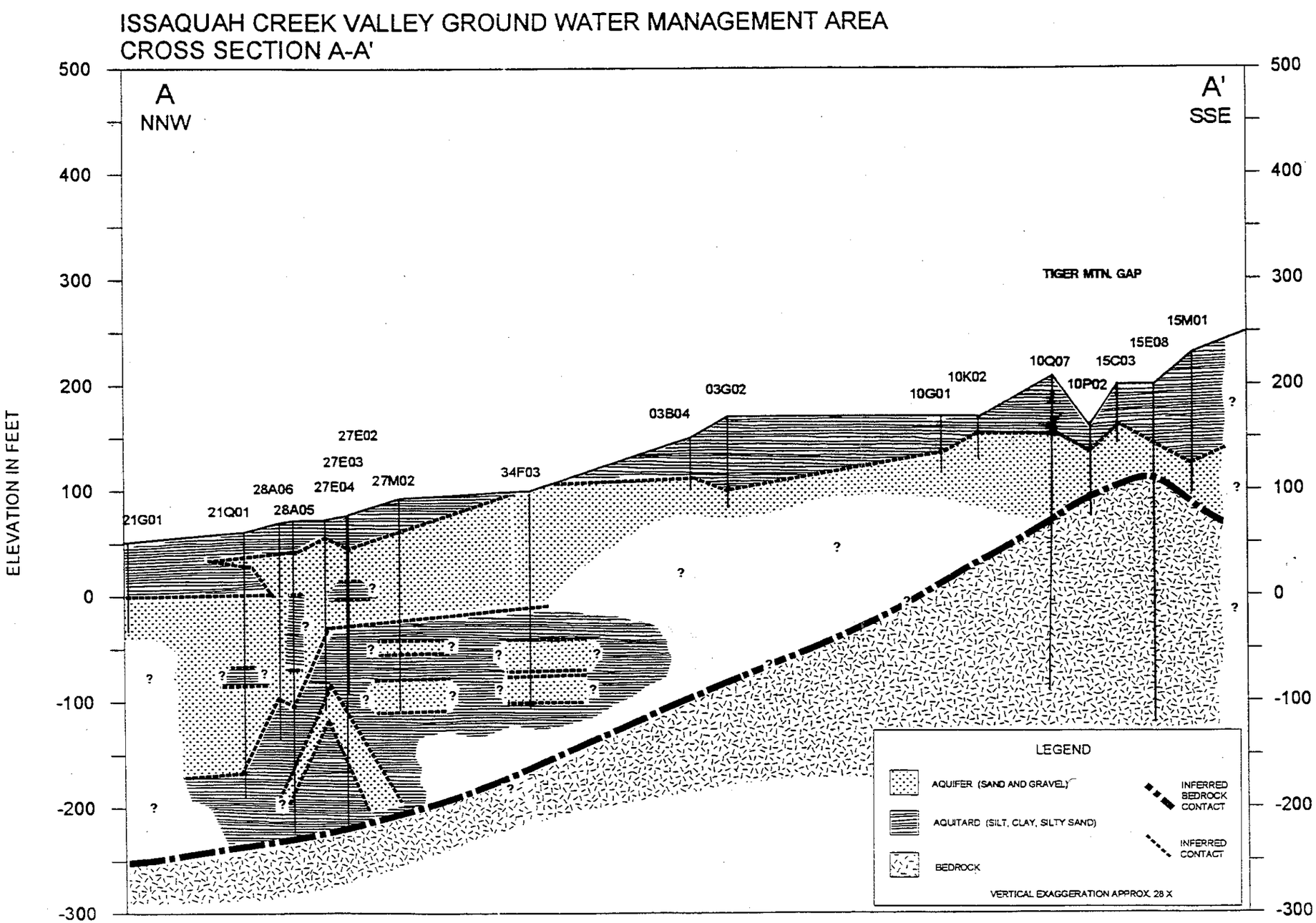
Fig. 7.4
Seasonal Ground Water Levels and Direction of Flow



Source: Wellhead Protection Study
Golder Associates 1993

Fig. 7.5 Example Water Level Hydrograph, Arco Site

Fig. 7.6 Cross Section A-A'



Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

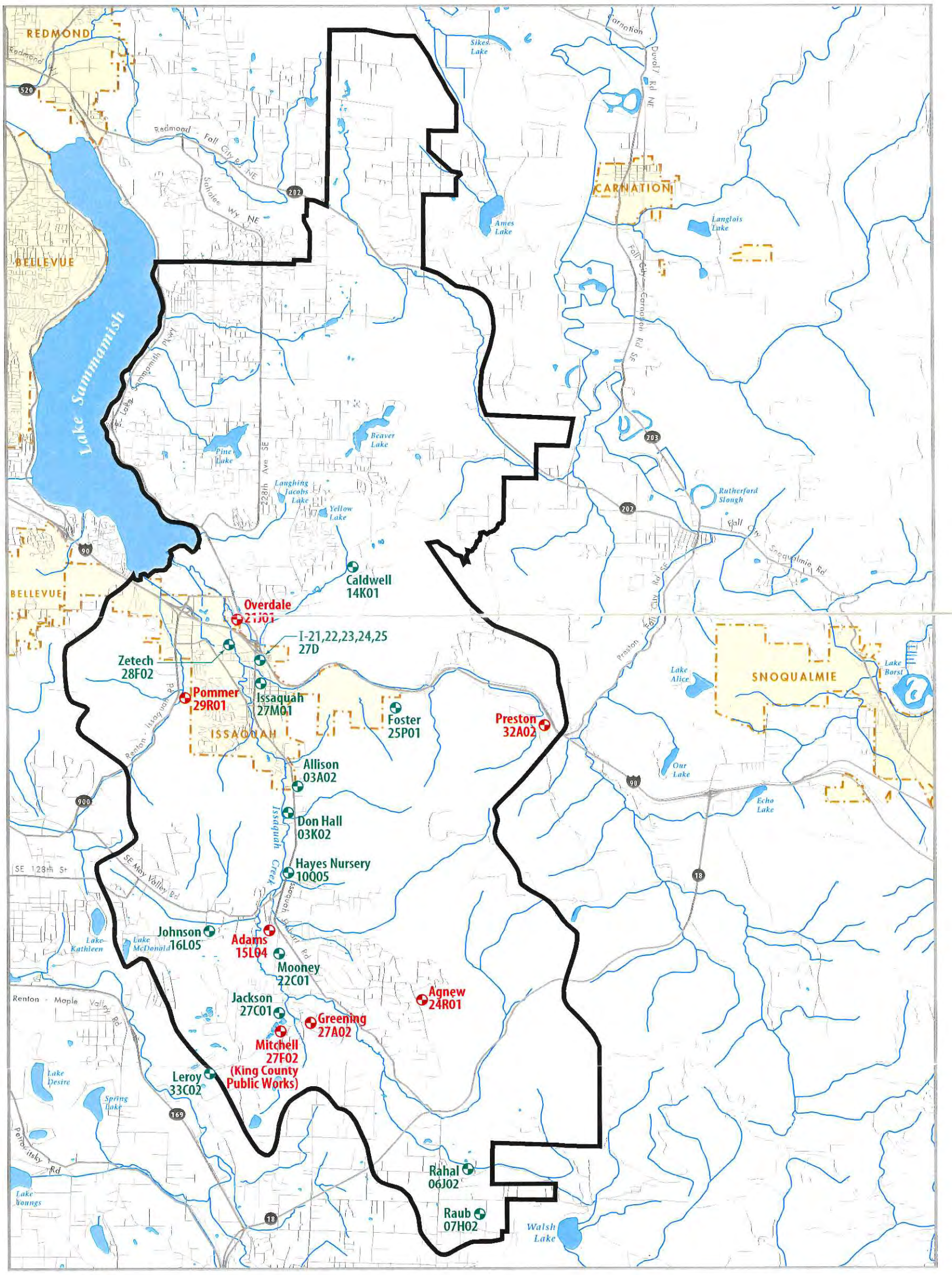
SCALE IN MILES

0 .5 1

Figure 7.16

Wells Sampled

Issaquah Creek Valley Ground Water Management Area



Well Sampled for the Issauqah Creek Valley Groundwater Management Program

Well Individually Graphed (figs. 7.17-7.23)

Stream/Lake

Groundwater Management Area

Incorporated Area

N

0 1 2 Miles

March 1999

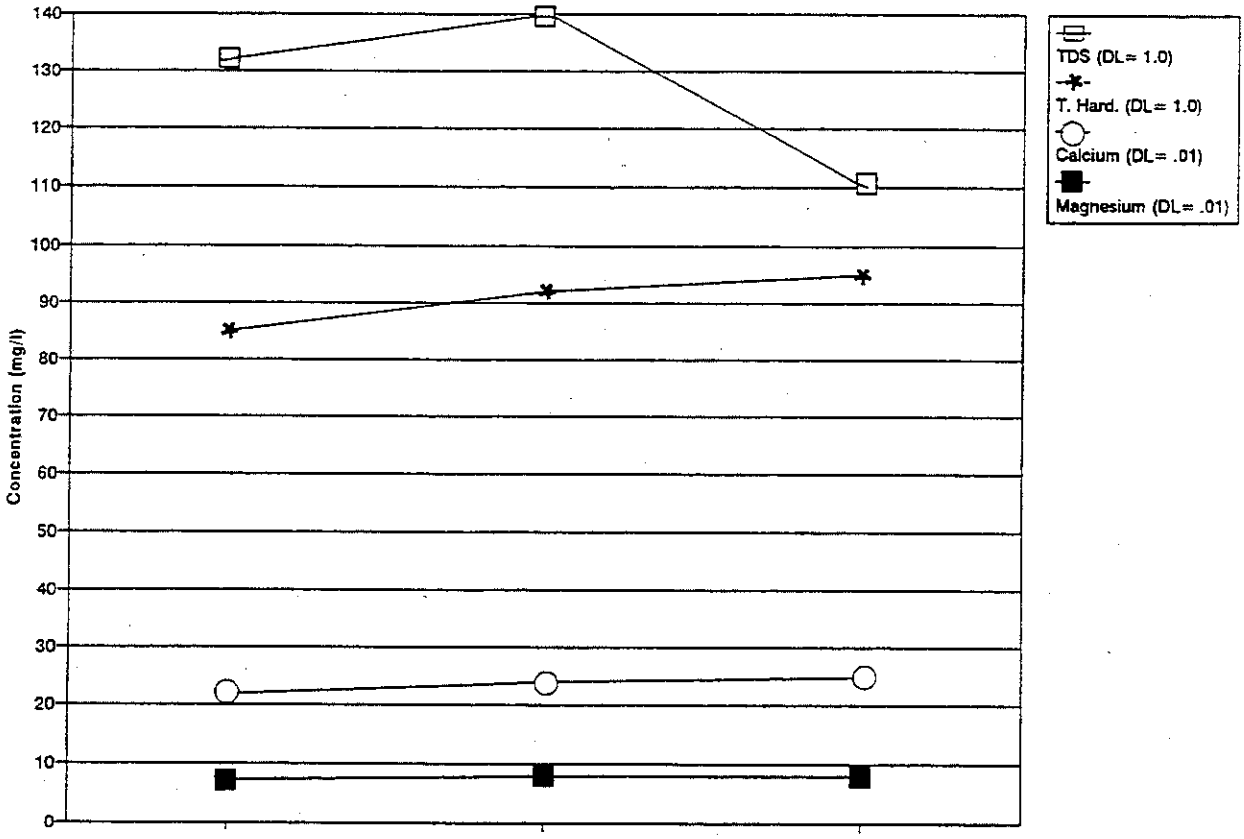
File name: 9903 IssGWwells716 wg

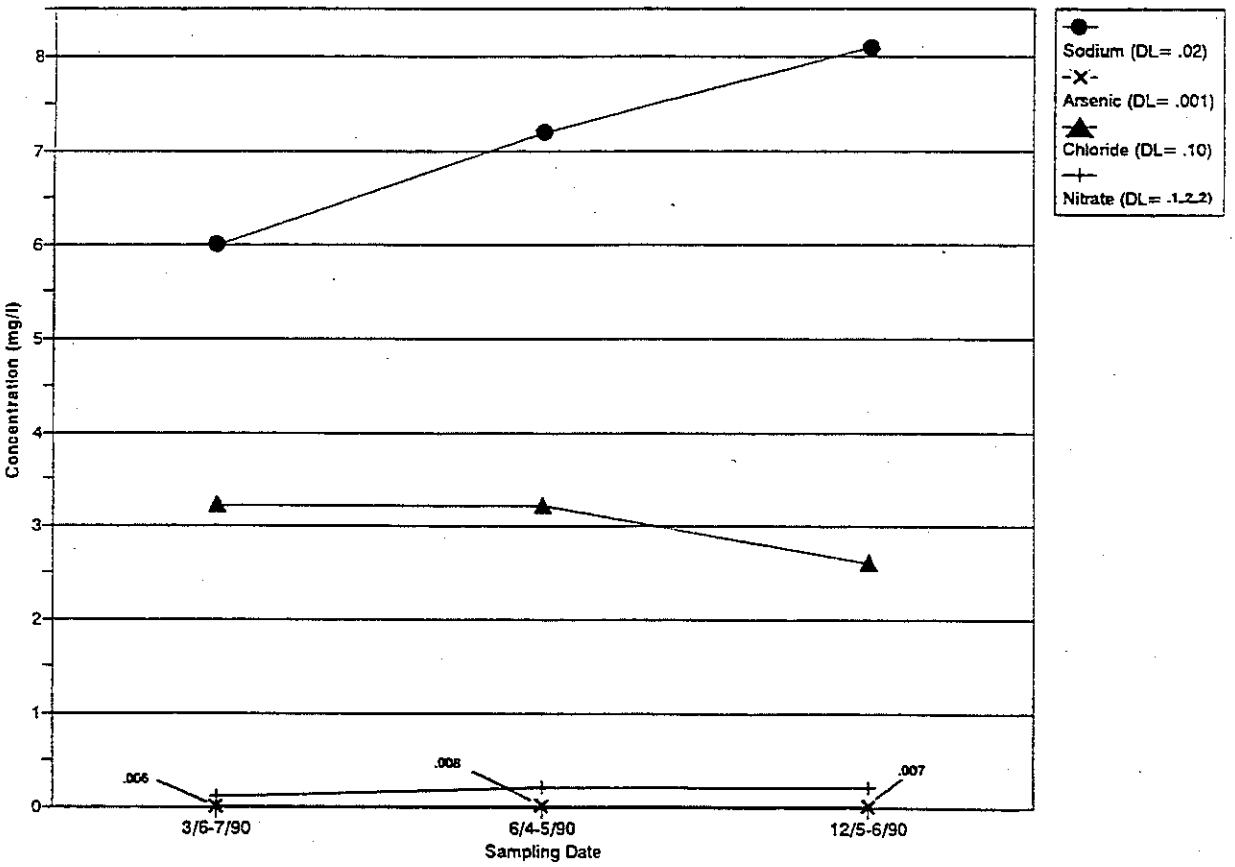
Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

