# PROJECT DESCRIPTION AND WORK PLAN
# FOR
# SNOQUALMIE AQUIFER PROJECT

## PERMIT APPLICATIONS G1-27384 AND S1-22877

**Submitted to:**

**State of Washington Department of Ecology**

**Submitted by:**

**East King County**
**Regional Water Association**


Prepared by:

Golder Associates Inc.,
Redmond, Washington
And
HDR Engineering, Inc.
Bellevue, WA



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# 1. INTRODUCTION

## 1.1 Purpose, Scope and Organization of Document

This document presents the conceptual project description for development of a regional groundwater supply from the Snoqualmie Aquifer system, located in the Upper Snoqualmie Basin. The primary purpose of this document is to provide a basis for the issuance of a preliminary permit on Applications G1-27384 and S1-22877. In addition, the EKCRWA intend to address other environmental aspects of the project, such as they would be addressed in an environmental impact statement (EIS), concurrently with the process of obtaining a determination on the water right permits. This document is intended to initiate this process by:

1. Providing background on regional water supply issues and technical aspects of the Snoqualmie Basin;
2. Outlining the principal project components and alternatives;
3. Defining substantive issues that need to be addressed; and
4. Outlining the study requirements for making a determination on the water right permit applications.

## 1.2 Regional Water Supply Issues

### 1.2.1 Regional Water Supply Systems

The majority of water supply in King County is provided by two large reservoirs located in the foothills of the Cascade Mountains. Both of these reservoirs are within the general geographical area of the Snoqualmie Basin. Figure 1-1 shows the regional supply system. The Chester Morse Reservoir conveys water southward along the Cedar River. The Tolt Reservoir conveys water eastward along the Tolt Pipeline. A new filtration plant is being constructed for the Tolt system, which will increase peak capacity of the Tolt to 120 MGD. In conjunction with the new filtration plant, a second Tolt Pipeline has been permitted that will parallel the existing pipeline into the Snoqualmie Valley, and then split, running along Novelty Hill toward Redmond, rather than toward Woodinville.

### 1.2.2 Regional Water Supply Demand Projections

The 1996 East King County Coordinated Water System Plan (EKC-CWSP) Update provides an updated water demand forecast for the East King County service area. The initial EKC-CWSP was prepared in 1989. The 1996 update specifically addressed revised water demand forecasts; boundaries between utilities; regional water supply options; conservation programs; minimum water system design standards; amendments to RCW 70.116, 70.119 and 70.119A; and the relationship between the 1990 Growth Management Act (GMA), the 1994 King County Comprehensive Plan, and the CWSP water demand forecasts. The CWSP Update was approved by the Water Utility Coordinating Committee (WUCC), consisting of 55 members, including representatives from Eastside water purveyors, King County, City of Seattle, Seattle/King County Health Department, and Washington State Department of Health.

The CWSP demand forecasts are based on demand and growth projections for 24 individual utilities and 31 other utilities grouped as a single demand entity (Table 1-1). The methodology used in preparing the demand forecast is consistent with methods for regional water system plans specified by WDOE and WDOH in their publication on conservation planning requirements (WDOE, 1994). The details of the methodology and results are available in the CWSP document (EKCRWA, 1996), and are summarized below.

The approach for demand forecasting is based on actual 1994 water sales (when available), projected population growth, conservation and price elasticity impacts, and 10% losses for unaccounted water. Population growth was determined based on Puget Sound Regional Council (PSRC) historical and forecast population growth by Forecast Area Zones, which were matched to individual utilities. Conservation and price impacts are included as: 1.) price response resulting from a 25% increase in rates over the forecast period (resulting in a 5% decrease in consumption); 2) plumbing code savings; and 3) other conservation programs.

Table 1-2 shows the projected demand for base case, low growth and high growth scenarios. The base forecast is substantially lower than the 1989 forecast because of a lower growth rate provided in the PSRC population forecast. The difference between projected growth rates is about 0.9 percent. This revised lower growth rate is attributed to slower economic growth and King County Comprehensive Planning which minimizes growth outside urban growth boundaries. Whether this lower rate of growth is consistent with recent economic and growth indications is not known.

Water utilities typically plan on a 50-year cycle for new supplies, thus new supplies are sized and evaluated for future demand projections. The projected demand for 2050 is between 80 and 129 MGD, with a base forecast of 107 MGD. At the higher population growth rates used in the 1989 CWSP, demand in 2040 was 168 MGD.

Present capacity is on the order of 78 MGD. Although upgrades to the Tolt Filtration Plant will increase the capacity of the regional supply system, additional water supply capacity is needed to meet forecast demands.

### 1.2.3 Regional Water Supply Alternatives

The Snoqualmie Aquifer is one 16 supply options evaluated in the 1996 East King County CWSP. These supply options were also evaluated in the Phase 1 Feasibility Study for the Snoqualmie Aquifer prepared for the EKCRWA (CH2M Hill, 1993). The Snoqualmie Aquifer, Seattle-Tacoma Intertie, and Tolt Filtration Plant were selected by the WUCC as the future sources for the region. These sources are intended to be integrated, and the development of one option does not preclude the need for the others.

Table 1-3 shows the CWSP demand forecasts and possible supply scenarios. With the addition of the Tolt Filtration Plant (9 MGD) and Seattle/Tacoma Intertie (15 MGD), a capacity of about 102 MGD could be in place 2010. This assumes that all of the increased capacity from these projects is used to supply growth in the service areas evaluated in the CWSP. This supply is still insufficient to meet the base forecast of 107 MGD for 2050, and is well below the high growth forecast of 130 MGD. With development of the Snoqualmie Aquifer, capacity of 142 MGD could be achieved, and phased to meet increasing demand.

Other water supply planning efforts in King County have revolved around the ongoing permitting for the Seattle-Tacoma Intertie, or Pipeline 5. A programmatic EIS is being conducted for the intertie project that is evaluating other water supply alternatives, including the Snoqualmie Aquifer, that could feasibly be constructed to meet near term demand projections.

## 1.3 Snoqualmie Aquifer Project Background

This section describes the work that has been completed on the Snoqualmie Aquifer project.

### 1.3.1 East King County Regional Water Association

The East King County Regional Water Association (EKCRWA) is a public agency responsible for administering the East King County Critical Water Supply Service Area under the Public Water System Coordination Act (WAC 70.116). One of the EKCRWA's key functions is to prepare and update the East King County Coordinated Water System Plan (ECK-CWSP), which includes the identification of present and future water needs.

### 1.3.2 Project Location

The project is located in the Snoqualmie Basin, east of the Seattle/Bellevue/Redmond metropolitan area. The Snoqualmie Aquifer is located in the Upper Snoqualmie Basin, above Snoqualmie Falls. This aquifer has been referenced previously by others as the "North Bend" Aquifer.

The upper Snoqualmie basin encompasses 375 square miles of the 1,275 square mile Snohomish Basin. The basin consists of three sub-basins corresponding to the North Fork, Middle Fork and South Fork of the Snoqualmie River, which converge on the main stem of the Snoqualmie above Snoqualmie Falls in the vicinity of North Bend.

### 1.3.3 Project History

A chronological history of the project is provided below.

- The project was initially conceived in 1991, partially as a result of the drought the previous year and resulting moratoriums on water use. Previous geologic theories provided a basis for concluding that a large groundwater supply might be developed in the upper Snoqualmie Basin.
- A feasibility study (CH2M Hill, 1993) was conducted in 1992 to evaluate possible groundwater supply and transmission options for the Upper Snoqualmie Basin. It was concluded that there was potential for a regional supply in the Upper Snoqualmie basin. The project was conceived as a conventional wellfield and pipeline, delivering groundwater from the Upper Snoqualmie Basin to the regional supply system.
- An exploration program (Golder Associates, 1994) was undertaken to further evaluate the hydrogeology in three portions of the watershed: Area 1 (Snoqualmie Confluence), Area

2 (Middle Fork Snoqualmie) and Area 3 (North Fork Snoqualmie). This study identified a favorable test well location in Area 2 and recommended that additional work focus on this sub-basin.

