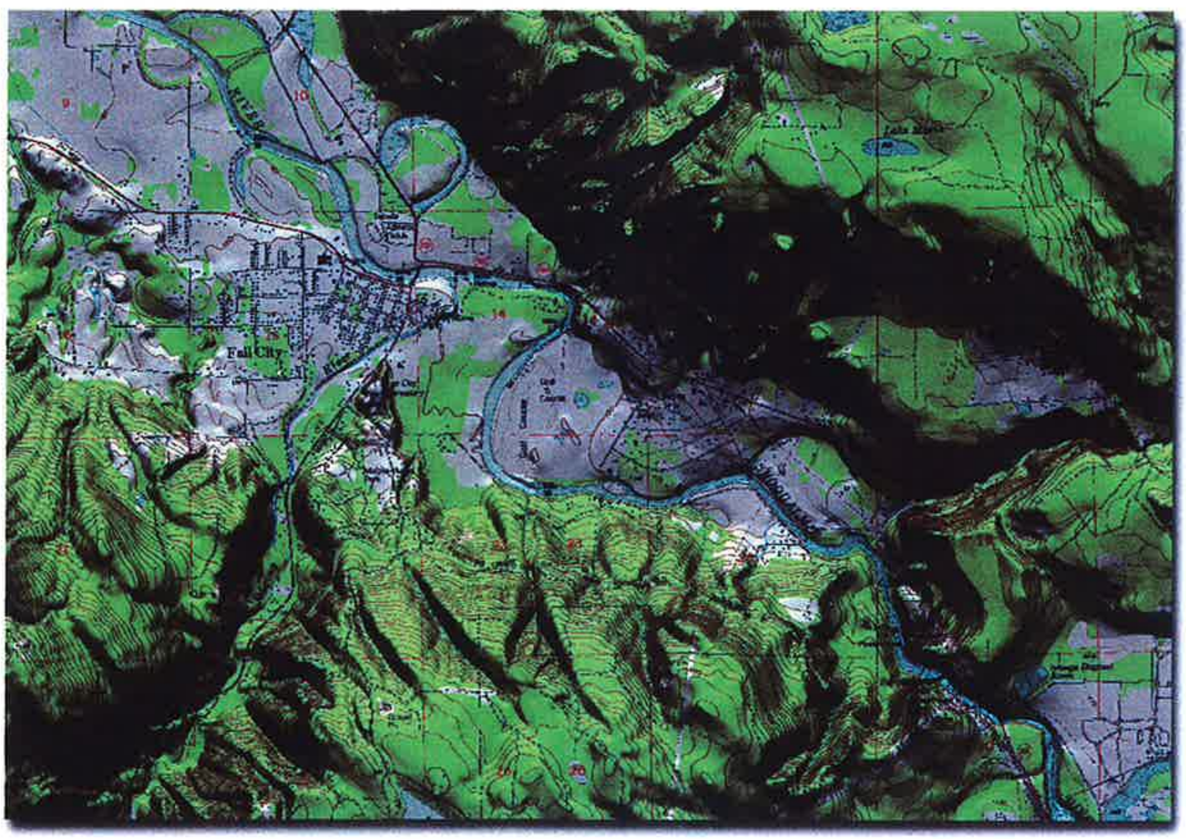
KING COUNTY PUBLIC HEALTH
DEPARTMENT OF NATURAL RESOURCES

KING COUNTY

REPORT

FALL CITY ALTERNATIVE ONSITE WASTEWATER PROJECT

AUGUST 1, 2001



Gray & Osborne, Inc.
CONSULTING ENGINEERS

HWA Geosciences

Aqua-Test, Inc.

Gray & Osborne, Inc.
CONSULTING ENGINEERS

August 1, 2001

Mr. Todd Yerkes
Public Health - Seattle & King County
Community Environmental Health Section
14350 SE Eastgate Way
Bellevue, Washington 98007

SUBJECT: TECHNICAL REPORT, FALL CITY ALTERNATIVE ONSITE WASTEWATER PROJECT
KING COUNTY, WASHINGTON
G&O #01641

Dear Mr. Yerkes:

Enclosed is the final Fall City Alternative Onsite Wastewater Report. We hope that the information provided in this technical plan was beneficial in understanding the complex issues involved in addressing the wastewater needs of the Fall City commercial district. The infrastructure in Fall City is not unlike a significant number of rural communities throughout the State of Washington. The difficulty lies in finding affordable, cost-effective wastewater alternatives while still complying with state regulatory requirements.

Very truly yours,

GRAY & OSBORNE, INC.

Tony Vivolo, P.E.

TV/ts
Encl.

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EXECUTIVE SUMMARY

This technical report describes the evaluation of alternatives for wastewater treatment for the Fall City business district, and presents recommendations of the King County Fall City Stakeholders Group to solve the existing wastewater treatment problem in the area. King County staff environmental issues, facilitation staff and the County's technical consultant for the study, Gray & Osborne, Inc., assisted the Stakeholders Group in considering a range of alternative solutions, including existing individual onsite septic tank and drainfield repair and management, cluster and community drainfields, and a centralized community sewer system/centralized treatment plant.

BACKGROUND

The Metropolitan King County Council passed Motion 10960 on June 12, 2000 (see Appendix A) directing the Executive to convene a Stakeholders Group to research and recommend solutions to the existing wastewater treatment problem in the Fall City business district. The Stakeholder appointments were confirmed by the Council May 7, 2001, and the first Stakeholders Group meeting took place on May 9, 2001.

The Stakeholders Group held six public meetings in Fall City during the period of May, June, and July 2001 to discuss the range of possible alternative solutions. After being hired by the County at the end of May 2001, Gray & Osborne and its subconsultants, Aqua Test and HWA Geosciences, reviewed existing documents relating to the project, including the *Fall City Wastewater Facilities Plan* (2nd Draft, May 1991 by RW Beck and Associates), the *Fall City Subarea Plan 1999*, and the *Fall City Water District Water System Plan 1999,* performed a field assessment/evaluation of the existing onsite systems in the business district, and presented preliminary findings to the stakeholders group at two public meetings, June 13 and June 20.

Gray & Osborne completed and delivered a draft report to County staff on July 3, 2001 with several alternatives for resolving wastewater treatment. This draft report was presented and discussed at the stakeholder group meeting on July 11, 2001. In response to comments at that meeting, Gray & Osborne revised the summary cost tables comparing the alternatives to distinguish collection system from treatment and disposal costs, and to estimate costs on an equivalent residential unit (ERU) basis. The revised tables were delivered to County staff on July 16, 2001. Gray & Osborne prepared and delivered the final revised report to County staff on August 1, 2001, per the original schedule defined for the study in Motion 10960.

KEY FINDINGS

For purposes of this study, at the May 30th meeting, the Stakeholders divided the business district into a Phase 1 area, comprising the parcels fronting the Redmond - Fall City Road (SR202), plus a few parcels on both sides of the Preston – Fall City Road near the intersection of the two roads (36 parcels total), and a Phase 2 area, comprising parcels south of the alley between SR202 and SE 43rd Street (16 parcels total). Phase 1 consists almost entirely of commercial properties, and Phase 2 consists mainly of residential properties which are zoned for potential business uses should sewer service become available. Please see Figure 2-6 Fall City Business District Parcel/Zoning Map for a depiction of the Phase 1 and 2 areas.

Using parcel maps, zoning records, metered water use records from the Fall City Water District, and field observations, current wastewater strengths and flows for the business district were estimated by the technical consultants, and future flow projections were made for 52 parcels of property comprising the Phase 1 and Phase 2 areas. The minimum flow projection for each area (Phase 1 and Phase 2 areas) was defined as the current metered water use of all the parcels in the area plus 20%. The maximum flow projection was defined as double the minimum flow projection; and the intermediate flow projection was defined as the average of the minimum and maximum flow projections. The Phase 1 minimum flow projection was approximately 27,800 gallons per day (gpd). Please see Tables 4-7 and 4-8, Flow Projections for Phase 1 and Phase 1 and 2, for the flow amounts of each projection.

The potential for onsite treatment and disposal was assessed for the 36 parcels in the Phase 1 area, and for the 16 parcels in the Phase 2 area. For the Phase 1 area, it was determined that most of the businesses do not have enough land available to provide adequate onsite wastewater treatment in accordance with existing codes, and that less than a quarter of the current wastewater flow can be adequately treated and disposed of via individual onsite septic systems at each business property, even assuming that non-conforming repairs to several existing onsite systems could be made (see Table 5-2, Current Onsite System Flows Handled by Available Treatment Options).

Stakeholder and public questions and comments were addressed by the technical consultant team via presentations at the public meetings and in the report. The alternatives developed in Chapter 5 were selected to address the stakeholder concerns such as preservation of the rural character of the town, affordability, fairness of distribution of costs, and long term adequacy of any solution in terms of allowing flexible business uses and adequate business growth.

It was determined that a wastewater management entity of some kind needs to be developed to serve the Fall City business district. Such an entity would not only operate and maintain the wastewater system, it would also facilitate the securing of loan and grant funding to pay system capital costs, and provide an entity to assess monthly fees to cover operation & maintenance (O&M) costs for the system. A range of options exists as to the type of management entity that might be utilized, including:

(1) The Fall City Water District (FCWD) becoming a water and sewer district,

(2) formation of a property owners association, backed by a secondary public agency such as King County, or the FCWD,

(3) formation of a sewer district, and

(4) inclusion of the system in King County Metro sewer system.

The development of a wastewater management entity is an important next step in the process of finding a solution to the business district's wastewater management problem.

COST ESTIMATES

Tables 6-1A, B, and C in Chapter 6 present summary cost estimate comparisons for the alternatives for three (3) different flow projections, representing minimum, intermediate, and maximum flow projections. Included are estimates of both capital and O&M costs for each alternative. The cost estimates assume that new facilities will be constructed using a public works bidding and construction process. Total capital cost estimates (including collection, treatment, and disposal costs) for the Phase 1 minimum flow projection of 27,800 gpd range from $2.5M for Alternative 4D (package plant with a conventional drainfield), to $2.9M for Alternative 4A (centralized recirculating gravel filter [RGF] treatment plant with a subsurface drip irrigation drainfield). For the Phase 1 & 2 maximum flow projection of 70,800 gpd, the total capital cost estimates range from $3.6M to $5.1M for these same alternatives.

Annual O&M cost estimates for the Phase 1 minimum flow projection of 27,800 gpd range from $37,600 for Alternative 4A (the centralized RGF plus subsurface drip irrigation drainfield), to $103,800 for Alternative 4B (a centralized class A reuse facility with disposal via rapid infiltration). For the Phase 1 & 2 maximum flow projection of 70,800 gpd, annual O&M cost estimates range from $52,200 to $159,900 for these same alternatives.

Comparison of these tables shows that there is little difference in the capital costs of alternatives, especially for the Phase 1 minimum flow projection of 27,800 gpd, and that Alternative 4A, a centralized RGF with subsurface drip irrigation disposal, has the highest capital cost but also the lowest annual O&M costs for all flow projections. The relatively higher capital costs of alternative 4A are due to three factors unique to this alternative:

(1) the additional cost of aerobic treatment units (ATUs) needed for pretreatment of high strength wastewater flows from seven properties has been included,

(2) higher land costs associated with the large land area required for subsurface drip irrigation drainfields, and

(3) the high cost of the pressure-compensating drip tubing installed in the drainfield. The relatively lower O&M costs for Alternative A are due to

the lower labor requirements associated with this mechanically simple treatment plant, and fewer monitoring needs under a State Waste Discharge (SWD) permit for discharge to ground water, relative to a class A reuse facility (Alternative B), and relative to a package plant with a river outfall (Alternative 4C) and its associated National Pollutant Discharge Elimination System (NPDES) permit.

RECOMMENDATIONS AND ALTERNATIVES

The Stakeholders evaluated the wastewater system alternatives described in Chapter 5 and summarized with cost estimates in Chapter 6, and submitted their recommendations and comments to the project facilitator. Their recommendations and comments were compiled and discussed at the July 25, 2001 Stakeholders meeting. A separate transmittal of the Stakeholder's recommendations will be delivered to King County.

IMPLEMENTATION ISSUES AND RECOMMENDATIONS (NEXT STEPS)

The following list represents Gray & Osborne's understanding of the Stakeholders recommendations, and parallels the recommendations in the Stakeholders letter.

1. Engage the Dept. of Ecology in the project planning process, to include discussion of environmental permitting, Snoqualmie River 303(d) listing and TMDL issues for both point and non-point sources.

2. Pursue water quality sampling and testing of groundwater and surface water in and around the downtown business district to characterize the nature and extent of any pollution arising from the existing onsite septic systems in the business district. Evaluate the results of the water quality characterization study for compliance with current regulations, including the Snoqualmie River Total Maximum Daily Load (TMDL), and its associated Nonpoint Action Plan (see Appendix J and K).

3. Resolve any planning and growth management issues with King County Department of Development and Environmental Services. Concerns expressed include: community vs. public sewers and the feasibility of alternatives under GMA. The Stakeholders requested at the July 25, 2001 meeting that the feasibility of a tightline (force main) connection to an existing sewer system, such as that of the Sammamish Plateau Water and Sewer District, be evaluated with respect to GMA, current regulations and technical requirements. This evaluation would be made prior to selection of the preferred alternative.

4. Develop and implement a Management Plan for the administration, planning, operations and funding for the selected alternative. This plan will identify and describe the management entity that would own and operate the new facilities.

5. Prepare a detailed Funding Options and Financing Study.

6. Prepare an Engineering Report/Facilities Plan per WAC 173-240-050 to evaluate and identify the site-specific alternative to meet the needs of the Fall City Stakeholders. The report will build on the existing technical report and provide site specific preliminary engineering evaluations to include phasing, financing, permitting, and SEPA. The report will address various treatment processes to include the process described in Mr. Bernard's letter of June 27, 2001. The detailed financing study will be included in the Engineering Report, after the preferred alternative is selected.

7. Once the Engineering Report is approved, apply for loans and grants from the Funding Agencies identified in the Report.

CHAPTER 1

INTRODUCTION AND BACKGROUND

Fall City is a rural community located at the confluence of the Snoqualmie and Raging Rivers in central King County. Fall City is an old community, dating back one hundred years. A traditional wastewater management system infrastructure of private septic tanks and drainfields has developed within the town, and most onsite systems were installed prior to the Department of Health's minimum lot standard which requires up to ½ acre of land per septic system for the most permeable soils. There is concern among the residents and regulatory agencies that the current system may not be adequate to protect public health and the environment, especially in the commercial area. The community businesses produce a larger amount of wastewater than single family residences, and have small lots for septic systems with a high percentage of impervious area. This report will evaluate alternatives the business community of Fall City can employ to manage their wastewater in compliance with current regulations. The study will describe, evaluate, and provide preliminary design criteria and cost estimates for septic systems management programs, onsite systems, clustered systems, a community drainfield, alternative wastewater treatment technologies.

Fall City has been the focus of planning efforts in the last decade. In 1990, RW Beck and Associates developed a *Wastewater Facilities Plan*, in 1998, the Fall City Water District completed the *Wellhead Protection Plan* for the area, and in 1999, King County developed the *Fall City Sub-area Plan*.

WASTEWATER FACILITY PLAN, 1990

King County began this planning process in November 1989 due to concern that inadequate septic systems in the commercial area were contaminating the Snoqualmie River. It was concluded that there were many inadequate septic systems, and that the area should be sewered as soon as financially feasible. The plan was extended to include the residential areas surrounding the commercial area in hopes to secure the needed funding. The Plan recommended installing gravity sewers to convey wastewater to a Sequencing Batch Reactor Wastewater Treatment Plant that would discharge the effluent into the Snoqualmie River. The community was opposed to this plan, fearing that sewers would lead to unwanted growth and impose too high a financial burden on the community. Consequently, no change to the existing wastewater management system was constructed.

FALL CITY SUBAREA PLAN, 1999

This plan was developed by King County as a part of the Growth Management Act planning process. Fall City was included in the Snoqualmie Valley Community Plan as one of three "Rural Towns". Therefore it was zoned with higher density than other rural areas to enable continued growth of the Fall City area. The subarea plan makes recommendations to amend several policies and the land use map in the King County Comprehensive Plan, the zoning map, and zoning code (King County Code Title 21A). The goal of the zoning in Fall City is to direct development in the manner the majority of the residents of Fall City desire. They place high value on the rural character of their town, its small, compact size, and the local ownership of businesses. In order to maintain this quality, the only commercial zoning granted was the area that is already commercial, although the adjacent parcels have the option to convert from residential to commercial for a specified business type.

BACKGROUND

Due to public rejection of the plan for the installation of public sewers, the 1990 Plan was not implemented. Little has been done in the last 10 years to address the wastewater management concerns in the commercial area, but it is still a problem. Currently, due to inadequately sized septic systems in the commercial area, business owners are unable to expand their operations, or sell the property to another business venture because in order to get new operating permits, facilities must comply with current onsite wastewater disposal codes. Unless new facilities are installed, the business community will lose any ability to improve its economic viability while protecting public health and local surface and ground waters. As current systems fail, the businesses they serve will have to downsize, change business, or close, because the lots are not large enough to comply with present-day minimum lot size standards. However, another concern may be that increasing Fall City's ability to manage wastewater will promote unwanted growth. The Fall City community has seen nearby regions such as Redmond become suburbanized, and is making every effort to prevent similar changes from happening to Fall City. The negative response to the 1990 Plan was partly due to the issue of financing the potential project, and many people were concerned that low income and fixed income residents would be unable or hard pressed to come up with the required payments for construction and operation and maintenance of the new system. By reducing the project area to only include the business area, it is hoped that these concerns will be reduced. These conflicting concerns will come into play when the Stakeholder Group decides which wastewater management process to use, and the capacity to size the system for.

Gray & Osborne, Inc. has been retained by King County to provide technical assistance to the Stakeholder Group by identifying and evaluating a range of options for wastewater management within the Fall City Business Community. The study includes evaluation of septic system management program, community drainfield(s), and alternative centralized wastewater treatment and disposal technologies. Each option is assessed for effectiveness, feasibility, compliance and cost. The final draft report will be submitted to the Stakeholder Group by August 1, 2001. The Stakeholder Group, facilitator, and Gray & Osborne will meet four times in May and July, 2001, to keep the process on track and to assist the Stakeholders in reaching consensus on a recommended plan.

CHAPTER 2

STUDY AREA ENVIRONMENT

LOCATION

AREA LOCATION

Fall City is located in the Snoqualmie River Valley in central King County, 8 miles north of Interstate 90. This is designated as Section 15, Township T24N, Range R7E.

As stated in the subarea plan, "The Rural Town boundaries of Fall City adopted in the 1989 by King County are: Snoqualmie River on the north, Raging River on the northeast, SE David Powell Road and Lake Alice Road SE on the east, SE 56th St. on the south, Preston-Fall City Road and 328th Way SE on the southwest, SE 48th St and SE 46th St. and 326th Ave. SE at the central westside, and 321st Ave. SE at the northerly portion of the west side. This encompasses nearly 700 acres of land."

The area to be evaluated in this study is the commercial district, which sits along State Route 202, just south of the Snoqualmie River, bounded on the east by the Raging River at its inlet into the Snoqualmie River. Please see Figure 2-1 for a location map.

DEMOGRAPHICS

TAKEN FROM THE SUBAREA PLAN

"The 1990 United States Census reported a population of 3,888 and 1,395 housing units within Census Tract 326.00. Fall City is not an incorporated city and census information is not available specifically for the area encompassed by the Rural Town boundaries. Fall City, however is within an area identified in the census as a "Census Designated Place" and the 1990 population was reported as 1,850. The 1997 population estimate for Census Tract 326.00 is approximately 4,500, with about 1,700 housing units. About half of this may be within the current boundaries of the Rural Town of Fall City. Based on 1997 data from the Washington State Employment Security Department, the total employment level in Census Tract 326.00 was about 1,100 jobs. Of these, there were about 700 jobs in the government and education sector and some 400 private sector jobs."

AREA DESCRIPTION (FROM THE 1990 WASTEWATER FACILITY PLAN, RW BECK)

Various natural features of the study area location are discussed below, such as climate and precipitation, geology, soils, critical areas, flood plains, wetlands, air quality, and surface and ground water resources. Information on the public utilities available in the area is also discussed.

CLIMATE AND PRECIPITATION

The climate of the Fall City area is a mid-latitude, west coast maritime type. Mean temperatures range from about 38°F in January to 63°F in July. Precipitation records are not available for the Fall City area; however, such records are available for two nearby locations, Carnation and Snoqualmie Falls. Carnation receives an average of 46 inches precipitation per year, while Snoqualmie Falls receives considerable more, about 60 inches per year. The majority of the precipitation at both locations occurs during late fall, winter, and early spring as rainfall. Potential evapotranspiration exceeds precipitation in the Fall City area during only about three months of each year.

RIVER BASINS AND FLOODPLAINS

The Fall City Planning Area borders the Snoqualmie River. The Raging River, which flows through the southeast portion of Fall City, joins the Snoqualmie River just east of the commercial district. The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel Number 53033C 0709 (5-20-96) indicates that the central business area of the City lies within the Regulatory Floodway of the Snoqualmie River (Figure 2-2). This places significant federal, state and county restrictions on development activities in this area, which will be discussed later in this Report. The much narrower Raging River floodplain transverses southeast Fall City. The Snoqualmie River and its tributaries are classified by the State Department of Ecology (Ecology) as Class A waters. The Snoqualmie River is listed on the 303(d) list for temperature, but has not been listed for the other tested parameters of fecal coliform, pH, or dissolved oxygen.

TOPOGRAPHY AND GEOLOGY

The commercial area and most older housing is located on the alluvial plain located at the confluence of the Snoqualmie and Raging Rivers. The soils in the areas are classified as Type 1, which are coarse sands and gravel, and are highly permeable. Hills rise about 0.5 mile to the south of Fall City to over 1,000 feet. See Figure 2-3.

HYDROGEOLOGY

According to the 1990 Wastewater Facilities Plan, the entirety of Fall City is underlain by two aquifers. The first is a shallow aquifer within the younger alluvial deposits. The second is a deeper aquifer, confined by fine grained, lacustrine recessional outwash deposits from which the Fall City Water District obtains drinking water. Flow between the two aquifers is believed to be negligible. Groundwater generally flows north from the hills towards the Snoqualmie River. The uplands serve as recharge areas throughout the year, and the Snoqualmie and Raging Rivers may recharge the shallow aquifer seasonally. The water table under the commercial area is approximately 30 feet below groundlevel, and most likely experiences seasonal fluctuations. The rate of horizontal groundwater flow was estimated to vary from about 0.23 to 111 feet per day, based on soil porosity, hydraulic conductivity and hydraulic gradient. A reasonable average estimate is 5 feet per day, however this number should be used with caution due to area variability. Excerpts from the 1991 Facility Plan relating to hydrogeology are included in Appendix B, and additional hydrogeological data is available in a report by CH2M Hill in Appendix C.

VEGETATION

Areas of unaltered native vegetation do not exist in the commercial area. There are no known occurrences of endangered, threatened or sensitive plant species in or near the commercial area.

FISHERIES

The lower main stem of the Snoqualmie River below Snoqualmie Falls is an important spawning area for anadromous fish. Four Pacific salmon species – Chinook, coho, pink and chum salmon – spawn and rear in this area. The major spawning species is pink salmon. Sockeye, steelhead, cutthroat, and Dolly Varden trout are also present in significant numbers.

Spawning characteristics vary by species. Coho generally pass through the main stem, spawning in the tributary streams. Chinook (King) salmon generally spawn in gravel at the bottom of deeper, faster runs. Pink salmon emerging from the Snoqualmie River constitute the third largest migration of pinks to Puget Sound and their numbers exceed the other species combined. The most notable single spawning sites are gravel bars in the Snoqualmie River. Important spawning areas include:

- The Snoqualmie River at Carnation between Harris Creek and the Tolt River. This is one of the few high quality spawning areas for all anadromous species in the Snoqualmie River.
- The Snoqualmie River near Stickney Slough, midway between Fall City and Carnation has good spawning gravels located in a small, wide, shallow area in an otherwise channelized reach.
- The most intense Chinook spawning occurs between River Mile 34 and 35, about two miles downstream from Fall City.
- Pink and chum salmon and steelhead trout spawn in the shallower gravel bars of the main stem and larger tributary streams. They also use the gravel bars between River Mile 34 and 35 as well as in the mouth of the Raging River (Mile 36.1).
- Bull trout may also be present in the Snoqualmie and Raging Rivers. Bull trout could stray into the Snoqualmie River from the Skykomish River.