Source: 1996 Issaquah Creek Valley GWMP

King County
Department of Natural Resources

Adams Well
23/06E-15L04

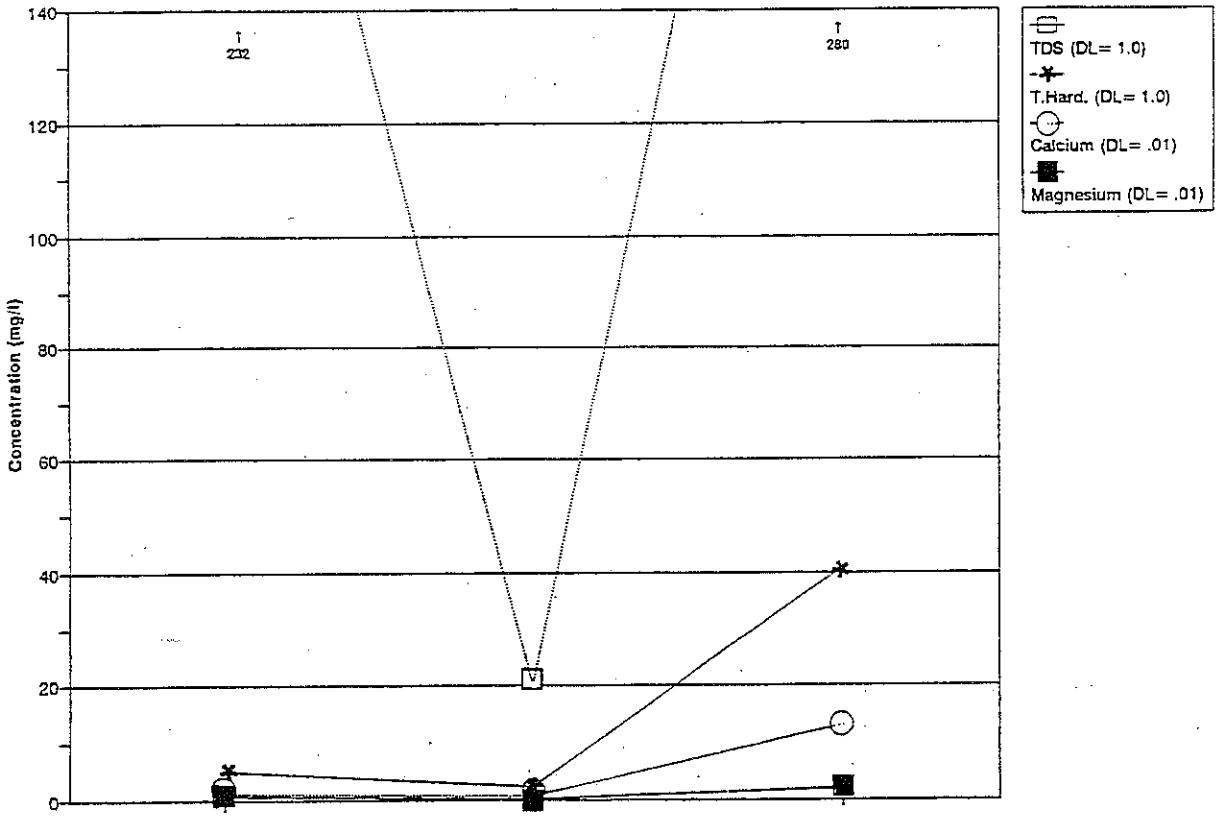


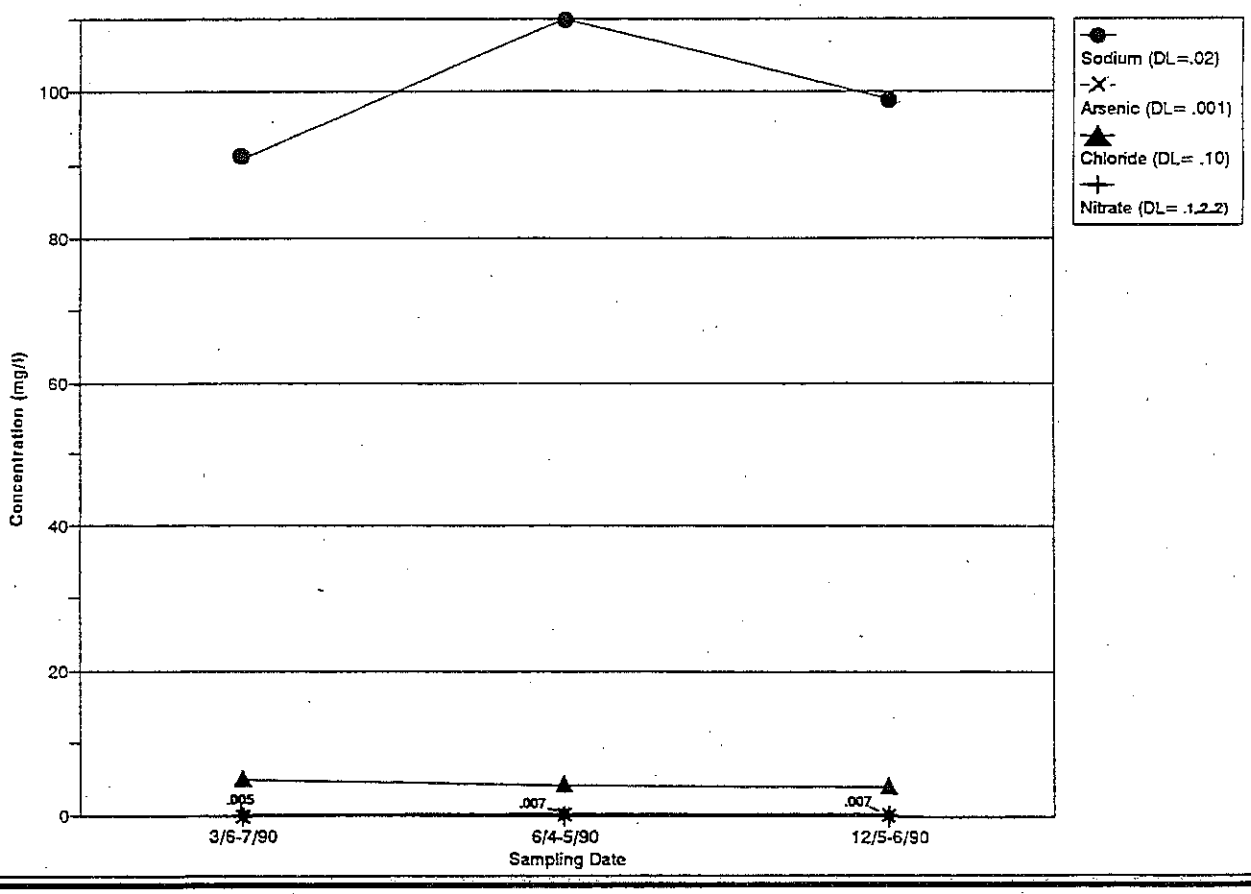


Source: Task 5: Hydrogeological Report - Carr/Associates. Sept. 1993

Fig. 7.17 Adams Well

Agnew Well
23/06E-24R01

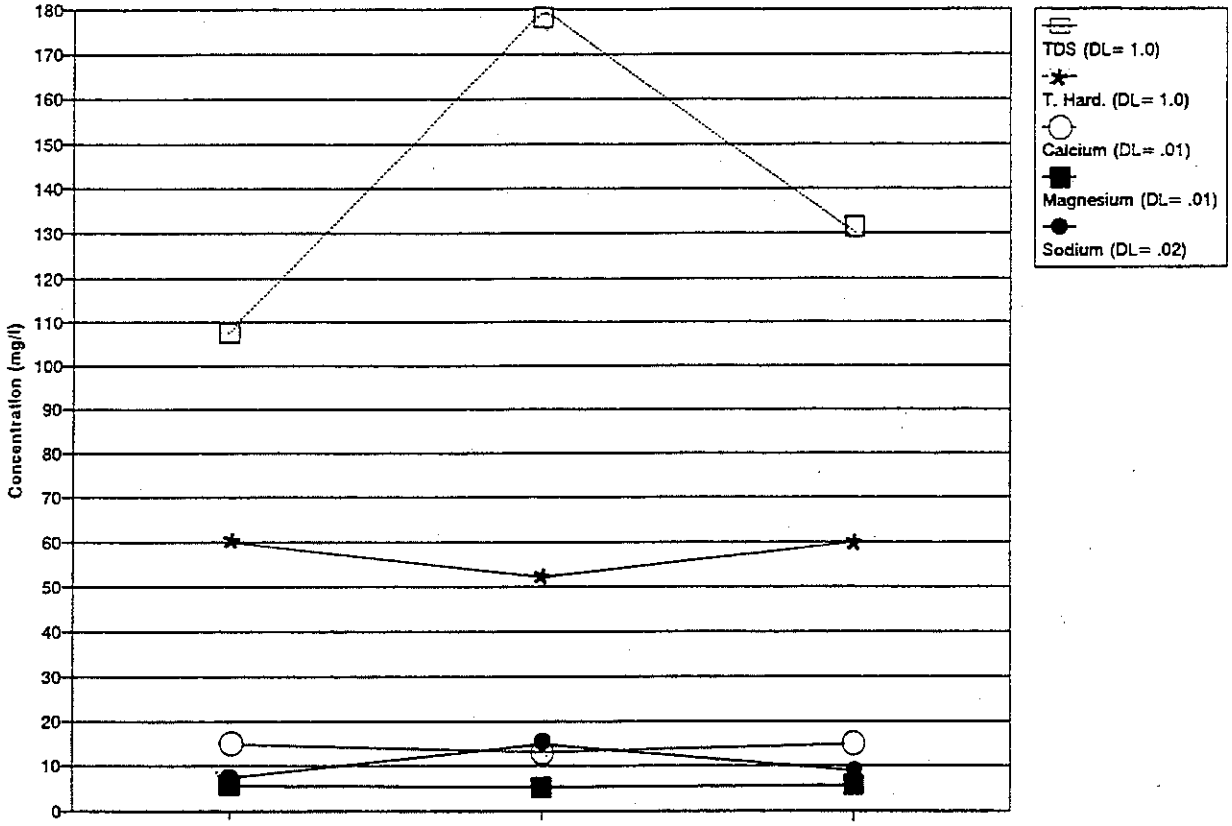


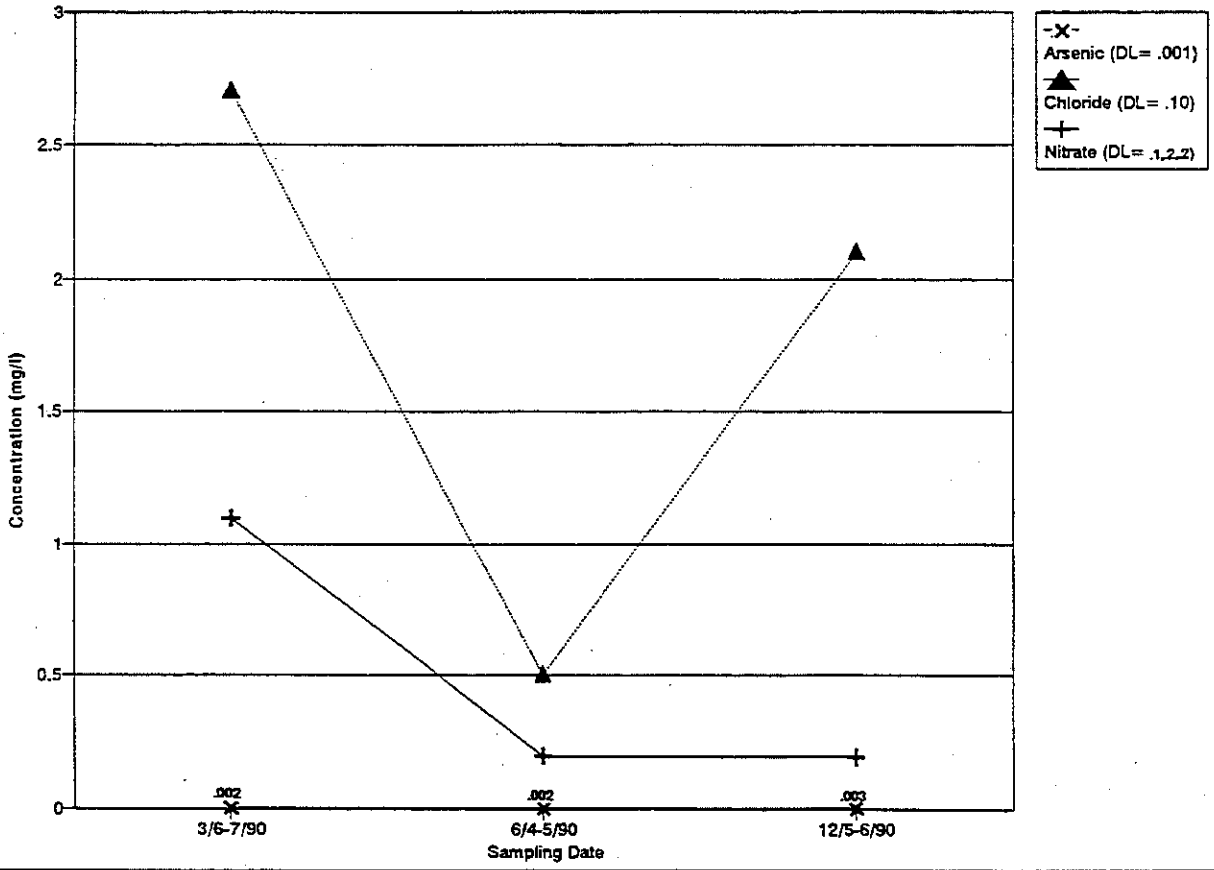


Source: Task 5: Hydrogeological Report - Carr/Associates. Sept. 1993

Fig. 7.18 Agnew Well

Greening Well
23/06E-27A02

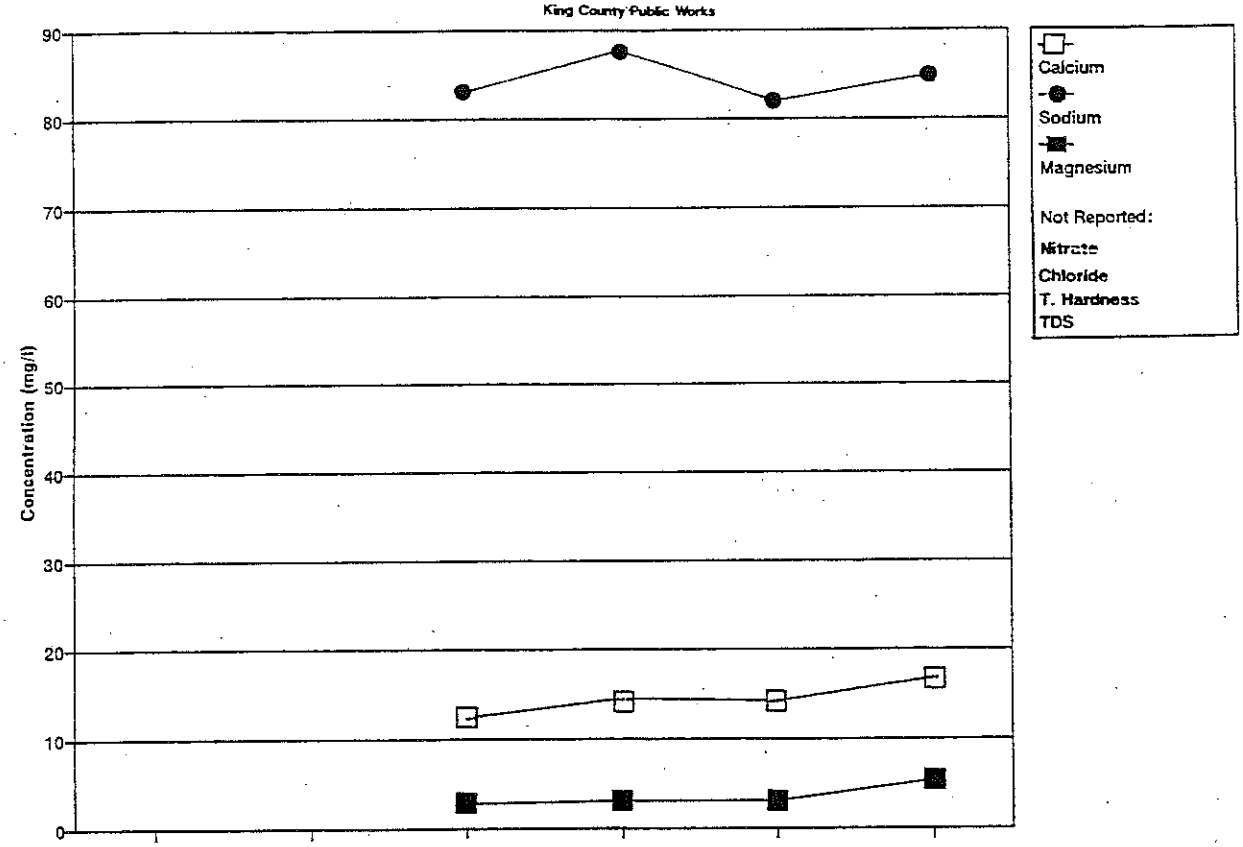


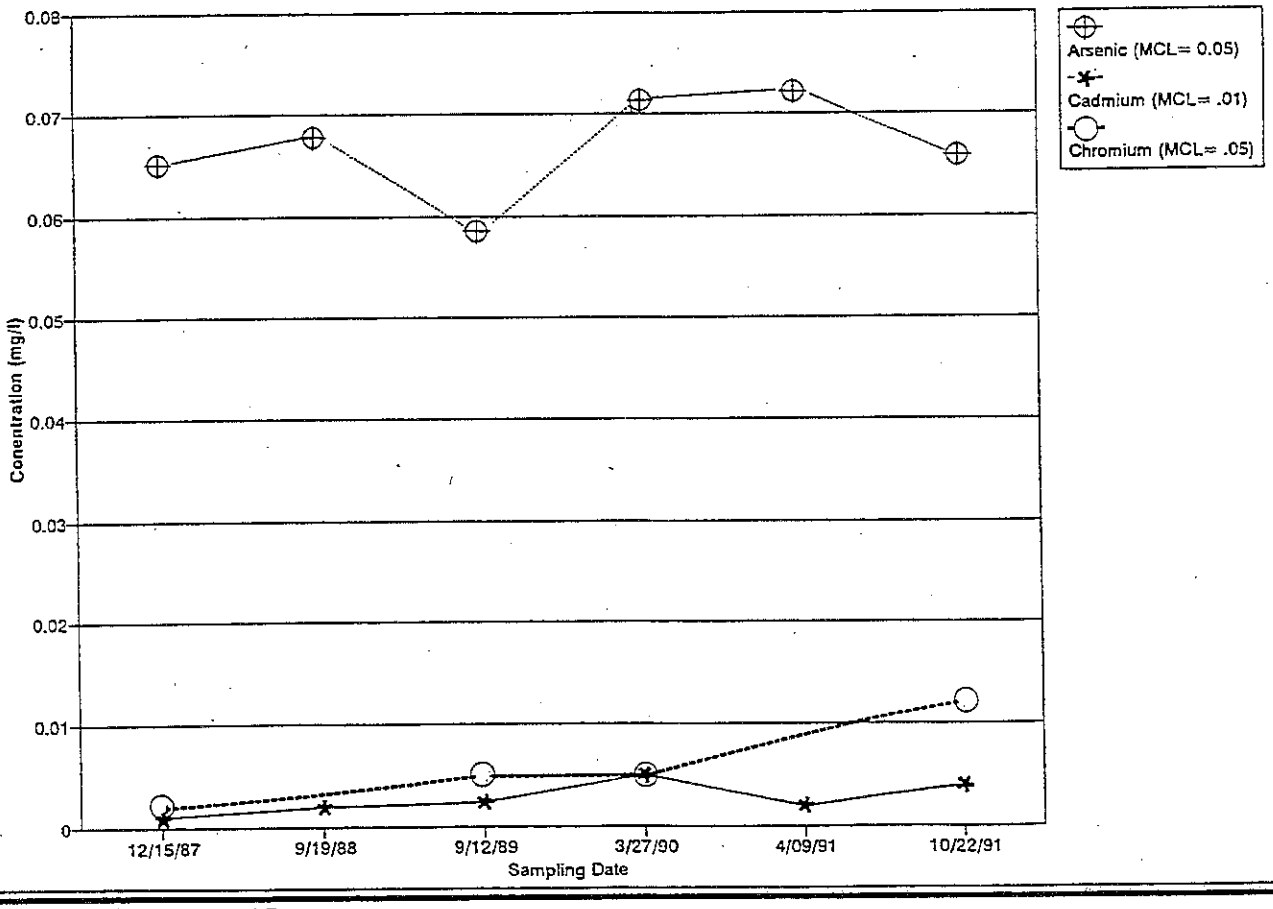


Source: Task 5: Hydrogeological Report - Carr/Associates. Sept. 1993

Fig. 7.19 Greening Well

Mitchell Well
23/06E-27F02