- A joint water right application (G1-27384) was filed with the Washington Department of Ecology (WDOE) by the East King County Regional Water Association (EKCRWA) and Seattle Water Department (now Seattle Public Utilities) on January 19, 1994 to withdraw 60 million gallons per day (MGD) from the Upper Snoqualmie basin. This is equivalent to 92 cubic feet per second (cfs), or 67,200 acre-feet per year (AF/y).
- A test well was installed and tested in Area 2 (Golder Associates, 1995) which encountered a highly transmissive and productive deep aquifer with excellent water quality.
- A monitoring program (Golder Associates, 1996) was then initiated which included the installation of two additional monitoring wells, a precipitation gage, several automated data loggers to measure water levels, and a monthly program of water-level measurement in area wells. The monitoring program has continued uninterrupted since 1995.
- A groundwater model was developed (Golder Associates, unpublished) to estimate the yield from the aquifer and to simulate complex stream/aquifer interaction in the basin.
- An engineering study was conducted (HDR, 1996) to re-evaluate pipeline transmission alignments and costs.
- A meeting was held with Ecology in January, 1997 to outline the process for obtaining a preliminary permit for the project. It was agreed that a "preliminary permit," as defined in RCW 90.03.290, was the appropriate process for defining the basis, or "road map" for future studies and determinations on the project.
- In October, 1997 EKCRWA hosted a series of open informational meetings at Ecology Regional Headquarters to discuss project elements and solicit comments from interested parties.
- In December, 1997 a new project alternative was developed that incorporated the conjunctive use of surface water and groundwater.

### 1.3.4 Technical Studies

A substantial volume of data on the Upper Snoqualmie Basin is available. Appendix A contains a bibliography of relevant references for the project.

### 1.3.5 Public Participation

The EKCRWA has made a concerted effort to publicly describe the project and solicit comments from concerned parties. This has occurred through briefings to organizations, such as water utilities, chambers of commerce, and other interest groups, as well as through public meetings and technical presentations in water-related forums. The EKCRWA is committed to maintaining an open process for assessment of the permit.

# 2. SNOQUALMIE BASIN WATER RESOURCES

## 2.1 Climate

There are several precipitation gages in the area including: Cedar Lake (1932-present), South Fork Tolt (1962-present), Grouse Ridge (1994-present), and Snoqualmie Falls (1899-present). Cedar Lake is actually in the Cedar-Sammamish Basin, but its proximity to the Upper Snoqualmie Basin makes it useful for gaging precipitation in the higher elevations. Mean annual precipitation in the upper reaches of the basin is on the order of 102 inches per year. At Snoqualmie Falls, mean annual precipitation is on the order of 70 inches per year. The hydrology of upper basin is also influenced by snowpack on the western side of the Cascade Mountains.

The principal long-term precipitation gage in the downstream portion of the basin in at Monroe (1948-present). Precipitation data is also collected on a volunteer basis for King County throughout the developed portion of the basin.

## 2.2 Hydrology/Streamflow

Streamflow in the Upper Snoqualmie is gauged at a number of locations, and a good historical record is available for Snoqualmie Falls dating to the late 1800's. Minimum instream flow requirements are set for the following gages on or tributary to the Snoqualmie River, including gages downstream of Snoqualmie Falls:

| Gage Number | Station Description |
|---|---|
| 12.1430.00 | North Fork Snoqualmie River at Snoqualmie |
| 12.1445.00 | Snoqualmie River at Snoqualmie Falls |
| 12.1490.00 | Snoqualmie River at Carnation |
| 12. | Snoqualmie River (mouth) at Monroe |
| 12.1485.00 | Tolt River |

Flow data are presented in this document using two simple aggregating methods:

1. Daily Flow: Daily flow describes the average flow for a given day. This is the flow that is typically published in the USGS streamflow record. This value is averaged over an entire month to determine mean monthly flow, which is equivalent to the mean daily flow for the month. Maximum, minimum and standard deviation are also calculated using daily flow data.
2. 7-Day Flow: 7-day flow describes the average daily flow over a 7-day period. Of particular interest is the 7-day low-flow. This value is used in total maximum daily load (TMDL) studies of water quality, and is also considered a good indicator for fisheries. This value is the lowest 7-day flow for a given month. Mean, minimum and median 7-day low flows describe the 7-day low flows over the period of record.

Streamflows measured on the Snoqualmie River are highly variable, commonly at low levels during the summer, and often below minimum instream flows set by WAC 173-507-020. These low flows have occurred throughout the period of record and do not appear to be a reflection of recent development in the basin. Low flows experienced on the Snoqualmie are a naturally occurring aspect of the streamflow regime. Tables 2-1, 2-2, and 2-3 summarize the streamflow statistics for the Snoqualmie Basin:

> Table 2-1 summarizes the streamflow statistics for the Snoqualmie River at Snoqualmie Falls. The mean daily and mean 7-day flows are similar. The mean 7-day low-flow is below instream flow requirements for seven of the months over the historic record. The minimum 7-day low flow is below instream flow requirement for all months except May. The standard deviation of daily flows on a monthly basis is high, indicating a high variability. The average change in flow over a one day period is greater than 250 cfs when flows are declining, and greater than 88 cfs when flows are increasing. Clearly the flow regime at Snoqualmie Falls is highly variable.

> Table 2-2 summarizes the streamflow statistics for the Snoqualmie River at Carnation. The mean daily and mean 7-day flows are similar. The mean 7-day low-flow is below instream flow requirements for nine of the months over the historic record. The minimum 7-day low flow is well below instream flow requirement for all months except May. The standard deviation of daily flows on a monthly basis is high, indicating a high variability. The average change in flow over a one day period is greater than 270 cfs when flows are declining, and greater than 95 cfs when flows are increasing. The flow regime at Carnation is also highly variable.

> Table 2-3 summarizes the length of periods below instream flow requirements at Snoqualmie Falls, Carnation, and Monroe. The data are summarized in terms of total days below instream flow requirements, and in terms of occurrences below instream flow requirements. An occurrence is any period of one or more days where instream flow requirements are not met. Using this information, the typical length (in days) of existing instream flow violation can be calculated.

## 2.3 Hydrogeology/Groundwater

The geology of the Upper Snoqualmie Basin is complex and unique in terms of the scale and extent of glacially derived sediments in the area. It is these sediments that host the aquifers in the basin. The understanding of the geologic framework in which these glacial sediments have been deposited has changed little since it was first investigated by J. Hoover Mackin in 1932. The unique aspect of the glacial history of the Upper Snoqualmie area is that it is located at the historical margins of both continental glaciers that entered the Puget Sound from Canada, and alpine glaciers that descended from the Cascade mountains. The confluence of these two glacial environments provided for large accumulations of sediment. The sheer volume of saturated sediments in the Snoqualmie Basin, in conjunction with high precipitation (both rain and snow) is the most basic indication that a large groundwater development is plausible. More detailed studies by the EKCRWA and others have confirmed that large accumulations of sediments are present in the Basin, and that they are capable of supplying large quantities of groundwater.

Conceptually, the Snoqualmie Aquifer System can be described as a series of interconnected aquifers, with recharge and groundwater inflows along its margins, and surface water discharge and deeper groundwater outflows in the Snoqualmie Falls area. Figure 2-1 conceptually summarizes the hydrogeology of the Basin. The following is a summary of hydrogeologic conditions:

***Shallow unconfined aquifers***

- Valley Aquifer: An unconfined aquifer of variable thickness (possibly up to 400 feet) exists throughout the main trunk of the Upper Snoqualmie valley from Snoqualmie Falls upstream along the Middle and South Forks of the Snoqualmie River. This aquifer is primarily used for local potable supply.
- Upland Aquifers: Other shallow aquifers exist on uplands that commonly flank the valley floor. These uplands include the North Fork/Tokul Delta, Lake Alice Plateau, Middle and South Fork Embankments, and the Cedar Moraine. The large embankment features are up to 400 feet thick and are hydraulically linked to the valley aquifer.