FALL CITY
ALTERNATIVE ONSITE
WASTEWATER PROJECT
FIGURE 2-1
LOCATION MAP

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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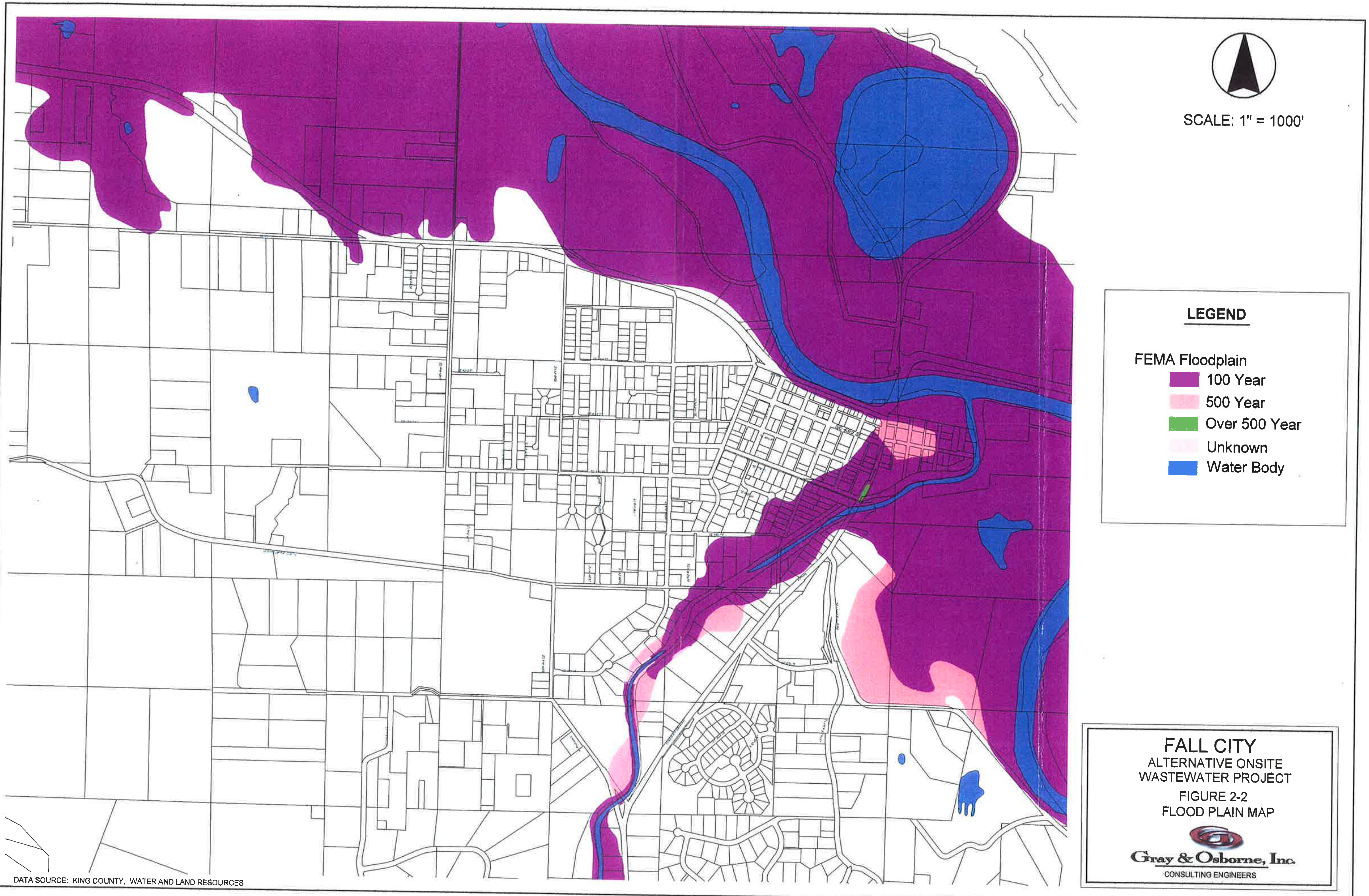
SCALE: 1" = 1000'
LEGEND
FEMA Floodplain
100 Year
500 Year
Over 500 Year
Unknown
Water Body
FALL CITY
ALTERNATIVE ONSITE
WASTEWATER PROJECT
FIGURE 2-2
FLOOD PLAIN MAP
Gray & Osborne, Inc.
CONSULTING ENGINEERS
DATA SOURCE: KING COUNTY, WATER AND LAND RESOURCES
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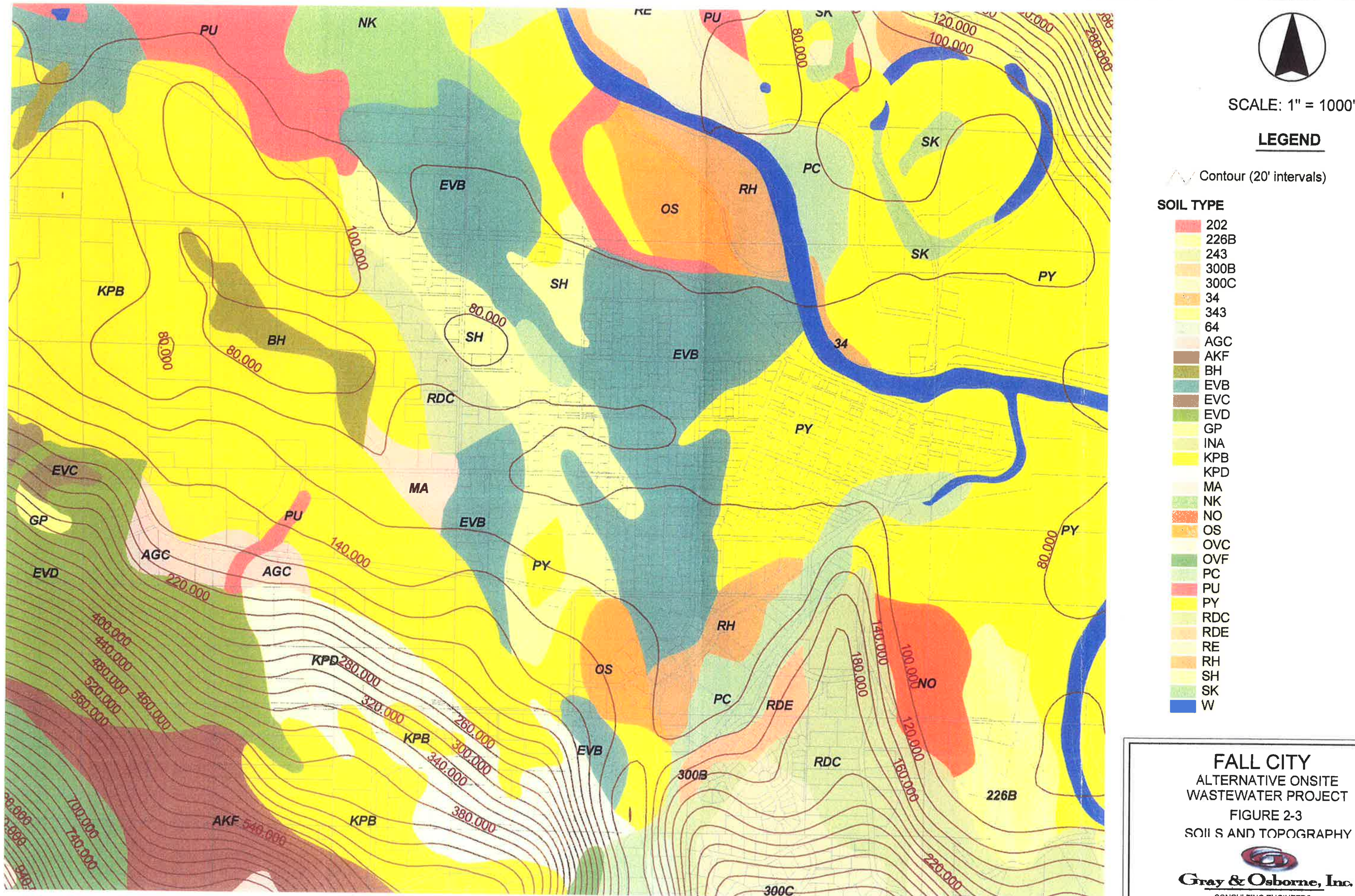

FALL CITY
ALTERNATIVE ONSITE WASTEWATER PROJECT
FIGURE 2-3
SOILS AND TOPOGRAPHY

Gray & Osborne, Inc.
CONSULTING ENGINEERS

SOURCE: KING COUNTY GIS

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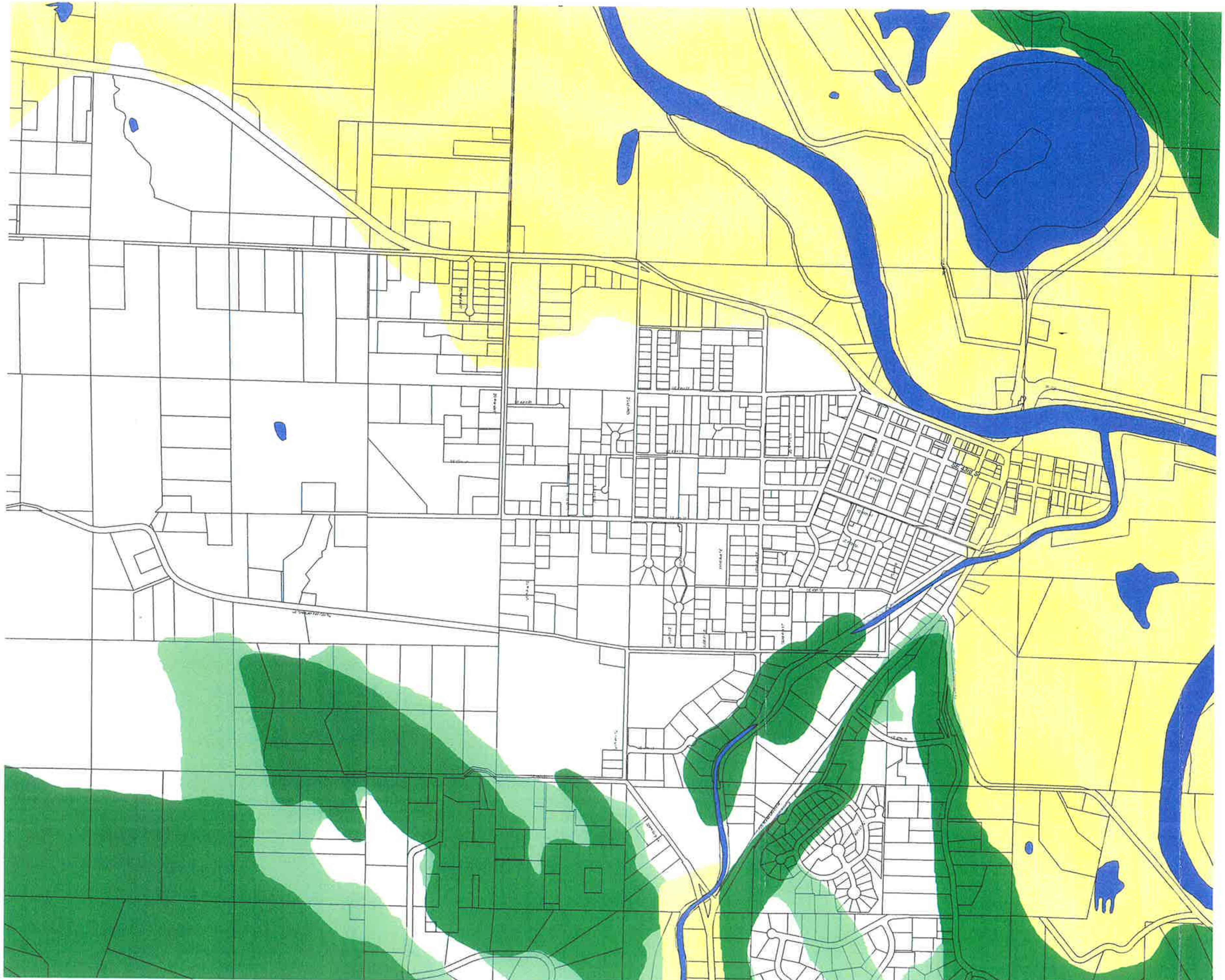

SCALE: 1" = 1000'

LEGEND

- Seismic Hazards
- Erosion Hazards
- Slide Hazards

SOURCE: KING COUNTY DEPARTMENT OF DEVELOPMENT AND ENVIRONMENTAL SERVICES, 2000

FALL CITY

ALTERNATIVE ONSITE WASTEWATER PROJECT

FIGURE 2-4

GEOLOGICALLY SENSITIVE AREAS

Gray & Osborne, Inc.

CONSULTING ENGINEERS

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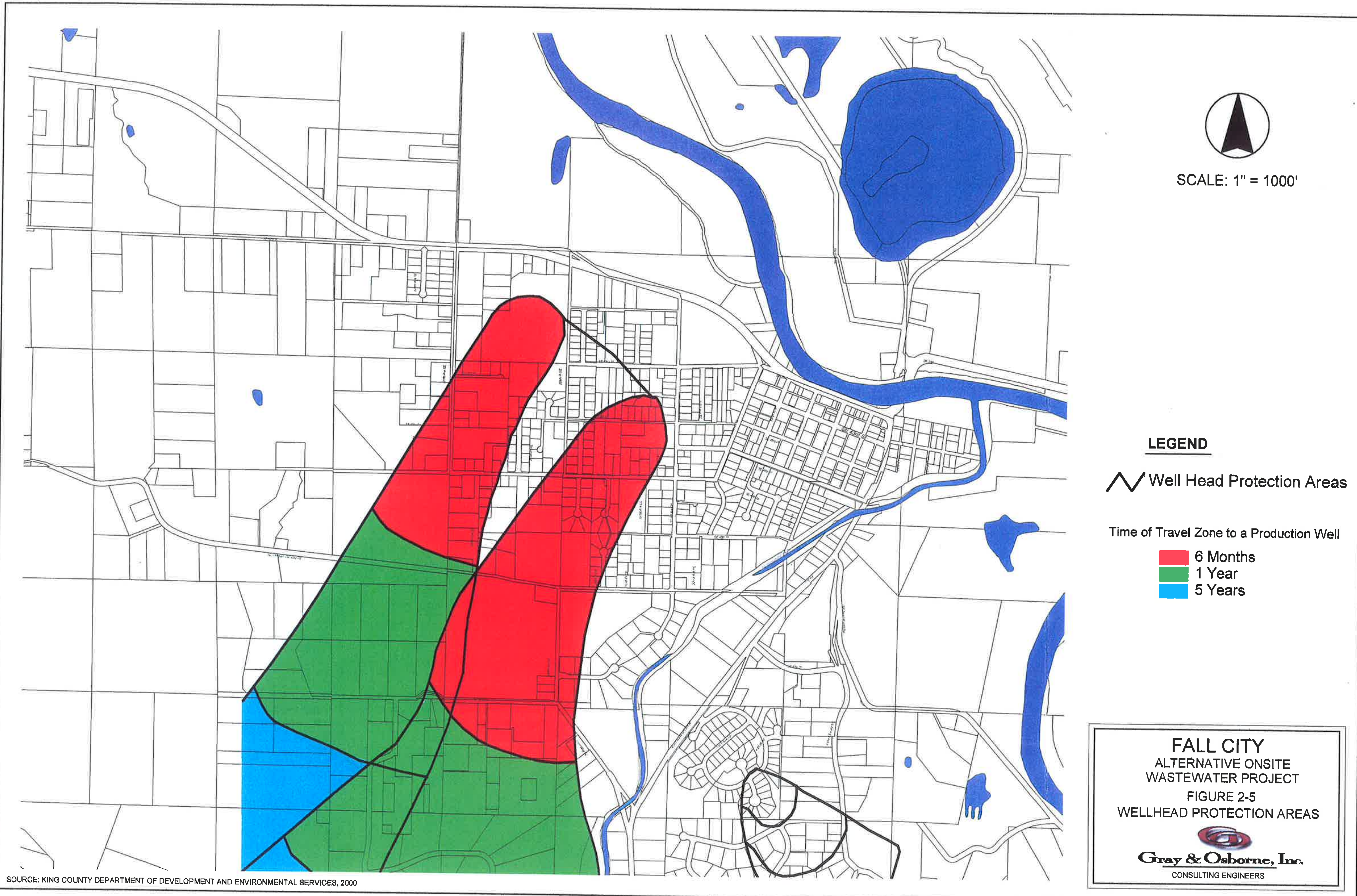

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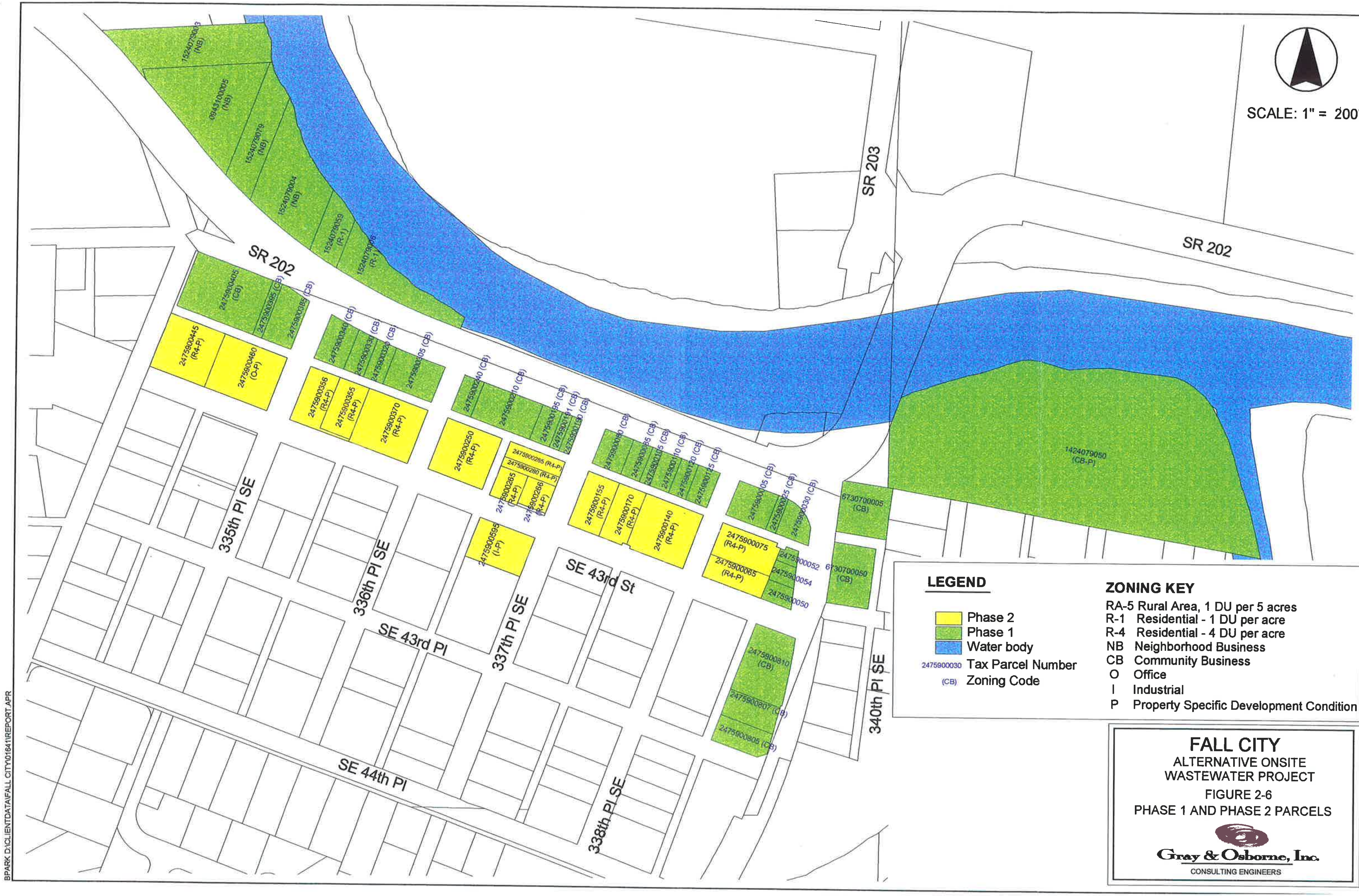

SCALE: 1" = 200'
SR 202
SR 203
SR 202
335th Pl SE
336th Pl SE
337th Pl SE
338th Pl SE
340th Pl SE
SE 43rd St
SE 43rd Pl
SE 44th Pl
LEGEND
Phase 2
Phase 1
Water body
2475900030 Tax Parcel Number
(CB) Zoning Code
ZONING KEY
RA-5 Rural Area, 1 DU per 5 acres
R-1 Residential - 1 DU per acre
R-4 Residential - 4 DU per acre
NB Neighborhood Business
CB Community Business
O Office
I Industrial
P Property Specific Development Condition
FALL CITY
ALTERNATIVE ONSITE
WASTEWATER PROJECT
FIGURE 2-6
PHASE 1 AND PHASE 2 PARCELS
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CONSULTING ENGINEERS
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CHAPTER 3

REGULATIONS AND DESIGN GUIDELINES

Within the state of Washington, wastewater treatment systems are regulated at three different levels based on their peak day design flow and the complexity of the treatment process. Treatment systems with a design flow less than 3,500 gallons per day (gpd), regardless of the means of treatment, are the responsibility of the owner and are regulated by the county or local health department. Individual and larger onsite systems designed for peak day flows between 3,500 gpd and 14,500 gpd are regulated by the Washington Department of Health (DOH).

Mechanical treatment facilities with a design flow greater than 3,500 gpd and any type of treatment system with a design flow greater than 14,500 gpd are under the regulation of the Washington Department of Ecology (Ecology). For each of these levels, specific standards and regulations apply. These standards and regulations, and other pertinent laws and requirements are discussed in the following sections.

FLOODPLAIN MANAGEMENT

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel Number 53033C 0709 (5-20-96) indicates that the central business area of the Town of Fall City lies within the Regulatory Floodway of the Snoqualmie River. This places significant federal, state and county restrictions on development activity in this area.

The current FEMA designations of the floodway in the Fall City area have been contested by two residents who have had their property surveyed, and believe their properties are out of the floodway. This will have to be confirmed with FEMA. A copy of a letter received from one of these residents is included in the Appendices.

Revised Code of Washington (RCW 86.12 & 86.16) and King County Sensitive Area Ordinances

These codes and ordinances include the following restrictions:

- Prohibit new construction in floodway
- Any construction or repair allowed in the floodway must not increase the 100-year flood elevation.

- Repairs cannot cost more than ½ the pre-flood value of a structure.
- Utilities may be allowed within the zero-rise floodway only if no feasible alternative site is available:
    - The King County Health Department must approve onsite septic systems in the floodway.
    - Construction of centralized sewage treatment facilities in floodways is prohibited.

ONSITE SEWAGE SYSTEMS

Chapter 246-272 WAC (Washington Annotated Code) is the primary regulation governing onsite sewage treatment systems in the state of Washington. The purpose of the regulation is to protect public health by minimizing effects to the following circumstances:

- The potential for public exposure to sewage from onsite systems;
- The adverse effects that onsite sewage discharge may have on surface water and ground water resources.

In the regulation, an onsite sewage system (OSS) is defined as a system that provides subsurface soil treatment and disposal on or near the property where it originates for residences or facilities that are not connected to a public sewer system. Chapter 246-272 addresses both individual onsite systems and large onsite systems.

The King County Board of Health implements the regulation at the local level, overseeing systems with a design flow up to 3,500 gpd. Large onsite systems (LOSS) are regulated at the state level by DOH. Large onsite systems are defined in the regulation as onsite systems that have a design flow, at any common point, greater than 3,500 gpd. As stated above, any systems with a design flow greater than 14,500 gpd is regulated by Ecology.

INDIVIDUAL ONSITE SEWAGE SYSTEMS

CHAPTER 246-272 WAC

Chapter 246-272 WAC presents the minimum design requirements for onsite systems with regard to design flow, horizontal and vertical separation, soil and site evaluation, loading rate, and minimum lot sizes. The regulation also addresses the responsibilities of the state and local authorities with regard to system installation, inspection, operation and maintenance, and repairs of existing systems.