King County Public Works

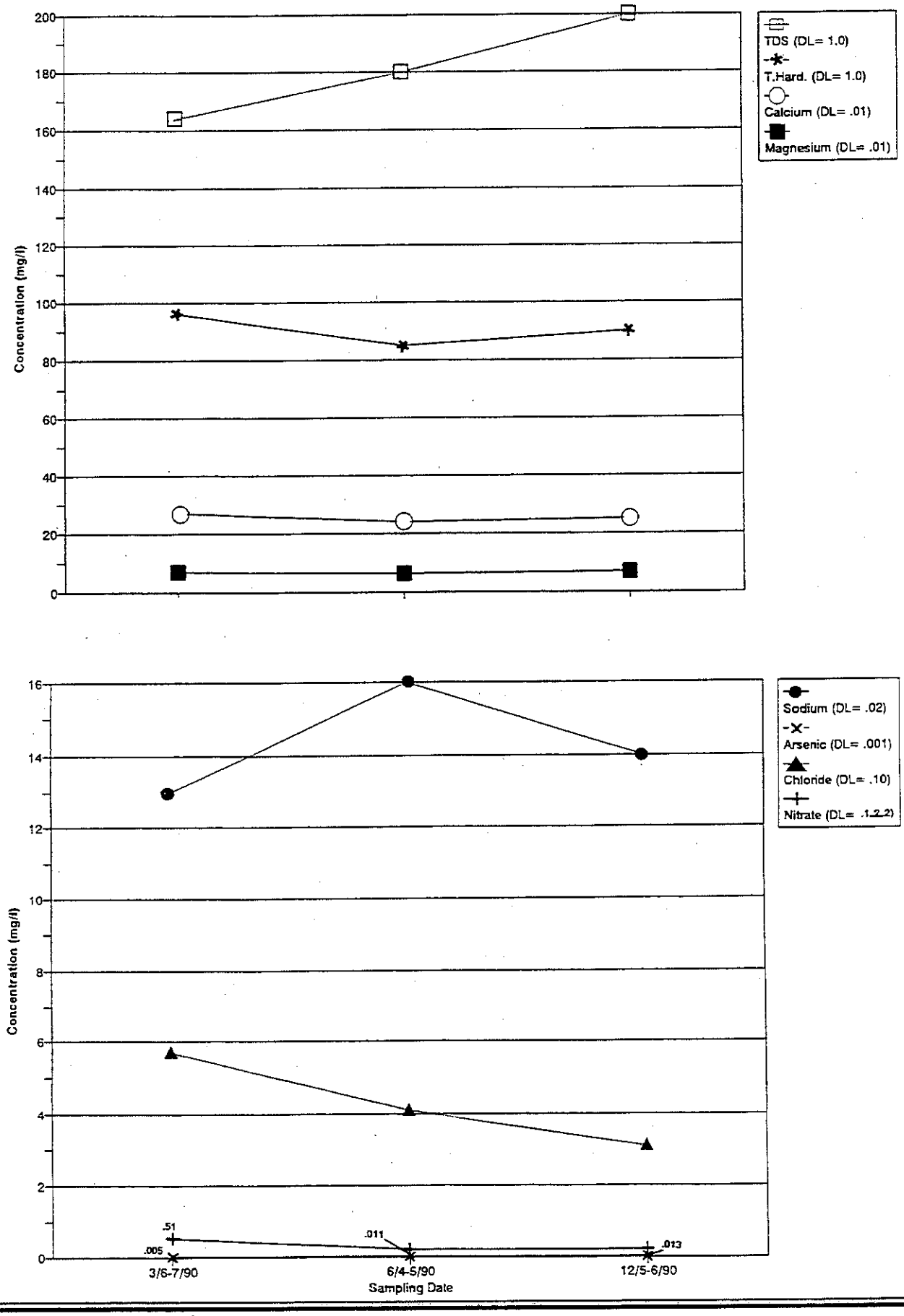




Source: Task 5: Hydrogeological Report - Carr/Associates. Sept. 1993

Fig. 7.20 Mitchell Well

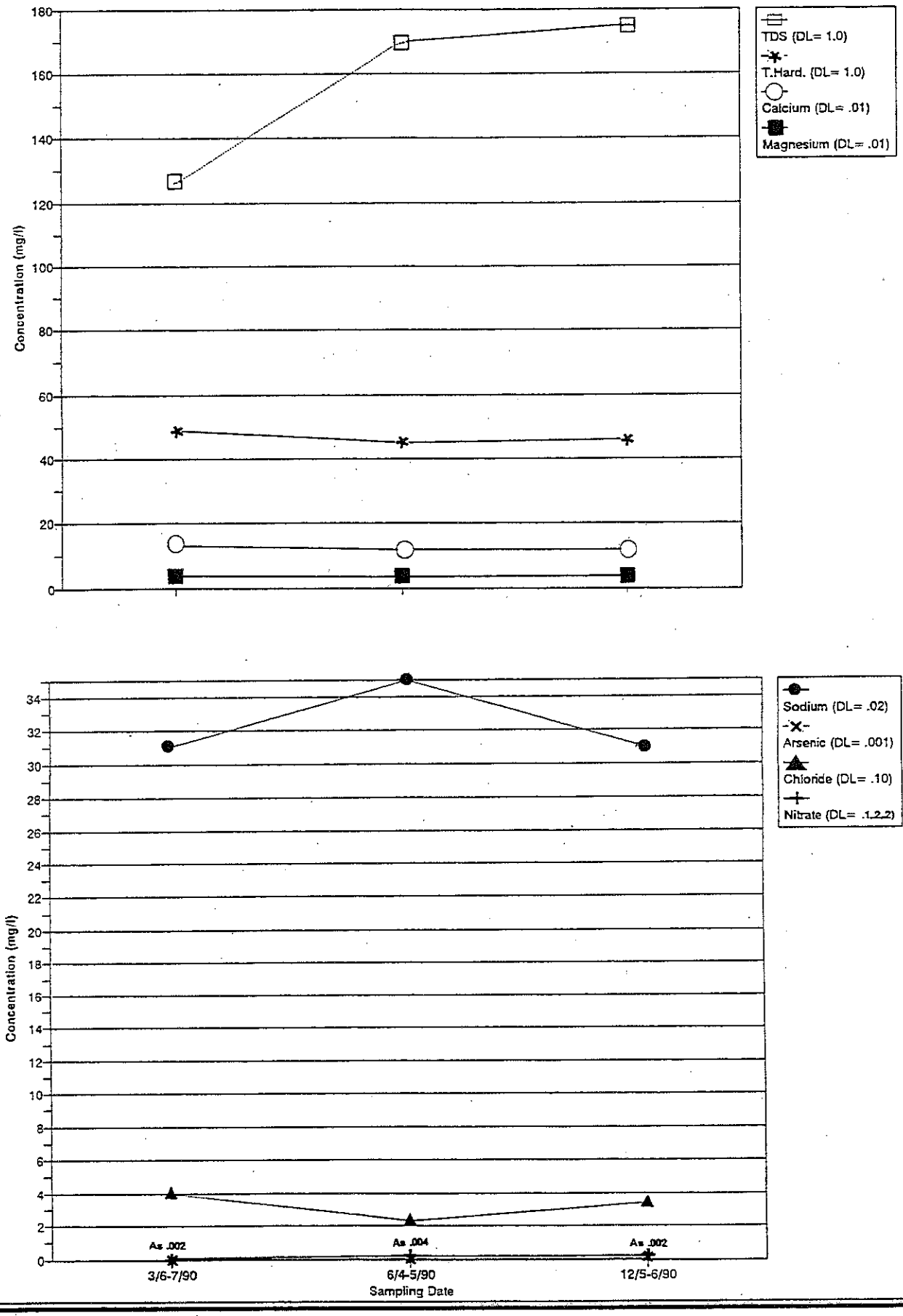
Overdale Well
24/6E-21J01



Source: Task 5: Hydrogeological Report - Carr/Associates. Sept. 1993

Fig. 7.21 Overdale Well

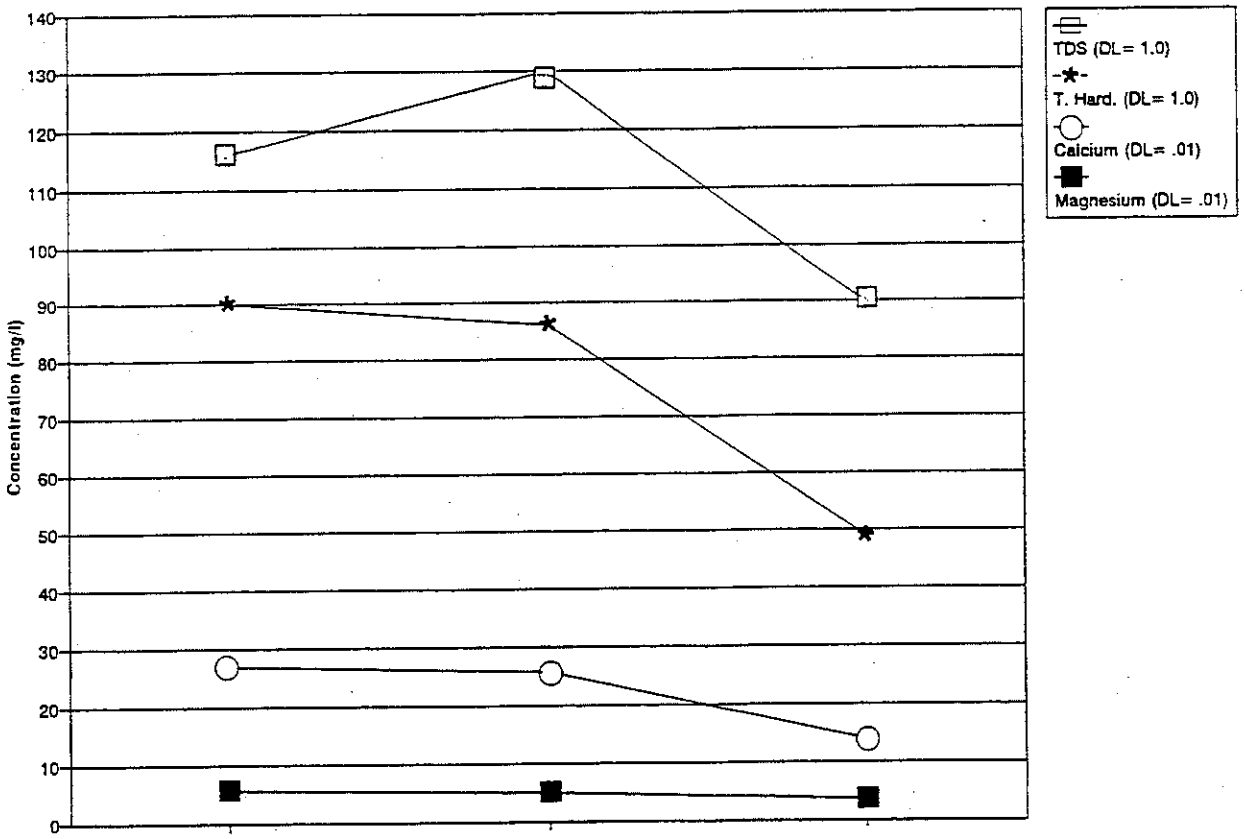
Pommer Well
24/06E-29R01

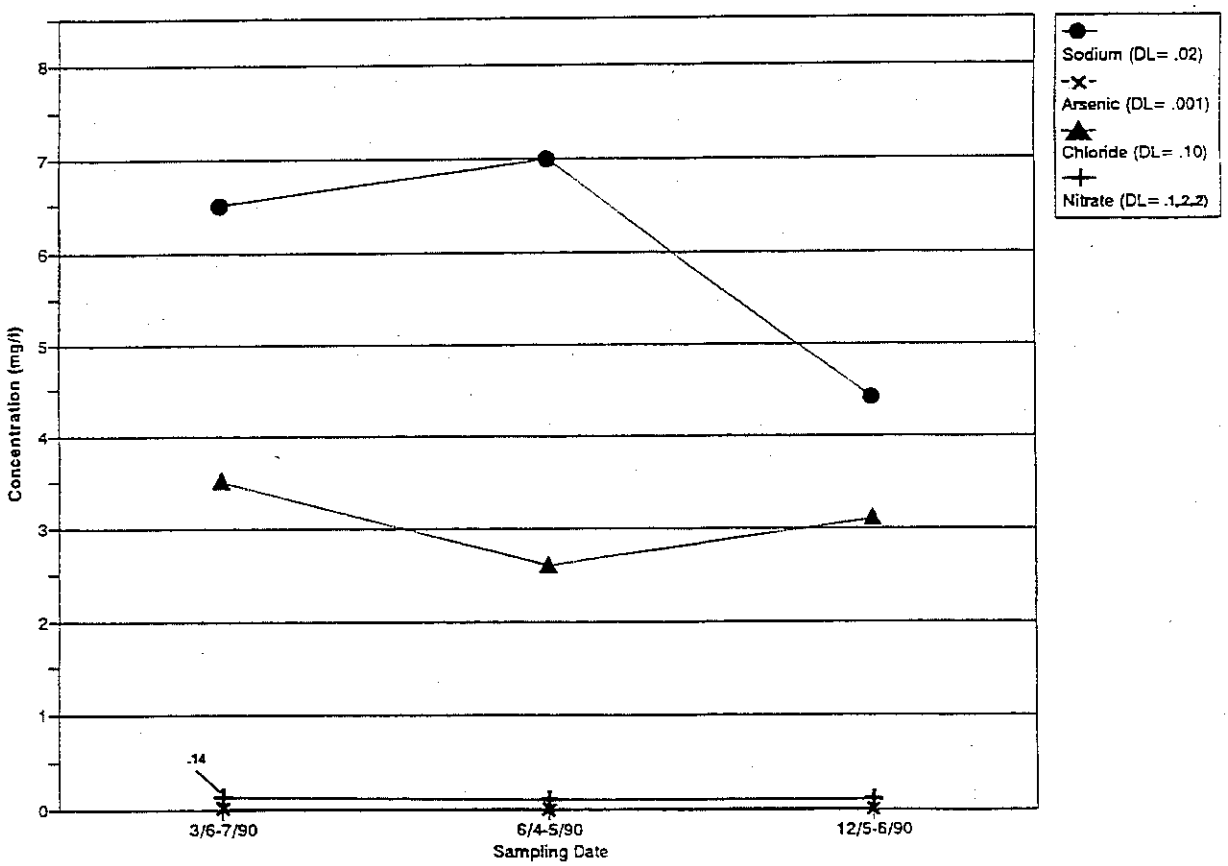


Source: Task 5: Hydrogeological Report - Carr/Associates. Sept. 1993

Fig. 7.22 Pommer Well

Preston Industrial Park
24/07E-32A

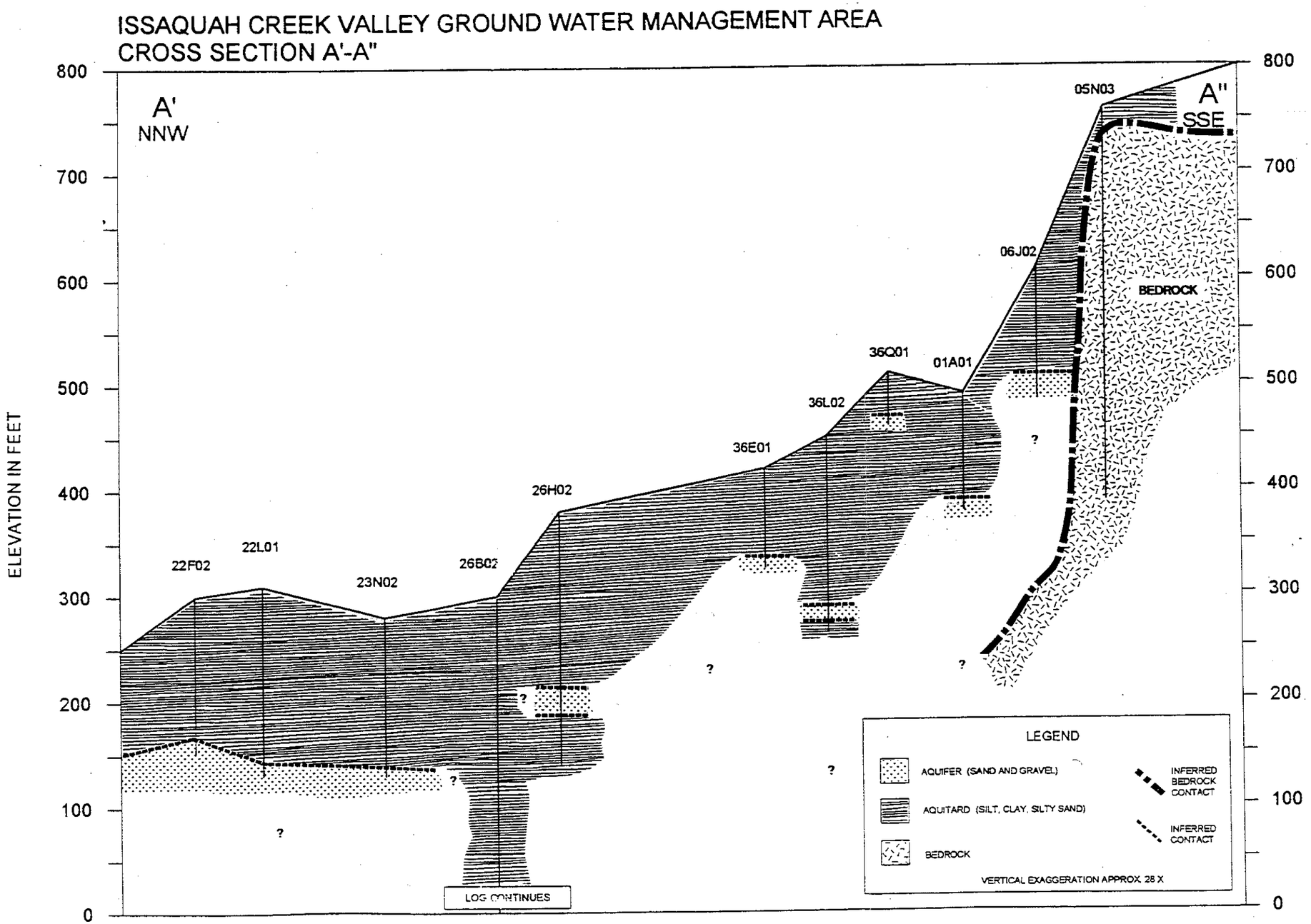




Source: Task 5: Hydrogeological Report - Carr/Associates. Sept. 1993

Fig. 7.23 Preston Industrial Park

Fig. 7.7 Cross Section A'-A"