***Deep confined to semi-confined aquifer***

- Valley Aquifer: A confined to semi-confined aquifer exists at depths of up to 600 feet throughout the main trunk of the Upper Snoqualmie valley from Snoqualmie Falls upstream along the Middle and South Forks of the Snoqualmie River. This aquifer is tapped by wells drilled by the City of Snoqualmie and proposed Snoqualmie Ridge development, and may also be tapped by several wells in the vicinity of Tanner. This is the aquifer encountered in the EKCRWA test well in 1993. The aquifer is well defined in the Middle Fork/Tanner area and is overlain by a glacial till. It is also well defined between the City of Snoqualmie and Snoqualmie Falls, and is overlain by lacustrine materials and possibly till. The aquifer is not well defined in the vicinity of North Bend. Although a highly productive well was recently installed by the City of North Bend, the well was not drilled to bedrock and there remains some uncertainty with regards to the continuity of the deep aquifer to the up-valley and down-valley aquifers intersected by other wells. Transmissivity of the confined/semi-confined aquifer ranges from 5,000 to 46,000 $ft^2/d$, generally decreasing in permeability in a downstream direction.
- Bedrock Aquifer: At least 43 wells in the upper basin obtain groundwater from bedrock, which is reported as sandstone, shale and basalt. Based on data presented by the USGS, these wells have static water levels that are fairly shallow relative to their depth, and have wide-ranging transmissivities, many in the range of 500 to 5000 $ft^2/d$. The bedrock, is therefore relatively productive in comparison to some bedrock aquifers.

***Recharge or inflow areas***

- Upland Recharge: Precipitation infiltrates through the glacial embankment moraines along the edges of the valley is transmitted downward to the shallow and deep valley aquifers. Water-level monitoring on the Middle Fork Embankment indicates 5 to 7 feet of seasonal water-level fluctuation caused by storage of winter precipitation in the embankment sediments. Total upland recharge is estimated at 30 cfs annually. Similar fluctuations may occur on the South Fork and Cedar Embankments. The Cedar Embankment is also affected by Chester Morse Reservoir. It is estimated that up to 20 cfs of leakage from Chester Morse Reservoir enters the Snoqualmie Basin through the moraine in the area of Boxley Creek. The North Fork Snoqualmie/Tokul Delta also provides some inflow to the valley aquifers.

- Valley Recharge: Precipitation falling on the valley floor also infiltrates to the shallow aquifers. It is estimated that shallow groundwater recharge in the valley is on the order of 60 cfs, based on observed water-level fluctuations in wells over an approximate area of 18-square miles for the valley floor.

***Discharge or outflow areas***

- Snoqualmie Confluence: Groundwater discharges to the Snoqualmie River along at the confluence of the Middle, North and South Forks. Estimates of the magnitude of groundwater discharge are in the range of 50 to 75 cfs, based on an analysis of streamflow between 1961 and 1971 (when gages on all forks of the Snoqualmie were active).
- Lake Alice Plateau/Tokul Creek: Groundwater leaves the upper Snoqualmie Basin as downvalley flow that by-passes Snoqualmie Falls. Two deep channels are present on either side of Snoqualmie Falls, one beneath the Lake Alice Plateau and one beneath the Tokul Delta. It is estimated that outflow ranges between 10 and 20 cfs annually.

## 2.4 Groundwater/Surface Water Interaction

The interaction of groundwater and surface water is a key watershed issue in the basin. It is also technically complex, and, in many cases, a specialized groundwater flow model is necessary to properly assess impacts to streamflows and the viability of mitigation. The EKCRWA have developed a preliminary groundwater flow model to evaluate impacts from development of a groundwater source in the Upper Snoqualmie Basin. The model is capable of simulating transient (e.g., seasonal or time-varying) aspects of recharge and groundwater withdrawal, and is fully coupled to the stream network in the valley so that impacts to streamflow can be determined. Technical uncertainties are still present in the model because of insufficient hydrogeologic information in some areas of the basin. The model has been used as part of the overall hydrogeologic characterization of the basin, with a particular emphasis on the effects of pumping on surface water and regional drawdowns in the aquifer system. Figures 2-2 and 2-3 show the present configuration, boundary conditions, and hydraulic properties of the groundwater flow model.

Based on the proposed groundwater withdrawal quantities, pumping may result in a reduction in natural baseflow discharge to the Snoqualmie River, but not an increased infiltration of surface water to groundwater. This is based on the present understanding of the hydrogeologic system, observed streamflow relationships, and preliminary groundwater model results. The groundwater model also indicates a time-lag between the onset of groundwater pumping and the predicted reduction in baseflow discharge. The analyses of baseflow reduction are expressed as a percent of wellfield yield. After 30 days of pumping, 30% of the yield of a well or wellfield is reflected in a decrease in baseflow discharge. After 180 days of pumping, 70% of the yield is reflected as decreased baseflow discharge. Figure 2-4 summarizes the predicted relationship between pumping and streamflow impacts. This relationship is sensitive to the hydraulic properties of the shallow and deep aquifer properties, as well as stream bed properties. Additional refinements to this relationship developed through the groundwater model may be warranted if additional data are collected.

# 3. SNOQUALMIE BASIN WATER SUPPLY ALTERNATIVES

Two broadly defined alternatives to developing a water supply from the Snoqualmie Basin have been identified. One alternative is “conventional,” and involves the withdrawal of groundwater from a wellfield and transmission of that water via a pipeline to the regional supply system (Tolt or Eastside reservoir). This alternative is discussed in Section 3.1, and includes three possible pipeline alignments. The second alternative is a conjunctive-use concept that involves the use of both surface water and groundwater. This alternative is discussed in Section 3.2. For the purpose of the preliminary permit, no specific alternative has been selected. During the course of developing the information needed for Ecology to make a decision on the permit applications, one specific alternative will be selected.

## 3.1 Conventional Wellfield/Pipeline Alternatives

### 3.1.1 Project Description

The project would consist of a two wellfields in the upper Snoqualmie Basin and a pipeline to transmit groundwater to the regional water supply system. The siting of wells and transmission routes has been evaluated in an engineering study prepared for the EKCRWA in 1996 (HDR, 1996). This study refined an initial engineering assessment conducted in 1993 (CH2M Hill, 1993). The most recent study evaluated two wells fields and three possible pipeline routes, and it examined associated construction and operation costs. Figure 3-1 show the conceptual wellfield layouts and Figure 3-2 shows the three pipeline routes under consideration.

### 3.1.2 Project Operation

The project would operate on a demand basis. The exact operational strategy has not been determined, but there would likely be higher demands during the summer months. It is also likely that the operational aspects of this alternative would include mitigation systems designed to offset and/or enhance streamflows and habitat that might be affected by operation of the wellfield. One key element of any work plan developed for this alternative would be a detailed, integrated operational supply model of the Tolt, Snoqualmie and Cedar systems.

### 3.1.3 Potential Impacts

The potential impacts from the project as configured for these three alternatives are summarized below.

### 3.1.4 Mitigation

It is likely that mitigation of impacts to streamflow will be required to develop the groundwater source to full potential for these three alternatives. Potential mitigation measures have been evaluated in a preliminary fashion. It should be noted that they assume that mitigation is required only during summer low flow periods, when instream flow targets are not met. Further, they assume that the maximum rate of mitigation required is limited to the maximum rate of groundwater withdrawal. These concepts are not intended to restore natural streamflows to the instream flow requirement, but to replace some or all "lost" streamflow during periods of critical flow, and, to offer the opportunity for enhancement of the natural streamflow regime to some degree.

### 3.1.5 Preliminary Assessment

The preliminary assessment of the "conventional" wellfield and pipeline alternative is that complete permitting and development of the project may be complex and difficult, given present environmental concerns in the basin. For the purpose of the preliminary permit, this alternative is included as an element of the project description, but the second project alternative (discussed below in Section 3.2) will likely be selected as the "preferred" project alternative for final consideration and determination on the water right permit applications.

## 3.2 Conjunctive Use and River Enhancement Alternative

### 3.2.1 Project Description

The project would consist of a two wellfields in the upper Snoqualmie, a surface water intake in the lower Snoqualmie River below Carnation, a water treatment plant located in the Novelty Hill area, and two short pipelines to connect the intake to the treatment plant, and to connect the treatment plant to the regional supply system. The main element of this design is the conjunctive use of surface water from the Snoqualmie River and groundwater from the Snoqualmie Aquifer. A conceptual description of the operation of the system is provided below. Figure 3-3 shows the conceptual wellfield layouts and Figure 3-4 shows the river intake and filtration plant locations. This alternative is still in a conceptual design stage, and, unlike the alternatives discussed in Section 3.1, no detailed engineering studies have been completed.

**Wellfield:** The wellfield would be designed for a capacity of up to 60 cfs, similar to the wellfield design for a conventional supply. However, the wells would only be operated during the summer months, and the water pumped from the wells would be put directly back into the Snoqualmie River above Snoqualmie Falls. Pumping groundwater directly into the river will increase river flows and improve water quality. The amount that river flows are increased at any point in time is determined by the amount of storage that is withdrawn from the aquifer. This relationship can be simulated by the groundwater model.