Design Flow. The design flow for a residential onsite system in King County must be based on 150 gallons per day (gpd) per bedroom for the first 3 bedrooms minimum, and 120 gpd for each additional bedroom. However, the minimum design flow for any system must be at least 450 gpd, unless technical justification is provided to support approval of a lower design flow. This design flow is considered to be a peak day flow for the system, and all components must be sized to transport and treat this amount of flow. It is critical that extraneous water from surface runoff, footing drains, roof drains, and other non-sewage flows be kept from the onsite system components and the areas where the system is located. Excessive flows into the system will limit treatment effectiveness and greatly increase the potential for system failure.

To determine design flows for non-residential facilities, the designer is referred to the *"Design Manual: Onsite Wastewater Treatment and Disposal Systems,"* (USEPA, EPA-625/1-80-012, October, 1980); the *"Design Standards for Large Onsite Sewage Systems,"* (DOH, December 1993); or *"Criteria for Sewage Works Design,"* (Ecology, December 1998), as appropriate.

Horizontal Separation. To reduce the potential for impacts to public health and surface and ground waters, various onsite system components are required to be located minimum distances from drinking water sources such as wells and springs, surface waters, drainage courses, building foundations, and easement and property lines.

Table 3-1 presents the minimum horizontal separation distances required under King County regulations. These requirements may be increased if a condition exists that creates a greater potential for contamination or pollution. Such conditions include excessively permeable soils, unconfined aquifers, shallow or saturated soils, dug wells, and improperly abandoned wells. The horizontal setback requirements may be decreased if certain specified protective physical conditions exist and enhanced treatment beyond a conventional system is provided.

TABLE 3-1

Minimum Horizontal Separations

Items Requiring Setback	From Edge of Disposal Component and Reserve Area	From Septic Tank, Holding Tank, Containment Vessel, Pump Chamber and Distribution Box	From Building Sewer, Collection, and Nonperforated Distribution Line[1]
Non-public well or suction line	100 ft.	100 ft.	100 ft.
Public drinking water well	100 ft.	100 ft.	200 ft.
Public drinking water spring[2]	200 ft.	200 ft.	200 ft.
Spring or surface water used as drinking water source[2],[3]	100 ft.	100 ft.	100 ft.
Pressurized water supply line[4]	10 ft.	10 ft.	10 ft.
Properly decommissioned well[5]	10 ft.	NA	NA
Surface[3]			
Marine water	100 ft.	100 ft.	10 ft.
Fresh water	100 ft.	100 ft.	10 ft.
Building foundation			
Downslope	15 ft.	5 ft.	2 ft.
Upslope	10 ft.	5 ft.	2 ft.
Property or easement line	10 ft.	5 ft.	NA
Interceptor/curtain drains/drainage ditches			
Downgradient[6]	30 ft.	5 ft.	NA
Upgradient[6]	10 ft.	NA	NA
Downgradient cuts or banks with at least 5 ft. of original, undisturbed soil above a restrictive layer due to a structural or textural change	25 ft.[7]	NA	NA

TABLE 3-1 – (continued)

Minimum Horizontal Separations

Items Requiring Setback	From Edge of Disposal Component and Reserve Area	From Septic Tank, Holding Tank, Containment Vessel, Pump Chamber and Distribution Box	From Building Sewer, Collection, and Non-perforated Distribution Line(1)
Downgradient cuts or banks with at least 5 ft. of original, undisturbed soil above a restrictive layer due to a structural or textural change	50 ft.(8)	NA	NA

(1) "Building sewer" as defined by the most current edition of the Uniform Plumbing Code. "Nonperforated distribution" includes pressure sewer transport lines.

(2) If surface water is used as a public drinking water supply, the designer shall locate the OSS outside of the required sanitary control area.

(3) Measured from the ordinary high water mark.

(4) The local health officer may approve a sewer transport line within ten feet of a water supply line if the sewer line is constructed in accordance with section 2.4 of the Department of Ecology's *"Criteria for Sewage Works Design," revised October 1985*, or equivalent.

(5) Before any component can be placed within one hundred feet of a well, the designer shall submit a "decommissioned water well report" provided by a licensed well driller, which verifies that appropriate decommissioning procedures noted in chapter 173-160 WAC were followed. Once the well is properly decommissioned, it no longer provides a potential conduit to ground water, but septic tanks, pump chambers, containment vessels, or distribution boxes should not be places directly over the site.

(6) The item is downgradient when liquid will flow toward it upon encountering a water table or a restrictive layer. The item is upgradient when liquid will flow away from it upon encountering a water table or restrictive layer.

(7) Fifteen feet plus the height of the cut or bank, minimum 25 feet.

(8) Fifteen feet plus the height of the cut or bank, minimum 50 feet not to exceed 100 feet.

Soil and Site Evaluation. Evaluation of the proposed treatment site and the soils on the site is very critical to the design of the onsite system. The regulation requires that this evaluation be completed by an engineer, a qualified onsite system designer, or a soil scientist. The evaluation must include a sufficient number of soil logs to determine the classification of soils in primary and reserve disposal areas and the presence of a restrictive layer within five feet of the surface. Table 3-2 presents the soil classification information used to evaluate soils for onsite sewage systems.

TABLE 3-2

Soil Textural Classification

Soil Type	Soil Classification Description
1A	Very gravelly[(1)] coarse sands or coarser, all extremely gravelly soils[(2)].
1B	Very gravelly medium sand, very gravelly find sand, very gravelly very fine sand, very gravelly loamy sands.
2A	Coarse sands (also includes ASTM C-33 sand)
2B	Medium sands
3	Fine sands, loamy coarse sands, loamy medium sands
4	Very fine sands, loamy fine sands, loamy very fine sands, sandy loams, loams.
5	Porous, well developed structure in silt and silt loams
6[(3)]	Other silt loams, silty clay loams, clay loams
Unsuitable	Sandy clay, clay, silty clay, and strongly cemented or firm soils.

(1) Very gravelly + >35% and <60% gravel and coarse fragments, by volume.
(2) Extremely gravelly = >60% gravel and coarse fragment, by volume.
(3) Unsuitable in King County.

The site evaluation must determine the ground water conditions and the expected maximum ground water table level. The proposed site also must be reviewed for drainage, slide and erosion potential, flood potential, cuts, banks, fill areas, and existing appurtenances such as wells, surface water, and existing utilities.

Vertical Separation. Vertical separation is defined by Chapter 246-272 WAC as follows:

> "...the depth of unsaturated, original, undisturbed soil of soil types 1B-6 between the bottom of a disposal component and the highest seasonal water table, a restrictive layer, or soil type 1.A..."

The vertical separation that exists between the bottom of the disposal component and the high ground water table, restrictive layer, or a Type 1A soil, along with soil classification and horizontal separation requirements, have a significant bearing on the level of treatment and type of disposal required. The effects of vertical separation and soil classification on treatment and effluent distribution requirements are presented in Table 3-3.

TABLE 3-3

Treatment and Effluent Distribution Requirements for Soil Types and Depths

	Vertical Separation			
Soil Type	<1 Foot	≥1 Foot to <2 Feet	≥2 Feet to <3 Feet	≥3 Feet
1A	Not allowed	Pressure Distribution(1), 2)	Pressure Distribution(1)	Pressure Distribution(1)
2A	Not allowed	Pressure Distribution(1), (2)	Pressure Distribution	Pressure Distribution
1B-6	Not allowed	Pressure Distribution(1), 2)	Pressure Distribution	Gravity Distribution

(1) System meeting Treatment Standard 2 required.
(2) Mound systems installed where the original, undisturbed, unsaturated soil depth is between twelve and eighteen inches require pretreatment by an intermittent sand filter.

As indicated in Table 3-3, onsite systems are not allowed where less than one foot of vertical separation exists. Where less than 3 feet of vertical separation exists and where soil types 1A and 2A are found, pressure distribution of effluent is required. Also, where only 1 to 2 feet of separation exists and wherever soil type 1A is found, enhanced treatment beyond that provided by a septic tank is required. The treatment required must meet or exceed Treatment Standard 2.

Treatment Standards 1 and 2, as defined in Chapter 246-272 WAC, indicate treatment systems that produce an effluent with less than 10 milligrams per liter (mg/l) of biochemical oxygen demand (BOD_5) and total suspended solids (TSS). Treatment Standard 1 must have less than 200 fecal coliforms per 100 milliliters (FC/100ml); Treatment Standard 2 must have less than 800 FC/100ml. The treatment requirements are based on a monthly average. If mound systems are used to provide treatment and additional separation where the vertical separation is only 12 to 18 inches, an intermittent sand filter must be used for pretreatment in order to meet the treatment requirements.

Loading Rate. The volume of effluent that can be applied to a disposal area is determined by the soil classification and, for soil type 1A, also by the type of treatment provided. Table 3-4 indicates the maximum loading rates per soil type for domestic sewage disposal. This table can be used to calculate the total soil absorption area required to be provided for the given design flows. The available soil absorption area is based on the total area of the bottom of the disposal trench.

TABLE 3-4

Maximum Hydraulic Load Rate for Residential Sewage[1]

Soil Type	Loading Rate (gal/sf/day)
1A	Varies according to system selected to meet Treatment Standard 2[2]
1B	Varies according to soil type of non-gravel portion[3]
2A	1.2
2B	1.0
3	0.8
4	0.6
5	0.45
6[4]	0.2

(1) Compacted soils, cemented soils, and/or poor soil structure may require a reduction of the loading rate or make the soil unsuitable for conventional OSS systems.

(2) Due to the highly permeable nature of type 1A soil, only alternative systems that meet or exceed Treatment Standard 2 can be installed. However, a conventional gravity system may be used if it meets all criteria listed under Chapter 246-272-11501(2)(h). The loading rate for these systems is provided in the appropriate guideline.

(3) The maximum loading rate listed for the soil described as the non-gravel portion is to be used for calculating the absorption surface area required. The value is to be determined from this table.

(4) Unsuitable in King County.

Soil type 1A is extremely coarse and gravelly, resulting in a very high permeability. Because soil type 1A is so permeable, it provides minimal soil treatment, and therefore, requires that enhanced treatment be provided. The soil classification ascension from Type 1A to Type 6 indicates soils that are increasingly less permeable. Table 3-4 demonstrates that, as the soil type becomes less permeable, the allowable loading rate decreases. This results in an increasing area requirement for absorption.

Repair and Replacement of Existing Systems. When existing onsite systems fail and the proposed repair or replacement system cannot conform to the previously discussed requirements, Chapter 246-272 WAC provides for a means of repair or replacement through enhanced treatment requirements. The enhanced requirements are found in Table VI of the regulation and are, therefore, commonly referred to as "Table 6 repairs." These requirements are presented in Table 3-5.

TABLE 3-5

Requirements for Repair or Replacement of Disposal Components Not Meeting Vertical and Horizontal Separations(1),(2)

Vertical Separation in Feet	Horizontal Separation in Feet(3)		
	<25	25-50	>50-≤100
<1	Treatment Standard 1	Treatment Standard 1	Treatment Standard 1(4)
1-2	Treatment Standard 1	Treatment Standard 1(4)	Treatment Standard 2
>2 – 3	Treatment Standard 1(4)	Treatment Standard 2	Treatment Standard 2
>3	Treatment Standard 2	Treatment Standard 2	Pressure Distribution

(1) The treatment standards refer to effluent quality before discharge to unsaturated, subsurface soil.

(2) The local health officer may permit ASTM C-33 sand to be used as fill to prevent direct discharge of treated effluent to ground water, surface water or upon the surface of the ground.

(3) The horizontal separation indicated is the distance between the disposal component and the surface water, well, or spring. If the disposal component is upgradient of a surface water, well or spring to be used as a potable water source, the next higher standard level of treatment shall apply unless treatment standard 1 is already being met.

(4) Mound systems are not allowed to meet treatment standard 2.

The horizontal separation requirements presented in Table 3-5 refer to the distance to surface water, a well, or a spring. If the surface water, well, or spring is used as a potable water source, then the next higher standard of treatment is required. Treatment Standard 1 was previously defined as a system that produces an effluent with less than 10 mg/l of BOD_5 and TSS and less than 200 FC/100ml, based on a monthly average. Treatment Standard 2 has the same requirement for BOD_5 and TSS, but a less stringent fecal coliform requirement, less than 800 FC/100ml.

Minimum Land Area. Chapter 246-272 WAC also contains minimum land requirements for new developments and subdivisions to be served by onsite systems. These minimum land area requirements are based on soil type and the proposed source of drinking water supply. Table 3-6 presents the minimum land area requirements for new onsite systems being served by a public water supply and by private wells.

TABLE 3-6

Minimum Land Area Requirement Single Family Residence or Unit Volume of Sewage

Type of Water Supply	Soil Type					
	1A, 1B	2A, 2B	3	4	5	6
Public	0.5 acre(1) 2.5 acres(2)	12,500 sf	15,000 sf	18,000 sf	20,000 sf	22,000 sf
Individual on each lot	1 acre(1) 2.5 acres(2)	1 acre	1 acre	1 acre	2 acres	2 acres

(1) Due to the highly permeable nature of type 1 soil, only alternative systems which meet or exceed Treatment Standard 2 can be installed.

(2) A conventional gravity system in type 1 soil is only allowed if it is in compliance with all conditions listed under WAC 246-272-11501 (2)(h). One of these limiting conditions is a 2.5 acres minimum lot size.

King County Regulations

King County Board of Health is the local authority that implements Chapter 246-272 WAC for onsite systems with design flows up to 3,500 gpd. At a minimum, the County must implement the requirements of the state regulation. The County may elect to make certain provisions more stringent or implement additional requirements to address local conditions. The County implements the state regulation by means of the King County Board of Health Code, Title 13.

King County Board of Health Code, Title 13. The stated purpose of the County regulation is to:

- Provide for and promote the health of the general public;
- Establish location, design, installation, alteration, addition, repair, relocation, replacement, maintenance, monitoring and use standards for all onsite sewage systems to accommodate effective treatment and disposal of sewage on a long term basis;

The County's onsite system regulation adopts and incorporates by reference, as minimum standards, Chapter 246-272 WAC. Title 13 design standards expand and add to the requirements of Chapter 246-272 WAC. The County's onsite regulation also establishes requirements for certification of pumpers, installers, designers, and maintenance specialists and outlines rules for enforcement and appeals.

The design standards outline procedures for obtaining approval of an onsite sewage system, as well as design, installation and operation and maintenance requirements. The system must be designed by a septic designer or professional engineer in good standing under Chapter 18.43 RCW.

Design Criteria. For the most part, the Title 13 design criteria are slightly more conservative than Chapter 246-272, for design flow and vertical and horizontal separation. The minimum tank volume is based on the number of bedrooms in the home, as shown in Table 3-7. Under Title 13, a larger tank volume is required per bedroom, and the installation of a garbage grinder is included.

TABLE 3-7

Minimum Septic Tank Volume

Number of Bedrooms	Volume of Tank (Gallons)
1-4	1,000
Each Additional Bedroom	Add 250 Gallons per Bedroom
Garbage Grinder Installed	Add 750 Gallons

The design standards incorporate guidelines from the Washington State Technical Review Committee (TRC) for the design of alternative systems and pressure distribution.

Operation and Maintenance. Table 3-8 summarizes the minimum frequency of operation and maintenance required for each type of onsite system, and the owner's options for completing the necessary operation and maintenance work. As the table indicates, with increasing technical complexity of the onsite system, more frequent O&M oversight is required. There is also a greater need to have the work completed by appropriately trained technical personnel.

TABLE 3-8

Onsite System Operation and Maintenance Requirements

Inspection Interval	Conventional Gravity System	Pressure Distribution	Mound or Sandfilter	Aerobic Units	Non-Discharging Toilets	Commerce and Food Service
First 45 days[(2)]	n/a	n/a	n/a	OSM or System Designer	n/a	n/a
Every 3 months	n/a	n/a	n/a	OSM[(5)]	N/a	n/a
First 6 months[(2)]	SO, designer or OSM	OSM or System Designer[(3)]	OSM or System Designer[(3)]	n/a	SO	OSM or System Designer[(3)]
Annually	SO[(4)] or OSM	OSM[(4)]	OSM[(3)]	OSM[(3)]	SO[(3)]	OSM[(3)]
Every 3 years	SO, pumper or OSM	OSM[(3)]	n/a	n/a	N/a	n/a

SO = System Owner OSM = Certified Onsite System Maintainer

(1) The system components and conditions which must be inspected shall be specified in the approved OSS owner's operation and maintenance instruction manual.

(2) An initial system performance inspection to insure that the system has been properly designed and installed, is adjusted properly, is being operated correctly and is performing as expected.

(3) A complete OSS performance monitoring evaluation is to be conducted and a system performance monitoring report, on forms provided by the health officer, is to be submitted by the person performing the maintenance inspection to the OSS owner at the time of inspection and to the health officer within thirty days of the inspection.

(4) At least an annual septic tank maintenance check is required if the structure served is equipped with a garbage grinder waste disposal unit. If a screened outlet baffle is present an annual check is recommended. Pumpers shall report each pumping event to the health officer in accordance with Chapter 13.68.

(5) A quarterly maintenance and monitoring inspection of the ATU is required.

From Section 13.60.005 of Title 13:

In addition to the mandatory maintenance schedule, every system owner is responsible for "the continuous proper operation and maintenance of the OSS, and shall determine the level of solids and scum in the septic and at least once every three years for residential systems with no garbage grinder, and once every year if a garbage grinder is installed, and, unless otherwise provided in writing by the health officer, once every year for commercial systems."

Other requirements include maintaining flows at or below the approved design both in waste quality and quantity, employing an approved pumper to remove septage from tank, and not adding anything atypical of residential wastewater or not approved by DOH to the tank.

LARGE ONSITE SEWAGE SYSTEMS

Onsite systems with design flows, at any common point, greater than 3,500 gallons per day are considered "large" or "community" onsite sewage systems. In King County, Public Health – Seattle & King County under contract with the Washington Department of Health (DOH) approves and regulates large onsite sewage systems (LOSS) up to a peak day flow of 14,500 gpd.

CHAPTER 246-272 WAC

While the overall general requirements of Chapter 246-272 WAC apply to LOSS, the large systems are specifically addressed in Section 246-272-08001 of the regulation. This section identifies information that must be submitted to Public Health – Seattle & King County and DOH in order to obtain approval of a LOSS, as well as management, operation and maintenance, and permitting requirements.

Due to the potential for greater impacts from a LOSS, the proponent must submit an engineering report that includes the proposed design information, as well as a thorough analysis of the proposed site. The site analysis must discuss site topography, geology, surface and ground water, drainage, zoning, surrounding land use, etc. The proponent must also present how the system will be managed, operated, and maintained. The engineering report, as well as the design plans and specifications, are required to be prepared by a professional engineer. A certified installer is required to construct the system, and the design engineer must inspect the construction of the system.

Once the engineer documents that construction is complete and the DOH engineer, in conjunction with Public Health – Seattle & King County, performs the final inspection, the LOSS is issued an operating permit from both DOH and Public Health – Seattle &

King County. As-built drawings and an operation and maintenance (O&M) manual, prepared by the design engineer, are also required. The operating permit is renewed annually, if the management, treatment adequacy, and O&M is acceptable to both DOH and Public Health – Seattle & King County.

DOH DESIGN STANDARDS

Chapter 246-272-08001 WAC states that a proposal to construct a LOSS must meet the requirements of the *Design Standards for Large Onsite Sewage Systems,* (revised DOH, 1994). These standards are based on the regulation and outline in more detail the planning and design requirements for large onsite systems.

Design Flows and Loadings. Design flows for multiple single homes or multi-family dwellings that discharge to a LOSS are based on 120 gallons per day per bedroom. Table 3-9 indicates the allowable flows per dwelling unit based on number of bedrooms and estimated individuals per dwelling unit. These design flows are assumed to be peak flows. Therefore, if actual peak flows are expected to be greater than these estimates, the higher flow estimates should be used.

TABLE 3-9

Residential Design Flows for Large Onsite Sewage Systems

Bedrooms/Unit	Individuals/Unit	Design Flows (gpd)
1	2	300(1)
2	3	240
3	3.5	360
4	4.5	480

(1) Seventy five gallons per person, 2 person per bedroom, 2 bedroom minimum per unit.

Note: 75 gpd per person, minimum 3 bedrooms, 2 people per bedroom, per lot or space.

Design flows for facilities other than residential, including commercial, recreational, and institutional facilities, should be based on Table 3-10 or King County Board of Health Title 13 - Table 13.28-5, whichever is more restrictive. Also, if water use data is available, this information can be used to justify design flows.

Septic Tanks. Septic tank volume must be sized to provide 1.5 days detention time at the peak day design flow. This volume can be provided with a single tank or with multiple tanks. If multiple tanks are used, the first tank should have a minimum of 24 hours detention time at peak flow. Enhanced treatment beyond a septic tank may be required based on factors such as soil type, strength of the wastewater, and location in an area of special concern. Typical domestic wastewater strength is assumed to be 230 mg/l BOD_5, 150 mg/l TSS, and <50 mg/l of Total Oil and Grease (TOG). If wastewater strength is expected to be significantly greater than these levels, then enhanced treatment beyond that provided by a septic tank would likely be required.

TABLE 3-10

Design Flows for Non-Residential Development[(1)]

Discharge Facility	Design Units	Flow** (gpd)	Flow Duration (hr)
School w/ showers and cafeteria	Per person	16	8
School w/o showers and w/ cafeteria	Per person	12.6	8
School w/o showers and w/o cafeteria	Per person	10	8
Boarding schools	Per person	75	16
Motels @ 65 gal/person (rooms only)	Per room	130	24
Restaurants*	Per seat	50	16
Interstate or through highway restaurants*	Per seat	180	16
Interstate rest areas	Per person	5	24
Service stations	Per vehicle served	10	16
Factories w/showers	Per person/8-hr shift	25	Operating period
Factories w/o showers	Per person/8-hr shift	15	Operating period
Shopping centers*	Per 1,000 sf of floor space	200-300	12
Hospitals*	Per bed	300	24
Nursing homes*	Per bed	200	24
Homes for the aged*	Per bed	100	24
Doctor's office in medical center*	Per 1,000 sf	500	12
Laundromats	Per machine	500	16
Community colleges	Per student and faculty	15	12
Swimming pools	Per swimmer	10	12
Theaters, drive-in type	Per car	5	4
Theaters, auditorium type	Per seat	5	12
Churches w/o kitchen	Per seat	3	4
Churches w/ kitchen	Per seat	5	4
Day care centers	Per person	20	12

TABLE 3-10 – (continued)

Design Flows for Non-Residential Development(1)

Discharge Facility	Design Units	Flow** (gpd)	Flow Duration (hr)
Picnic areas	Per person	5	12
Campgrounds w/ limited comfort stations, no laundry, no sewer hookup	Per camp site	50	24
Campgrounds/RV parks w/ flush toilets, showers, laundry, no sewer hookup	Per camp site	75	24
Campgrounds/RV parks w/ flush toilets, showers, w/ or w/o laundry, and sewer hookup	Per camp site	100	24
Campgrounds/RV parks w/ sewer hookup only, no comfort station	Per camp site	50	24
Trailer dump stations*	Per dump	20	24

(1) Or King County Board of Health Title 13 – Table 13.28-5, whichever is more restrictive.
*Indicates potential high waste strengths facilities requiring pretreatment
**Includes normal infiltration
Source: Criteria for Sewage Works Design (Ecology, revised December 1998)

Disposal Field Design. Vertical separation at the proposed LOSS disposal site must be a minimum of 3 feet to any restrictive layer, high ground water table, or Type 1A soil. Mounds or sand fill cannot be used to achieve the required minimum separation. Pressure distribution is required for all LOSS disposal fields, regardless of soil type or treatment design. Design must be according to the TRC "*Guidelines for the Use of Pressure Distribution Systems*".

The disposal field is required to be constructed in two drainfields, each at 50 percent of the required area. A third disposal field equal to 50 percent of the required area must also be constructed to provide for alternating disposal. The alteration of discharges should be designed according to the TRC "*Guidelines for Alternating and Dosing Systems*". An additional area equal to 50 percent of the required disposal area must be reserved for construction of a future replacement disposal field.

Disposal field loading rates are as shown in Chapter 246-272 WAC, however, a LOSS would not be allowed in Type 6 soils. A LOSS would only be allowed in Type 1A soils if enhanced treatment was provided.