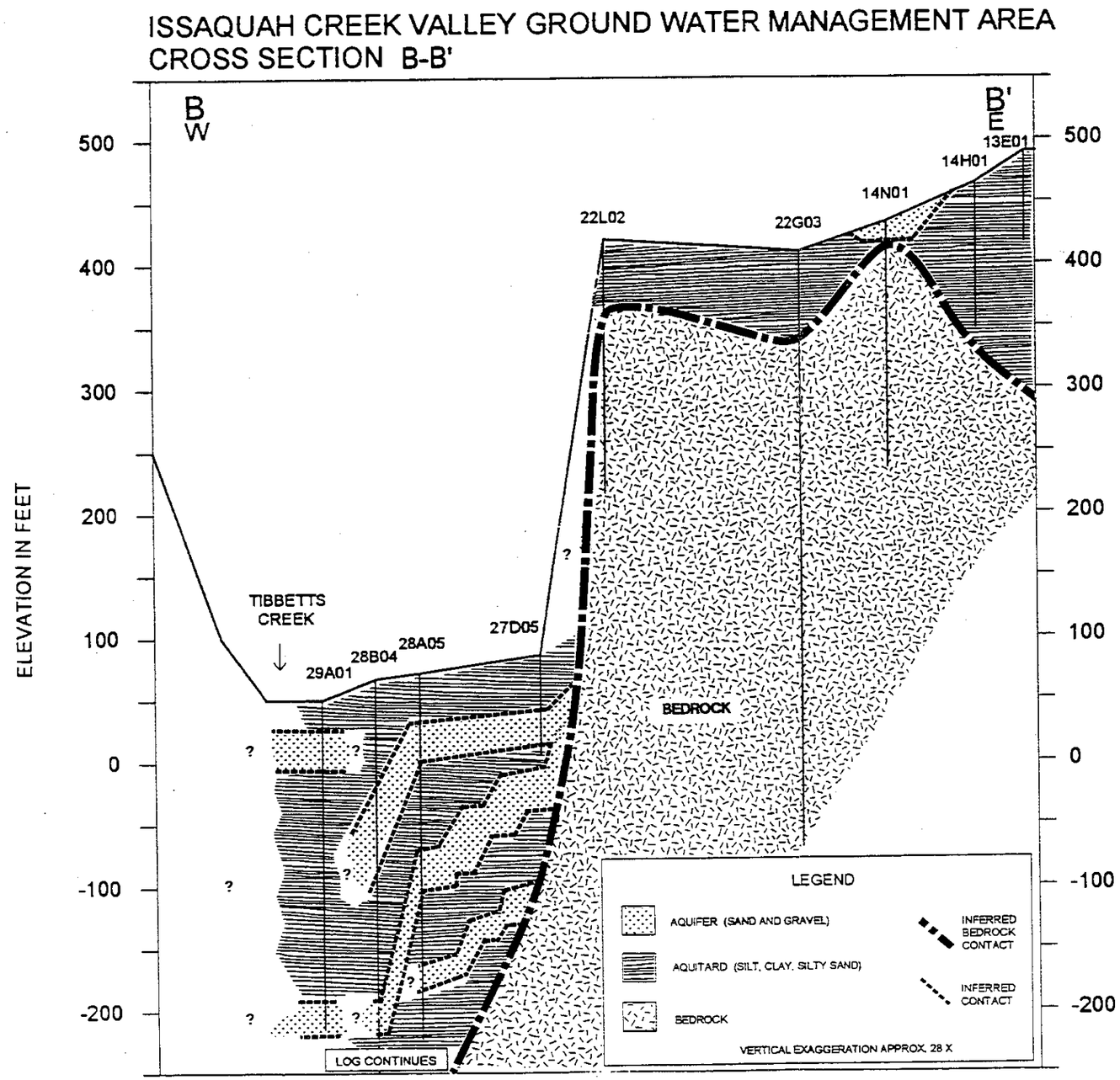


Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

SCALE IN MILES

0 .5 1

Fig. 7.8 Cross Section B-B'

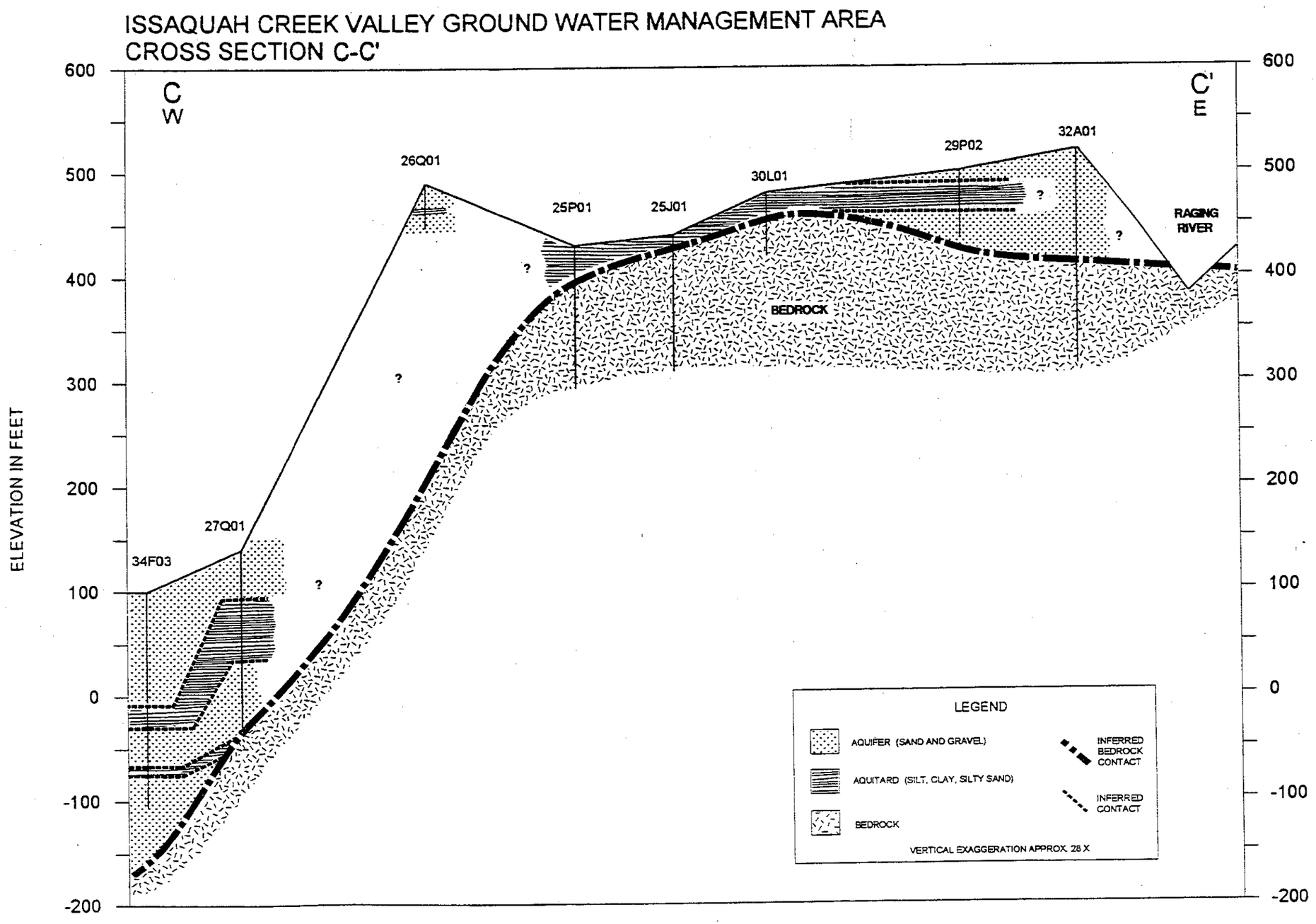


Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

SCALE IN MILES

0 .5 1

Fig. 7.9 Cross Section C-C'



Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

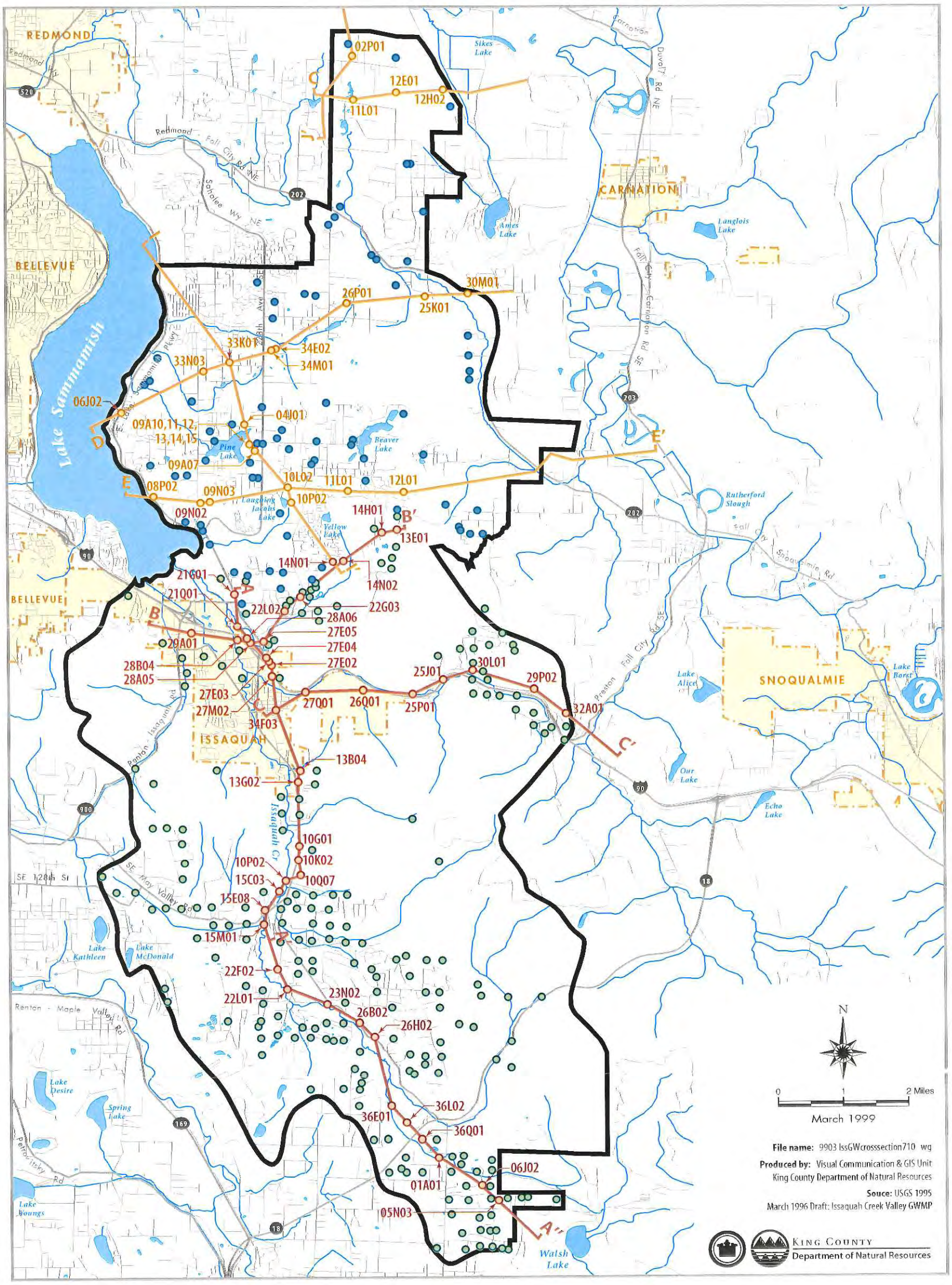
SCALE IN MILES

0 .5 1

Figure 7.10

Cross Section Location Map

Issaquah Creek Valley Ground Water Management Area

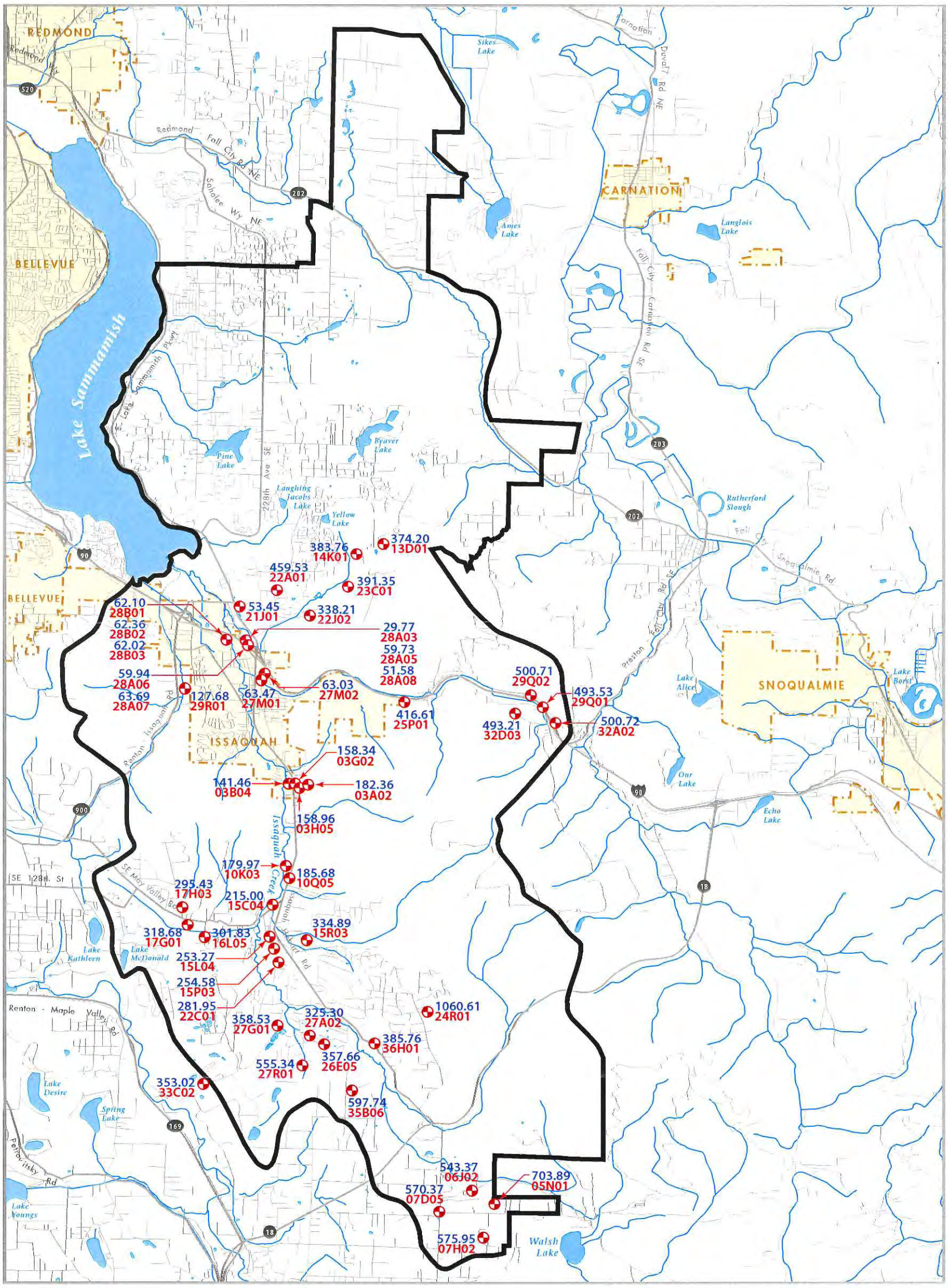


- Approximate Well location from IGWMA Database
- 05N03 Approximate Well location used in IGWMAHydrogeologic Cross Section
- A A' Hydrogeologic Cross Section Location In Original Issaquah Creek Valley GWMA
- Approximate Well location from USGS Database
- 05N03 Approximate Well location used in USGS Hydrogeologic Cross Section
- D D' Hydrogeologic Cross Section Location in Sammamish Plateau Area, See USGS (1995)
- Stream/Lake
- Groundwater Management Area
- Incorporated Area