**Dispersion Structures**: The wellfield discharge would be put back into the Snoqualmie River via dispersion structures that would allow the discharge to upwell into the river, rather than a surface discharge. The location and design of these structures has not been determined, but they could be integrated with adjacent wetlands or placed directly in the Middle, South, or Main Stem of the Snoqualmie River above the falls. Water entering the dispersion structures would be aerated to increase dissolved oxygen (DO) levels. Temperature, DO, quality, and flow rate would be monitored prior to discharge.

**River Intake:** A surface water intake would be located on the Snoqualmie River in the vicinity of Novelty Hill to withdraw water for supply. The location and design of these structures has not been determined, but the intake facility would consist solely of the intake structure, which would include fish screens and debris grates, and a booster pump to pump water from the intake toward the filtration plant.

**Filtration Plant:** A filtration plant would be built to filter and treat water from the river intake. The location and design of the plant has not been determined, but it the proposed location is on the Novelty Hill Plateau. The final design capacity for the facility is estimated at 80 cfs.

**Pipelines:** Two pipelines would be constructed. One would convey water from the river intake to the treatment plant, and one would convey water from the treatment plant to the regional supply pipeline (Tolt Phase 2) that will run along Novelty Hill Road. Total pipeline lengths are estimated at less than three miles and would follow existing powerline alignments.

### 3.2.2 Project Operation

The project would operate as a conjunctive use system. Physically, the filtration plant is supplied, at all times, by surface water from the Snoqualmie River. However, the Snoqualmie River will be used for conveyance of groundwater for the supply system when the wellfield is in operation. Operation of the wellfield upstream of Snoqualmie Falls will augment streamflows with groundwater, which will then be "withdrawn" from the river at the downstream supply intake.

The wellfield will operate between June and October at rates of up to 60 cfs. Wellfield operation will be based on weekly flow targets, and daily changes in wellfield flow rate are not anticipated. During wellfield operation, the predicted net increase in flow at Snoqualmie Falls will be calculated, based on the groundwater model. Additional streamflow and groundwater monitoring will also provide data on wellfield operation. The wellfield will be shut down gradually to compensate for time-lag effects in the reduction of groundwater discharge.

On days when minimum instream flow requirements on the Snoqualmie River at Carnation are met, the filtration plant will operate at its design capacity or whatever is available above the minimum instream flow requirement. This is the "normal operating condition." On days when minimum instream flow requirements are not met, the filtration plant will operate at a capacity defined by the predicted net increase in flow provided by the wellfield. This is the "reduced operating condition."

An example operational scenario is described as follows: During July, the wellfield is withdrawing 60 cfs from the aquifer and increasing flows in the Snoqualmie River by 40 cfs over naturally occurring flows. For the first week of July, flow in the Snoqualmie River is above minimum instream flow requirements. Therefore, the filtration plant operates at its normal operating capacity. For the second week of July, flow in the Snoqualmie River is below minimum instream flow requirements. Therefore, the filtration plant operates at a maximum of 40 cfs, which is defined by the amount of augmentation provided by the wellfield.

**System Monitoring**

### 3.2.3 Potential Impacts

The potential impacts from this alternative are much reduced in comparison to the conventional alternatives. The "typical" impacts from this alternative would include impacts from construction and operation of a wellfield, filtration plant, and river intake. Specific to streamflow and watershed impacts, the following potential impacts have been identified:

1. During periods of wellfield operation, drawdown in shallow and deep aquifers will occur. Present estimates are that this drawdown will not cause impairment of senior groundwater rights, domestic groundwater users, or wetlands. As part of the preliminary permit, detailed analyses will be conducted to determine the potential impact.
2. During periods of wellfield operation, water quality in the Snoqualmie River may change as a result of increased groundwater discharge to the river. Present estimates are that water quality will not be adversely affected, and will likely improve. As part of the preliminary permit, detailed analyses will be conducted to determine the potential impact.
3. During "normal operating conditions," streamflows below the intake will be lower than naturally occurring flows. However, the filtration plant will only operate in this fashion when there is adequate flow in the river, above minimum instream flow requirements. As part of the preliminary permit, detailed analyses will be conducted to determine the potential impact to these flow regimes.
4. During "reduced operating conditions," streamflows below the intake will not be lower than naturally occurring flows.

### 3.2.4 Potential Benefits

Upstream of Snoqualmie Falls, streamflows will be increased during periods of wellfield operation. These increased flow will be maintained throughout the "enhancement reach" between North Bend and Novelty Hill including:

1. Improved streamflow conditions during the summer low flow period;
2. Improved water quality conditions during the summer low flow period; and
3. Improved fisheries habitat resulting from improved flow and water quality.

### 3.2.5 Mitigation

Mitigation is an integrated element of this alternative, and mitigation is not envisioned as a necessary "external" element of the project. However, the project does offer the opportunity for mitigation in the sense that the operation of the wellfield can be adjusted to increase the net benefit to streamflows.

### 3.2.6 Assessment

The EKCRWA believes this alternative is preferable to the conventional alternatives discussed in Section 3.1, but, until additional feasibility studies are conducted, are not prepared to abandon the conventional alternatives for the purpose of a preliminary permit.

# 4. PROPOSED SCOPE OF ANALYSIS

This section outlines the proposed scope of analysis for determining resource impacts and cumulative effects from the project. The format is similar to an environmental impact statement, and, consistent with the overall intent of the preliminary permit, is intended to provide a means for simultaneous preparation of documentation for both the water right permit determination and the EIS determination. As presently outlined, this section identifies the issues under each category that will be addressed as a requirement of the preliminary permit. Detailed work plans will be developed to address each of these issues. The proposed scope of analysis is organized according to four basic elements, or milestones:

- Hydrogeologic Study
- Environmental Study
- Engineering Study
- Permitting

Section 6 summarizes the work plan for the Hydrogeologic Study which will address a number of the groundwater and surface water issues identified in the following sections. Additional detailed work plans for each element will be developed and submitted to Ecology for review and approval as the project develops.

## 4.1 Resource Issues

### 4.1.1 Geology and Soils

1. The project will develop a full understanding of the geology and soils of the area as they affect the ability of the aquifer to recharge, support local groundwater withdrawal, and supply baseflow discharge to the Snoqualmie River.
2. The project will evaluate potential changes in land use over time and develop a full understanding of what is needed to ensure and protect the aquifer's ability to produce high quality ground water.
3. The project will develop a full understanding of the geology and soils of the area to locate principal project features such that impacts to sensitive areas are avoided or minimized.
4. The project will identify what measures will be needed to prevent erosion and sedimentation into the Snoqualmie River during project construction and operation.

### 4.1.2 Aquatic Resources

1. The project will ensure that flows in the Snoqualmie River will not be reduced during low flow periods by pumping of the deep aquifer.
2. The project will quantify and address whether periodic reductions in flow in the Snoqualmie River downstream of the diversion intake will have any potential adverse impacts.

3. The project will determine the extent of a seasonal summer lowering of water levels in recharge areas caused by pumping and determine the ability of the aquifer to fully recharge during ensuing winter months.
4. The project will determine the extent of a seasonal lowering of the water table in the upper aquifer, and assess its impact on local wells present in the area.
5. The project will evaluate streamflow changes and the resultant effects on water quality and fish. In the enhancement reach, this impact may result from more water in the river during wellfield operation. Downstream of the river intake, this impact may result from less water in the river during high flow periods.
6. The project will evaluate the effect of construction, operation, and maintenance of structures used to introduce groundwater into the river.

### 4.1.3 Terrestrial Resources

1. Where principal project features may affect sensitive areas, necessary Best Management Practices and/or construction mitigation measures will be identified.
2. The project will determine the extent of a seasonal lowering of the water table in the upper aquifer, and assess its impact on wetlands in the area.
3. The project will determine whether project construction would permanently affect vegetation and wildlife.

### 4.1.4 Threatened Endangered and Sensitive Species

1. The project will determine the potential for the presence of federally listed candidate, threatened, endangered, or sensitive species at either the well field area, or at the river downstream pump station and water treatment area sites.
2. The project will determine if construction and operation might affect any species determined to be present and determine whether any potential impacts can be avoided, minimized, or mitigated.
3. The project will determine if there is any potential for any adverse impact to the candidate salmonid species presently under review for potential federal listing. In the “enhancement reach” this impact may result from more water in the river during wellfield operation. Downstream of the river intake, this impact may result from less water in the river during high flow periods.