GROUND WATER DISCHARGE

Within the state of Washington, a discharge of wastewater effluent to ground water greater than 14,500 gallons per day (gpd) is regulated by the Department of Ecology (Ecology). The discharges to ground water are required to comply with Chapter 173-200 WAC, the Ground Water Quality Standards. Ecology implements the Ground Water Standards through issuance of a State Waste Discharge Permit, which details permit limits, special conditions, and monitoring requirements. Procedures for issuance of a State Waste Discharge Permit are presented in Chapter 173-216 WAC.

GROUND WATER QUALITY STANDARDS

Chapter 173-200 applies to all ground waters of the state that occur in the saturated zone beneath the land surface. According to the regulation, discharges must be applied in a manner that will not cause pollution of any ground waters in the saturated zone. Compared to surface water, ground water is relatively immobile. Ground water residence times can vary from a few weeks to thousands of years. This fact alone makes the assimilative capacity of ground water limited. Once reaching an underground aquifer, the physical and chemical characteristics of water change slowly. While ground water may support a number of beneficial uses, the overriding basis for the regulations is to protect all ground water as a potential drinking water source.

GROUND WATER QUALITY CRITERIA

Accordingly, the Ground Water Standards contain numerical criteria that cannot be exceeded in ground water, with exception of natural causes. The ground water quality criteria in WAC 173-200 are human health based standards that, for many parameters, are equivalent to the Washington State Department of Health Drinking Water Standards. The Drinking Water Standards do not directly apply to the discharge, but are mentioned for comparison and explanation of the Ground Water Quality Standards.

ANTI-DEGRADATION POLICY

The State of Washington has very high quality ground water, such that it often does not require treatment to be used directly for drinking water. The goal of the Ground Water Standards is to maintain that high quality, and to protect it to the level of a drinking water source. The intent of the regulation is to prevent degradation of ground water quality beyond existing background conditions. Degradation above background levels can only be allowed when "an overriding consideration of the public interest will be served" and "all contaminants have been provided with all known, available, and reasonable methods of prevention, control and treatment (AKART) prior to entry." This policy is known as "anti-degradation." The policy of anti-degradation often becomes the prime determinant of what can be discharged to ground water.

As stated above, the Ground Water Standards contain numerical criteria that cannot be exceeded in ground water (with the exception of natural causes) and that are comparable to the numerical criteria established for drinking water. The most significant standard is for nitrate, which is 10 mg/l. The Ground Water Standards do not allow a discharge to cause an increase in nitrate, or any other parameter, in the ground water up to the value cited in the ground water quality criteria. Quite to the contrary, as previously mentioned, the intent is to maintain the water quality that is present prior to the onset of the discharge (i.e., the background water quality).

The background water quality would be the quality of a sample taken upgradient of the discharge area. In essence, the intent of the Ground Water Standards is to maintain the quality of the ground water downgradient of the discharge area at the same quality as the upgradient ground water. This policy is known as the "Antidegradation Policy", which is found in WAC 173-200-030. Section (2)(a) and (c) of this policy are reiterated as follows:

(a) Existing and future beneficial uses shall be maintained and protected and degradation of ground water quality, that would interfere with or become injurious to beneficial uses, shall not be allowed.

(c) Whenever ground waters are of a higher quality than the criteria assigned for said waters, the existing water quality shall be protected, and contaminants that will reduce the existing quality thereof shall not be allowed to enter such waters. Exceptions to this standard can be issued in those instances where it can be demonstrated to the department's satisfaction that: (i) An overriding consideration of the public interest will be served; and (ii) All contaminants proposed for entry into said ground water shall be provided with all known, available, and reasonable methods of prevention, control, and treatment prior to entry.

In actuality, most waste discharges to the ground water will result in an increase in contaminants above the level of the background water quality in the area downgradient of the discharge. When this occurs, Ecology must make a determination of what constitutes degradation and impact to beneficial use, what constitutes an overriding consideration of the public interest, and what constitutes all known, available, and reasonable methods of prevention, control, and treatment (AKART) for the effluent discharge.

DESIGN REQUIREMENTS

Nitrogen is the major parameter of concern with the discharge of treated wastewater into ground water. Nitrate nitrogen (NO_3-N) is the form of nitrogen of highest concern because of its potential impact on human health. The ground water standard for nitrate is

10 mg/L, the same as the current drinking water standard. Nitrate is a highly soluble and mobile species. If it is not taken up in the root zone, it will readily migrate to groundwater. Reduced forms of nitrogen, such as organic nitrogen and ammonia, are readily oxidized to nitrate. Therefore, reduction of total nitrogen to less than 10 mg/L prior to ground water discharge is generally recommended. To be accepted as AKART, treatment technologies for wastewater effluent discharges to ground water must be capable of reducing total nitrogen in the discharge to less than 10 mg/l.

In situations where the background nitrate level is low (i.e. less than 0.5 mg/l), Ecology will generally seek to limit the downgradient increase in nitrate to no more than 2 to 3 mg/l. This higher contaminant limitation is viewed as not resulting in degradation of beneficial uses. Increases significantly above this level would be required to demonstrate that there is a significant "overriding consideration of the public interest" that will be served by the project. As a result, in designing a disposal system with such as a drainfield or sprayfield, nitrogen loading must be evaluated along with hydraulic loading to determine area requirements.

HYDROGEOLOGICAL SITE INVESTIGATION

The proponent of a discharge to ground water would be required to perform a hydrogeological evaluation of the proposed discharge area. The evaluation must include the following elements:

- Soil investigation (test pits)
- Monitoring well installation
- Aquifer testing and characterization
- Ground water sampling
- Hydrogeologic analysis
- Site characterization and monitoring report

Soil samples should be analyzed for parameters such as grain size, pH, salinity, organic content, and cation exchange capacity. The ground water would need to be evaluated to establish background water quality. The ground water should be tested for parameters such as nitrogen compounds (i.e., nitrate, TKN, ammonia), BOD5, total dissolved solids (TDS), total suspended solids (TSS), coliform, alkalinity, chloride, sulfate, iron, manganese, pH, conductivity and temperature.

GROUND WATER MODELING

Modeling of the proposed discharge would be required to evaluate the necessary discharge area and to estimate potential impacts to ground water, primarily with respect to nitrate loading. The model would estimate annual nitrogen loads infiltrating from the discharge area, and then estimate the resulting nitrate-nitrogen concentration in ground water when nitrate from the infiltrating source is added to background concentrations.

STATE WASTE DISCHARGE PERMIT

As stated previously, Ecology implements the Ground Water Standards through issuance of a State Waste Discharge Permit. The permit details the effluent limits, monitoring requirements, and special conditions. Procedures for issuance of a State Waste Discharge Permit are presented in Chapter 173-216 WAC.

It is anticipated that monitoring would be required for a ground water recharge project in order to ascertain impacts and to ensure there is no significant degradation. Ongoing monitoring requirements would be established by Ecology in the State Waste Discharge Permit. Parameters that would generally be monitored under a State Waste Discharge Permit include the following:

- Nitrate
- Total Kjeldahl nitrate (TKN)
- Ammonia
- Biological oxygen demand (BOD)
- Total dissolved solids (TDS)
- Total suspended solids (TSS)
- Total coliform bacteria
- Calcium
- Potassium
- Sodium
- Bicarbonate
- Carbonate
- Chloride
- Sulfate
- Iron
- Manganese

The following field parameters would also be measured in the ground water and reported to the Department:

- pH
- Conductivity
- Dissolved oxygen
- Temperature

CHAPTER 4

PROJECTED FLOWS AND LOADINGS

In preparation for the site visit, it was necessary to obtain detailed information regarding each parcel of land within the study area. Using a parcel map of downtown Fall City as reference, King County Assessor data was obtained for each parcel of land from the county website using the geographic information system application at http://www.metrokc.gov/wwwnav.map. Descriptive and quantitative information (e.g. Property Type, Gross Sq. Ft) was then extracted from this data and summarized in spreadsheet form for Phases 1 and 2. Excerpts of this spreadsheet are shown in Table 4-1 through 4-6.

Once this spreadsheet was prepared, a request was made to Fall City Water District for recent water demand data. This information was required to calculate the hydraulic and organic loadings. A copy of the summary spreadsheet was provided for their use in extracting this data from their billing system. The Water District responded with corrections to the spreadsheet and over a year of monthly water demand data for each customer, recorded in cubic feet. Twelve months of data, from June 2000 through May 2001, was entered into the spreadsheet. See Table 4-1 for Phase 1 water use and Table 4-2 for Phase 2 water use. Water use data was reviewed for anomalies. Fall City Water District was contacted to identify the cause of one customer's increasing water use. The design flows for this customer were modified as described in Note 3 of Table 4-1.

The maximum month water use was derived by selecting the highest monthly water use during the June 2000 through May 2001 period for each parcel. The average daily maximum month (ADMM) water use was calculated by dividing the maximum month water use by the average total number of days per month (30.4) and converting from cubic feet (cf) to gallons per day (gpd). The ADMM value was used as the design (ADMM) sewage flow. Design criteria for hydraulic loading is described in *Criteria for Sewage Works Design (CSWD)*, Ecology publication #98-37 WQ, section G2-1.2.1, "The hydraulic capacity of the treatment works should be based on the maximum expected flow". Verification will be further required to ensure that water use Ecology's not occur over a more restrictive time than 30 days, or that water use increases if the wastewater issue is addressed.

To check the water use data, a parallel calculation was carried out based on Ecology's methodology using the procedure described in *Criteria for Sewage Works Design*, section G2-1.2.4 New Systems. The results of this analysis are shown in Tables 4-3 and 4-4 and a detailed description of the procedure followed is given in the footnotes.

TABLE 4-1

Water Use Determinations for Phase 1

Phase 1 Designation	Parcel Number	Property Type	Lot Sq. Ft.	Building Sq. Ft.	Present Use	Max. Month(1) (cf/month)	Average Daily Max. Month(2) (gpd)
A	943100005	Commercial	43,995	1,448	Retail Store	2,300	566
A	1424079050	Commercial	290,109	Unknown	Vacant(Commercial)	0	0
A	1524079003	Residential	33,541	Unknown	Mobile Home	1,300	320
A	1524079004	Commercial	83,199	2,620	Single Family(C/I Use)	3,100	762
A	1524079006	Residential	26,136	Unknown	Vacant(Single-Family)	0	0
A	1524079059	Commercial	16,988	2,720	Medical/Dental Office	1,800	443
A	1524079079	Commercial	83,199	2,620	Single Family(C/I Use)	700(3)	172
A	2475900005	Commercial	9,000	3,568	Service Building	1,100	271
A	2475900025	Commercial	2,250	756	Tavern/Lounge	1,300	320
A	2475900030	Commercial	5,725	1,076	Service Station	1,800	443
A	2475900050	Commercial	3,525	448	Restaurant(Fast Food)	3,000	738
A	2475900052	Commercial	1,900	1,104	Single Family(C/I Use)	1,100	271
A	2475900054	Commercial	2,925	Unknown	Parking(Assoc)	0	0
A	2475900080	Commercial	6,750	4,004	Restaurant(Fast Food)	4,900	1,205
A	2475900085	Commercial	4,500	1,600	Retail Store	200	49
A	2475900105	Commercial	2,250	676	Retail Store	200	49
A	2475900110	Commercial	4,500	3,736	Medical/Dental Office	300	74
A	2475900120	Commercial	4,298	3,036	Restaurant/Lounge	9,100	2,238
A	2475900125	Commercial	4,703	2,836	Tavern/Lounge	1,200	295
A	2475900190	Commercial	2,250	1,440	Retail Store	300	74
A	2475900191	Commercial	2,250	1,224	Retail Store	100	25
A	2475900195	Commercial	4,500	1,656	Office Building	1,200	295
A	2475900210	Commercial	13,500	2,022	Medical/Dental Office	4,100	1,008
A	2475900240	Commercial	4,500	2,160	Office Building	500	123
A	2475900305	Commercial	11,563	5,400	Grocery Store	4,100	1,008
A	2475900330	Commercial	5,100	5,040	Retail Store	100	25

TABLE 4-1 – (continued)

Water Use Determinations for Phase 1

Phase 1 Designation	Parcel Number	Property Type	Lot Sq. Ft.	Building Sq. Ft.	Present Use	Max. Month(1) (cf/month)	Average Daily Max. Month(2) (gpd)
A	2475900340	Commercial	7,880	1,277	Utility	3,300	812
A	2475900385	Commercial	10,125	1,380	Historic Prop(Retail)	300	74
A	2475900395	Commercial	3,500	1,248	Retail Store	0	0
A	2475900405	Commercial	27,300	2,842	Governmental Service	2,500	615
A	2475900805	Residential	8,537	3,168	Multiple Residence (Low Rise)	900	221
A	2475900320	Commercial	4,875	4,036	Retail Store	3,800	934
A	2475900807	Residential	8,728	3,168	Multiple Residence (Low Rise)	3700	910
A	2475900810	Residential	19,536	Unknown	Single Family(Res Use/Zone)	0	0
A	6730700005	Commercial	15,000	6,816	Restaurant/Lounge	20,300	4,992
A	6730700050	Commercial	15,000	6,328	Grocery Store	15,700	3,861
TOTALS			**793,637**	**81,453**		**94,300**	**23,190**

(1) Max. Month is the Maximum Monthly Water Use for all months during this period.

(2) Calculation of Average Daily Maximum Month (ADMM) Water Use: Maximum Monthly Water Use (cf/month) converted to gallons and divided by (365/12) days

(3) This customer experienced a leak during the month of October 2000. This water ran into the ground and not the septic system. (Source: Terri Divers Fall City Water District) so the next largest max month was used for analysis.

Notes:

1. The information in this table was either obtained or derived from King County Assessor Data except as noted below:
    - Parcels were located using the GIS tool on the following website http://www.metrokc.gov/gis/mapportal/
    - Raw data was downloaded from the website as "html" files, loaded into Microsoft Excel and summarized in this table.
2. Monthly water use data for the past 12 months was obtained for all properties from Fall City Water District.
3. Winter Base Flow represents the average flow from December 2000 through February 2001.

TABLE 4-2

Water Use Determinations for Phase 2

Phase 2 Designation	Parcel Number	Property Type	Lot Sq. Ft.	Building Sq. Ft.	Present Use	Max. Month(1) (cf/month)	Average Daily(2) Max. Month (gpd)
X	2475900065	Residential	8,550	1,180	Single Family(Res Use/Zone)	500	123
X	2475900075	Residential	12,000	1,120	Single Family(Res Use/Zone)	2,500	615
X	2475900140	Residential	20,950	2,870	Single Family(Res Use/Zone)	1,600	393
X	2475900155	Residential	Unknown	3300	Residential	3,600	885
X	2475900170	Residential	9,583	1,220	Single Family(Res Use/Zone)	1,100	271
X	2475900250	Residential	18,900	1,700	Single Family(Res Use/Zone)	4,100	1,008
X	2475900265	Residential	5,250	960	Single Family(Res Use/Zone)	1,400	344
X	2475900266	Residential	4,900	720	Single Family(Res Use/Zone)	300	74
X	2475900280	Residential	3,500	1,000	Single Family(Res Use/Zone)	500	123
X	2475900285	Commercial	5,600	1,104	Club	1700	418
X	2475900355	Residential	10,125	1,040	Single Family(Res Use/Zone)	1,100	271
X	2475900356	Residential	10,500	1,660	Single Family(Res Use/Zone)	2,000	492

TABLE 4-2 – (continued)

Water Use Determinations for Phase 2

Phase 2 Designation	Parcel Number	Property Type	Lot Sq. Ft.	Building Sq. Ft.	Present Use	Max Month(1) (cf/month)	Average Day(2) Max Month (gpd)
X	2475900370	Residential	21,000	1,350	Single Family(Res Use/Zone)	3,000	738
X	2475900445	Residential	19,600	1,130	Single Family(Res Use/Zone)	900	221
X	2475900460	Commercial	22,400	4,503	Post Office/Post Service	400	98
X	2475900595	Commercial	14,000	2,820	Garage	1,000	246
TOTALS			**186,858**	**27,677**		**25,700**	**6,320**

(1) Max. Month is the Maximum Monthly Water Use for all months during this period.
(2) Calculation of Average Daily Maximum Month (ADMM) Water Use: Maximum Monthly Water Use (cf/month) converted to gallons and divided by (365/12) days.

Notes:

1. The information in this table was either obtained or derived from King County Assessor Data except as noted below.
   - Parcels were located using the GIS tool on the following website http://www.metrokc.gov/gis/mapportal/
   - Raw data was downloaded from the website as html files, loaded into Microsoft Excel and summarized in this table.
2. Monthly water use data for the past 14 months was obtained for all properties from Fall City Water District.
3. Winter Base Flow represents the average flow from December 2000 through February 2001

TABLE 4-3

Estimated Average Daily Maximum Month Sewage Flow for Phase 1

							Ecology's Methodology		From Water Use	
Phase 1 Designation	Parcel Number	Property Type	Lot Sq. Ft.	Building Sq. Ft.	Present Use	Design Units (DUs)	Quantity of DUs	Sewage Flow (gpd)	Quantity of DUs	Sewage Flow (Q) (gpd)
A	943100005	Commercial	43,995	1,448	Retail Store	1000 sq ft.	1.4	217.2	3.8	565.6
A	1424079050	Commercial	290,109	Unknown	Vacant(Commercial)	1000 sq ft.	0.0	0.0	0.0	0.0
A	1524079003	Residential	33,541	Unknown	Mobile Home	Persons	2.5	250.0	3.2	319.7
A	1524079004	Commercial	83,199	2,620	Single Family(C/I Use)	Persons	2.5	250.0	7.6	762.3
A	1524079006	Residential	26,136	Unknown	Vacant(Single-family)	Persons	0.0	0.0	0.0	0.0
A	1524079059	Commercial	16,988	2,720	Medical/Dental Office	1000 sq ft.	2.7	1360.0	0.9	442.7
A	1524079079	Commercial	83,199	2,620	Single Family(C/I Use)	1000 sq ft.	2.6	393.0	1.1	172.1
A	2475900005	Commercial	9,000	3,568	Service Building	1000 sq ft.	3.6	535.2	1.8	270.5
A	2475900025	Commercial	2,250	756	Tavern/Lounge	Seats	38.0	1900.0	6.4	319.7
A	2475900030	Commercial	5,725	1,076	Service Station	1000 sq ft.	1.1	161.4	3.0	442.7
A	2475900050	Commercial	3,525	448	Restaurant(Fast Food)	Seats	0.0	0.0	14.8	737.8
A	2475900052	Commercial	1,900	1,104	Single Family(C/I Use)	1000 sq ft.	1.1	165.6	1.8	270.5
A	2475900054	Commercial	2,925	Unknown	Parking(Assoc)	1000 sq ft.	0.0	0.0	0.0	0.0
A	2475900080	Commercial	6,750	4,004	Restaurant(Fast Food)	Seats	38.0	1900.0	24.1	1205.0
A	2475900085	Commercial	4,500	1,600	Retail Store	1000 sq ft.	1.6	240.0	0.3	49.2
A	2475900105	Commercial	2,250	676	Retail Store	1000 sq ft.	0.7	101.4	0.3	49.2
A	2475900110	Commercial	4,500	3,736	Medical/Dental Office	1000 sq ft.	3.7	1868.0	0.1	73.8
A	2475900120	Commercial	4,298	3,036	Restaurant/Lounge	Seats	114.0	5700.0	44.8	2237.9
A	2475900125	Commercial	4,703	2,836	Tavern/Lounge	Seats	38.0	1900.0	5.9	295.1
A	2475900190	Commercial	2,250	1,440	Retail Store	1000 sq ft.	1.4	216.0	0.5	73.8
A	2475900191	Commercial	2,250	1,224	Retail Store	1000 sq ft.	1.2	183.6	0.2	24.6
A	2475900195	Commercial	4,500	1,656	Office Building	1000 sq ft.	1.7	248.4	2.0	295.1
A	2475900210	Commercial	13,500	2,022	Medical/Dental Office	1000 sq ft.	2.0	1011.0	2.0	1008.3
A	2475900240	Commercial	4,500	2,160	Office Building	1000 sq ft.	2.2	324.0	0.8	123.0
A	2475900305	Commercial	11,563	5,400	Grocery Store	1000 sq ft.	0.0	0.0	6.7	1008.3
A	2475900320	Commercial	4,875	4,036	Retail Store	1000 sq ft.	4.0	605.4	6.2	934.5
A	2475900330	Commercial	5,100	5,040	Retail Store	1000 sq ft.	5.0	756.0	0.2	24.6
A	2475900340	Commercial	7,880	1,277	Utility	1000 sq ft.	1.3	191.6	5.4	811.5

TABLE 4-3 – (continued)

Estimated Average Daily Maximum Month Sewage Flow for Phase 1

							Ecology's Methodology		From Water Use	
Phase II Designation	Parcel Number	Property Type	Lot Sq. Ft.	Building Sq. Ft.	Present Use	Design Units (DUs)	Quantity of DUs	Sewage Flow (gpd)	Quantity of DUs	Sewage Flow (Q) (gpd)
A	2475900385	Commercial	10,125	1,380	Historic Prop(Retail)	1000 sq ft.	1.4	207.0	0.5	73.8
A	2475900395	Commercial	3,500	1,248	Retail Store	1000 sq ft.	1.2	187.2	0.0	0.0
A	2475900405	Commercial	27,300	2,842	Governmental Service	1000 sq ft.	2.8	426.3	4.1	614.8
A	2475900805	Residential	8,537	3,168	Multiple Residence (Low Rise)	Persons	0.0	0.0	2.2	221.3
A	2475900807	Residential	8,728	3,168	Multiple Residence (Low Rise)	Persons	0.0	0.0	9.1	909.9
A	2475900810	Residential	19,536	Unknown	Single Family (Res Use/Zone)	Persons	0.0	0.0	0.0	0.0
A	6730700005	Commercial	15,000	6,816	Restaurant/Lounge	Seats	114.0	5700.0	99.8	4992.1
A	6730700050	Commercial	15,000	6,328	Grocery Store	1000 sq ft.	6.3	949.2	25.7	3860.9
TOTALS			**793,637**	**81,453**				**27,947**		**23,190**

Notes:

1. The information in this table was either obtained or derived from King County Assessor Data except as noted below:
   - Parcels were located using the GIS tool on the following website http://www.metrokc.gov/gis/mapportal/
   - Raw data was downloaded from the website as "html" files, loaded into Microsoft Excel and summarized in this table.
2. Values in this portion of the table were derived using the procedure described in *Criteria for Sewage Works Design (CSWD)*, a Ecology publication (#98-37 WQ) section G2-1.2.4 *New Systems*,
   a. Using the information in the "Present Use" and "Property Type" columns of this table each parcel was categorized according to type of 'Discharge Facility' as described in Table G2-1 Design Basis for New Sewage Works in the CSWD. The four categories are listed in the Formulas reference table at the bottom. The Retail category corresponds to the "Shopping Center" category in Table G2-1, the Medical Office category corresponds to "Doctor's office in medical center", and the Residential category corresponds to "Dwellings".
   b. Each type of discharge facility has a corresponding Design Unit (DU) either persons, seats or Gross square footage. These were listed in the 'Design Unit' Column.
   c. The values in the "Quantity of DUs" column were either derived from the "Building Sq. Ft." column, for Retail and Medical Office Categories, or assigned values. The Residential parcels were assigned a value of 2.5 persons as the Design Unit. An estimate of seats in each Restaurant parcel was obtained from information supplied from Northshore Public Health Center, Environmental Health Division.
   d. The values in the "Sewage Flow" and "Quantity of DUs", columns were derived using the formulas as summarized at the bottom of the table. These formulas were taken as given in Table G2-1 of the CSWD except for the Retail category for which the Sewage Flow multiplication factor was set at 150 gpd/DU which is outside 200-300 gpd/DU range given in Table G2-1.