Figure 7.11

Well Location Map

Issaquah Creek Valley Ground Water Management Area



Well Included in Monthly Monitoring

570.37 Water Level (Dec. 1990)

07D05 Location Identifier

Stream/Lake

Groundwater Management Area

Incorporated Area

N

0 1 2 Miles

March 1999

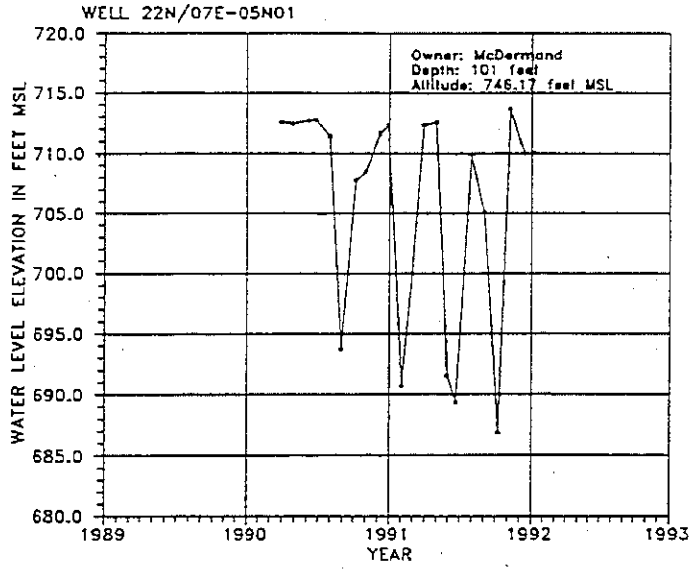
File name: 9903 IssGWwells711 wg

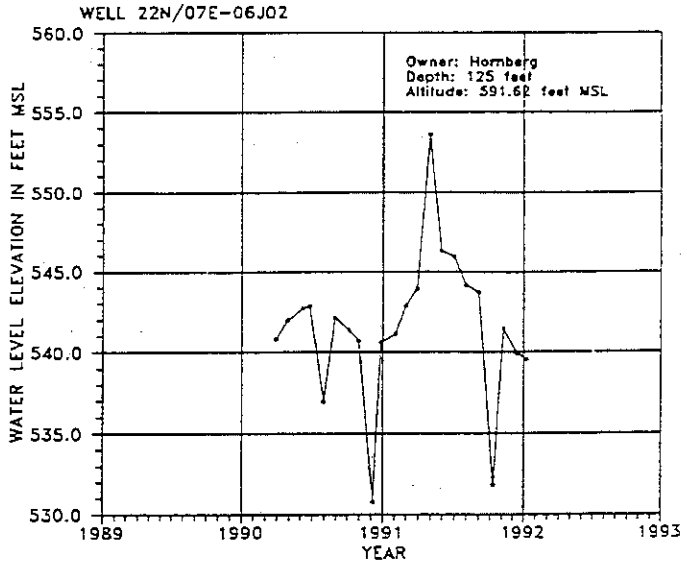
Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

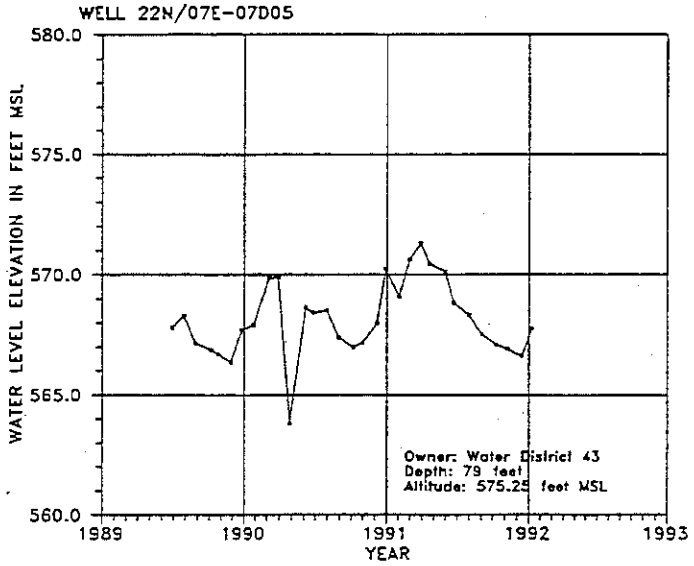
Source: 1996 Issaquah Creek Valley GWMP

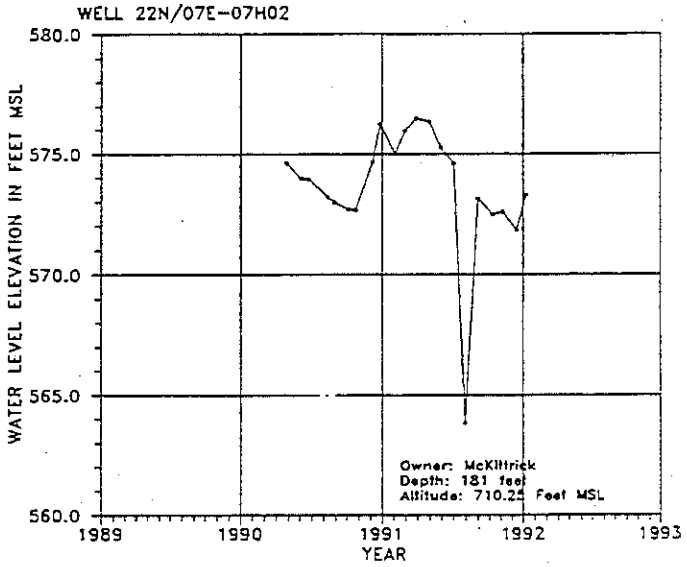
King County
Department of Natural Resources

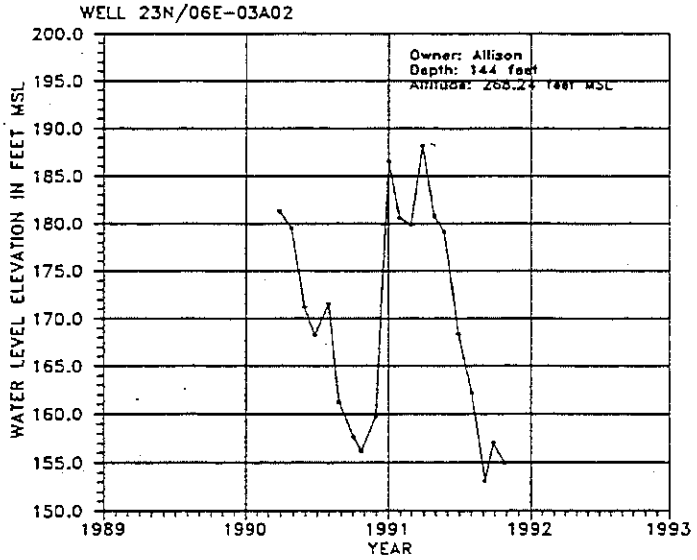
Issaquah Ground Water Management Program

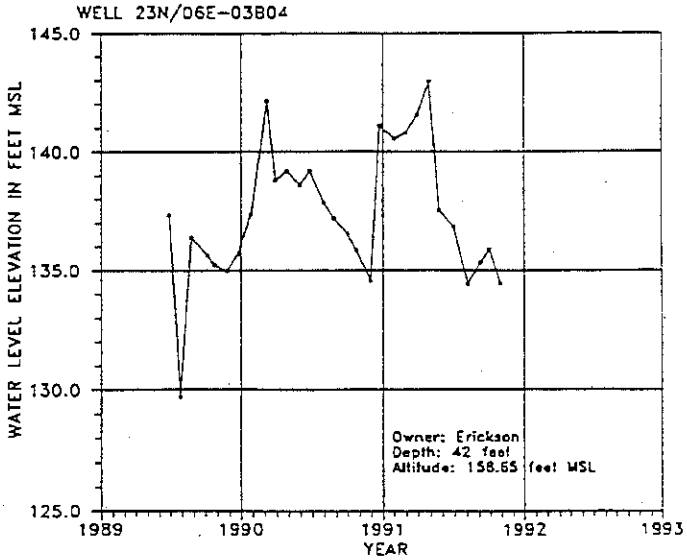








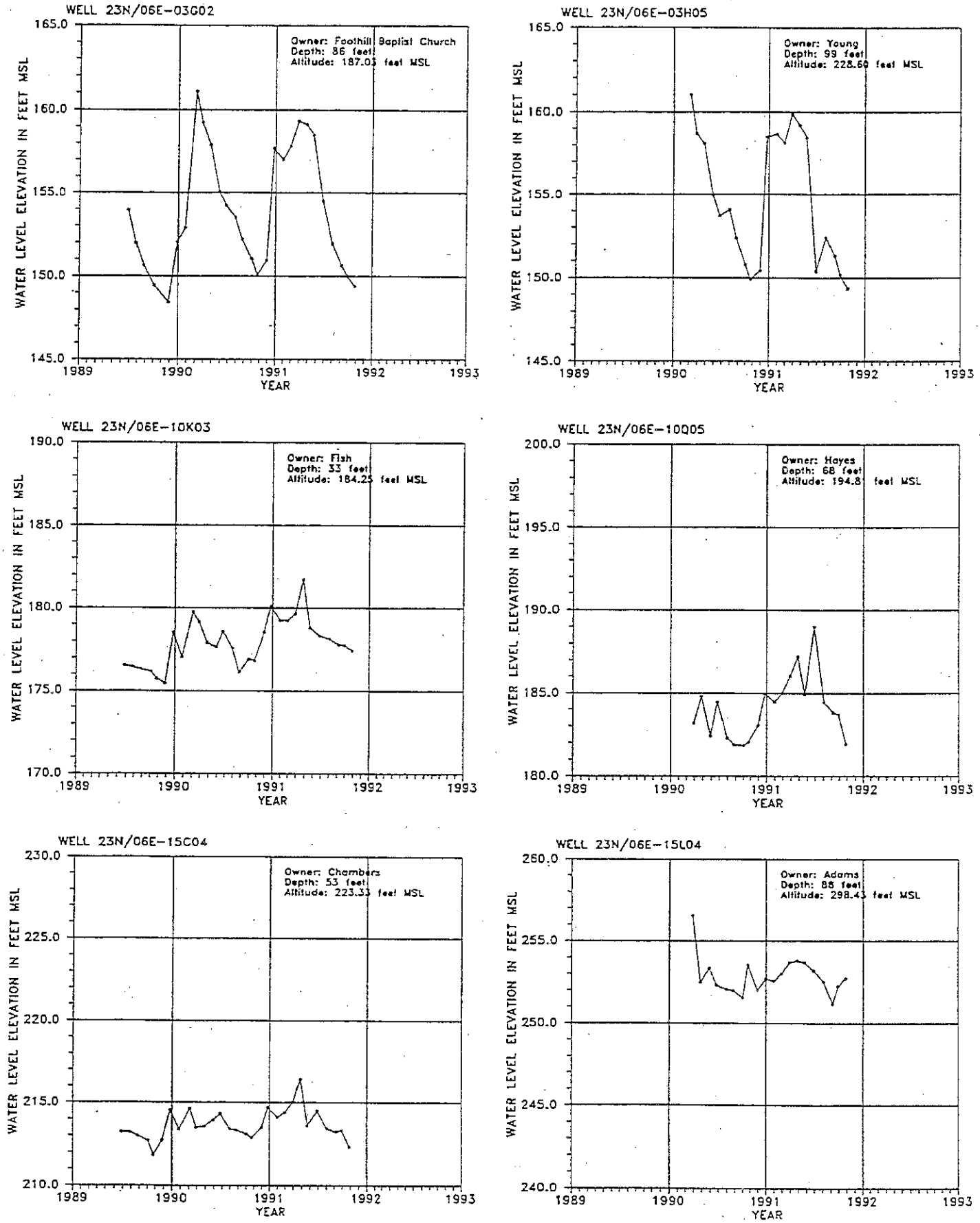




Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

Fig. 7.12A Water Level Trend

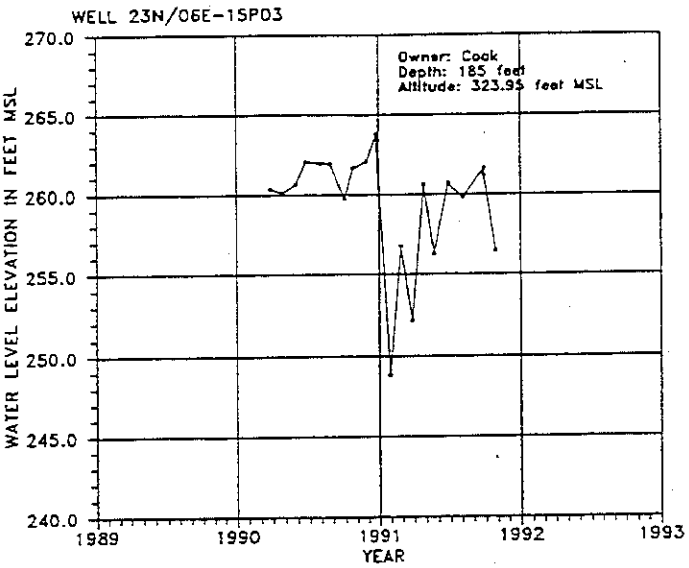
Issaquah Ground Water Management Program

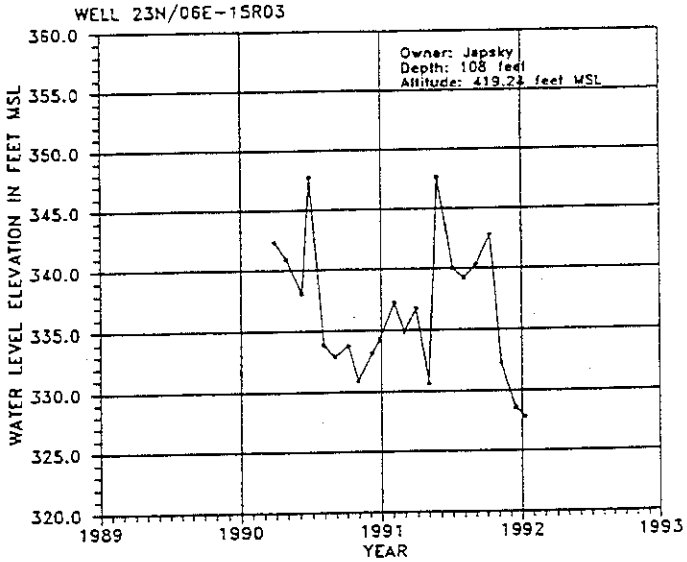


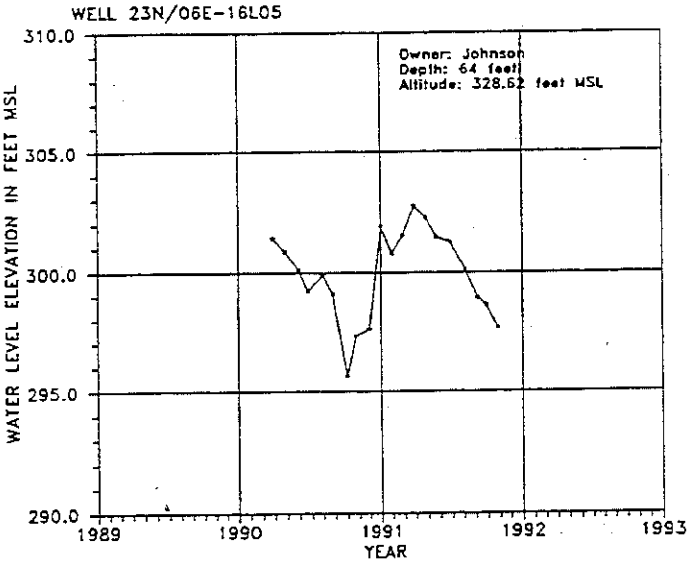
Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

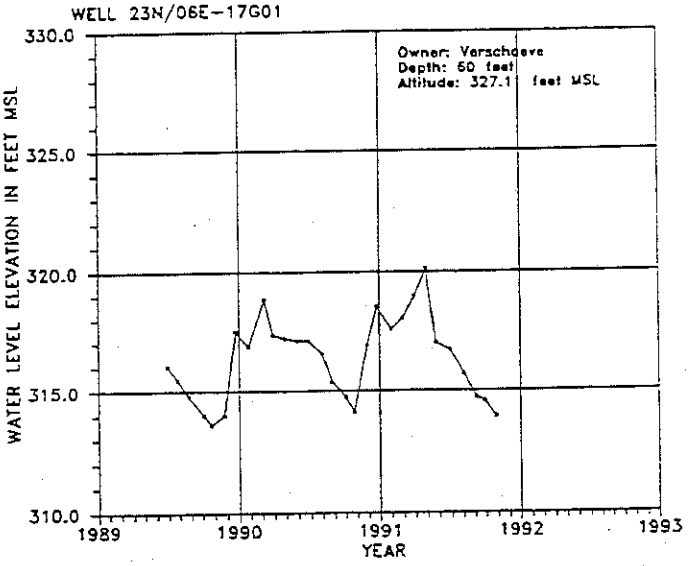
Fig. 7.12B Water Level Trend

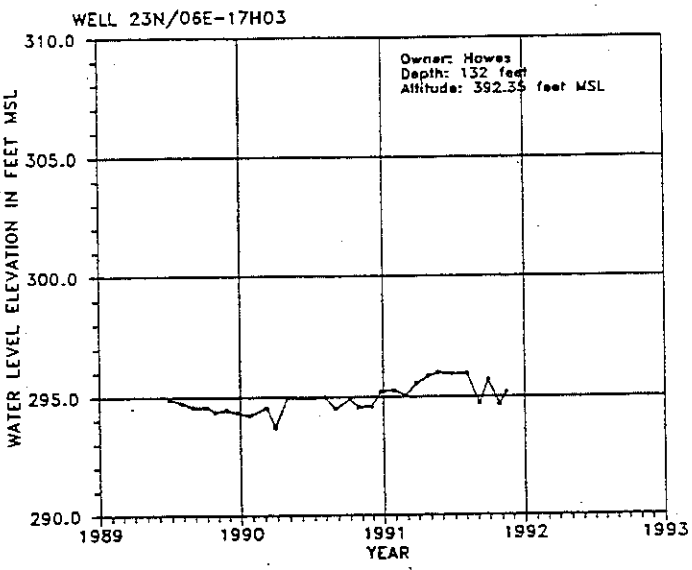
Issaquah Ground Water Management Program