### 4.1.5 Aesthetic Resources

The project will determine whether project construction and operation would adversely impact aesthetics.

#### 4.1.6 Recreation and Land Use

The project will determine any impacts to recreational use of the river based on changes to flows in the river. In the "enhancement reach" this impact may result from more water in the river during wellfield operation. Downstream of the river intake, this impact may result from less water in the river during high flow periods. The project will determine the potential for impacts to land use by the siting of the principal project features

#### 4.1.7 Socioeconomic Issues

The project will determine whether project construction and operation would result in socioeconomic impacts.

#### 4.1.8 Cultural and Historical Resources

The project will determine whether any cultural or historical resources exist in the areas of project construction, and will determine whether project construction would adversely impact cultural resources that may exist in the project areas.

### 4.2 Cumulative Effects

The cumulative effects analysis will consider the interrelationships between the various environmental disciplines, and identify whether significant cumulative impacts are associated with the construction and operation of the project.

#### 4.2.1 Geographic Scope

The project will prepare of a GIS base map containing the river basin, the primary service areas for water supply, and a variety of data elements including: municipal and county boundaries, waterways, land use indications, main transportation routes, land ownership, GMA boundaries, and major infrastructure features (particularly water supply).

#### 4.2.2 Basin Analysis

The project will identify significant individual projects or developments (historic, present, and planned) that have had or may have potentially significant adverse impacts to basin resources.

# 5. COORDINATION OF PUBLIC AND PERMIT PROCESSES

## 5.1 SEPA/NEPA

Regulations provide for the development of a single, project specific Environmental Impact Statement (EIS) that will satisfy both the State Environmental Protection Act (SEPA) requirements and the National Environmental Protection Act (NEPA) requirements. When thoroughly and well performed, the SEPA EIS can be routinely adopted for achieving compliance with NEPA requirements and vice versa.

The SEPA/NEPA process allows for full participation by the general public, special interest groups, tribes, and special utility districts, as well as federal, state, county, and local regulatory, resource, and permitting agencies. The SEPA/NEPA process allows for both written and oral comments to be heard and addressed by the project sponsor. The following three primary steps are followed in the SEPA/NEPA process:

- Step 1 Conduct of Scoping Meeting(s) (written and oral comments are heard);
- Step 2 Preparation and distribution of the Draft EIS (written comments requested); and
- Step 3 Preparation and distribution of the Final EIS (responses to each comment provided).

The project-specific EIS addresses project specific impacts, as is discussed in Section 5.2 below. When various differing major projects might be able to address the same need, then a Programmatic EIS may be performed to help determine which project(s) should likely proceed. In the case of the Snoqualmie Aquifer Project, other major regional water supply projects should be assessed and compared to the Snoqualmie Aquifer Project. The Programmatic EIS process is discussed below in Section 5.2.

## 5.2 Programmatic Environmental Impact Statement

The Snoqualmie Aquifer Project will achieve compliance with the spirit and intent of the State of Washington's SEPA process. This will require an environmental impact analysis for the preferred project, project alternatives, and the no action alternative. The lead agency for the project specific EIS will need to be determined. It is the desire of the East King County Regional Water Association (EKCRWA) that Washington State Department of Ecology (Ecology) be a co-lead with the EKCRWA in conduct of the project specific EIS. EKCRWA's desire to have Ecology as a co-lead is based, in part, on the significance of Ecology's role in the project. Specifically, the significance is the essential nature of the issuance of water right permits for the project by Ecology. EKCRWA also understands Ecology's expressed desire to fully participate in the public process in order to hear first-hand any concerns with the project, and the applicant's responses to such concerns.

Coupled with a Programmatic EIS, as defined below, the conduct of a complete project specific EIS can address all SEPA/NEPA requirements for the Snoqualmie Aquifer

Project. It is the express desire and goal of the EKCRWA to have the project specific EIS address SEPA/NEPA requirements for all permits and permissions, including the water rights issued by Ecology.

## 5.3 Project Environmental Impact Statement

The City of Seattle is presently conducting a Programmatic EIS for water supply alternatives located within the Seattle and Eastside regions of the Puget Sound Basin. The geographic area of Seattle's Programmatic EIS encompasses the area of the Snoqualmie Aquifer Project. Seattle's Programmatic EIS geographic boundaries include both the Cedar River Basin to the South, and the Tolt River Basin to the North. The Snoqualmie River Basin is geographically located in between these two major water supply river basins. The Cedar and the Tolt Rivers are the sole existing rivers from which the City of Seattle and the Eastside cities and towns of King County are presently and have historically used for primary water supply.

The geographical scope and the timing of Seattle's Programmatic EIS are coincidentally fortuitous for the EKCRWA. For these reasons, the EKCRWA contacted Seattle in January 1998 and requested and secured Seattle's permission and support for the inclusion of the Snoqualmie Aquifer Project within the Programmatic EIS. Therefore, the desire for the Snoqualmie Aquifer Project to be assessed along with other potential regional water supplies for the subject Puget Sound regional area is being performed at this time. EKCRWA is supplying information to the City of Seattle for inclusion in the Programmatic EIS for Scoping and the Draft EIS, and will be providing responses to any comments received regarding the Snoqualmie Aquifer Project for inclusion in the Final EIS.

## 5.4 Permits with Public Hearings

Securing approval for a major water supply project such as the Snoqualmie Aquifer Project involves many jurisdictions/authorities and requires obtaining a large number of permits as well as SEPA/NEPA compliance. The particular permits/permissions needed are dependent on the final design and location of the principal project features, the potential adverse environmental project impacts, and the permitting requirements in effect at the time of application. Permits and permissions for the proposed project could include the following:

Washington State Department of Ecology:

- Water Right Permits
- 401 Water Quality Certification
- Coastal Zone Consistency Certification
- Temporary Modification of Water Quality Criteria
- NPDES Stormwater Permit

United States Army Corps of Engineers:

Section 10 and 404 Permits
(Includes prescribed Endangered Species Act consultations and Section 106 tribal consultations)

King County:

Public Agency Utility Exception
Shoreline Permit
Clearing/Grading Permit
Right-of-way Permit/Franchise
Road Utilities Permit

North Bend, Snoqualmie, other municipalities:

Clearing/Grading Permits
Shoreline Permits
Conditional Use Permits
Right-of-way Permits
Sensitive Area and Wetland Permits

Washington Department of Community Development/State Historic Preservation Officer (SHPO):

Cultural Resource Review

Washington Department of Natural Resources:

Aquatic Land Lease(s)
Forest Practices Permit

Washington Department of Fish & Wildlife:

Hydraulic Project Approval(s)

Washington Department of Transportation:

Right-of-way Permits/Franchise

## 5.5 Other Permits/Permissions

Depending on the significance of potential adverse environmental impacts by the proposed Snoqualmie Aquifer Project, a hearing may be required for one or more permits. Some of these permits also allow for administrative approval of a permit, if warranted by the level of environmental impact.

The following is a preliminary list of permits that could potentially have a hearing:

Washington Department of Ecology:

Water Right Permits
401 Water Quality Certification

United States Army Corps of Engineers:
Section 10 and 404 Permits

King County:
Public Agency Utility Exceptions
Shoreline Permits

North Bend, Snoqualmie, other municipalities:
Shoreline Permits
Conditional Use Permits

As a matter of communications and permitting efficiency, the EKCRWA plans to combine as many public hearings into a single hearing as possible and acceptable to the agencies. Combining required hearings will allow the various commentors to hear each other's concerns, as well as hear the applicant's responses to any concerns raised. The need for public input by the various agencies requiring a public hearing process are primarily focused on understanding, assessing, avoiding, and mitigating for potential adverse project impacts to the natural and built environments. Since the focus of these public processes are the same, it makes good sense to combine these meetings into a single forum. It is the desire of the EKCRWA to have Ecology support and participate in the conduct of the combined hearings as part of the SEPA/NEPA proceedings to the greatest extent possible.