Formulas	**Sewage Flow (gpd)**	**Quantity of DUs**
Retail	DUs x 150	Q/150 gpd
Restaurant	DUs x 50	Q/50 gpd
Medical Office	DUs x 500	Q/500 gpd
Residential	DUs x 100	Q/100 gpd

TABLE 4-4

Estimated Average Daily Maximum Month Sewage Flow for Phase 2

							Ecology's Methodology		From Water Use	
Phase 2 Designation	Parcel Number	Property Type	Lot Sq. Ft.	Building Sq. Ft.	Present Use	Design Units (DUs)	Quantity of DUs	Sewage Flow (gpd)	Quantity of DUs	Sewage Flow (Q) (gpd)
X	2475900065	Residential	8,550	1,180	Single Family(Res Use/Zone)	Persons	2.5	250.0	1.2	123.0
X	2475900075	Residential	12,000	1,120	Single Family(Res Use/Zone)	Persons	2.5	250.0	6.1	614.8
X	2475900140	Residential	20,950	2,870	Single Family(Res Use/Zone)	Persons	2.5	250.0	3.9	393.5
X	2475900155	Residential	Unknown	3300	Residential	Persons	2.5	250.0	8.9	885.3
X	2475900170	Residential	9,583	1,220	Single Family(Res Use/Zone)	Persons	2.5	250.0	2.7	270.5
X	2475900250	Residential	18,900	1,700	Single Family(Res Use/Zone)	Persons	2.5	250.0	10.1	1008.3
X	2475900265	Residential	5,250	960	Single Family(Res Use/Zone)	Persons	2.5	250.0	3.4	344.3
X	2475900266	Residential	4,900	720	Single Family(Res Use/Zone)	Persons	2.5	250.0	0.7	73.8
X	2475900280	Residential	3,500	1,000	Single Family(Res Use/Zone)	Persons	2.5	250.0	1.2	123.0
X	2475900285	Commercial	5,600	1,104	Club	1000 sq ft.	1.1	165.6	2.8	418.1
X	2475900355	Residential	10,125	1,040	Single Family(Res Use/Zone)	Persons	2.5	250.0	2.7	270.5
X	2475900356	Residential	10,500	1,660	Single Family(Res Use/Zone)	Persons	2.5	250.0	4.9	491.8
X	2475900370	Residential	21,000	1,350	Single Family(Res Use/Zone)	Persons	2.5	250.0	7.4	737.8
X	2475900445	Residential	19,600	1,130	Single Family(Res Use/Zone)	Persons	2.5	250.0	2.2	221.3

TABLE 4-4 – (continued)

Estimated Average Daily Maximum Month Sewage Flow for Phase 2

							Ecology's Methodology		From Water Use	
Phase 2 Designation	Parcel Number	Property Type	Lot Sq. Ft.	Building Sq. Ft.	Present Use	Design Units (DUs)	Quantity of DUs	Sewage Flow (gpd)	Quantity of DUs	Sewage Flow (Q) (gpd)
X	2475900460	Commercial	22,400	4,503	Post Office/Post Service	1000 sq ft.	4.5	675.5	0.7	98.4
X	2475900595	Commercial	14,000	2,820	Garage	1000 sq ft.	2.8	423.0	1.6	245.9
16	**TOTALS**		**186,858**	**27,677**				**4514.1**		**6320.1**

Notes:

1. The information in this table was either obtained or derived from King County Assessor Data except as noted below:
   - Parcels were located using the GIS tool on the following website http://www.metrokc.gov/gis/mapportal/.
   - Raw data was downloaded from the website as "html" files, loaded into Microsoft Excel and summarized in this table.
2. Values in this portion of the table were derived using the procedure described in *Criteria for Sewage Works Design (CSWD)*, a Ecology publication (#98-37 WQ) section G2-1.2.4 *New Systems*, as follows:
   a. Using the information in the "Present Use" and "Property Type" columns of this table each parcel was categorized according to type of "Discharge Facility" as described in Table G2-1 Design Basis for New Sewage Works in the CSWD. The four categories are listed in the Formulas reference table at the bottom. The Retail category corresponds to the "Shopping Center" category in Table G2-1, the Medical Office category corresponds to "Doctor's office in medical center", and the Residential category corresponds to "Dwellings".
   b. Each type of discharge facility has a corresponding Design Unit (DU) either persons, seats or Gross square footage. These were listed in the 'Design Unit' Column.
   c. The values in the "Quantity of DUs" column were either derived from the "Building Sq. Ft." column, for Retail and Medical Office Categories, or assigned values. The Residential parcels were assigned a value of 2.5 persons as the Design Unit. An estimate of seats in each Restaurant parcel was obtained from information supplied from Northshore Public Health Center, Environmental Health Division.
   d. The values in the "Sewage Flow" and "Quantity of DUs" columns were derived using the formulas as summarized at the bottom of the table. These formulas were taken as given in Table G2-1 of the CSWD except for the Retail category for which the Sewage Flow multiplication factor was set at 150 gpd/DU which is outside 200-300 gpd/DU range given in Table G2-1

Formulas	**Sewage Flow (gpd)**	**Quantity of DUs**
Retail	DUs x 150	Q/150 gpd
Restaurant	DUs x 50	Q/50 gpd
Medical Office	DUs x 500	Q/500 gpd
Residential	DUs x 100	Q/100 gpd

The current average day maximum month flow in Phase 1 was calculated from water use records to be 23,200 GPD, while using the Ecology method gave 27,900 GPD. For Phase 2, the current average day maximum month flow from water use records was 6,300 GPD, while the Ecology criteria resulted in 4,500 GPD. The similarity of these numbers showed that the actual water use records have no significant errors. For future loading and flow calculations, the flows determined from the Fall City water records were used.

METHODOLOGY FOR PROJECTING FUTURE FLOWS

Prior to deciding on which of the many offsite treatment options to construct, the stakeholder group must determine the design flow. In order to create a solution that will last for at least 20 years, it is necessary to predict the capacity of the system required in 20 years. At the June 13th meeting, it was decided that three different flows would be evaluated, a minimum flow, an intermediate flow and a maximum flow. The minimum design flow was estimated by taking the current water use in each Phase area as calculated previously, and adding an additional 20% to account for minimal growth.

A maximum flow rate was determined by estimating water use for complete potential land development. Complete potential land development is the highest density that is allowed under current zoning in the Fall City Subarea Plan. If all the potential for land development occurs, it was assumed that water use in the Phase 1 area will become twice the minimum flow projection. Currently three quarters of the commercial lots are in use, but through expansion and changes in ownership, the water use at developed sites can be expected to increase.

An intermediate flow rate will be calculated as the mean of the minimum and maximum flows and will represent the future design flow if half of the remaining development potential is realized.

The Phase 2 area has the potential to develop from being primarily residential, 4 dwelling units per acre, to commercial. The conditions placed on changing the zoning from residential to business are (from Ordinance 1999-0494):

"Community Business zoning for these parcels may be realized through an area-wide rezone initiated by the King County Council after June 12, 2002, or when the recommendations of the stakeholder group created by proposed motion 2000-0363 are issued, whichever occurs first. Future development of the properties could be realized through an area-wide rezone subject to the recommendations for wastewater treatment from the stakeholder group proposed by council motion 2000-0363."

Phase 2 area flow projections were calculated in the same manner as the Phase 1 flow projections.

The annual average daily flow was calculated by adding all water use from June 2000 through May 2001 as provided by the Fall City Water District and dividing the total by 365 days. The peak hour flow was calculated by multiplying the annual average flow by a peaking factor of 4.2. Ecology requires that treatment facilities be sized to pass the peak hour flow. This peaking factor is the appropriate amount per the Ecology Criteria for Sewage Works Design, Table C1-1, based on a service population of under 100. The number is high due to the low service area population and variable nature of selected sewage flows. To calculate the average annual gpd flow rate for maximum potential land development, it is assumed that the ratio of the average day, maximum month flow to the average annual flow would remain the same from minimum flow projections to full potential land development. See Tables 4-5 and 4-6 for the results of these calculations.

CURRENT LOADINGS

Pollutant loadings were calculated in two (2) ways: using Ecology Criteria, and using Aqua Test's estimates. The Ecology design manual estimates levels of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) for specific establishments. For example, for a restaurant, BOD is 0.2 lbs/day multiplied by the number of seats that restaurant contains. Tables 4-5 and 4-6 show the result of using these design factors with the current flows found from the water records.

The second column of loading estimations is from field observation. Aqua Test, Inc. estimated the current flows and organic loadings from 27 of the 36 parcels in Phase 1 based on experience and field visits. See Appendix E for this data. Due to the diverse nature of facilities in the area, there was a large range of organic loading. An Equivalent Residential Unit (ERU) of flow was chosen as 350 mg/L of BOD and 250 gpd of flow. These characteristics are typical of high strength residential wastewater. It was assumed that any establishment with a waste strength higher than the ERU would pretreat their effluent onsite to the ERU standard prior to discharging it to a community system. This is a common practice in wastewater treatment. In order to calculate the average organic loading to the system, we assumed that properties not assessed by Aqua Test had a effluent concentration of 350 mg/L, and reduced all parcels with loadings above 350 mg/L to 350 mg/L (since onsite pretreatment was assumed). Each parcel's concentration was multiplied by the water use on that parcel to get the loading per parcel in lbs/day, and then those values were added to get total daily loading. This load in lbs/day was divided by the current average day, maximum month flow to generate an influent concentration of 337 mg/L of BOD. It was assumed that the concentration remained the same regardless of flow scenario. The loading for each scenario were calculated by multiplying the projected flow by the concentration. The Total Kjeldahl Nitrogen (TKN) concentration was assumed to be 20% of the BOD, which is typical for high strength domestic wastewater (Wastewater Engineering Treatment, Disposal and Reuse, Metcalf and Eddy, Inc., 1991). This information is summarized in the last column of Tables 4-7 and 4-8.

TABLE 4-5

Estimated Pollutant Loadings for Phase 1

							Loadings Calculated with Ecology's Methodology			Aqua Test Loading Estimates			
Phase 1 Designation	Parcel Numbers	Property Type	Lot Sq Ft	Building Sq Ft	Present Use	Sewage Flow[1] (gpd)	Quantity of DUs	BOD (lbs/day)	SS (lbs/day)	Organic Waste Strength[2] (mg/L)	Influent Strength[3] (mg/L)	BOD (lbs/day)	TSS[4] (lbs/day)
A	943100005	Commercial	43,995	1,448	Retail Store	565.6	3.8	0.0	0.0		*350.0*	1.6	1.6
A	1424079050	Commercial	290,109	Unknown	Vacant(Commercial)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A	1524079003	Residential	33,541	Unknown	Mobile Home	319.7	3.2	0.6	0.6		*350.0*	0.9	0.9
A	1524079004	Commercial	83,199	2,620	Single Family(C/I Use)	762.3	7.6	1.5	1.5		*350.0*	2.2	2.2
A	1524079006	Residential	26,136	Unknown	Vacant(Single-Family)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A	1524079059	Commercial	16,988	2,720	Medical/Dental Office	442.7	0.9	0.1	0.1		*350.0*	1.3	1.3
A	1524079079	Commercial	83,199	2,620	Single Family(C/I Use)	172.1	1.1	0.0	0.0		*350.0*	0.5	0.5
A	2475900005	Commercial	9,000	3,568	Service Building	270.5	1.8	0.0	0.0	250.0	250.0	0.6	0.6
A	2475900025	Commercial	2,250	756	Tavern/Lounge	319.7	6.4	1.3	1.3	400.0	**350.0**	0.9	0.9
A	2475900030	Commercial	5,725	1,076	Service Station	442.7	3.0	0.0	0.0	350.0	350.0	1.3	1.3
A	2475900050	Commercial	3,525	448	Restaurant(Fast Food)	737.8	14.8	3.0	3.0	350.0	350.0	2.2	2.2
A	2475900052	Commercial	1,900	1,104	Single Family(C/I Use)	270.5	1.8	0.0	0.0	350.0	350.0	0.8	0.8
A	2475900054	Commercial	2,925	Unknown	Parking(Assoc)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A	2475900080	Commercial	6,750	4,004	Restaurant(Fast Food)	1205.0	24.1	4.8	4.8	2479.0	**350.0**	3.5	3.5
A	2475900085	Commercial	4,500	1,600	Retail Store	49.2	0.3	0.0	0.0	350.0	350.0	0.1	0.1
A	2475900105	Commercial	2,250	676	Retail Store	49.2	0.3	0.0	0.0	350.0	350.0	0.1	0.1
A	2475900110	Commercial	4,500	3,736	Medical/Dental Office	73.8	0.1	0.0	0.0	350.0	350.0	0.2	0.2
A	2475900120	Commercial	4,298	3,036	Restaurant/Lounge	2237.9	44.8	9.0	9.0	1200.0	**350.0**	6.5	6.5
A	2475900125	Commercial	4,703	2,836	Tavern/Lounge	295.1	5.9	1.2	1.2	500.0	**350.0**	0.9	0.9
A	2475900190	Commercial	2,250	1,440	Retail Store	73.8	0.5	0.0	0.0	250.0	250.0	0.2	0.2
A	2475900191	Commercial	2,250	1,224	Retail Store	24.6	0.2	0.0	0.0	350.0	350.0	0.1	0.1
A	2475900195	Commercial	4,500	1,656	Office Building	295.1	2.0	0.0	0.0	350.0	350.0	0.9	0.9
A	2475900210	Commercial	13,500	2,022	Medical/Dental Office	1008.3	2.0	0.2	0.2	200	200	1.7	1.7
A	2475900240	Commercial	4,500	2,160	Office Building	123.0	0.8	0.0	0.0	350	350	0.4	0.4
A	2475900305	Commercial	11,563	5,400	Grocery Store	1008.3	6.7	0.1	0.1	600.0	**350.0**	2.9	2.9
A	2475900320	Commercial	4,875	4,036	Retail Store	934.5	6.2	0.1	0.1	350.0	350.0	2.7	2.7
A	2475900330	Commercial	5,100	5,040	Retail Store	24.6	0.2	0.0	0.0	350.0	350.0	0.1	0.1

TABLE 4-5 – (continued)

Pollutant Loadings for Phase 1

							Loadings Calculated with Ecology's Methodology[4]			Aqua Test Loading Estimates			
Phase 1 Designation	Parcel Number	Property Type	Lot Sq Ft	Building Sq Ft	Present Use	Sewage Flow[1] (gpd)	Quantity of DUs	BOD (lbs/day)	SS (lbs/day)	Organic Waste Strength[2] (mg/L)	Influent Strength[3] (mg/L)	BOD (lbs/day)	TSS[4] (lbs/day)
A	2475900340	Commercial	7,880	1,277	Utility	811.5	5.4	0.1	0.1	250.0	250.0	1.7	1.7
A	2475900385	Commercial	10,125	1,380	Historic Prop(Retail)	73.8	0.5	0.0	0.0	350.0	350.0	0.2	0.2
A	2475900395	Commercial	3,500	1,248	Retail Store	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A	2475900405	Commercial	27,300	2,842	Governmental Service	614.8	4.1	0.0	0.0	350.0	350.0	1.8	1.8
A	2475900805	Residential	8,537	3,168	Multiple Residence (Low Rise)	221.3	2.2	0.4	0.4		*350.0*	0.6	0.6
A	2475900807	Residential	8,728	3,168	Multiple Residence (Low Rise)	909.9	9.1	1.8	1.8		*350.0*	2.7	2.7
A	2475900810	Residential	19,536	Unknown	Single Family(Res Use/Zone)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A	6730700005	Commercial	15,000	6,816	Restaurant/Lounge	4992.1	99.8	20.0	20.0	1100.0	**350.0**	14.5	14.5
A	6730700050	Commercial	15,000	6,328	Grocery Store	3860.9	25.7	0.3	0.3	400.0	**350.0**	11.3	11.3
TOTALS			**793,637**	**81,453**		**23,190**						**65**	**65**

(1) These values were derived from Fall City Water District water records from June 2000 through May 2001. See Table 4-1.
(2) Aqua Test has assessed each parcel and determined expected organic loadings based on similar facilities in Western Washington.
(3) An Equivalent Residential Unit (ERU) has been selected as flows of 250 gpd, with organic loadings of 350 mg/L. Any site Aqua Test was unable to assess has been designated as 350 mg/L of BOD. In addition, it is recommended that facilities with high strength waste flows be required to pre-treat their waste to reduce organic loadings to 350 mg/L. Therefore, any parcel having a higher waste strength was re-designated as having 350 mg/L BOD.
(4) Total Suspended Solids (TSS) is equivalent to the BOD loading.
(5) The values in BOD and SS columns (Ecology Methodology) were derived using these formulas.

Formulas[5]	BOD (lbs/day)	SS (lbs/day)
Retail Store	DUs x 0.01	DUs x 0.01
Restaurant	DUs x 0.2	DUs x 0.2
Medical Office	DUs x 0.1	DUs x 0.1
Residential	DUs x 0.2	DUs x 0.2

Bold in Influent Strength Column: Loading Reduced from >350 mg/L to 350 mg/L
Italicized in "Influent Strength Column": Unassessed, assumed 350 mg/L

Notes:
1. The information in this table was either obtained or derived from King County Assessor Data except as noted below:
   - Parcels were located using the GIS tool on the following website http://www.metrokc.gov/gis/mapportal.
   - Raw data was downloaded from the wesbsite as html files, loaded into Microsoft Excel and summarized in this table.

TABLE 4-6

Estimated Pollutant Loadings for Phase 2

Phase 2 Designation	Parcel Number	Property Type	Lot Sq. Ft.	Building Sq. Ft.	Present Use	Sewage[1] Flow (gpd)	Loadings Calculated with Ecology's Methodology			Aqua Test Loading Estimates			
							Quantity of DUs	BOD (lbs/day)	SS (lbs/day)	Organic Waste Strength[2] (mg/L)	Influent Strength[2] (mg/L)	BOD (lbs/day)	TSS[4] (lbs/day)
X	2475900065	Residential	8,550	1,180	Single Family(Res Use/Zone)	123.0	1.2	0.2	0.2	350.0	350.0	0.4	0.1
X	2475900075	Residential	12,000	1,120	Single Family(Res Use/Zone)	614.8	6.1	1.2	1.2	350.0	350.0	1.8	0.4
X	2475900140	Residential	20,950	2,870	Single Family(Res Use/Zone)	393.5	3.9	0.8	0.8	350.0	350.0	1.1	0.2
X	2475900155	Residential	Unknown	3300	Residential	885.3	8.9	1.8	1.8	350.0	350.0	2.6	0.5
X	2475900170	Residential	9,583	1,220	Single Family(Res Use/Zone)	270.5	2.7	0.5	0.5	350.0	350.0	0.8	0.2
X	2475900250	Residential	18,900	1,700	Single Family(Res Use/Zone)	1008.3	10.1	2.0	2.0	350.0	350.0	2.9	0.6
X	2475900265	Residential	5,250	960	Single Family(Res Use/Zone)	344.3	3.4	0.7	0.7	350.0	350.0	1.0	0.2
X	2475900266	Residential	4,900	720	Single Family(Res Use/Zone)	73.8	0.7	0.1	0.1	350.0	350.0	0.2	0.0
X	2475900280	Residential	3,500	1,000	Single Family(Res Use/Zone)	123.0	1.2	0.2	0.2	350.0	350.0	0.4	0.1
X	2475900285	Commercial	5,600	1,104	Club	418.1	2.8	0.0	0.0	350.0	350.0	1.2	0.2
X	2475900355	Residential	10,125	1,040	Single Family(Res Use/Zone)	270.5	2.7	0.5	0.5	350.0	350.0	0.8	0.2
X	2475900356	Residential	10,500	1,660	Single Family(Res Use/Zone)	491.8	4.9	1.0	1.0	350.0	350.0	1.4	0.3
X	2475900370	Residential	21,000	1,350	Single Family(Res Use/Zone)	737.8	7.4	1.5	1.5	350.0	350.0	2.2	0.4
X	2475900445	Residential	19,600	1,130	Single Family(Res Use/Zone)	221.3	2.2	0.4	0.4	350.0	350.0	0.6	0.1
X	2475900460	Commercial	22,400	4,503	Post Office/Post Service	98.4	0.7	0.0	0.0	350.0	350.0	0.3	0.1

TABLE 4-6 – (continued)

Estimated Pollutant Loadings for Phase 2

Phase 2 Designation	Parcel Number	Property Type	Lot Sq. Ft.	Building Sq. Ft.	Present Use	Sewage[1] Flow (gpd)	Loadings Calculated with Ecology's Methodology			Aqua Test Loading Estimates			
							Quantity of DUs	BOD (lbs/day)	SS (lbs/day)	Organic Waste Strength[1] (mg/L)	Influent Strength[3] (mg/L)	BOD (lbs/day)	TSS[4] (lbs/day)
X	2475900595	Commercial	14,000	2,820	Garage	245.9		0.0	0.0	350.0	350.0	0.7	0.1
TOTALS			**186,858**	**27,677**		**6320.1**		**11.1**	**11.1**			**18.4**	**3.7**

(1) These values were derived from Fall City Water District water records from June 2000 through May 2001.

(2) Aqua Test has assessed each parcel and determined expected organic loadings based on similar facilities in Western Washington.

(3) An Equivalent Residential Unit (ERU) has been selected as flows of 250 gpd, with organic loadings of 350 mg/L. Any site Aqua Test was unable to assess has been designated as 350 mg/L of BOD. In addition, it is recommended that facilities with high strength waste flows be required to pre-treat their waste to reduce organic loadings to 350 mg/L. Therefore, any parcel having a higher waste strength was re-designated as having 350 mg/L BOD.

(4) Total Suspended Solids (TSS) is equivalent to the BOD loading.

(5) The values in BOD and SS columns (Ecology Methodology) were derived using these formulas.

Formulas[5]	BOD (lbs/day)	SS (lbs/day)
Retail Store	DUs x 0.01	DUs x 0.01
Restaurant	DUs x 0.2	DUs x 0.2
Medical Office	DUs x 0.1	DUs x 0.1
Residential	DUs x 0.2	DUs x 0.2

Notes:

(1) The information in this table was either obtained or derived from King County Assessor Data except as noted below.

- Parcels were located using the GIS tool on the following website http://www.metrokc.gov/gis/mapportal/
- Raw data was downloaded from the website as "html" files, loaded into Microsoft Excel and summarized in this table.

PROJECTED WASTEWATER FLOWS & LOADINGS

Tables 4-7 and 4-8 present the flows and loadings which will be utilized in this report. The tables of projected flows and loadings include only Phase 1, and Phase 1 and 2. The scenario of only Phase 2 was not included, because the stakeholders have indicated that there is no potential to develop a system for only Phase 2.

TABLE 4-7

Projected Wastewater Flows and Loadings for Phase 1

Phase 1 Flow Projections	Max. Month (gpd)	Annual Average(5) (gpd)	Peak Hour(6) (gpd)	BOD (mg/L)	BOD (lb/day)	TKN (lb/day)
Current(1)	23,200	13,700	57,500	337	65	13
Minimum(2)	27,800	16,400	69,000	337	78	16
Intermediate(3)	41,700	24,600	103,500	337	117	23
Maximum(4)	55,600	32,800	138,000	337	156	31

TABLE 4-8

Projected Wastewater Flows and Loadings for Phase 1 and 2

Phase 1 and 2 Flow Projections	Max. Month (gpd)	Annual Average(5) (gpd)	Peak Hour(6) (gpd)	BOD (mg/L)	BOD (lb/day)	TKN (lb/day)
Current(1)	29,500	17,200	72,100	337	83	17
Minimum(2)	35,400	20,600	86,600	337	99	20
Intermediate(3)	53,100	30,900	129,800	337	149	30
Maximum(4)	70,800	41,200	173,100	337	199	40

(1) Current wastewater flow is derived from the monthly Fall City Water District's water use records from June 2000 through May 2001.
(2) Minimum wastewater flows are current wastewater flows with a 20% growth factor.
(3) This is the mean of the minimum and maximum flows of Phase 1 and 2.
(4) Phase 1 and 2 maximum flows are assumed to be double the minimum flows of Phase 1 and 2.
(5) Annual Average (Max.) = Max. Month (Max.) * Ann. Ave. (Min.)/Max. Month (Min.)
(6) Peak hour flow was calculated by multiplying the Annual Average flow by a peaking factor of 4.2 per the Ecology Criteria, Table C1-1.

CHAPTER 5

TREATMENT ALTERNATIVES

INTRODUCTION

The Stakeholder group elected to evaluate a number of alternative wastewater systems to potentially serve the commercial area. The alternatives include individual onsite treatment systems, clustered treatment systems, and centralized systems. Once the Stakeholder Group has selected an alternative, it is assumed that individual businesses will choose whether or not to participate in the project and be served by the new system.