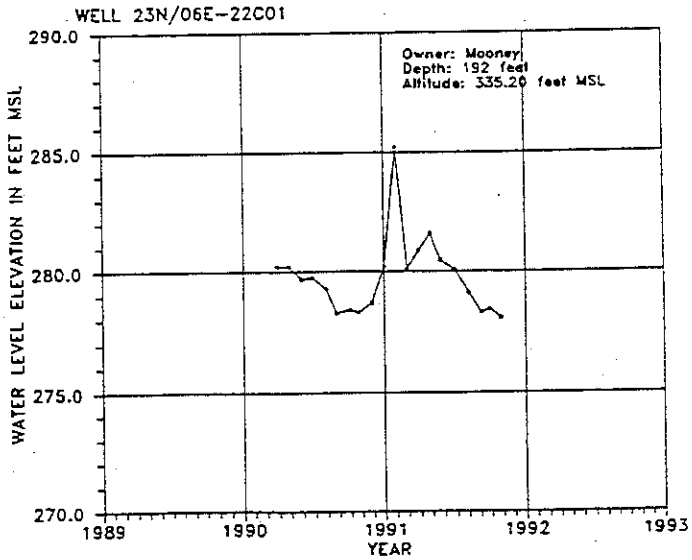








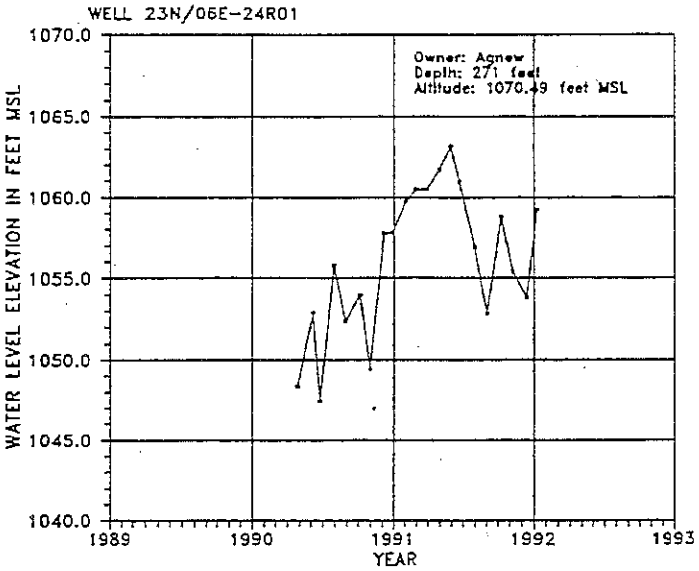


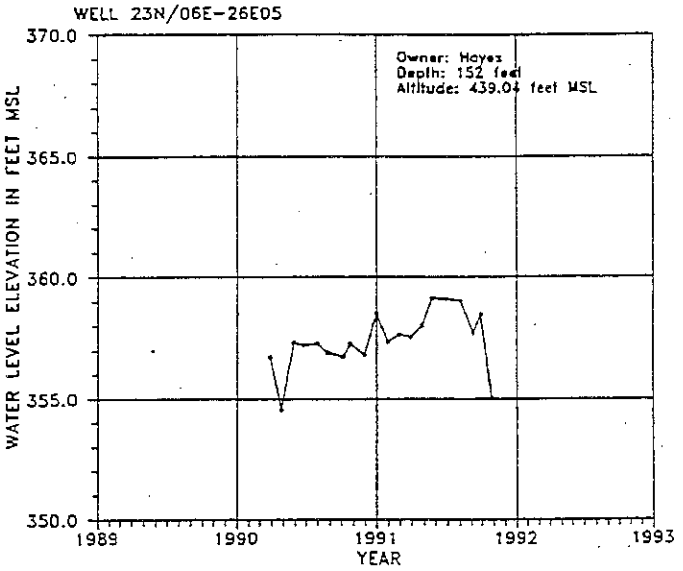


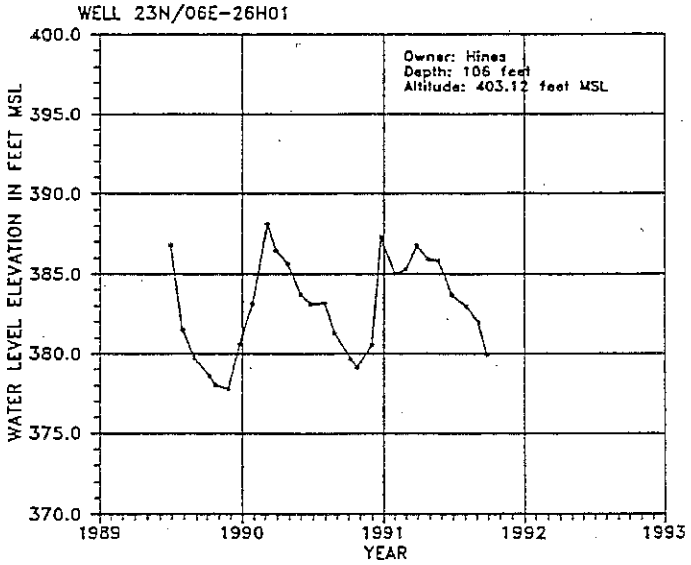
Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

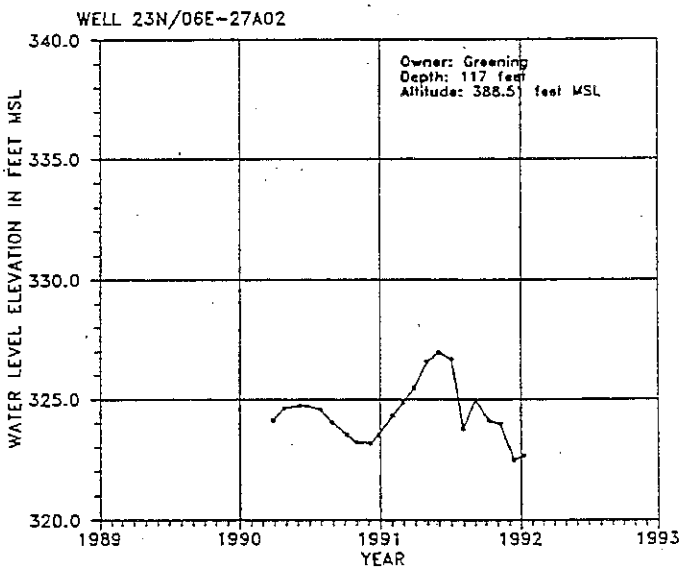
Fig. 7.12C Water Level Trend

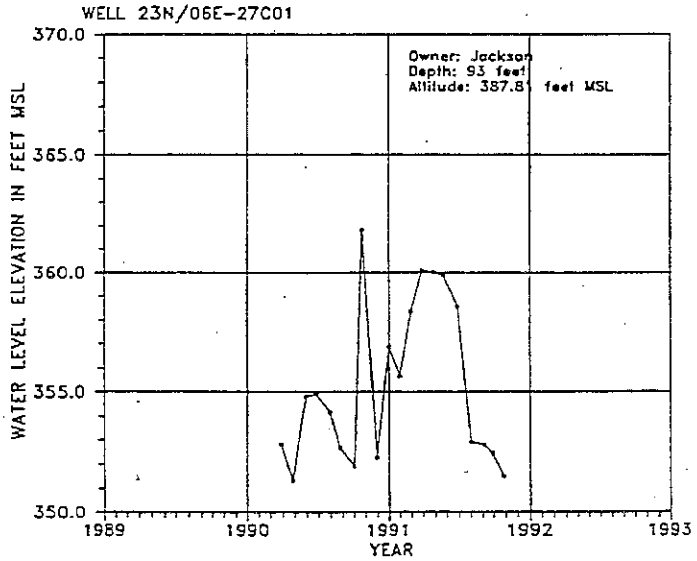
Issaquah Ground Water Management Program

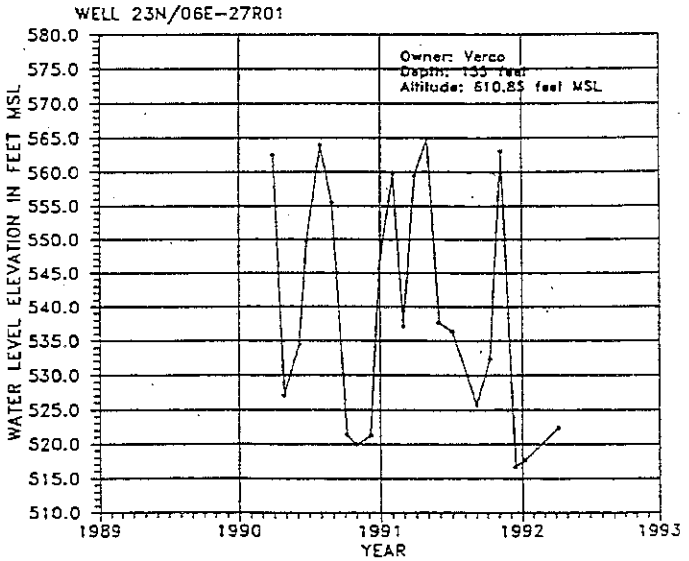








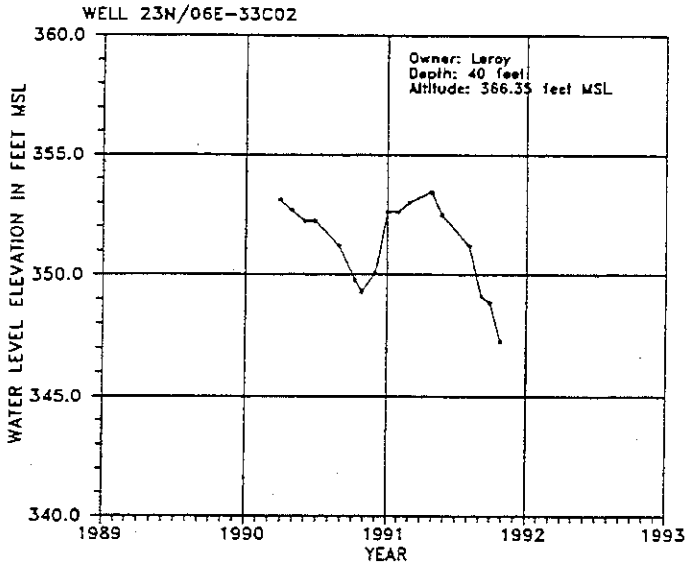


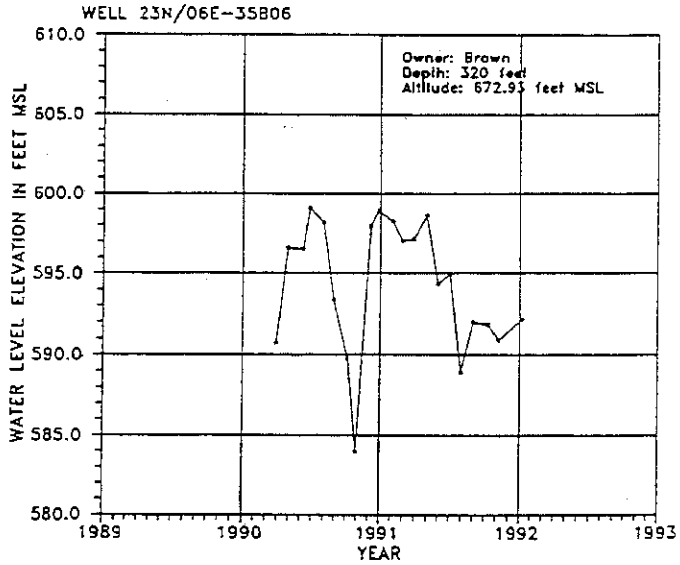


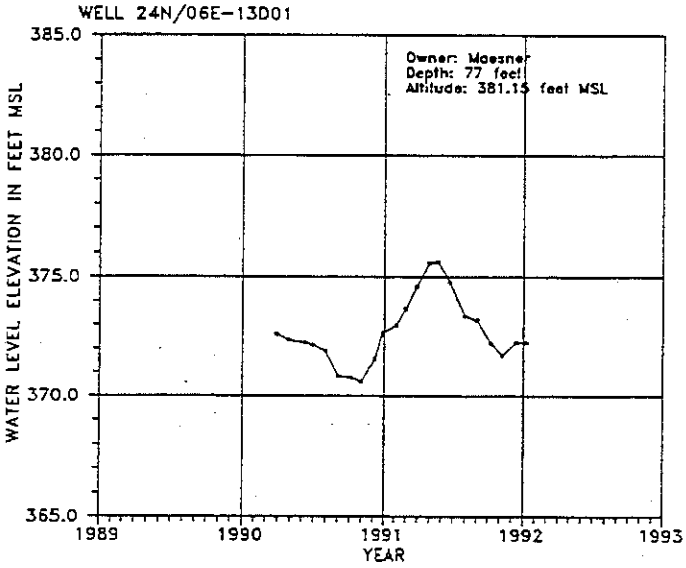
Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

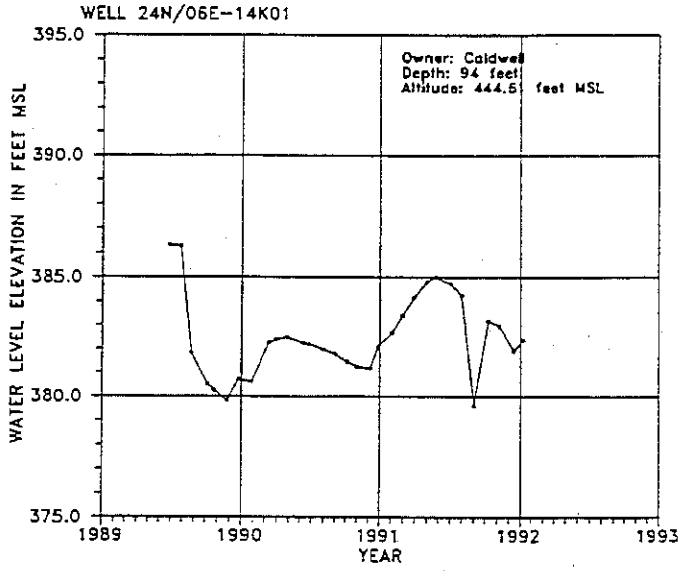
Fig. 7.12D Water Level Trend

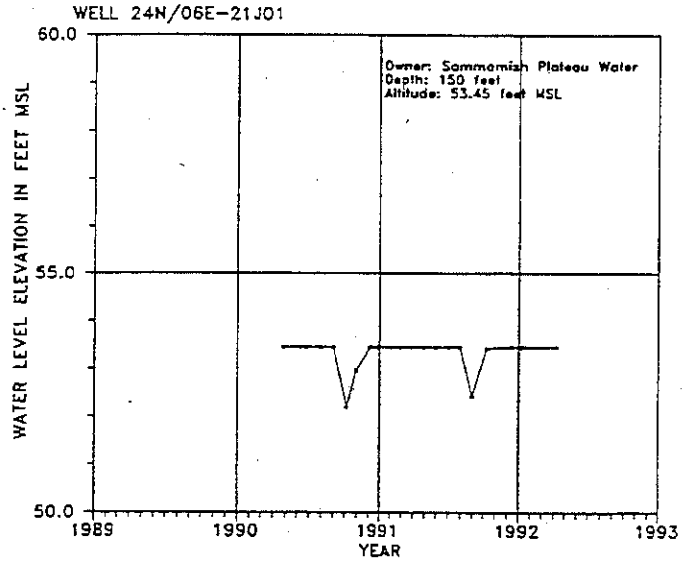
Issaquah Ground Water Management Program