## 5.6 Tribal Consultation

It is EKCRWA's express desire to engage the tribes in open and productive dialogue on the Snoqualmie Aquifer Project. In addition, tribal consultations are specifically required for compliance with two of the permits that will likely be needed for this project. These two permits are the Washington Department of Community Development/State Historic Preservation Officer (SHPO), Cultural Resource Review, and the U.S. Army Corps of Engineers, Section 10 and 404 Permits. It is the desire of EKCRWA that Ecology supports and encourages the tribes to engage in productive dialogue both in general and within SEPA/NEPA and the specific permit processes required for the project.

# 6. PROJECT WORK PLAN AND SCHEDULE

## 6.1 Agency Oversight and Milestones

The project will establish regular status meeting with Ecology, establish agendas, prepare meeting minutes, and make information available to the public as needed. The RWA will work closely with Ecology to ensure open communication with all interested parties and the public.

The project will remain integrated with regional water planning initiatives currently underway, specifically that of the Seattle Public Utilities and other relevant jurisdictions.

The project will identify milestones, prepare schedules, and produce technical analyses for environmental media. Four technical milestones are envisioned:

1. Baseline Studies
2. Hydrogeologic Studies
3. Environmental Studies
4. Supporting Studies

## 6.2 Baseline Studies

This element of the work plan is intended to assist Ecology in evaluating beneficial use through an assessment of regional water supply options, project alternatives, and system operation scenarios. This element of the work plan will also provide a database and information dissemination capabilities. The specific elements are as follows:

1. Conduct a Programmatic EIS using the SPU Pipeline 5 by reference.
2. Present monthly demand projections for the planned users of the water supply and clearly show the conservation elements in the projections.
3. Present all existing groundwater and surface water rights in the Upper Snoqualmie Basin and estimate exempt well withdrawals.
4. Develop system operation scenarios that match demand projections and encompass the following hydrologic scenarios:
   - Wet year precipitation;
   - Normal year precipitation;
   - Dry year precipitation; and
   - Drought year precipitation.
5. Develop a database that contains pertinent technical information in a readily accessible format. This information should include maps and tables documenting:
   - General topographic, land use, transportation, and cultural features;
   - The proposed supply system layout;

- Location of documented wells; and
- Location of documented wetlands.

6. Develop an Internet Web site to disseminate project information.

## 6.3 Hydrogeologic Studies

### 6.3.1 Groundwater

This element of the work plan is intended to assist Ecology in evaluating the groundwater flow system in the Upper Snoqualmie Basin. Both existing information and additional data will be used to refine the technical understanding of the groundwater system and predict impacts caused by groundwater pumping. The key components of this element of the work plan will include additional field testing data and a groundwater flow model of the upper basin. The specific elements are as follows:

1. Collect additional exploratory information to adequately demonstrate the extent of the shallow and deep aquifer system.
2. Collect additional testing and/or monitoring information to adequately delineate the distribution of hydraulic characteristics of the shallow and deep aquifer systems, including aquifer transmissivity and aquifer storage coefficient.
3. Collect additional testing and/or monitoring information to adequately demonstrate the location, magnitude and general timing of recharge to the shallow and deep aquifers.
4. Collect additional testing and/or monitoring information to adequately delineate groundwater discharge and hydraulic properties of the river beds for the Middle Fork, South Fork, and Main Stem Snoqualmie above Snoqualmie Falls. Information on the North Fork will be limited to the reach between the Confluence and Ernies Grove.
5. Collect additional testing and/or monitoring information to adequately define the relationship between wetlands and the aquifers that may experience drawdown as a result of pumping.
6. Construct and calibrate a groundwater flow model that adequately predicts observed existing conditions in the shallow and deep aquifers on a biweekly time step. Include all presently known groundwater withdrawals and land-uses. Submit all modeling codes and input parameters to Ecology for review and comment. This will represent the base case for the analysis of impacts.
7. Run the groundwater flow model under proposed wellfield development scenarios, including potential changes in land use (i.e., increased impervious surface), senior groundwater permit applications (i.e., City of North Bend) and the potential for additional exempt wells. Groundwater flow model runs will encompass the following hydrologic scenarios:
    - Wet year precipitation;
    - Normal year precipitation;

- Dry year precipitation; and
- Drought year precipitation.

8. Using the groundwater flow model, predict preliminary wellhead protection areas for 1-year, 5-year, and 10-year time-of travel for each proposed well in wellfield.

### 6.3.2 Surface Water

This element of the work plan is intended to assist Ecology in evaluating the surface water flow system in the Upper Snoqualmie Basin. Existing information is available with regards to historical streamflow conditions and variability of the flow regime, but additional data and analyses are needed to refine the technical understanding of streamflows and predict impacts caused by groundwater pumping. The key components of this element of the work plan will include additional stream gages and groundwater seepage data, as well as a hydrologic assessment of wetlands. The specific elements are as follows:

1. Collect additional testing and/or monitoring information to adequately delineate the distribution of groundwater seepage into the Snoqualmie River during the months July to October. Particular emphasis will be placed on wetlands and riparian habitats as potential groundwater discharge areas, and the general hydrology of these wetlands will be assessed.
2. Establish stream gages and develop a rating curve showing the relationship between flow and river stage on the Middle Fork Snoqualmie at the Mt. Si Road bridge; on the Main Stem Snoqualmie in the vicinity of Meadowbrook Slough; and on the Main Stem Snoqualmie at Novelty Hill. Existing USGS gages and rating curves will be used at Snoqualmie Falls and Carnation.

### 6.3.3 Impacts

1. Predict all project impacts without consideration for mitigation using the following categories and criteria:
   - Aquifer drawdown: For each aquifer and for each hydrologic scenario (wet, normal, dry, drought conditions), present the maximum drawdown for a given wellfield operation scenario compared to the base case scenario. This information will be presented at the following locations:
     1) Significant wetlands;
     2) All identified wells with senior groundwater rights;
     3) All identified wells with senior groundwater applications; and
     4) The generalized locations that support exempt wells.
   - Water balance: For each hydrologic scenario (wet, normal, dry, drought conditions), present the predicted changes in water volumes at a biweekly time step for each wellfield operation scenario, as compared to the base case scenario. Water volumes will be tracked in terms of aquifer storage, aquifer/river interaction, wells, aquifer

recharge, and aquifer boundaries, as appropriate. A numerical model error tolerance of 0.5% in the water balance is desirable.

- The aquifer/river interaction portion of the water balance for each operation scenario will be extrapolated into the historical record of streamflows on the Snoqualmie River at Snoqualmie Falls, Carnation, and Monroe to produce a hypothetical record of streamflow under the proposed groundwater withdrawal. A comparison of the historical and hypothetical streamflow records will be performed that shows, on a monthly aggregate basis, the additional number of days streamflow were (hypothetically) not met, the hypothetical increase in the length of instream flow violations, and the hypothetical percent reduction in mean monthly streamflow.

## 6.4 Engineering Studies

Various engineering studies will be conducted in a phased manner in support of permitting and preliminary design. These studies are listed here along with a brief description of the study purpose and focus.

### 6.4.1 Conceptual Design

Define and optimally size the Principal Project Features (Wellfield and Collection System, Aeration & Dispersion Structures, Diversion Structure and Lifting Pumps, Treatment Plant, and Transmission Pipelines.

### 6.4.2 Siting Analysis

Identify and describe alternative parcels for siting of principal project features. Siting items will include purchase price of land or easements, coordination with interconnecting utilities, geotechnical considerations, environmental impact potential, agency coordination and an assessment of permitability, and construction considerations.

### 6.4.3 Costs

Develop a conceptual level Opinion of Probable Project Cost for the principal project features. This estimate will be developed to about a 30 to 40 percent contingency level. Also prepare an opinion of probable annual operation and maintenance costs for the optimally sized project.

### 6.4.4 Preliminary Design

Development of Design Criteria, development of select primary plan view design drawings to about a 30 percent completion level, conduct hydraulic analyses, coordinate the design of fish interface features (dispersion and diversion structures), define the treatment plant process to a pre-design level, conduct discussions to define the operational coordination of the system with interconnecting utilities, and refinement of the Opinion of Probable Cost to a 20 percent contingency level.

### 6.4.5 Final Design

Final design efforts, the complete development of drawings, specifications, and associated Contract documents for bidding purposes, will likely not occur until receipt of the water right permit from ecology is granted.