Based on the wastewater system options selected for analysis, the following seven alternatives will be evaluated:

- No Action
- Individual Onsite Systems
- Cluster System
- Centralized Recirculating Gravel Filter with Subsurface Drip Irrigation
- Class A Re-Use Facility with Wetland or Rapid Infiltration
- Centralized Package Plant with a River Outfall
- Centralized Package Plant with Drainfield

At this stage of the planning process, it is important to establish how different alternatives will perform relative to the others. In order to achieve this comparison, current regulation design criteria have been used to insure that these systems are all being evaluated against the appropriate standards. For onsite and cluster systems the alternatives will meet Department of Health (DOH) criteria, and with offsite centralized systems Department of Ecology (Ecology) criteria will be met. It is assumed that a management entity will be formed to operate, monitor, and maintain the alternative that the Fall City business community selects. Our cost analysis has assumed that the implementation of the project will follow a public works bidding procedure, and that the construction will be overseen by the public management entity mentioned above.

Another design criterion applied to all alternatives was the drainfield hydraulic loading rate. For this, and all conventional drainfield sizing in this report, an overall hydraulic loading rate of 0.4 gpd/ft^2 was used corresponding to a trench bottom area loading rate of 1.0 gpd/ft^2. This number was derived from field investigations of areas located in the vicinity of the business district, literature review, and discussions between Aqua Test, HWA Geosciences and Gray & Osborne engineers. See Appendix F and G for HWA Geosciences Technical Memo and soils data regarding Golf Course on east side of Raging River, respectively. It must be understood that the hydraulic loading rate can change significantly over a small distance. For a drip irrigation drainfield, an overall hydraulic loading rate of 0.17 gpd/ft^2 was used. For rapid infiltration, a hydraulic loading rate of 2 in/hr (30 gpd/ft^2) was used. These design hydraulic loading rates are shown in Table 5-1. Subsurface conditions in the Fall City area vary significantly with depth and area distribution. The allowable wastewater loading rates and wastewater infiltration rates used in our analyses represent our professional judgement for typical ranges or averages for soil conditions known to occur in the Fall City area. Determining actual loading and infiltration rates requires site specific soils and ground water investigations. Consequently, actual loading and infiltration rates could vary depending on site specific soils and ground water conditions. Prior to the design of the system selected by the stakeholder committee, soils analysis and hydraulic load testing will need to be conducted on the chosen site to obtain actual design rates. This analysis can be conducted for specific sites as part of an Engineering Report, which will be required prior to implementation.

Table 5-1

Hydraulic Loading Rates

Disposal Drainfield Type	Overall Loading Rate (gpd/ft^2/day)
Conventional	0.4
Subsurface Drip	0.17
Rapid Infiltration (Class A Reuse)	30

Operation and Maintenance alternatives can also be evaluated based on estimated operation and maintenance requirements. O&M requirements vary based on the type of technology and the regulatory authority. Alternatives regulated by DOH (no action, individual onsite systems, cluster systems and the 14,500 gpd offsite RGF) have minimal monitoring and reporting requirements in comparison with systems regulated by Ecology. DOH requires that large onsite systems have annual operating permits and O&M manuals. Annual reports are required to DOH to demonstrate compliance with the procedures in the O&M manual. O&M requirements consist of inspections and the manufacturer's recommended maintenance.

Ecology requires that facilities have National Pollutant Discharge Elimination System (NPDES) or State Waste Discharge (SWD) permits, which require a certified wastewater treatment operator and performance monitoring and reporting. Permits will often require weekly monitoring of performance parameters. The production of Class "A" reclaimed water requires additional performance monitoring and reporting, which may include daily coliform testing. However, the testing and reporting schedule is adapted to the specific requirements of the facility and environment. The Town of Starbuck operates a 20,000-gpd wastewater treatment facility using attached growth filters and drainfield disposal that is regulated by Ecology. The SWD permit reporting requirements include continuous flow measurement, monthly sampling of several parameters at the treatment facility, and groundwater monitoring at monthly, quarterly and semi-annual frequencies. The Town of Starbuck, WA uses an average of 10 to 15 hours per week to operate the system, including an average of 3.5 hours per week on sampling and reporting. Based on similarity of size and disposal method, Ecology may set reporting requirements for the proposed Fall City alternatives under its jurisdiction similar to those at the Town of

Starbuck, WA. The monitoring and O&M labor required at the Town of Starbuck facility was used as a guide in estimating O&M costs for centralized treatment alternatives.

Labor costs for system O&M were developed based on an estimated cost of $40 per hour for a public management agency employee, including salary and overhead. The wastewater utility may determine to contract for O&M of this facility; this could potentially result in different labor costs than estimated here. Power costs are based on $0.07 per kilowatt-hour ($/kw-hr), and solids hauling costs are based on $0.13 per gallon for hauling and disposal of septic tank solids every three years.

Currently, the adequacy of existing onsite systems in the Phase 1 and 2 study areas varies greatly. Water use information for each parcel was used by Aqua Test to complete an assessment of the septic systems in the area of concern. During field visits, Aqua Test assessed 33 of the 36 sites in Phase 1, and all 16 sites in Phase 2. Based on water use, gross lot square footage and observation, Aqua Test determined whether a drainfield could potentially handle the wastewater onsite in a manner that complied with current regulations. Of the assessed parcels, only one was identified as having the ability to conform to standards. According to this assessment, over half of the sites are not able to treat all of their wastewater onsite and must send at least a portion of it offsite for treatment and disposal in order to comply with regulations. Another 10 could potentially be repaired and granted a "non-conforming repair" status by DOH. This is a variance that exempts the owner from standard regulatory requirements for system sizing, but decreases the property value, requires frequent maintenance, and limits the property to its current use. Another 5 sites have the potential to treat a portion of their wastewater onsite, but not all. At the remaining 16 sites, there is no opportunity for onsite treatment, and all wastewater must be sent offsite for treatment and disposal in order to comply with current regulation. Of the 16 parcels in the Phase 2 area, 5 have the ability to conform to standards using onsite treatment, 8 could qualify for the "non-conforming repair" variance, and 3 must send a portion or all of their wastewater offsite for treatment and disposal. See Table 5-2 for a breakdown of current flows for each category of existing onsite system condition. For onsite alternatives, no future increases in flow are projected since limited space is available to accommodate additional flow.

Table 5-2

Current Onsite System Flows Handled by Available Onsite Treatment Options

Phase	Conforming Onsite (gpd)	Non-Conforming Repair (gpd)	Some Onsite (25%) / Some Offsite (75%) (gpd)	Only Offsite (gpd)	Total Treatable Onsite(1) (gpd)	Total Offsite Required(2) (gpd)
1	1,000	2,500	7,400	12,400	5,400	17,900
2	2,100	3,700	400	100	5,900	400
Total	3,100	6,200	7,800	12,500	11,300	18,300

(1) Sum of flows for conforming onsite, non-conforming repair, and the portions of some onsite/some offsite that can be treated onsite.

(2) Sum of flows for all offsite and the portion of some onsite/some offsite that must be treated offsite.

ALTERNATIVE 1: NO ACTION

This is the scenario in which nothing is done to address wastewater management in Fall City. The benefit is that in the short term, there is no additional cost to anyone in the community. However, this alternative solves none of the current problems. Currently, the business area has no room for expansion, and some participants in the June 21, 2001 meeting felt that the existing onsite systems are already inadequate with respect to protection of public health and the environment. Presently, there are three portable toilets in the commercial district, because business owners do not have the capacity in their septic systems to allow customers to use their bathrooms. Some owners require hauling of wastewater since they have unusable drainfields. For many business owners, the potential to expand their operation, change the type of business, or sell their establishment is impossible due to inadequate wastewater systems. The No Action option leaves businesses whose septic systems fail little choice but to close or haul wastewater away, and does nothing to protect local groundwater and the Snoqualmie River from potential pollution.

ALTERNATIVE 2: INDIVIDUAL ONSITE SYSTEMS

In this analysis it is assumed that all existing septic tanks are serviceable, not leaking and are capable of being utilized for the onsite or cluster system.

This option is open to those residences and businesses who have enough space on their site to place a treatment unit and a drainfield (i.e., a conforming onsite system that meets current King County codes), or who can obtain a non-conforming repair exemption from King County or DOH. If the business community forms its own management district, then DOH will be the agency to grant the exemption. If no management entity is formed, King County will administer any exemptions. With the exception of a few sites, any property owners wishing to perform onsite treatment will need to install an Aerobic Treatment Unit (ATU). These are special treatment tanks installed in series with traditional septic tanks to pretreat wastewater prior to discharge into the drainfield. Due to the treatment, DOH allows disposal of the treated wastewater into a smaller drainfield than current regulations allow. For this stage in the planning process, the Whitewater® ATU has been selected as a typical ATU for residential use. It was approved by DOH in 1994, and 1,500-2,000 units have been installed in Washington State. It is capable of reducing BOD levels from 100-300 mg/L to 5-10 mg/L, and TSS levels from 100-350 mg/L to 5 – 10 mg/L. Commercial establishments have a higher waste strength than residences, and therefore will require an ATU developed for high strength wastewater. These commercial ATUs have higher capital costs than residential ATUs. Appendix H shows an ATU cost table.

Many properties in the business district have insufficient land area available for adequate onsite treatment; therefore, not all of the business district's wastewater flows can be treated by individual onsite systems.

See Table 5-3 for design criteria, Tables 5-4 and 5-5 for capital cost estimate and Table 5-6 for annual O&M cost estimate of individual onsite septic systems.

Table 5-3

Onsite Systems Design Criteria

Parameter	Max. Day
Flow (gpd)	11,300[1]
BOD (lb/day)	22
TSS (lb/day)	22
TKN (lb/day)	4.4
No. of Residential Units	1
No. of Commercial Units	12

(1) For Phase 1 and 2

Table 5-4

Capital Cost Estimate For Onsite Residential Non-conforming Repair (1 existing property only)[(1), (3)]

No.	Item	Quantity	Unit	Unit Price	Amount
1.	Inspection/Evaluation of Site/Existing OSS[(2)]	1	LS	$1,000	$1,000
2.	Repair of Existing Drainfield	1	LS	$5,000	$5,000
3.	Residential Aerobic Treatment Unit (ATU)	1	LS	$5,000	$5,000
4.	Electrical[(4)]	1	LS	$1,000	$1,000
5.	Piping	1	LS	$1,000	$1,000
6.	Site Work	1	LS	$500	$500
7.	Mobilization/Demobilization[(5)]	1	LS	$800	$800

Subtotal	$14,300.00
Contingency (15%)	$ 2,145.00
Subtotal	$16,445.00
Sales Tax (8.4%)	$ 1,381.00
Estimated Construction Cost	$17,826.00
Legal, Engineering, & Administration (20%)	$ 3,565.00
Total Estimated Project Cost	$21,400.00
Number of Residential Properties Repaired	1

Total Estimated Project Cost For Community (1 property).. $21,400.00

(1) Assumes use of an ATU is required to bring waste strength down below 350 mg/l BOD.
(2) Assumes use of an existing septic tank and drainfield
(3) Assumes public works bidding procedure/contractor installation overseen by a wastewater management entity.
(4) Assumes 120V electric service for the ATU is available at the building being served by the OSS.
(5) Mobilization/Demobilization is calculated as 8% of items 1-6 subtotal.

Table 5-5

Capital Cost Estimate For Onsite Commercial Non-conforming Repair (For 12 Commercial Properties)[1], [3]

No.	Item	Quantity	Unit	Unit Price	Amount
1.	Inspection/Evaluation of Site/Existing OSS[2]	1	LS	$ 1,000	$ 1,000
2.	Repair of Existing Drainfield	1	LS	$ 5,000	$ 5,000
3.	Commercial High Strength ATU	1	LS	$35,000	$35,000
4.	Electrical[4]	1	LS	$ 2,000	$ 2,000
5.	Piping	1	LS	$ 1,000	$ 1,000
6.	Site Work	1	LS	$ 500	$ 500
7.	Mobilization/Demobilization[5]	1	LS	$ 1,500	$ 1,500

Subtotal $46,000.00
Contingency (15%) .... $ 6,900.00
Subtotal $52,900.00
Sales Tax (8.4%) .... $ 4,444.00
Estimated Construction Cost $57,344.00
Legal, Engineering, & Administration (20%) $11,469.00
Total Estimated Project Cost for One Property $68,800.00
Number of Commercial Properties Repaired 12

Total Estimated Project Cost For Community (12 properties) $825,600.00

(1) Assumes use of an ATU is required to bring waste strength down below 350 mg/l BOD.
(2) Assumes use of an existing septic tank and drainfield.
(3) Assumes public works bidding procedure/contractor installation overseen by a wastewater management entity.
(4) Assumes 120V electric service for the ATU is available at the building being served by the OSS.

Table 5-6

Annual O&M Cost Estimate for Onsite Septic Systems with Aerobic Treatment Units

Customer Type	Service Frequency	Estimated Annual Cost Per ATU System
Residential	2 times per year	$200.00
Commercial	4 times per year	$800.00

ALTERNATIVE 3: CLUSTER SYSTEMS

As can be seen in Table 5-2, of the 29,500 gpd of wastewater currently generated in Phase 1 and 2, only 11,300 gpd can be treated onsite adequately or managed onsite with a non-conforming repair exemptions. The remaining 18,200 gpd in Phase 1 and 2 must be treated remotely from the individual business parcels. One alternative for treating the remainder is a community cluster system. A cluster system consists of multiple small systems that each serve a portion of the needed service area as opposed to one large system. For a Fall City system, the clusters would need to accommodate 18,200 gpd to manage current flows, or 24,100 gpd to manage the minimum future Phase 1 and 2 flows. In order to project the future minimum flows for a cluster system, it was assumed that anyone who could potentially treat their wastewater onsite would do so. The growth factor of 20% was applied to current flows of Phase 1 and 2, and the extra flows generated in the "Conforming Onsite" and "Non-conforming Repair" were added to the amount of flows that must be treated offsite. For the maximum flow case at Phase 1 and 2, when the flows from all sites requiring offsite treatment are double the minimum flows, the offsite cluster system capacity would need to be 59,500 gpd.

CLOSE-IN CLUSTER SYSTEM

By creating cluster systems in the close vicinity of the business district, it enables treatment in onsite facilities with individual capacities of less than 14,500 gpd. This capacity is below the threshold for Ecology regulation, and therefore the facility will be regulated by DOH, as discussed in Chapter 3. This arrangement would reduce the treatment, monitoring and maintenance requirements.

Three potential sites for community drainfields have been located within a quarter mile of the commercial area. Therefore, the cluster system evaluated will include three community drainfields. Other suitable sites near the business district were not found in our investigation. The total capacity of these three parcels is 7,200 gpd, leaving 11,100 gpd (for Phase 1 and 2 current flows) that would need to be treated at a more remote site, as discussed below. For each site, it is assumed that the entire area, minus the required 5 foot buffer, will be used. Half of the site will contain the conventional drainfield, and the other half will be the mandatory, 100% reserve drainfield area. See Table 5-7 for Design Criteria, Table 5-8 and 5-10 for estimated capital costs and Table 5-9 and 5-11 for annual O&M cost estimate for the three cluster drainfields with a combined capacity of 7,200 gpd.

Table 5-7

Design Criteria for 7,200 gpd Cluster Drainfields (Combined Criteria for Three Separate Drainfields at 7,200 gpd Combined Capacity)

Component	Value
Flow (gpd)	7,200
Loadings	
BOD (lbs/day)	2.1
TSS (lbs/day)	2.1
TKN (lbs/day)	0.4
Surge Tanks	6@ 4,100 gallons
Distribution Pumps	6@50 gpm, 30 ft TDH
Drainfields	
Drainfield Application Rate	0.4 gpd/ft^2
Drainfield Zones, w/Alternation	9@1,500 ft^2
Drainfield Area Needed, w/Reserve	36,000 ft^2
Orifice Size	3/16"
Orifice Spacing	4 ft
Lateral Size	2"
Collection System	
Gravity Sewer	4"

O&M cost estimates are a portion of the costs for the 27,800 gpd system described in Alternative 4 based on relative flow rate.

Layout of cluster systems is shown in Figure 5-1 and a typical cluster system schematic is shown in Figure 5-2, which applies only to the sites located adjacent to the central business district. It is anticipated that some businesses (approximately three to four) will need to install an ATU to reduce the organic loading in their wastewater to below 350 mg/L as required. A shallow, small diameter, variable grade, gravity collection system will convey wastewater flows from the selected service area to the nearby drainfield. At the drainfield site, the wastewater will enter a surge tank to dampen fluctuations in flow volumes, and then the wastewater will be pumped into the conventional drainfield and be disposed of at a rate of 0.4 gpd/ft^2.

Table 5–8

Capital Cost Estimate for 7,200 gpd Cluster Drainfields (Combined Cost for Three Separate Drainfields at 7,200 gpd Combined Capacity)(1), (2)

No.	Item	Quantity	Unit	Unit Price	Amount
1.	Clearing & Grubbing	1	LS	$ 3,800	$ 3,800
2.	Sitework, Excavation, Waste Hauling	1	LS	$40,700	$ 40,700
3.	Surge Tanks	2	LS	$ 7,500	$ 15,000
4.	Drainfield Pumps, Controls	2	LS	$ 5,000	$ 10,000
5.	Drainfield Media	1	LS	$26,500	$ 26,500
6.	Geotextile	1	LS	$ 4,900	$ 4,900
7.	Electrical(3)	1	LS	$15,000	$ 15,000
8.	Site Piping, Valves	1	LS	$25,000	$ 25,000
9.	Topsoil, Mulch, Seeding	1	LS	$ 8,100	$ 8,100
10.	Road Work/Security Gates	1	LS	$12,500	$ 12,500
11.	Mobilization/Demobilization(4)	1	LS	$12,900	$ 12,900

Subtotal $174,400.00
Contingency (15%) .... $ 26,200.00
Subtotal $200,600.00
Sales Tax (8.4%) .... $ 16,900.00
Estimated Construction Cost $217,500.00
Legal, Engineering, & Administration (20%) .... $ 43,500.00
Land Acquisition(5) $100,000.00
Total Estimated Project Cost $361,000.00

(1) Assumes use of a septic tank, and, if needed, an ATU at the customer's property to reduce each customer's effluent waste strength to below 350 mg/l BOD, prior to gravity discharge to the pipe leading to the surge tank and cluster drainfield.
(2) Assumes public works bidding procedure/contractor installation overseen by a wastewater management entity.
(3) Assumes 120V electric service for the ATU is available at the building being served by the OSS.
(4) Mobilization/Demobilization is calculated as 8% of items 1-10 subtotal.
(5) Land Acquisition Cost based on 0.41 acres @ $25,000/acre, with a minimum cost of $100,00 for parcels less than 1 acre.

Table 5-9

Annual O&M Cost Estimate for 7,200 gpd Cluster Drainfields (Combined Cost for Three Separate Drainfields at 7,200 gpd Combined Capacity)

Item	Estimated Cost
Labor(1)	$2,080
Supplies	$ 250
Electric Power for Pumps(2)	$ 100
Septic Solids Hauling	$2,000
Repair & Replacement	$1,000
Miscellaneous	$ 250
Total Annual O&M costs	**$5,680**

(1) Labor estimated at 1 hr per week @ $40/hr.
(2) Power costs estimated at $0.07/Kw-hr

Table 5-10

Capital Cost Estimate for 7,200 gpd Cluster System Collection and Conveyance System

No.	Item	Quantity	Unit	Unit Price	Amount
1.	Dewatering	1	LS	$2,000	$ 2,000
2.	Traffic Control	1	LS	$2,000	$ 2,000
3.	Locate Utilities	1	LS	$1,000	$ 1,000
4.	4-inch PVC Sewer Pipe	1,300	FT	$ 16	$20,800
5.	4-inch Cleanouts	9	EA	$1,500	$13,500
6.	2" Side Sewer	520	FT	$ 14	$ 7,280
7.	Mobilization and Demobilization	1	LS	$5,000	$ 5,000

Subtotal $51,580.00
Contingency (15%) .... $ 7,737.00
Subtotal $59,317.00
Sales Tax (8.4%) .... $ 4,983.00
ESTIMATED CONSTRUCTION COST $64,300.00
20% Legal, Engineering, Administration $12,860.00
TOTAL ESTIMATED PROJECT COST $77,000.00

TABLE 5-11

Annual O&M Cost Estimate for 7,200 gpd Cluster System Collection and Conveyance System

No.	Item	Cost
1.	Labor[1]	$4,000
2.	Power[2]	$ 300
3.	Maintenance	$2,000
Total Estimated O&M Cost		**$6,300**

(1) Labor is estimated at 100 hours/year @ $40/hour.
(2) Power cost is based on 1/2 hp pump @ $0.07/Kw-hr.

OFFSITE 14,500 GPD RECIRCULATING GRAVEL FILTER SYSTEM

The flows in excess of 7,200 gpd (11,000 gpd for Phase 1 and 2 current flows) would be sent to an offsite treatment and disposal location west of the business district. See Figure 5-4. Because it is a relatively large flow, approaching the 14,500 gpd initially, and potentially expanding to above 14,500 gpd for future growth, it will require more treatment than flows applied to smaller onsite community drainfields. The treatment system proposed is a recirculating gravel filter (RGF) treatment process. Design criteria for the RGF process is shown in Table 5-12.

A shallow, 6-inch diameter gravity collection line would deliver the collected wastewater to a pump station, then it would pump the wastewater, through a 3-inch diameter force main, to the offsite treatment and disposal location.

Table 5-12

Design Criteria for Offsite 14,500 gpd Recirculating Gravel Filter System with Subsurface Drip Irrigation

Component	Value
Flow (gpd)	14,500
Loading	
BOD (lb/day)	42
TSS (lb/day)	42
TKN (lb/day)	8.5
Settling Tanks	2 @ 7,250 gallons
Recirculating Gravel Filter	
Filter Loading Rate	4.5 gpd/ft^2
Filter Surface Area, 2 Zones	3,200 ft^2
Recirculation Tank	21,750 gallons
Recirculation Pumps w/1 Redundant	3 @ 150 gpm, 30 ft TDH

Table 5-12 – (continued)

Design Criteria for Offsite 14,500 gpd Recirculating Gravel Filter System with Subsurface Drip Irrigation

Pump Tank	2,000 gallons
Distribution Pumps	2 @ 210 gpm, 30 ft TDH
Subsurface Drip Irrigation Drainfield	
Drainfield Application Rate	0.17 gpd/ft^2
Drainfield Zones, w/Alternation	6 @ 21,324 ft^2
Drainfield Area Needed, w/Reserve	4.1 acres
Maximum Daily Emitter Discharge	0.4 gpd/emitter
Emitter Spacing	1.5 ft
Emitter Absorption Area	2.25 ft^2
Collection & Conveyance	
Gravity Sewer Pipe	6" PVC
Gravity Sewer Length	2,180 ft
Pump Station	
Peak Flow	61,000 gpd
Pump Type	Submersible Centrifugal
No. of Pumps	2
Capacity of Pumps	60 gpm
TDH of Pumps	106 ft
Motor Size of Pumps	5.5 HP
Force Main	3" HDPE
Length of Force Main	6,300 ft

A recirculating gravel filter consists of two parallel septic tanks, a recirculation tank/pump tank, and a recirculating gravel filter (RGF), followed by disposal to a pressurized drainfield. The RGF would produce a relatively well-treated effluent, but cannot be relied on for nutrient removal. Therefore, the drainfield would be a drip irrigation system constructed at shallow depth (about 6 inches) in the (probably grass) root zone of the crop, relying upon plant uptake to remove nutrients. Soils in the drainfield would also provide additional polishing of the effluent and final disposal.

For this reason, an application rate of 0.17 gpd/ft^2 will be used to size the drainfield. This loading rate was devised from assuming a low permeability drainfield soil and using Table 2 in DOH's Interim Recommended Standards and Guidance for Subsurface Drip Systems. Note: See additional information on drainfield disposal in the discussion below Alternative 4: Centralized Systems.

Plant uptake of nutrients would be highest during the summer months, which is also the period of slowest groundwater movement, conversely, during the winter months, plant nutrient uptake would be lowered, but increased groundwater flows would dilute nutrients added by the treated effluent discharge from the drip irrigation emitters.

With this alternative, the influent wastewater at the treatment and disposal site flows initially into two (2) septic tanks operating in parallel mode, where the heavier solids are settled out. The wastewater then flows to the recirculation tank where it mixes with partially treated filter effluent. The mixed wastewater is pumped the RGF at regular intervals, with doses controlled by both a timer and a high level float switch. The wastewater is distributed under pressure to the gravel filter consisting of a layer of drain rock lying over the filter media. The filter media consists of a minimum of 36 inches of coarse sand, along with additional underdrain layers of drainrock and "pea gravel".