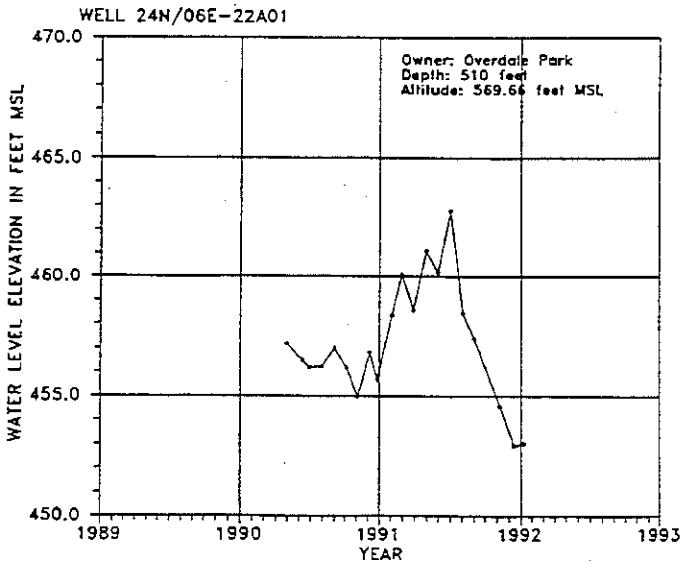








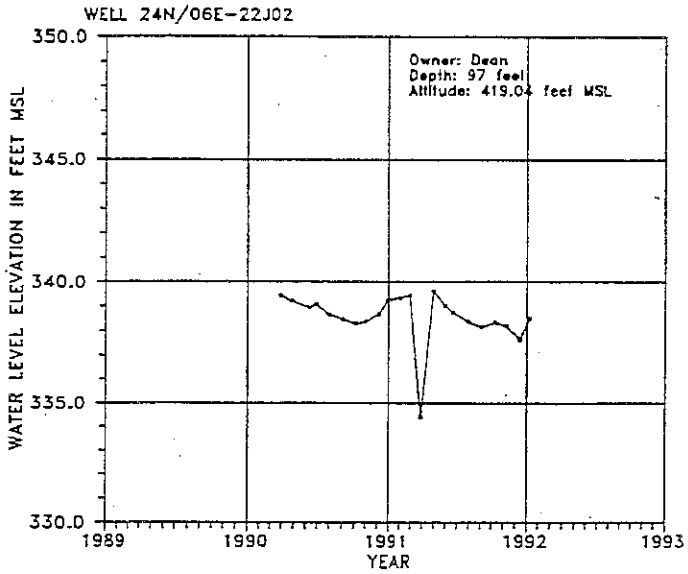


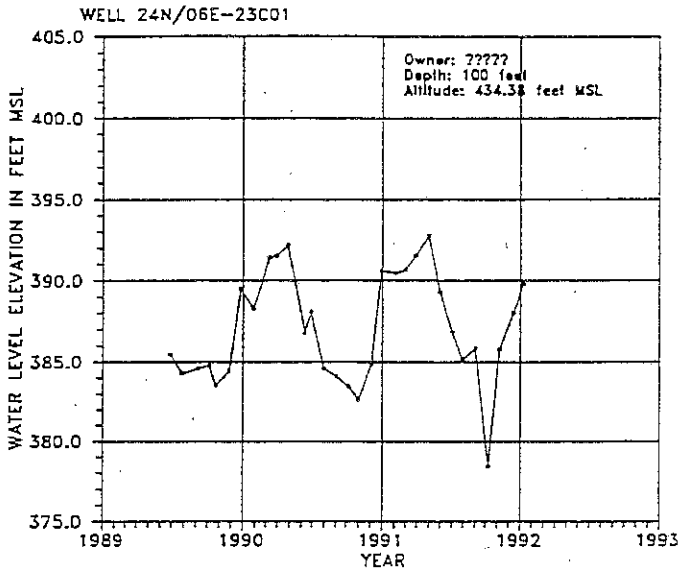


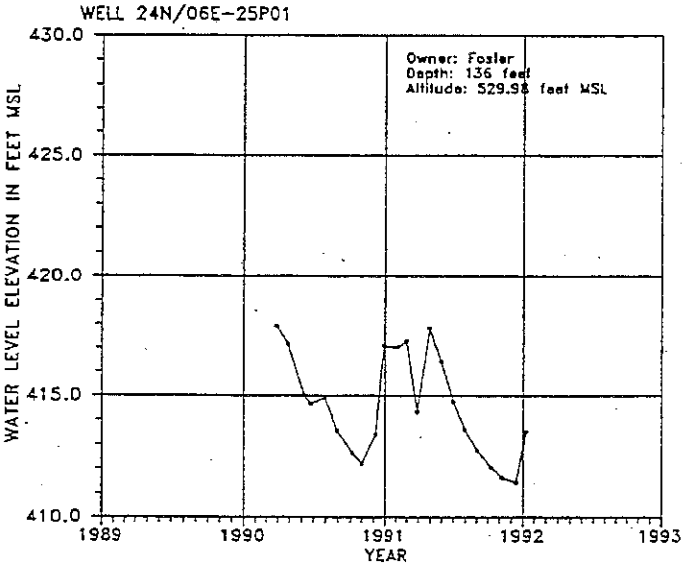
Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

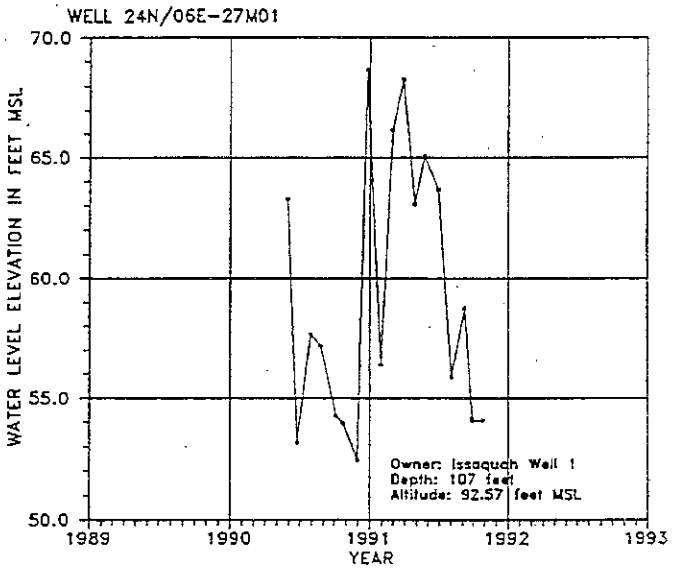
Fig. 7.12E Water Level Trend

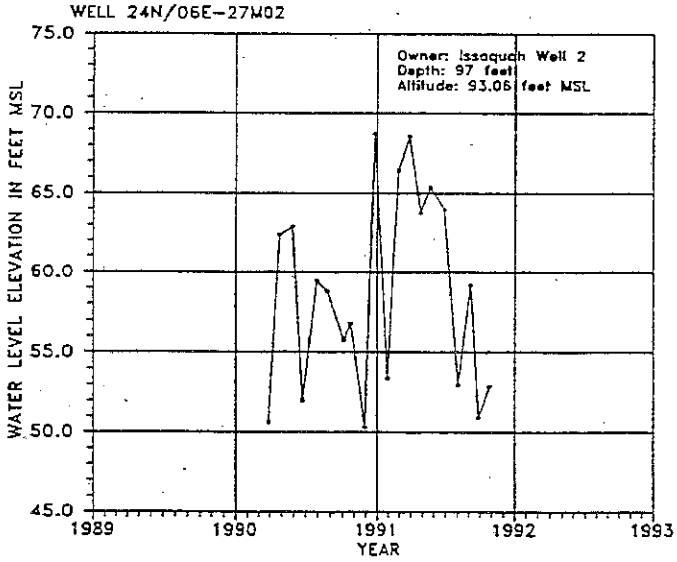
Issaquah Ground Water Management Program

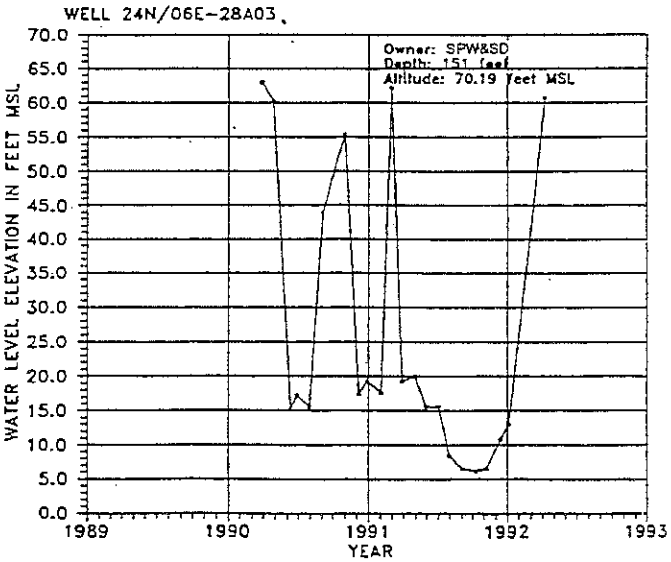








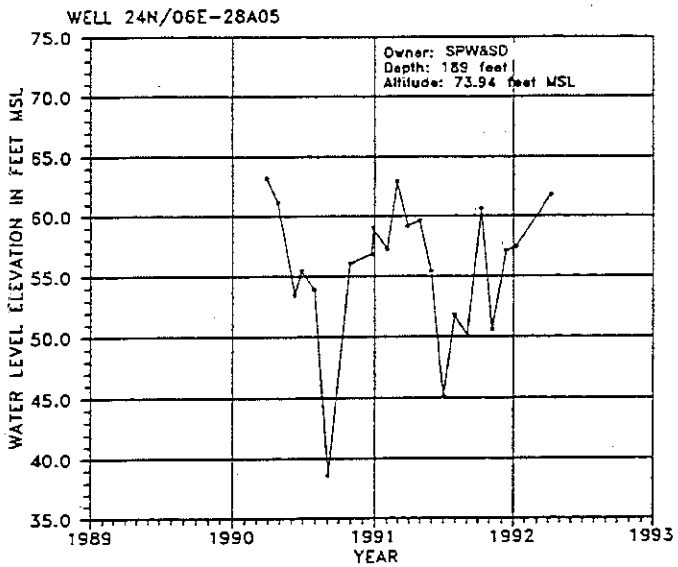


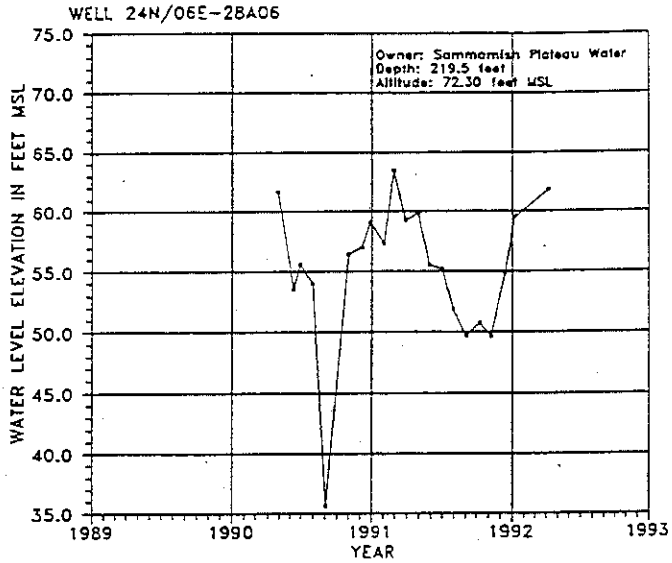


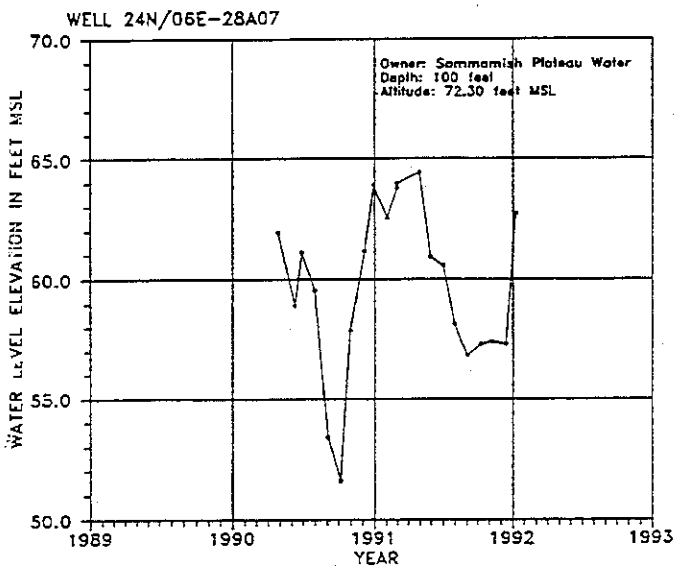
Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

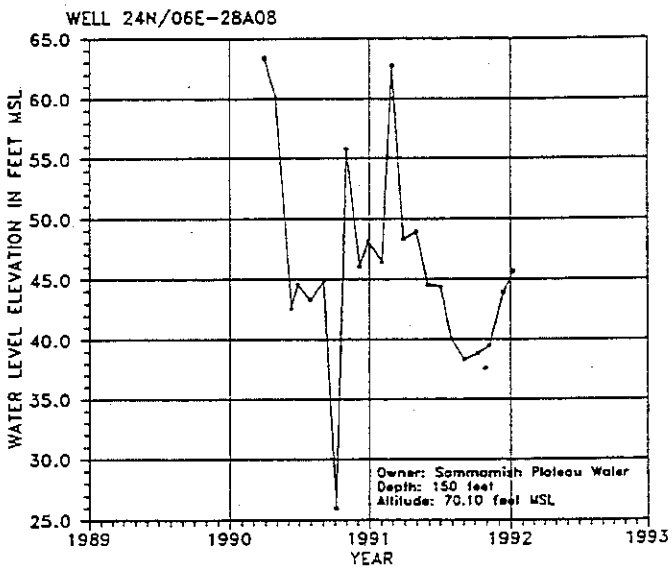
Fig. 7.12F Water Level Trend

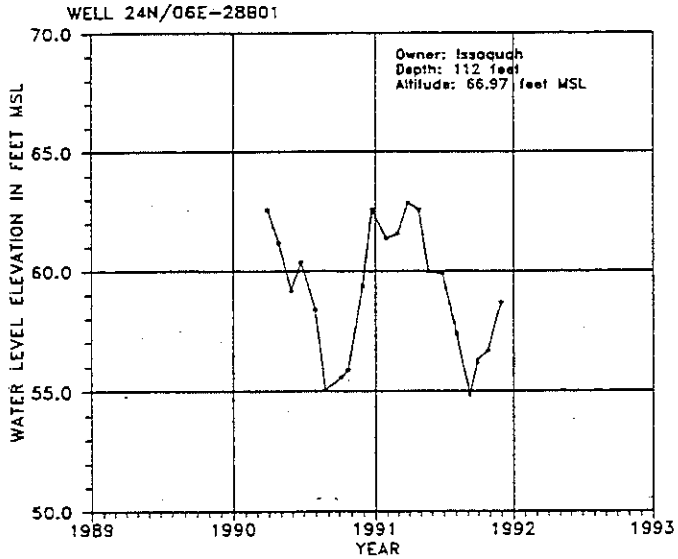
Issaquah Ground Water Management Program

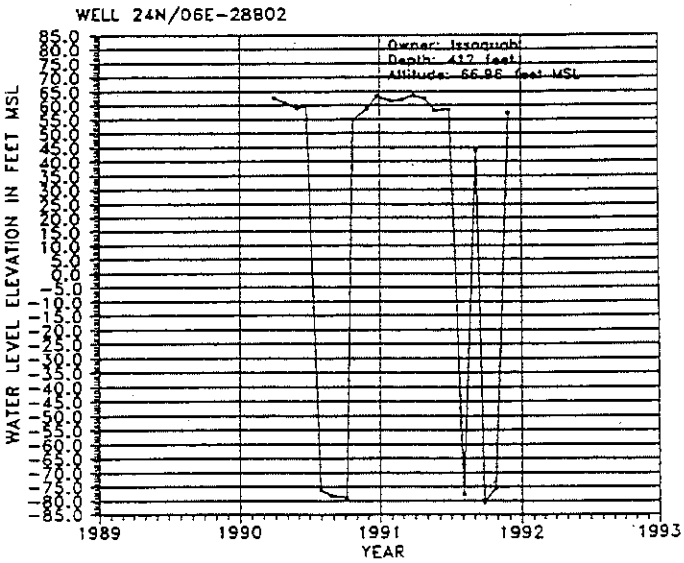








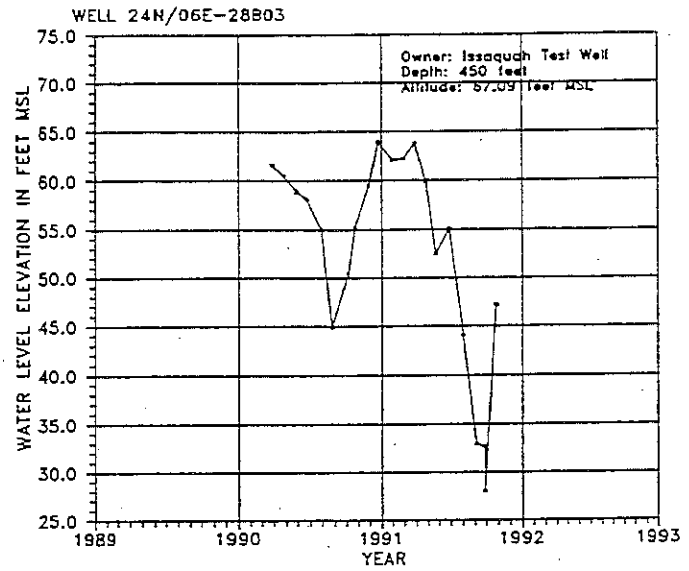


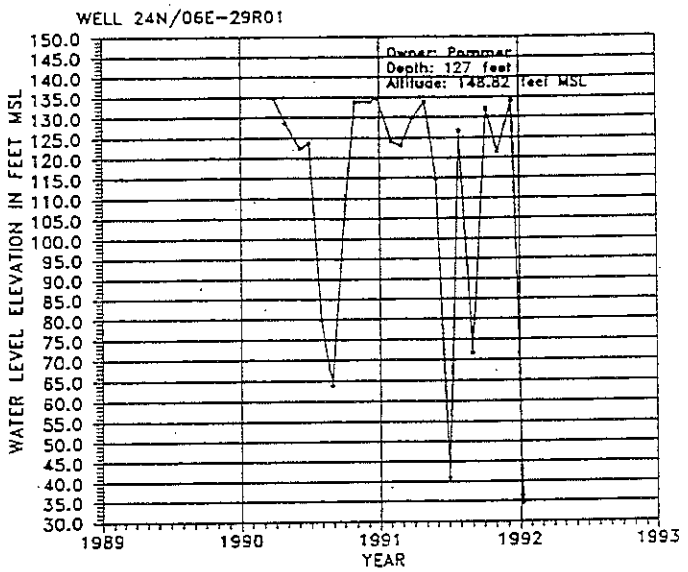


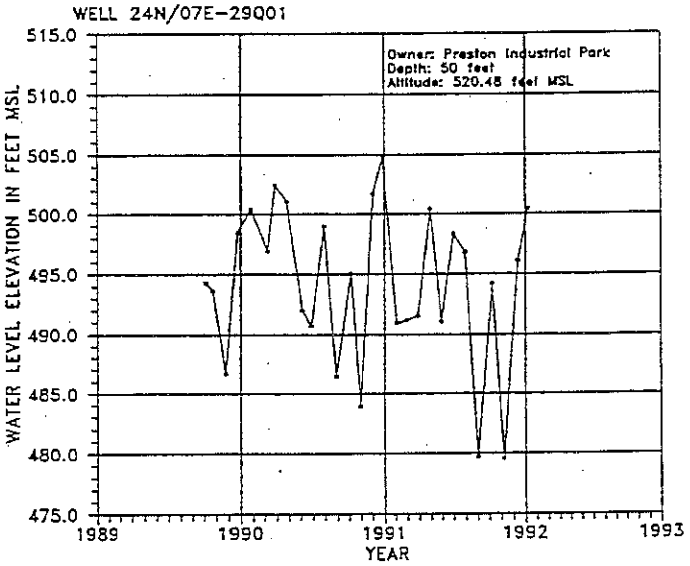
Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