TABLES

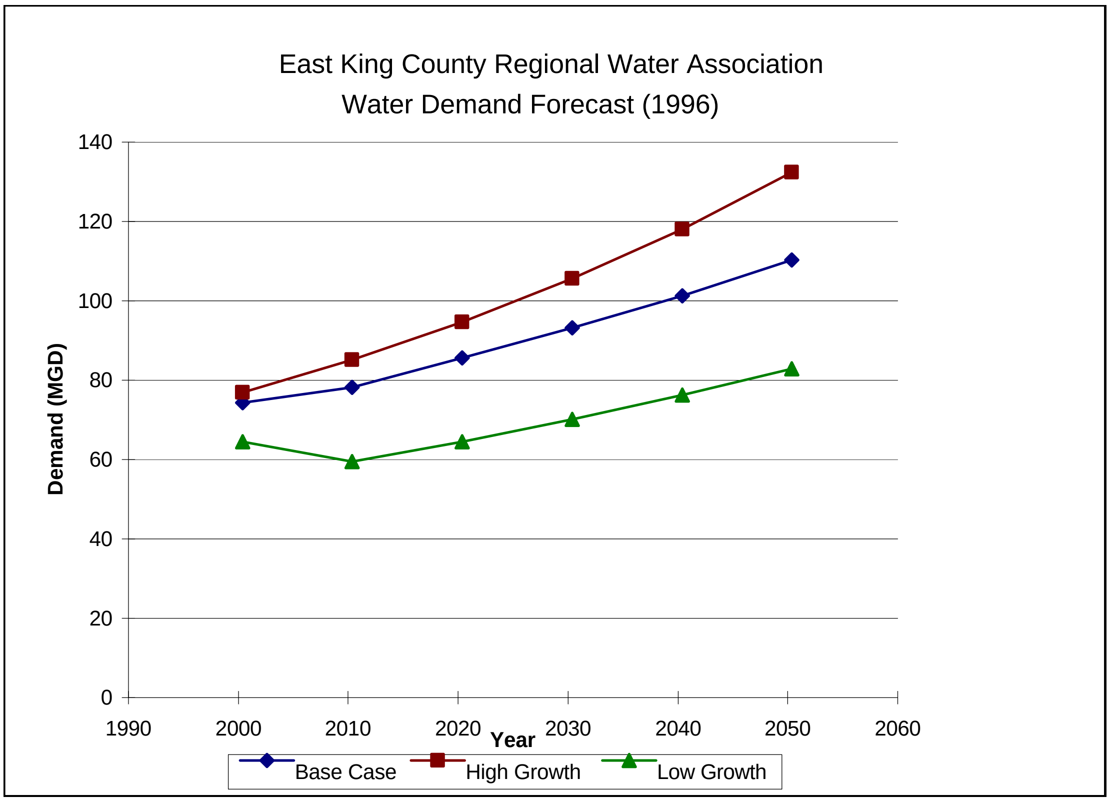
TABLE 1-1

EAST KING COUNTY UTILITIES INCLUDED IN DEMAND FORECAST

| Forecasted Individually | Grouped Utilities |
| --- | --- |
| Ames Lake Water Association | Avon Villa Trailer Park |
| Bellevue | Beaux Arts |
| Bothell | Campton Water Supply |
| Cedar River Water & Sewer District | Carnation |
| Coal Creek Water District | Carnation Research Farms |
| Duvall | Doore Don Water Systems |
| Fall City | Echo Glen Children's Center |
| Issaquah | Edgehill Water Association |
| Kirkland | Four Lakes Water System |
| Mercer Island | Heathercrest Water System |
| NE Sammamish Sewer & Water District | Lake Margaret Water System |
| North Shore Utility District | Loclomon Subdivision |
| Redmond | Maplewood Addition Coop |
| Renton | Mercercrest Water System |
| Sammamish Plateau Water & Sewer District | Mirrormont Services, Inc. |
| Sallal Water Association | Mobil Home Wonderland |
| Shoreline Water District | Mount Si Mobile Home Estates |
| Snoqualmie | North Bend |
| Soos Creek Water & Sewer District | Overdale Park Water |
| Union Hill Water Association | Riverbend Homesites |
| Water District #83 | Riverbend Mobile Home Park |
| Water District #90 | Shorewood Apartments |
| Water District #119 | Spring Glen Water Association |
| Woodinville | Trails End Maintenance Association |
| | Twenty-Three 800 Tiger Mountain Road Water Association |
| | Upper Preston Water Users Association |
| | Water District #1 |
| | Water District #17 |
| | Water District #117 |
| | Water District 123 |
| | Wilderness Rim Maintenance Association |

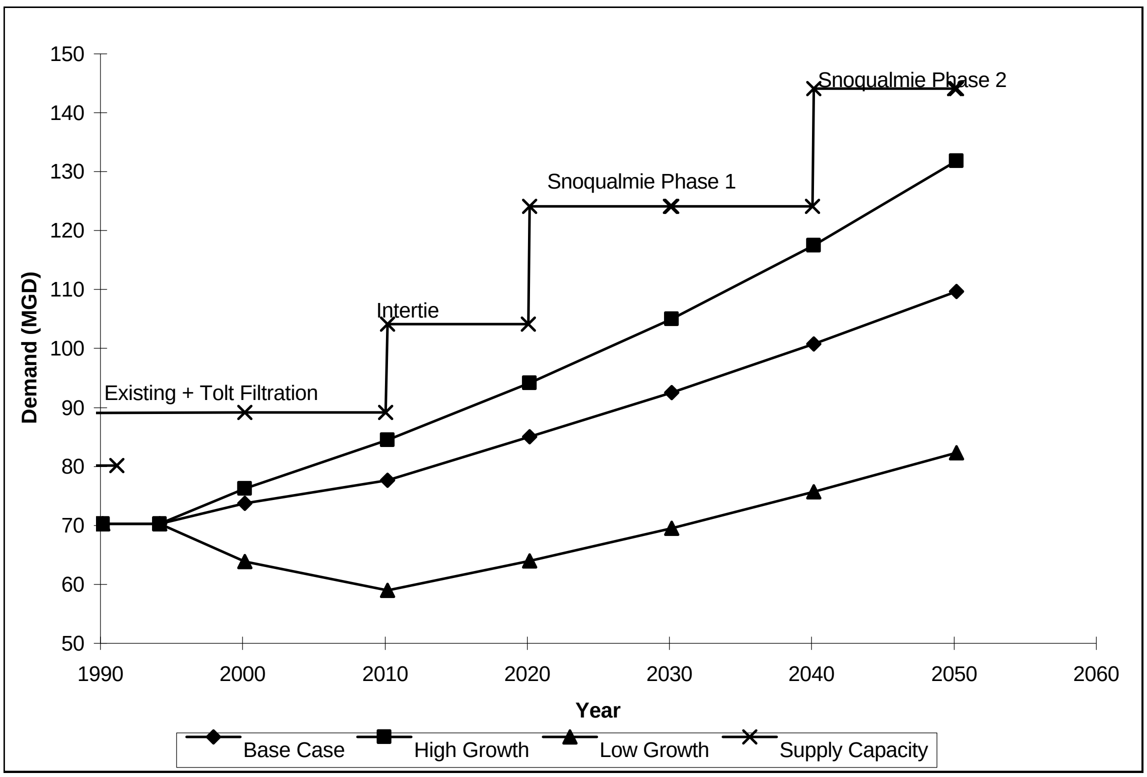
DEMAND FORECAST SUMMARY

| | Base Case | | High Growth | | Low Growth | |
|---|---|---|---|---|---|---|
| Year | Growth Rate | Water Demand | Growth Rate | Water Demand | Growth Rate | Water Demand |
| | (%) | (MGD) | (%) | (MGD) | (%) | (MGD) |
| 1994 | | 68.18 | | 68.18 | | 68.18 |
| 2000 | 0.81 | 71.58 | 1.41 | 74.14 | -1.64 | 61.73 |
| 2010 | 0.64 | 75.50 | 1.19 | 82.41 | -1.13 | 56.82 |
| 2020 | 0.76 | 82.95 | 1.16 | 91.98 | -0.37 | 61.83 |
| 2030 | 0.79 | 90.43 | 1.15 | 102.90 | -0.03 | 67.41 |
| 2040 | 0.81 | 98.61 | 1.15 | 115.39 | 0.16 | 73.51 |
| 2050 | 0.82 | 107.58 | 1.16 | 129.72 | 0.29 | 80.19 |