As the wastewater moves downward by gravity through the gravel media, biological growth attached to the media removes the organic material in the wastewater. The filtrate is collected at the bottom of the filter in a grid of collection piping and returned to the recirculation/mixing tank. A portion of the filtrate is discharged from a splitter box to the pump tank, and the remainder cycles back through the filter. A float-activated valve is frequently used to control recirculation and discharge from the tank. The RGF system is designed for wastewater to pass through the filter approximately 5 times prior to discharge. When discharged, treated wastewater would be pumped from the treatment system to the drainfield for final soil treatment and disposal.

The septic tanks should provide a minimum of 1.6 days detention time at peak monthly flow. Two cast-in-place tanks will be used to provide the required volume. The outlet of the tanks would be screened with a minimum 1/8 inch plastic mesh screen or a bag filter to prevent the passing of solids to the recirculation tank. The tanks are provided to enable draining of each individually for maintenance.

The recirculation tank volume would be sized to handle at least 150% of annual average daily flow. The recirculation pumps would operate on a timer, in alternating cycles of 5 minutes on, 25 minutes off. This dosing schedule provides 48 dosing periods per 24 hours, allowing the influent/filtrate mixture to cycle through the filter about 5 times before discharge. One recirculation pump per filter zone and one additional pump for backup will be provided.

Float switches would be wired in parallel with the timer to control the pumps during periods of excessive wastewater flows, and in the event of timer malfunction. Both timer and float switch controls are required, to protect the pump and the distribution piping from excessive solids, the pumps would be enclosed in a 1/8 inch mesh plastic screen. The tank would be designed to enhance settling and retain solids that might be flushed out of the filter.

Recirculating gravel filter sizing is based on a loading rate of 4.5 gallons per day per square foot at design monthly flow. At least two filter zones would be constructed so that one zone could be taken off line for maintenance. Gravel filter distribution laterals would be 1 1/2-inch diameter PVC piping laid at 2'-8" feet on center, with 3/16-inch orifices spaced at 2'-8" feet on center. Planning level estimates will assume an above-grade concrete filter basin.

The effluent would flow to a 2,000 gallon pump tank. Two pumps will be provided in the tank, along with the necessary floats and controls. Each pump will be capable of pumping the required flow necessary to pressurize the drainfield, so that the system can operate at peak flow with one pump out of service. The effluent from the RGF will be discharged through an in-line filter (probably Vortex) to the subsurface drip irrigation field. The pumps will be set to alternate pumping into the subsurface drip irrigation field.

The drip field area would be laid out in at least two zones. A reserve area capable of handling 100 percent of the peak day design flow would also be provided for a future replacement drainfield area. A process flow diagram for this alternative is presented in Figure 5-3.

Installing properly washed filter media that meets the DOH media specification is critical to the success of the RGF treatment. Past systems have failed due to the use of media that was too fine or media that contained too much fine material because it was not adequately washed. The filter media must meet the DOH criteria for particle size based upon a particle size analysis of the actual gravel material proposed for use. Each load of media used in construction should be sieve-tested to assure media specification compliance.

An access road will need to be provided for access to the site. Three phase power would be provided to the site to operate the recirculation and distribution pumps, as well as filter and disinfection facilities. The estimated construction costs for collection and conveyance and treatment and disposal systems are presented in Table 5-13. The estimated annual O&M costs are listed in Tables 5-14.

Table 5 – 13

Estimated Capital Costs For Offsite 14,500 gpd Recirculating Gravel Filter Facility with Subsurface Drip Irrigation

No.	Item	Quantity	Unit	Unit Price	Amount
Collection and Conveyance System					
1.	Dewatering	1	LS	$ 13,000	$ 13,000
2.	Traffic Control	1	LS	$ 11,000	$ 11,000
3.	Locate Utilities	1	LS	$ 4,000	$ 4,000
4.	6-inch PVC Pipe and Bedding	2,180	FT	$ 18	$ 39,240
5.	2" Side Sewer	1,160	FT	$ 12	$ 13,920
6.	60 gpm Pumps, Valves, Site Piping, Valve Vault	1	LS	$ 35,000	$ 35,000
7.	Boring	2	EA	$ 25,000	$ 50,000
8.	6' diameter wet well (14.5 feet deep)	1	LS	$ 10,000	$ 10,000
9.	Electrical	1	LS	$ 20,000	$ 20,000

Table 5 – 13 – (continued)

Estimated Capital Costs For Offsite 14,500 gpd Recirculating Gravel Filter Facility with Subsurface Drip Irrigation

No.	Item		Quantity	Unit	Unit Price	Amount
10.	Site work		1	LS	$ 2,000	$ 2,000
11.	3" HDPE Force Main		6,500	FT	$ 14	$ 91,000
Collection and Conveyance System						
12.	Surface Restoration					
	Gravel Surfacing		1,055	SF	$ 10	$ 10,550
	Asphalt		255	SY	$ 30	$ 7,650
	Hydroseeding		1,000	SY	$ 1	$ 1,000
13.	Imported Backfill		600	CY	$ 20	$ 12,000
Treatment and Disposal:(1)						
14.	Recirc./Mixing Tank	$39,000	2	EA	$ 44,500	$ 89,000
15.	Recirc. Pumps	$51,000	2	EA	$ 25,500	$ 51,000
16.	Concrete for RGF	$72,000	1	LS	$ 72,000	$ 72,000
17.	Media for RGF	$9,000	1	LS	$ 9,000	$ 9,000
18.	Effluent Filter	$20,000	1	LS	$ 20,000	$ 20,000
19.	Drainfield pump station	$20,000	1	LS	$ 20,000	$ 20,000
20.	Subsurface Drip Drainfield	$130,000	1	LS	$153,000	$153,000
21.	Piping & Valves	$70,000	1	LS	$ 70,000	$ 70,000
22.	Electrical	$36,000	1	LS	$ 36,000	$ 36,000
23.	Site Work	$25,000	1	LS	$ 25,000	$ 25,000
24.	Mobilization/Demobilization		1	LS	$ 56,000	$ 56,000

Subtotal .... $ 921,400.00
15% Construction Contingency .... $ 138,200.00
Subtotal $1,059,600.00
8.4% Sales Tax .... $ 89,000.00
Estimated Construction Cost $1,148,600.00
20% Legal, Engineering, and Administration .... $ 229,700.00
Land Acquisition(2) .... $ 113,000.00
TOTAL ESTIMATED PROJECT COST $1,491,300.00

(1) These costs are flow proportioned, based on costs shown in Table 5-20 for an RGF with subsurface drip drainfield for the Phase I Minimum Flow projection of 27,800 gpd for peak month flow. Some items, such as UV disinfection, and a building, have been eliminated for this DOH-regulated facility.

(2) Land Acquisition Cost based on 4.5 acres @ $25,000/acre.

Table 5 – 14

Estimated Annual O&M Costs For Offsite 14,500 gpd Recirculating Gravel Filter Facility with Subsurface Drip Irrigation

No.	Component(2)	Cost
Treatment and Disposal		
1.	Labor(1)	$ 6,240
2.	Power	$ 1,400
3.	Maintenance	$ 4,200
4.	Septage Handling	$ 950
Collection & Conveyance		
5.	Labor	$10,000
6	Power	$ 500
7.	Maintenance	$ 2,000
Estimated Total Annual O&M Cost		**$25,300**

(1) Labor is estimated at 3 hrs per week at $40/hr.
(2) The remaining costs are flow proportioned, based on costs shown in Table 5-20 for an RGF with subsurface drip drainfield for the Phase I Minimum Flow projection of 27,800 gpd for peak month flow.

A collection and conveyance system consisting of small diameter high density polyethylene (HDPE) pipe and pump station is required to deliver the wastewater to the cluster systems and offsite RGF. Capital and O&M costs for the collection system are shown in Tables 5-13 and 5-14, respectively.

It is important to note that the offsite RGF system will only be feasible for current flows. Of the 29,500 gpd of wastewater currently generated in Phase 1 and 2, 18,200 gpd must be treated offsite. Only 7,200 gpd can be disposed of on the three sites in town, and the offsite RGF facility would need to handle the remaining 11,000 gpd. For Phase 1 and 2 minimum projected flows, 24,100 gpd needs to be treated offsite. Therefore, an offsite RGF facility design capacity must be 16,900 gpd, which requires Ecology regulation of the system. Since the goal of this alternative is to remain under the less stringent DOH regulation, it provides little benefit to pursue this alternative for any flows beyond what currently exists. Therefore, the cost estimates for this alternative have only been determined for current flows.

For greater flows, a centralized system under Ecology jurisdiction may be more appropriate, as discussed in the next section.

ALTERNATIVE 4: CENTRALIZED SYSTEMS

LOCATION

All offsite treatment solutions require acquisition of suitable land on which to locate the system. A Geographic Information System database was used to identify parcels providing potential sites for wastewater treatment facilities in the Fall City area. All land within a 2 mile radius of the commercial area was initially considered, then areas which had undesirable features, were removed from consideration. First, all land north of the Snoqualmie River was removed from consideration, because piping raw sewage across a salmon-bearing river is discouraged by the regulatory agencies and would be very expensive. Next the floodplain was removed from consideration because the Revised Code of Washington prohibits new construction in a floodway. The other sensitive area that had to be removed is the Water District's Wellhead Protection Zone identified in the 1999 Wellhead Protection Plan for the Fall City Water District. The final area removed from consideration was the hills to the south of the commercial district. Steep slopes in this area are not suitable for use for wastewater facilities utilizing drainfields. Also, pumping water uphill is significantly more expensive and maintenance intensive than using flow by gravity. Therefore it is not economical to locate the central system at higher elevations. The only areas remaining for potential treatment facility sites lie west and southwest of the commercial area. All parcels between 5 and 10 acres, and parcels over 10 acres in the remaining area were located and identified as shown in Figure 5-5.

A centralized system will also require a wastewater collection and transmission pipeline. At this stage in the planning process, only the general area to which this pipeline will extend is presented. For preliminary design and cost estimating purposes, the collection and transmission pipeline from the commercial district is shown to extend into the middle of the area, which contains potential sites for the centralized facility. See Figure 5-5 for added detail. The following describes in detail the preliminary design and cost estimate for the collection and transmission component of the Fall City centralized facility alternatives.

COLLECTION SYSTEM TO CENTRALIZED WASTEWATER TREATMENT FACILITY

Due to the topography of the central business area in Fall City, a conventional gravity system appears to be best suited to serve the area. Prior to final design, this will have to be confirmed by a survey of the area. When compared to other type of collection systems, the primary advantage of a conventional gravity system is its reliability, low operation and maintenance costs compared to pressure or vacuum collection systems, capacity range, and ability to handle more solids and grease than small diameter (pressure and vacuum) systems. This last feature is especially important for collection systems serving commercial users with sources of high solids and grease.

For a collection area for Fall City's business area, the minimum size of gravity sewer line required by Ecology criteria is 8-inch diameter. To minimize cost, the gravity piping will be designed to have the minimum slope of 0.4 feet per 100 feet required by Ecology. This slope will provide self-cleaning velocities of at least 2 feet per second.

GENERAL COLLECTION SYSTEM LAYOUT

Since there are no sanitary sewers within Fall City at present, a completely new system must be designed to serve the area. It is proposed that all wastewater from the Phase 1 and 2 areas be conveyed with an 8-inch diameter main gravity line to the intersection of 334th Place SE and SE 42nd Street, where the wastewater will then be pumped via a new force main to the treatment and disposal sites. The site of treatment and disposal facilities is unknown at this point, but will most likely be located in the area west of the business district as described above. A preliminary layout of a conventional gravity system for the Phase 1 and 2 service area, a pump station and the force main is shown in Figure 5-6.

The existing building side sewers will be disconnected from the septic tanks and connected to a new 4-inch side sewer pipe, which will then be connected to the main gravity line. Individual connections may be required to have grease traps or onsite facilities to reduce high strength waste prior to discharging into the collection system.

Most of the main gravity sewer line will be located in the alley behind the central businesses. Currently there is a 4-inch potable water line running along the north side of the alley. The County is planning to move this water line to the front side of the businesses in the near future.

The Fall City parcel maps were used to establish the length of the main sewer collection line and the force main. The collection system, excluding side sewers, will consist of about 2,260 linear feet of gravity sewer pipeline.

CONVEYANCE SYSTEM TO CENTRALIZED WASTEWATER TREATMENT PLANT

The distance between the possible location of the site for treatment and disposal facilities and the sewage collection area requires sewage pumping. For the projected peak flow of 173,100 gpd (Phase 1 and 2), a single pump station is recommended. The wet well will be sized to accommodate flows during power failure for a period of 60 minutes to allow for connection to a portable generator. The concrete wet well will be 8 feet in diameter. The pump station will include two submersible pumps (one of them is a standby pump). Each pump will be sized to pump 120 gpm, which will provide 3 ft/s velocity in the 4 inch diameter force main. The pump size and quantity were selected to meet Class I reliability standard and for system redundancy. Department of Ecology criteria states that a standby pump be provided as well as a standby generator in case of pump malfunction or power outages. A portable standby generator will be stationed at the treatment facility to serve the pump station in case of power outage. Any pump station must also be protected from 100 year flood.

Table 5-15

Design Criteria for Centralized Systems Collection and Conveyance System

Components	Design Criteria
Flow	
Design Flow, gpm	70,000 (Phase 1 and 2)
Peak Flow, gpm	173,100 (Phase 1 and 2)
Gravity Sewer Main Diameter	
Diameter	8"
Material	PVC
Pump Station	
Type of Pumps	Submersible
Number of Pumps	2
Capacity, gpm (each)	120
TDH of Pumps	114 ft
Motor Size of Pumps	14 hp
Force Main	
Diameter	4"
Material	HDPE
Length	6,300 ft

Table 5-15 summarizes the preliminary design criteria of collection and conveyance system. Three phase power is assumed to be available near the site. The pump station will be equipped with an electrical distribution panel, and a local control panel. Pump station piping and valves will be designed to allow for access and maintenance.

This conveyance system is designed to convey the peak hour flows. Figure 5-3 shows the layout of the transmission line between the proposed pump station and the assumed end point of the force main at the treatment facility. The assumed endpoint is located in an area near the possible location of the future treatment facility and disposal site, see Figure 5-6. The purpose of selecting an assumed general area for the centralized treatment facilities and 6,300 feet (1.2 miles) of force main is to develop comparable cost estimates for the centralized treatment alternatives.

Department of Ecology criteria requires that the force main must be greater than or equal to 4 inches in diameter with minimum velocity of 2 feet per second. The conveyance pipeline should be sized to support peak flows for the design year 2021. One 4-inch pipe will support maximum potential peak hour flows of 149,300 gpd. The recommended pipeline material would be high-density polyethylene (HDPE) due to its resistance to corrosion and ease of installation.

COLLECTION AND CONVEYANCE SYSTEM COST ESTIMATES

Preliminary cost estimates for the collection system were based on a design peak hour flow of 173,100 gpd for the design year 2021. For each side sewer connection the cost includes an assumed average length of 40 feet, 4-inch diameter side sewer line and a 24-inch diameter sampling/metering pipe section. Payment for the side sewer from the building to the property boundary will be the responsibility of the property owner.

Construction cost estimates for the collection system were developed from preliminary design criteria, planning-level equipment quotations, preliminary quantity take-offs, and escalated bid summaries for similar projects and equipment. The total capital costs for the collection system, transmission line and pump station is shown in Table 5-16.

Table 5-16

Capital Cost Estimate of Collection and Conveyance System for Centralized System Alternatives

No.	Item	Quantity	Unit	Unit Price	Amount
1.	Dewatering	1	LS	$13,000	$13,000
2.	Traffic Control	1	LS	$11,000	$11,000
3.	Locate Utilities	1	LS	$4,000	$4,000
4.	8-inch PVC Pipe and Bedding	2,260	FT	$24	$54,240
5.	48" Gravity Sewer Manholes	10	EA	$1,500	$15,000
6.	4" Side Sewer	1,160	FT	$20	$23,200
7.	120 gpm Pumps, Valves, Site Piping, Valve Vault	1	LS	$35,000	$35,000
8.	Boring	2	EA	$25,000	$50,000
9.	8' diameter wet well (19 feet deep)	1	LS	$15,000	$15,000
10.	Electrical	1	LS	$20,000	$20,000
11.	Site work	1	LS	$7,000	$7,000
12.	4" HDPE Force Main	6,300	FT	$20.50	$130,000
13.	Surface Restoration				
	Gravel Surfacing	1,055	SF	$10	$10,550
	Asphalt	355	SY	$30	$10,650
	Hydroseeding	1,000	SY	$1	$1,000
14.	Imported Backfill	670	CY	$20	$13,400
15.	Mobilization and Demobilization	1	LS	$12,000	$12,000

Subtotal $425,040.00
Contingency (15%) .... $ 63,756.00
Subtotal $488,796.00
Sales Tax (8.4%) .... $ 41,059.00
ESTIMATED CONSTRUCTION COST $529,855.00
20% Legal, Engineering, Administration $105,971.00
TOTAL ESTIMATED PROJECT COST $635,826.00

Annual operation and maintenance (O&M) costs were based on labor, power, and equipment repair and replacement. Important factors for establishing O&M costs are the type and quantity of equipment required, system complexity, and operation requirements. O&M costs were developed from known costs for similar facilities in the region. Annual O&M cost estimates are shown in Table 5-17.

Table 5-17

Annual O&M Cost Estimate for Collection and Conveyance System Centralized Systems

No.	Item	Estimated Cost
1.	Labor	$10,000
2.	Power	$ 900
3.	Maintenance	$ 2,000
Total Estimated O&M Cost		**$12,900**

TREATMENT

The evaluation of wastewater treatment alternatives is largely driven by the ultimate means of effluent disposal and the regulatory requirements affecting the disposal. As discussed in Chapter 3, the regulatory requirements differ based on quality and volume of discharge and disposal method. The centralized system alternative will require compliance with Ecology regulations since wastewater projections are greater than 14,500 gpd. The first proposed centralized treatment alternative is a recirculating gravel filter (RGF) which will treat the wastewater to standards such that it can be disposed of into a drainfield. The second centralized treatment option to be evaluated is a Class A Water Reclamation facility from which the effluent can be reused for a number of purposes such as irrigation, stream flow augmentation, infiltration, washing vehicles and certain industrial uses. The third and fourth treatment options will be package plants, which utilize membrane filtration, and dispose of the treated water through land application to a drainfield or discharge directly to the Snoqualmie River.

We performed a cursory evaluation of additional wastewater management alternatives suggested by the Stakeholders Group. One of these alternatives was a wastewater package plant and soil infiltration bed that was considered in detail by one Stakeholder for a development in Fall City (see Appendix I for applicable letter regarding this alternative). The alternative did not include a wastewater conveyance system to the proposed site, nor did this suggested alternative include all the necessary equipment and structures required for a complete facility. Also, the package plant is a proprietary unit that is unknown to the technical consultant and apparently has only one (1) small installation in Washington State. Due to the tight time constraints of this engineering study, this suggested package plant alternative was not evaluated in detail. The proposed treatment process could be further evaluated in an Engineering Report at a later date.

DRAINFIELD DISPOSAL

The treated effluent from the RGF will be discharged into a drip irrigation drainfield. This type of drainfield disperses treated water through a system of shallow pipes. These pipes are buried 6 inches underground, and have "emitters", tiny orifices with 0.06 to 0.07 inch diameters. One benefit of a drip system is that the shallow application allows use of grass growing on the drainfield for nitrogen removal in combination with the soil vadose zone. According to Ecology criteria, a drainfield must not increase background levels of nitrogen by more than 2 mg/L at the edge of the aquifer below the drainfield. In the summer, when groundwater flows are lowest, the grass will be growing vigorously as a result of drainfield disposal, and removing up to 200 lbs/acre/year of nitrogen from the treated effluent. In the winter, when the grasses are dormant, local groundwater flows are at their highest due to winter precipitation recharging the aquifers, and nitrogen may not be a significant concern because it will be diluted in the groundwater below levels of concern and the disposal site will be located immediately upgradient of the Snoqualmie River. This disposal approach will require further discussion with and approval by Ecology.

For an initial Phase 1 design flow of 27,800 gpd, and based on the design criteria, a drip irrigation drainfield with 99,000 linear feet of tubing, and 66,250 emitters on 7.1 acres of land is required. One half of this area is active drainfield and other half is reserve area. It is anticipated that in the area west of Fall City, land can be purchased for about $25,000 an acre.

ALTERNATIVE 4A: RECIRCULATING GRAVEL FILTER FACILITY

This alternative is identical to the process recommended to treat the offsite flows under the Alternative 3, except that it will treat all the wastewater that needs to be treated rather than only a portion. The only difference in the process is that UV disinfection and filtration will be required as a final step prior to discharge into the drainfield. ATUs will still be required at the sites which discharge high strength wastewater in order to reduce BOD_5 and TSS to $\leq$ 350 mg/L. Because the facility is treating more that 14,500 gpd, it will operate under Ecology regulations. See Figure 5-7 for a schematic of the treatment process. The design criteria for the facility are presented in Table 5-18. The estimated capital costs for this alternative are presented in Table 5-19, and the estimated O&M costs are presented in Table 5-20.

The O&M labor cost estimate assumes four (4) hours per week of operator time based on an RGF design in the Finch Creek Design and Feasibility Study (G&O, 2000). The annual maintenance cost estimate is 0.5 percent of the total construction cost for all centralized alternatives.

ALTERNATIVE 4B: CLASS A RE-USE

This alternative presents treatment to meet Class A reclaimed water standards. The final disposal of effluent, for the purpose of this analysis, is assumed to be rapid infiltration to groundwater at an application rate of 2 inches per hour. Other options for effluent disposal may include constructed wetlands streamflow augmentation or river discharge. A potential may exist to utilize the facility as a demonstration facility. Water reclamation facilities are required to meet the requirements of the WRR standards in addition to the State Waste Discharge or NPDES permit depending on the type of reuse employed. Water reclamation projects must be fully described in an engineering report approved by the Departments of Ecology and Health. For groundwater recharge projects, hydrogeologic studies and groundwater monitoring will be generally required by the permitting authorities.

The State of Washington's Water Reclamation and Reuse (WRR) Standards for municipal wastewater define four classifications (Class A through D) based on the type of treatment provided.

TABLE 5 – 18

Design Criteria for Centralized Recirculating Gravel Filter Facility with Subsurface Drip Irrigation (Alternative 4A)

	Phase 1 Flows			Phase 1 & 2 Flows		
	Minimum (27,800 gpd)	Middle (41,7000 gpd)	Maximum (55,600 gpd)	Minimum (35,400 gpd)	Middle (53,100 gpd)	Maximum (80,800 gpd)
Total Septic Tank Volume (gallons)	44,000	67,00	89,000	57,000	85,000	114,000
Total RGF Area (sq. ft.)	5,000	8,450	11,236	7,200	10,816	14,400
Total Recirculation Tank Volume (gallons)	28,000	42,000	56,000	35,500	53,000	71,000
Recirculation Pumps (one redundant)	3 @ 290 gpm 25'TDH	3 @ 435 gpm 25'TDH	5 @ 290 gpm 25'TDH	3 @ 370 gpm 25'TDH	5 @ 280 gpm 25'TDH	5 @ 370 gpm 25'TDH
Filter Loading Rate	4.5 gpd ft^2	4.5 gpd ft^2	4.5 gpd ft^2	4.5 gpd ft^2	4.5 gpd ft^2	4.5 gpd ft^2
Effluent Pumps	2 @ 50 gpm 50'TDH	2 @ 75 gpm 50'TDH	2 @ 100 gpm 50'TDH	2 @ 60 gpm 50'TDH	2 @ 90 gpm 50'TDH	2 @ 120 gpm 50'TDH
Active Drainfield Area (Acres)	3.8	5.7	7.6	4.8	7.2	9.6
Reserve Drainfield Area (Acres)	3.8	5.7	7.6	4.8	7.2	9.6

Table 5 – 19

Estimated Capital Costs - Centralized Recirculating Gravel Filter Facility with Subsurface Drip Irrigation (Alternative 4A)

		Phase 1 Flows			Phase 1 & 2 Flows		
		Minimum (27,800 gpd)	Middle (41,700 gpd)	Maximum (55,600 gpd)	Minimum (35,400 gpd)	Middle (53,100 gpd)	Maximum (70,800 gpd)
1.	Septic Tanks	$ 77,000	$ 106,000	$ 135,000	$ 93,000	$ 129,000	$ 166,000
2.	Recirc./Mixing Tank	55,000	72,000	89,000	64,000	86,000	108,000
3.	Recirc. Pumps	64,000	78,000	92,000	72,000	89,000	107,000
4.	Concrete for RGF	159,000	250,000	341,000	209,000	324,000	440,000
5.	Media for RGF	21,000	34,000	46,000	28,000	44,000	60,000
6.	RGF Piping	37,000	59,000	80,000	49,000	76,000	104,0000
7.	Flow Meter	5,000	7,000	8,000	6,000	8,000	10,000
8.	Effluent Filter	44,000	52,000	60,000	48,000	58,000	68,000
9.	UV Disinfection	22,000	23,000	23,000	22,000	23,000	24,000
10.	Effluent Pump Station	49,000	53,000	57,000	51,000	57,000	62,000
11.	Drip Irrigation System	171,000	256,000	342,000	216,000	324,000	432,000
12.	Building	50,000	58,000	66,000	54,000	65,000	75,000
13.	Piping & Valves	121,000	168,000	214,000	146,000	205,000	265,000
14.	Electrical	98,000	136,000	174,000	119,000	167,000	215,000
15.	Site Work	38,000	52,000	67,000	46,000	64,000	83,000
16.	Mobilization/Demobilization	83,000	115,000	147,000	100,000	141,000	182,000
Subtotal		**1,094,000**	**1,519,000**	**1,941,000**	**1,323,000**	**1,860,000**	**2,401,000**
15% Construction Contingency		164,000	228,000	291,000	198,000	279,000	360,000
Subtotal		**1,258,000**	**1,747,000**	**2,232,000**	**1,521,000**	**2,139,000**	**2,761,000**
8.4% Sales Tax		106,000	147,000	187,000	128,000	180,000	232,000
Est. Construction Cost		**1,364,000**	**1,894,000**	**2,419,000**	**1,649,000**	**2,319,000**	**2,993,000**
20% Legal, Engineering, Administration		273,000	379,000	484,000	330,000	464,000	599,000
Land Acquisition		202,000	298,000	392,000	252,000	372,000	492,000
TOTAL ESTIMATED PROJECT COST[(1)]		**1,839,000**	**2,571,000**	**3,295,000**	**2,231,000**	**3,155,000**	**4,084,000**

(1) Cost does not include costs for the onsite ATUs to reduce higher strength waste.