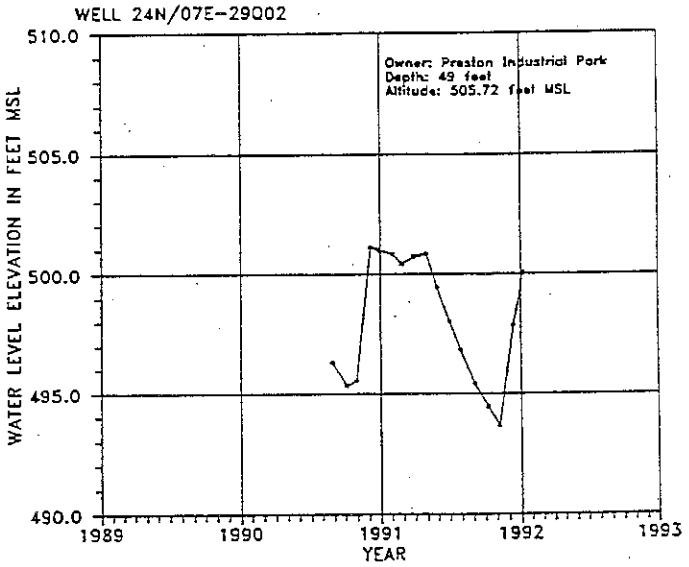
Fig. 7.12G Water Level Trend

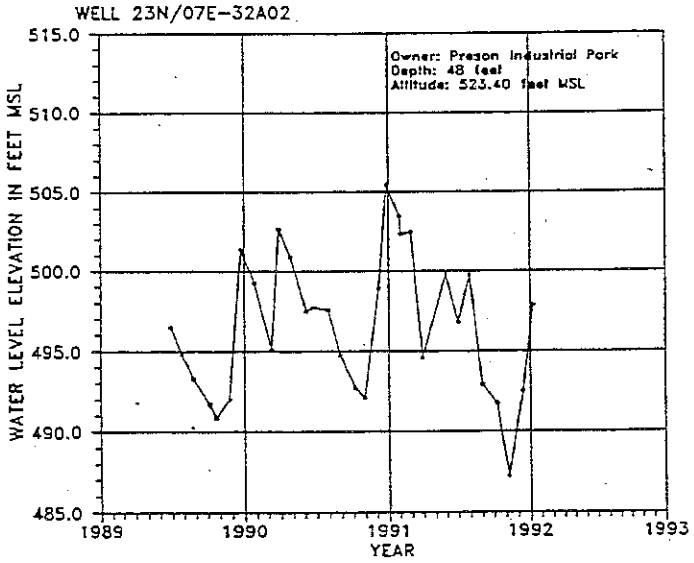
Issaquah Ground Water Management Program

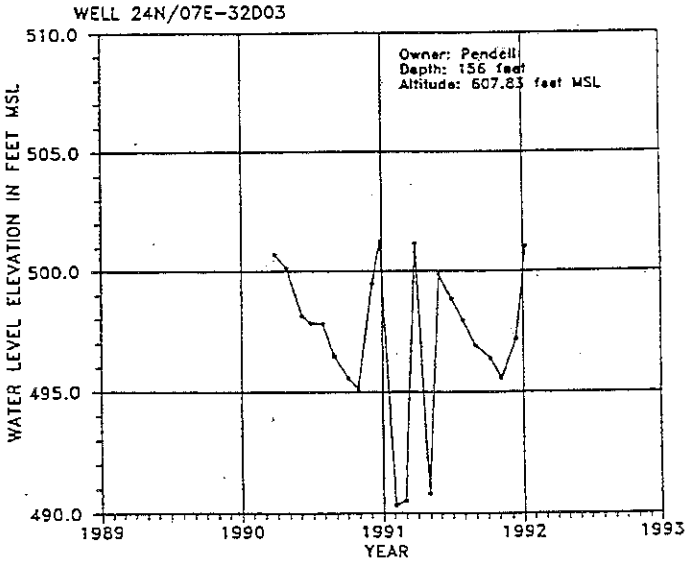












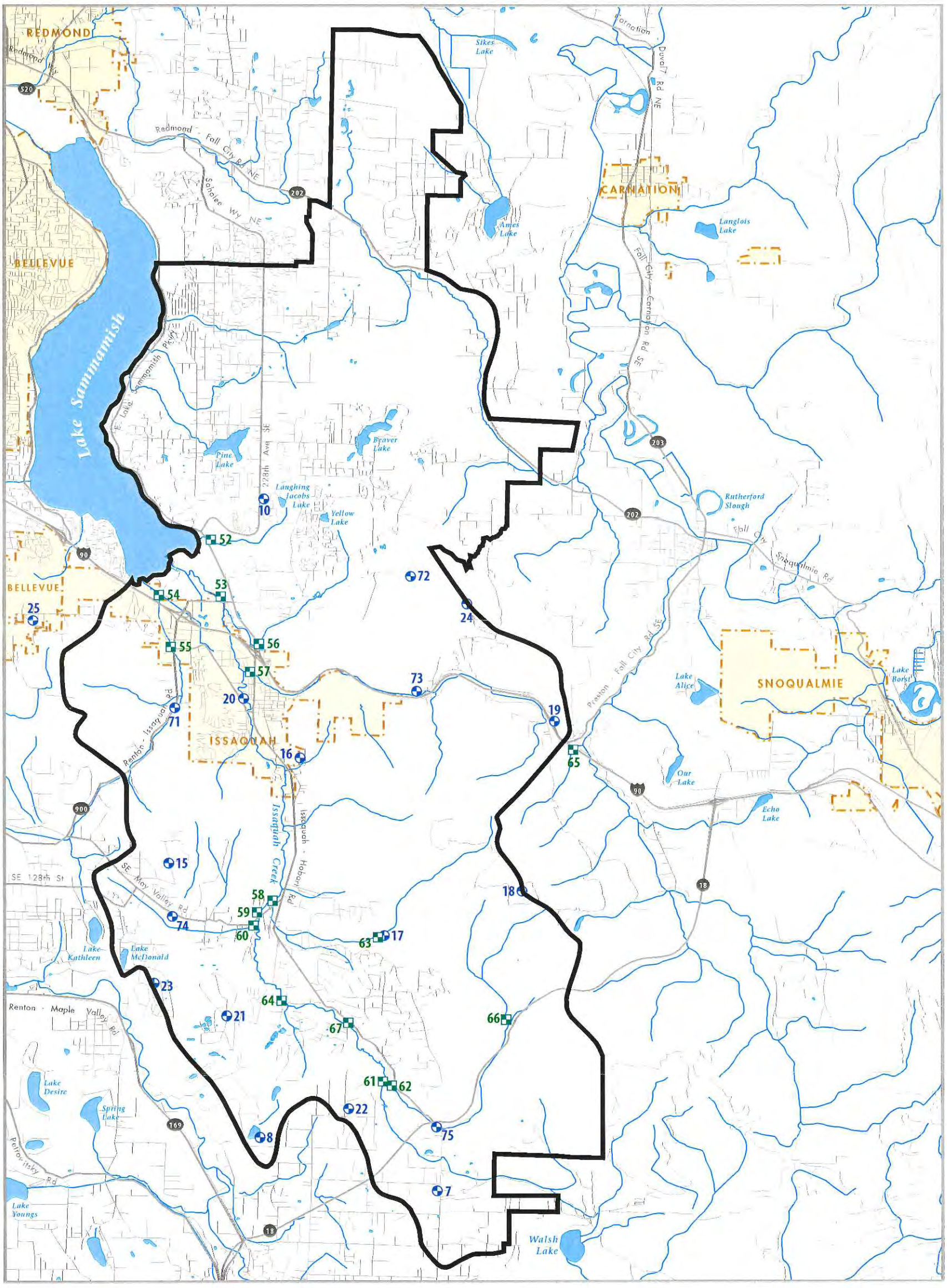
Source: Task 5: Hydrogeological Report - Carr/Association Sept. 1993

Fig. 7.12H Water Level Trend

Figure 7.13

Precipitation and Stream Gauging Sites

Issaquah Creek Valley Ground Water Management Area



21 Precipitation Gauge and Number

66 Stream Gauge and Number

Stream/Lake

Groundwater Management Area

Incorporated Area

N

0 1 2 Miles

March 1999

File name: 9903 IssGWprecipSTREAM713 wg

Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

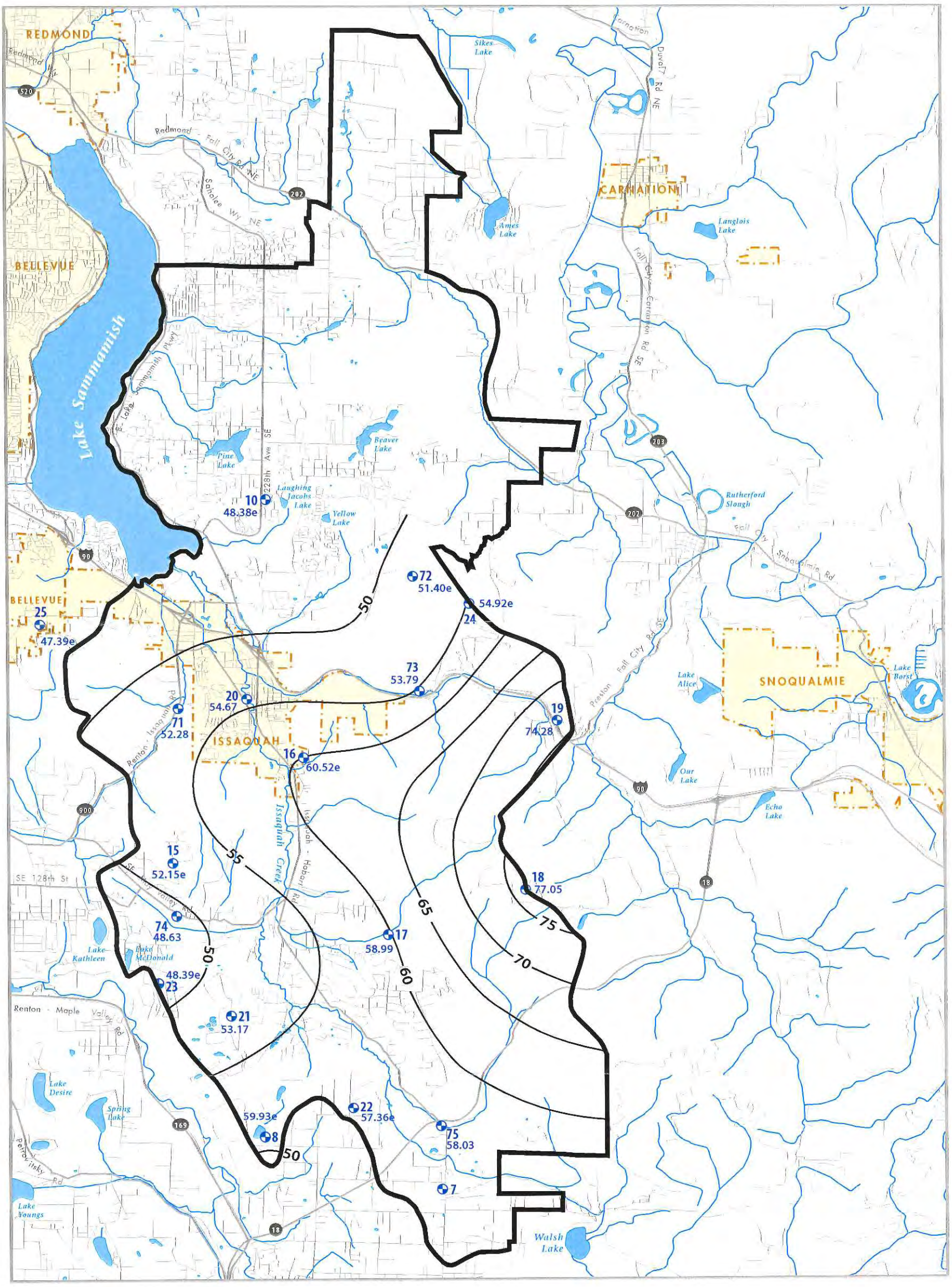
Source: 1996 Issaquah Creek Valley GWMP

King County
Department of Natural Resources

Figure 7.14

Precipitation Isohyetals 1988 Data Analysis

Issaquah Creek Valley Ground Water Management Area



50 Precipitation Isohyetals

75 Precipitation Gauge and Number

58.03 1988 Annual Precipitation in Inches ("e" indicates that value was estimated from 1990 data)

Stream/Lake

Groundwater Management Area

Incorporated Area

N

0 1 2 Miles

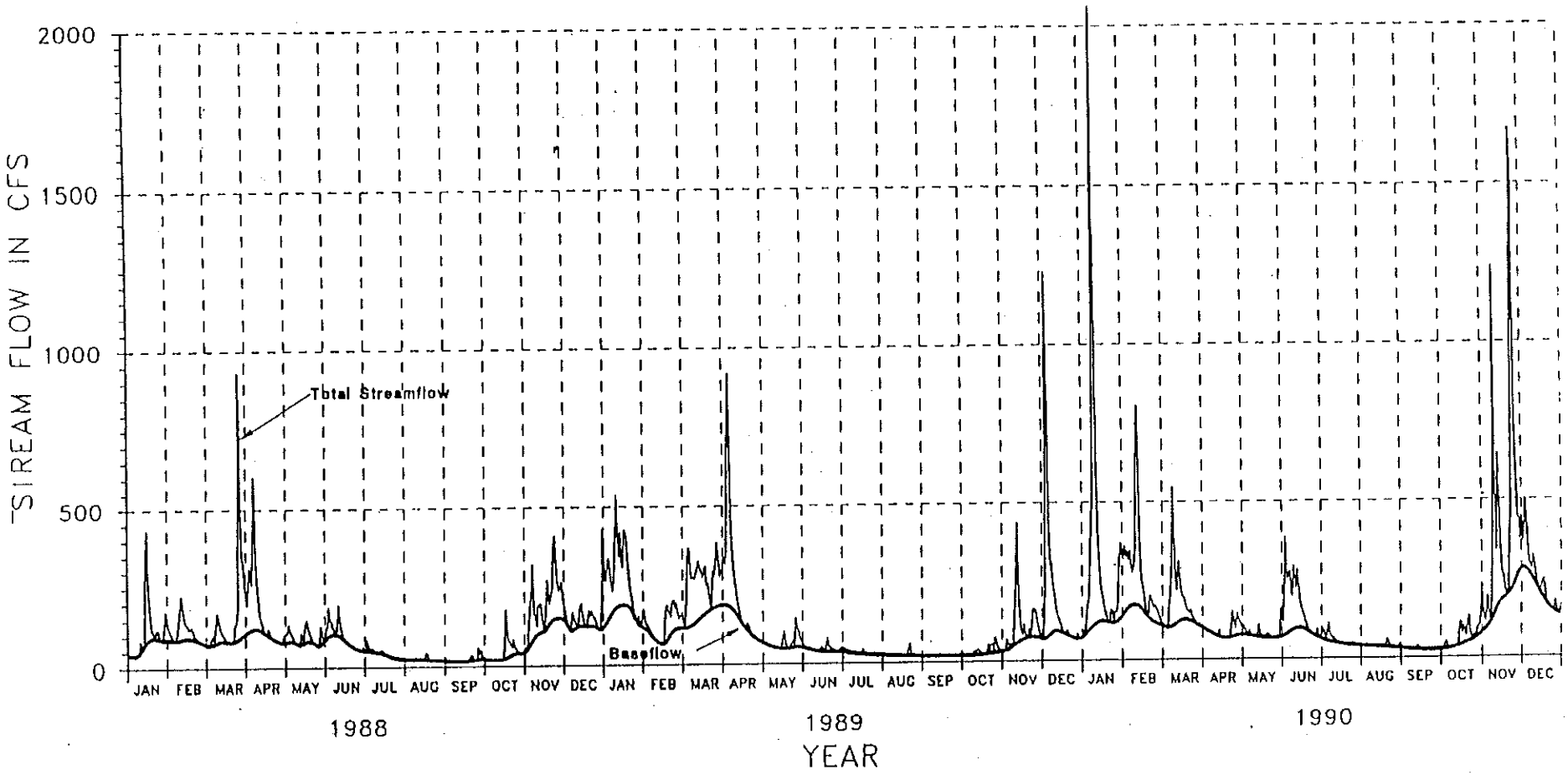
March 1999

File name: 9903 IssGWprecipISOHYETALS714 wg

Produced by: Visual Communication & GIS Unit
King County Department of Natural Resources

Source: 1996 Issaquah Creek Valley GWMP

King County
Department of Natural Resources



Source: Task 5: Hydrogeological Report - Carr/Associates. Sept. 1993

Fig. 7.15 Total Stream Flow and Baseflow Hydrographs USGS Stn. 121216