DEMAND FORECAST SUMMARY AND PREFERRED SUPPLY OPTIONS

| Year | Base Case Growth Rate (%) | Water Demand (MGD) | High Growth Growth Rate (%) | Water Demand (MGD) | Low Growth Growth Rate (%) | Water Demand (MGD) | New Supplies Source | Supply (MGD) |
|---|---|---|---|---|---|---|---|---|
| 1994 | | 68.18 | | 68.18 | | 68.18 | Existing | 78 |
| 2000 | 0.81 | 71.58 | 1.41 | 74.14 | -1.64 | 61.73 | Tolt Filtration | 87 |
| 2010 | 0.64 | 75.50 | 1.19 | 82.41 | -1.13 | 56.82 | Intertie | 102 |
| 2020 | 0.76 | 82.95 | 1.16 | 91.98 | -0.37 | 61.83 | Snoqualmie P1 | 122 |
| 2030 | 0.79 | 90.43 | 1.15 | 102.90 | -0.03 | 67.41 | | 122 |
| 2040 | 0.81 | 98.61 | 1.15 | 115.39 | 0.16 | 73.51 | Snoqualmie P2 | 142 |
| 2050 | 0.82 | 107.58 | 1.16 | 129.72 | 0.29 | 80.19 | | 142 |



# STREAMFLOW STATISTICS - SNOQUALMIE RIVER AT SNOQUALMIE FALLS

| | Mean Daily Flow | Standard Deviation | Median Daily Flow | Mean 7-Day Flow | Mean 7-Day Low Flow | Mean 7-Day Low | Min. 7-Day Low | Min. 7-Day Low | Instream Flow Requirement |
|---|---|---|---|---|---|---|---|---|---|
| | (cfs) | (cfs) | | (cfs) | (cfs) | (% ISF) | (cfs) | (% ISF) | (cfs) |
| Jan | 3547 | 1455 | 2190 | 3531 | 1443 | 93% | 666 | 43% | 1550 |
| Feb | 3093 | 1456 | 2260 | 3094 | 1571 | 101% | 786 | 51% | 1550 |
| Mar | 2441 | 951 | 2030 | 2458 | 1507 | 97% | 939 | 61% | 1550 |
| Apr | 2979 | 858 | 2555 | 2975 | 1980 | 128% | 1126 | 73% | 1550 |
| May | 3710 | 833 | 3310 | 3717 | 2504 | 162% | 1544 | 100% | 1550 |
| Jun | 3529 | 1290 | 3100 | 3520 | 2397 | 155% | 1049 | 68% | 1550 |
| July | 1855 | 970 | 1440 | 1856 | 1113 | 84% | 592 | 45% | 1325 |
| Aug | 888 | 429 | 680 | 895 | 621 | 91% | 354 | 52% | 685 |
| Sep | 1092 | 731 | 726 | 1085 | 591 | 99% | 340 | 57% | 600 |
| Oct | 1679 | 967 | 1060 | 1697 | 686 | 71% | 276 | 29% | 960 |
| Nov | 3393 | 1839 | 2425 | 3419 | 1576 | 102% | 339 | 22% | 1550 |
| Dec | 3659 | 1620 | 2435 | 3614 | 1515 | 98% | 772 | 50% | 1550 |

**Notes**

All values are based on actual USGS daily streamflow records between 1959 and 1993
Mean Daily Flow for a given month is the average daily flow over all days of record for that month
Median Daily Flow is the most likely flow to occur for a given month, based on the period of record.
Median Daily flow is equivalent to a 50% exceedance flow, where 50% of the values are either above or below the value shown
Mean 7-day flow for a given month is the average flow over all 7-day periods of record for that month
7-day low flow is the lowest average flow over a 7-day period for a given month
Mean and minimum 7-day low flows are determined from 7-day low flows for all months of record
Instream flow requirement is from WAC 173-513. Averaged for entire month when applicable.
% ISF compares the 7-day flows to instream flow requirements. Values > 100% indicate observed flow is greater than instream flow requirement.

# STREAMFLOW STATISTICS - SNOQUALMIE RIVER AT CARNATION

| | Mean Daily Flow (cfs) | Standard Deviation (cfs) | Median Daily Flow (cfs) | Mean 7-Day Flow (cfs) | Mean 7-Day Low Flow (cfs) | Mean 7-Day Low (% ISF) | Min. 7-Day Low (cfs) | Mean 7-Day Low (% ISF) | Instream Flow Requirement (cfs) |
|---|---|---|---|---|---|---|---|---|---|
| Jan | 5373 | 5191 | 3590 | 5387 | 2364 | 95% | 1127 | 45% | 2500 |
| Feb | 4564 | 3769 | 3440 | 4561 | 2466 | 99% | 1171 | 47% | 2500 |
| Mar | 3685 | 2187 | 3100 | 3664 | 2265 | 91% | 1244 | 50% | 2500 |
| Apr | 4129 | 1932 | 3775 | 4133 | 2860 | 114% | 1520 | 61% | 2500 |
| May | 4830 | 1803 | 4430 | 4822 | 3409 | 136% | 1469 | 59% | 2500 |
| Jun | 4383 | 2251 | 3940 | 4394 | 2928 | 117% | 1030 | 41% | 2500 |
| July | 2347 | 1475 | 1870 | 2346 | 1443 | 92% | 728 | 46% | 1575 |
| Aug | 1193 | 729 | 956 | 1184 | 825 | 100% | 381 | 46% | 825 |
| Sep | 1448 | 1378 | 960 | 1448 | 803 | 115% | 359 | 51% | 700 |
| Oct | 2270 | 2130 | 1515 | 2253 | 969 | 72% | 472 | 35% | 1350 |
| Nov | 4813 | 4559 | 3745 | 4794 | 2263 | 91% | 658 | 26% | 2500 |
| Dec | 5345 | 4972 | 3925 | 5384 | 2449 | 98% | 1410 | 56% | 2500 |

**Notes**

All values are based on actual USGS daily streamflow records between 1959 and 1993
Mean Daily Flow for a given month is the average daily flow over all days of record for that month
Median Daily Flow is the most likely flow to occur for a given month, based on the period of record.
Median Daily flow is equivalent to a 50% exceedance flow, where 50% of the values are either above or below the value shown
Mean 7-day flow for a given month is the average flow over all 7-day periods of record for that month
7-day low flow is the lowest average flow over a 7-day period for a given month
Mean and minimum 7-day low flows are determined from 7-day low flows for all months of record
Instream flow requirement is from WAC 173-513. Averaged for entire month where applicable.
% ISF compares the 7-day flows to instream flow requirements. Values > 100% indicate observed flow is greater than instream flow requirement.

## SUMMARY OF HISTORICAL INSTREAM FLOW CONDITIONS - SNOQUALMIE BASIN

| | [Period of Record] | Snoqualmie Falls (1960-1992) | Carnation (1960-1993)[1] | Monroe (1963-1993) |
|---|---|---|---|---|
| **(a)** | **All Months** | | | |
| | Total Days of record | 11,962 | 11,961 | 11,044 |
| | Total Days below requirement | 3,208 | 3,053 | 3,655 |
| | Days as % Record | 27% | 26% | 33% |
| | | | | |
| | Total occurrences | 355 | 391 | 370 |
| | Max. Length (days) | 77 | 70 | 167 |
| | Mean Length(days) | 9.0 | 7.8 | 9.9 |
| | Median Length (days) | 5.0 | 5.0 | 5.0 |
| | | | | |
| **(b)** | **July-November Only** | | | |
| | Total Days of record | 4,995 | 4,988 | 4,067 |
| | Total Days below requirement | 2,008 | 1,460 | 1,323 |
| | Days as % Record | 40% | 36% | 28% |
| | | | | |
| | Total occurrences | 182 | 230 | 119 |
| | Max. Length (days) | 77 | 70 | 167 |
| | Mean Length(days) | 11 | 7.3 | 11.1 |
| | Median Length (days) | 6.0 | 5.0 | 6.0 |

Notes

Table summarizes instream flow conditions, based on historical record, in terms of total days, total occurrences and length of occurrences below instream flow requirements set in WAC 173-507

[1] Intermittent Period of Record (missing 1987)

FIGURES

# APPENDIX A

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# APPENDIX B

# AGENCY & PUBLIC CORRESPONDENCE