Table 5-20

Estimated Annual O&M Costs for Centralized Recirculating Gravel Filter Facility with Subsurface Drip Irrigation (Alternative 4A)

		Phase 1 Flows			Phase 1 & 2 Flows		
		Minimum (27,800 gpd)	Middle (41,7000 gpd)	Maximum (55,600 gpd)	Minimum (35,400 gpd)	Middle (53,100 gpd)	Maximum (70,800 gpd)
1.	Labor	$ 8,400	$ 8,400	$10,400	$ 8,400	$10,400	$10,400
2.	Power	$ 2,000	$ 2,600	$ 300	$ 2,200	$ 2,900	$ 3,400
3.	Maintenance	$ 6,800	$ 9,500	$12,100	$ 8,200	$11,600	$15,000
4.	Septage Handling	$ 1,900	$ 2,900	$ 3,800	$ 2,400	$ 3,700	$ 4,900
Estimated Total Annual O&M Costs		$19,100	$23,400	$26,600	$21,200	$28,600	$33,700

The most critical treatment criteria is the disinfection standard for effluent total fecal coliform of 2.2 colonies per 100 ml (TC/100 mL) or less, which is the same for Class A or Class B reclaimed water. In order to meet this standard, the water must be highly treated prior to disinfection. Class A standards require that the water be filtered prior to disinfection. Class B standards do not require filtration, however, experience has shown that this disinfection standard can be difficult to meet if the water is not filtered prior to disinfection, therefore treatment to Class A standards is assumed.

With reclaimed water, protection of public health is considered the highest priority. Under the reuse standards there a number of operational and reliability requirements for a water reclamation plant. Several key requirements are summarized as follows:

- Minimum Class III Operator
- Setback distances and use area requirements
- Critical equipment and process failures must be signaled by an alarm
- Emergency storage/disposal in event of plant failure.
- Operating records provided to DOH as well as Ecology.
- No bypass reuse areas of untreated or partially treated water.
- A stand-by power supply or long term disposal or storage facilities

Allowable water reuse methods are listed below:

- Irrigation (non-food crops, food crops, or landscape irrigation)
- Landscape impoundments
- Constructed beneficial use wetlands and constructed treatment wetlands
- Groundwater recharge by surface percolation or direct injection
- Commercial and industrial uses
- Streamflow augmentation

The WRR standards specify treatment requirements and site management requirements for each water reuse methods. Not all of these methods provide adequate levels of reuse, due to the relatively small quantities and seasonal nature of the reuse method. However, two reuse methods offer the potential for 100 percent reuse on a year-round basis: groundwater recharge and streamflow augmentation.

Three categories of groundwater recharge are covered in the WRR standards: (1) direct injection to a drinking water aquifer, (2) direct injection to a non-drinking water aquifer and (3) surface percolation. For direct injection of reclaimed water to a drinking water aquifer, the WRR standards require reverse osmosis and additional effluent water quality standards. Groundwater recharge using surface percolation must at a minimum meet the Class A reclaimed water standards, unless a lesser level is allowed under a pilot project status by DOH and Ecology. In addition to secondary treatment to provide oxidized wastewater, the process must include a "step to reduce nitrogen prior to final discharge to groundwater". Due to the high level of treatment required for direct injection of reclaimed water, this report will evaluate groundwater recharge by surface percolation (rapid infiltration).

Streamflow augmentation requires an NPDES permit and adherence to the surface water quality standards (WAC 173-201A). However, the key difference between streamflow augmentation and surface water disposal is that a determination of beneficial use has been established based on a need to increase flows to the stream. This determination requires concurrence from Department of Fish and Wildlife that the need exists for additional instream flows. The alternatives for constructed wetland streamflow augmentation were not estimated at this time since this effluent disposal alternative is site specific.

The proposed treatment system includes an extended aeration activated sludge process, a common technology for smaller facilities. However, with this approach, the solids in the aeration basin would be separated from the liquid by an in-basin membrane unit, rather than using conventional settling methods. The use of the in-basin membranes creates a smaller footprint than conventional clarification and provides a very high quality filtrate. Also, because effluent nitrogen may be a parameter of concern in the wastewater for disposal to the groundwater, the treatment process would be designed to include both ammonia and total nitrogen removal. Following membrane filtration, the effluent would be disinfected with ultraviolet (UV) radiation, and piped to rapid infiltration site.

It is noted that a system using membrane filtration within the aeration basin has not yet been approved by Ecology for a Class A system, however, this technology has received State of California approval (Title 22) and Washington State. Department of Health and Ecology have recently determined for a specific project that membrane bioreactor technology satisfies the requirements of a Class A equivalent filtration technology for water reclamation facilities.

Ammonia removal is generally accomplished by acculturating bacteria in the aeration basins that convert the ammonia to nitrate, a form of nitrogen that is not toxic to fish and does not further reduce oxygen in the water. Because this biological conversion uses up a significant amount of alkalinity in the wastewater, it is generally desirable to also create an environment for denitrification, which removes total nitrogen and results in some alkalinity being returned to the wastewater. Denitrification involves creation of a separate anoxic zone (zero dissolved oxygen but nitrates present) at the influent end of the aeration basin. In this anoxic zone, incoming wastewater is mixed with recycle from the downstream aerobic zone (contains dissolved oxygen) of the aeration basin. Within the anoxic zone, the wastewater is mixed but not aerated, creating an environment where nitrate in the recycled aeration basin mixed liquor is biologically converted to nitrogen gas. From the anoxic zone the wastewater flows to the aerobic zone where nitrification takes place. A portion of the liquid is then recycled back to the anoxic basin for denitrification.

Modules containing a large number of membrane strands or panels can be placed directly into the aeration basin to provide clarification and filtration. Because the mixed liquor is drawn through membranes placed directly in the aeration basin, external settling of solids and of clarification in a settling tank is not required. As a result, the mixed liquor concentration in the aeration basin can be maintained at three to four times the normally used concentration. This allows for much lower hydraulic detention times, and the necessary aeration basin volume is reduced accordingly. Subsequently, the footprint is significantly smaller when compared to conventional clarification and filtration.

A low pressure vacuum pump draws the mixed liquor through the micropores resulting in a very high quality filtrate. Fouling is controlled by air movement around the membranes and short (15 to 30 seconds), frequent backpulsing with a chlorine solution. Cleaning of the membranes is accomplished by backpulsing with a stronger chlorine solution every few hours. Dip tanks filled with a dilute acid are also provided for more intensive cleaning of the membranes in the event of serious fouling. Recent improvements in membrane technology also have produced systems that do not require effluent pumping if sufficient discharge head (greater than 3 feet) is provided.

The chlorine solution could be standard bleach or some other concentration of sodium hypochlorite, whatever is readily available. This could then be diluted to the concentrations needed. The frequent backpulsing occurs every 15 to 30 minutes for 15 to 30 seconds; this requires a chlorine concentration of 2 to 10 mg/L. The backpulsing sequence is programmed, and can be adjusted based on cleaning requirements. More intense cleaning is recommended every 4 hours or so; this involves backpulsing for 15 to 30 seconds with a chlorine solution of 200 to 300 mg/L. This backpulsing would be put on a programmable timer with opportunity for adjustment. Using a standard 10 to 12 percent concentration of sodium hypochlorite, annual usage would be relatively small and inexpensive. Also, recent improvements in membrane system technology have shown that newer membranes may not require bleach cleaning as frequently as indicated here. The manufacturer of the filtration equipment will provide all of the necessary treatment process equipment and programmable logic controller (PLC), including aeration equipment and pumps. The company will also provide operator training for the system.

Pretreatment ahead of the aeration basins should consist of a mechanical fine screen. An equalization basin is recommended ahead of the reactor basins to even out flows to the aeration basins.

The UV radiation equipment will be sized to provide consistent disinfection to meet the total coliform standard of 2.2 TC/100 mL. The system will also be designed with redundant process units and alarms, as required by the Reclaimed Water Standards. After the UV disinfection, the reclaimed water would flow by gravity to the rapid infiltration area for reuse. The treatment facility, including laboratory and equipment storage, would be enclosed in a building, varying in size from 2,000 square feet to 2,500 square feet depending on the design flow.

The Standards require that reliability measures be installed to ensure that effluent not meeting reclaimed water standards is not released from the facility. For this facility, it is recommended that 24-hour storage of the maximum month flow, as well as standby equipment for the aeration, membrane filtration, disinfection and pumping systems, be provided. Therefore, a storage tank with a 1-day detention time would be located at the facility site. If any of the reclaimed water criteria were not being met, water would automatically be diverted to the tank. Once the facility was again operating within standards, this water would be returned through the treatment process. With alarms to alert operational staff of any problems and standby equipment on hand, such episodes should be infrequent and short-lived. The preliminary design criteria for Alternative 4B are presented in Table 5-21. A process flow diagram is shown in Figure 5-8.

Table 5-21

Design Criteria for Class A Re-Use (Alternative 4B)

Component	Value
Expected Effluent Quality	
BOD	<5 mg/l
TSS	<5 mg/l
NH_3	<1 mg/l
Total Nitrogen	<10 mg/l
Turbidity	<1 NTU
Total Coliform	2.2 TC/100 ml
Influent Fine Screen Openings	¼ inch
Equalization basin	
Dimensions	6 Hours Detention Time
Quantity of Process Basins	2
Design HRT, Max. Mo. Flow	9.2 hrs
Design MLSS	12,000 mg/l
Aeration	
Type	Fine Bubble Diffusers
Blower, No.	2
UV Disinfection, Type	Medium Pressure, In-Vessel
Non-Reclaimed Water Storage Tank	1 Day Detention Time
Storage Pond	Min. – 3 Days Detention Time
Biosolids Storage Tank	30 Days Detention Time

The facility must also have an alternative means of reuse, storage or disposal of the reclaimed water in the event the water cannot be discharged to the rapid infiltration site. Therefore, it is recommended that a storage pond with a detention time of at least three (3) days be constructed adjacent to the rapid infiltration site. The area required for treatment and disposal would be about 1/2 acre for the smaller flows and about 1 acre for the larger flows, including the detention pond.

Because the mixed liquor in the aeration basins is maintained at 10,000 mg/l or greater, biosolids are wasted directly out of the aeration basins. The biosolids would be stored onsite and periodically hauled offsite for treatment and disposal by contract. The storage tank would to provide 30 days of storage. The tank would be provided with aeration to further stabilize the biosolids and control potential for odors.

The estimated construction costs for Alternative 4B are presented in Table 5-22, and the annual O&M costs are presented in Table 5-23.

Labor costs for system O&M were developed based on 75 percent of a full-time operator contracted at an estimated cost of $40 per hour at the lower flows and a full-time operator at the higher flows. Ecology regulations would require at least a Group III Operator at this reuse facility. Much of the operational control can be handled by programmable control systems, but the operator must be able to understand the treatment concepts and make adjustments when necessary. A significant portion of the operator's time will be spent performing the monitoring and laboratory tests required by the discharge permit that will be issued for the facility from Ecology. Power costs are based on $0.07 per kilowatt-hour ($/kw-hr), and solids hauling costs are based on $0.13 per gallon for hauling and disposal of solids monthly. The membrane modules will need to be replaced every five to seven years, at a cost of about $3,500 per module. Maintenance was estimated at 0.5% of the construction cost of the facilities.

The advantages of this treatment approach are several. The facility has a small footprint and is able to be sited in the area where the wastewater is being generated. This saves a significant amount in transmission costs. The treatment process will produce a high quality of reclaimed water that can be reused in the community, with limitations. The treatment process can be readily expanded, and the site is adequate to accommodate potential expansion. The primary disadvantage of this alternative is the high capital cost, as well as high O&M costs. As a reclaimed water facility, the process must be consistently meeting all requirements, resulting in a higher level of oversight and monitoring than conventional facilities.

Although a reclamation facility has a greater construction and maintenance cost than other alternatives, it also has many features that could benefit the Fall City community. For example, there would be no need for a costly drainfield, it could provide the community with irrigation water for a park-like demonstration project, or constructed wetland and may more easily receive government funding than other alternatives if the plant is incorporated into a demonstration park facility.

TABLE 5-22

Estimated Capital Cost – Class A Reuse Facility with Rapid Infiltration

		Phase 1 Flows			Phase 1 & 2 Flows		
		Minimum (27,800 gpd)	Middle (41,7000 gpd)	Maximum (55,600 gpd)	Minimum (35,400 gpd)	Middle (53,100 gpd)	Maximum (70,800 gpd)
1.	Influent Screen	$ 65,000	$ 65,000	$ 65,000	$ 65,000	$ 65,000	$ 65,000
2.	Equalization Basin	$ 27,000	$ 30,000	$ 33,000	$ 29,000	$ 32,000	$ 36,000
3.	Membrane Treatment Process	$ 338,000	$ 394,000	$ 450,000	$ 369,000	$ 439,000	$ 510,000
4.	Building	$ 160,000	$ 186,000	$ 212,000	$ 174,000	$ 207,000	$ 240,000
5.	UV Disinfection (Inc. Standby)	$ 32,000	$ 48,000	$ 64,000	$ 40,000	$ 62,000	$ 82,000
6.	Non-Reduced Water/Storage	$ 50,000	$ 62,000	$ 74,000	$ 57,000	$ 72,000	$ 87,000
7.	Biosolids Storage	$ 29,000	$ 35,000	$ 42,000	$ 33,000	$ 41,000	$ 49,000
8.	Generator	$ 50,000	$ 58,000	$ 66,000	$ 54,000	$ 65,000	$ 75,000
9.	Alarms & Technology	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
10.	Effluent Pump Station	$ 49,000	$ 53,000	$ 57,0000	$ 51,000	$ 51,000	$ 62,000
11.	Disposal Area	$ 50,000	$ 75,000	$ 99,000	$ 63,000	$ 95,000	$ 126,000
12.	Piping & Valves (16%)	$ 144,000	$ 169,000	$ 194,000	$ 158,000	$ 190,000	$ 221,000
13.	Electrical (13%)	$ 117,000	$ 137,000	$ 158,000	$ 128,000	$ 154,000	$ 180,000
14.	Site Work (5%)	$ 45,000	$ 53,000	$ 61,000	$ 49,000	$ 59,000	$ 69,000
15.	Mobilization/Demobilization (11%)	$ 99,000	$ 116,000	$ 133,000	$ 108,000	$ 130,000	$ 152,000
Subtotal		$1,305,000	$1,531,000	$1,758,000	$1,428,000	$1,718,000	$2,004,000
15% Construction Contingency		$ 196,000	$ 230,000	$ 264,000	$ 214,000	$ 258,000	$ 301,000
Subtotal		$1,501,000	$1,761,000	$2,022,000	$1,642,000	$1,976,000	$2,305,000
8.4% Sales Tax		$ 126,000	$ 148,000	$ 170,000	$ 138,000	$ 166,000	$ 194,000
Estimated Construction Cost		$1,627,000	$1,909,000	$2,192,000	$1,780,000	$2,142,000	$2,499,000
20% Legal, Engineering, Administration		$ 325,000	$ 382,000	$ 438,000	$ 356,000	$ 428,000	$ 500,000
Land Acquisition		$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000
Total Estimated Project Cost		**$2,052,000**	**$2,391,000**	**$2,730,000**	**$2,236,000**	**$2,670,000**	**$3,099,000**

TABLE 5-23

Estimated O&M Costs – Class A Reuse Facility with Rapid Infiltration (Alternative 4B)

		Phase 1 Flows			Phase 1 & 2 Flows		
		Minimum (27,800 gpd)	**Middle (41,7000 gpd)**	**Maximum (55,600 gpd)**	**Minimum (35,400 gpd)**	**Middle (53,100 gpd)**	**Maximum (70,800 gpd)**
1.	Labor	$62,600	$ 69,400	$ 76,100	$ 66,300	$ 74,900	$ 83,500
2.	Power	$ 9,200	$ 13,600	$ 18,100	$ 11,600	$ 17,300	$ 22,900
3.	Biosolids Disposal	$ 8,700	$ 13,100	$ 17,500	$ 11,100	$ 16,700	$ 22,300
4.	Membrane Replacement	$ 2,300	$ 3,400	$ 4,600	$ 2,900	$ 4,400	$ 5,800
5.	Maintenance	$ 8,100	$ 9,500	$ 11,000	$ 8,900	$ 10,700	$ 12,500
Total Estimated Annual O&M Costs		**$90,900**	**$109,000**	**$127,300**	**$100,800**	**$124,000**	**$147,000**

ALTERNATIVE 4C: PACKAGE PLANT WITH RIVER OUTFALL

The treatment process for the alternative is basically the same as for the Class A Re-Use alternative except for the following items:

- Non-reclaimed water storage is not required.
- Lower level of alarms and telemetry facilities can be installed.
- Disinfection will be for a mean effluent coliform count of 200 MPN fecal coliform per 100/mL, rather than the 2.2 total coliform per 100 mL, for Class A Reuse
- Standby UV disinfection facilities are not required, although some redundancy is desirable.
- The standby generator will be smaller because of the above items.
- Testing requirements are less, resulting in a smaller building and less labor. The reporting requirements may be similar to the treatment facility of the Town of Starbuck, WA, as described previously. It is assumed that one half staff member is required for the smallest flow increase to about 3/4 of a person for the highest flow. Operator certification will be lower, probably Group II.
- An outfall to the Snoqualmie River will be constructed rather than a rapid infiltration area (or wetlands) and effluent storage facilities. It is assumed that the outfall pipe is approximately 4" diameter and that the effluent will be pumped through this pipe for a distance of 8,500 feet to a diffuser section in the river. This depends on siting. Some easement acquisition will be required for construction of this pipe.

This alternative involving a river outfall requires extensive environmental permitting. A Clean Water Act (CWA) Section 404 Nationwide Permit is needed. Components of this permit include a biological assessment that has been reviewed and approved in relation to endangered and threatened species by the National Marine Fisheries Service (NMFS) and the US Fish and Wildlife Service (USFWS). The State Environmental Policy Act Planning Process (SEPA) must be followed, most likely resulting in the need to produce an Environmental Impact Statement (EIS). A Hydraulic Project Permit must be obtained from the Washington State Department of Fish and Wildlife (WDFW) and a Shoreline Permit from King County. Since a federal waste discharge permit is required, the National Environmental Policy Act Planning Process must also be completed. A National Pollution Discharge Elimination System (NPDES) permit will be required based on the total maximum daily load analysis (TMDL) that was conducted on the Snoqualmie River by Ecology in 1993 (this analysis allocated 200,000 gpd of river discharge at 25 lb/day BOD and 8.4 lb/day ammonie to the Fall City area). Current wasteload allocations for existing point sources on the Snoqualmie River, such s the wastewater treatment plant for the City of Snoqualmie stipulate that there would be no additional permitted point sources on the river. This would make a river outfall for Fall City very difficult to permit. Since a federal waste discharge permit is required, Section 106 of the National Historic Preservation Act requires a consultation with the State Historic Preservation Office. In addition, King County requirements include a flood hazard permit, filling and grading permits, and a sensitive areas review. The entire permitting process can take anywhere from 2-4 years. The estimated construction costs for this alternative are presented in Table 5-24 while the estimated annual O & M costs are presented in Table 5-25.

ALTERNATIVE 4D: PACKAGE PLANT WITH DRAINFIELD

This alternative is the same as a package wastewater treatment plant with a river outfall, except the outfall and diffuser section in the Snoqualmie River is replaced with a drainfield. It also requires significantly fewer permits since construction of an outfall in the river and the discharge to a surface water is not required.

Instead of a federal discharge permit, a state discharge permit would be required. Therefore, completing NEPA may not be necessary. The wastewater treatment plant would be designed to provide nitrogen removal. Therefore a conventional pressurized drainfield could be utilized rather than the drip irrigation system in the root zone as proposed for the recirculating gravel filter (Alternative 4A). The drainfield would be designed for 0.4 gpd/ft^2 with an equal size area available for standby. Table 5-26 shows the areas required for this alternative for the various flow projection scenarios. Tables 5-27 and 5-28 show the annual capital and O&M cost estimates for this alternative. The estimated costs are similar to those for Alternative 4C, except as described above.

TABLE 5-24

Estimated Capital Cost for Package Plant with River Outfall (Alternative 4C)

	Phase 1 Flows			Phase 1 and 2 Flows		
	Minimum (27,800 gpd)	Middle (41,7000 gpd)	Maximum (55,600 gpd)	Minimum (35,400 gpd)	Middle (53,100 gpd)	Maximum (70,800 gpd)
1. Influent Screen	$ 65,000	$ 65,000	$ 65,000	$ 65,000	$ 65,000	$ 65,000
2. Equalization Basin	27,000	30,000	33,000	29,000	32,000	36,000
3. Membrane Treatment Process	338,000	394,000	450,000	369,000	439,000	510,000
4. Building	150,000	166,000	182,000	159,000	179,000	200,000
5. UV Disinfection	22,000	23,000	23,000	22,000	23,000	24,000
6. Biosolids Storage	29,000	35,000	42,000	33,000	41,000	49,000
7. Generator	40,000	46,000	53,000	44,000	52,000	60,000
8. Effluent Pump Station	49,000	53,000	57,000	51,000	57,000	62,000
9. Outfall Pipe and Diffuser	216,000	216,000	216,000	216,000	216,000	216,000
10. Piping and Valves (16%)	150,000	164,000	179,000	158,000	177,000	196,000
11. Electrical (13%)	122,000	134,000	146,000	128,000	144,000	159,000
12. Site Work	47,000	51,000	56,000	49,000	55,000	61,000
13. Mobilization/Demobilization (11%)	103,000	113,000	123,000	109,000	121,000	134,000
Subtotal	$1,358,000	$1,490,000	$1,625,000	$1,432,000	$1,601,000	$1,772,000
15% Construction Contingency	204,000	224,000	244,000	215,000	240,000	266,000
Subtotal	$1,562,000	$1,714,000	$1,869,000	$1,647,000	$1,841,000	$2,038,000
8.4% Sales Tax	131,000	144,000	157,000	138,000	155,000	171,000
Estimated Construction Cost	**$1,693,000**	**$1,858,000**	**$2,026,000**	**$1,785,000**	**$1,996,000**	**$2,209,000**
20% Legal, Engineering, Administration	339,000	371,000	405,000	357,000	399,000	442,000
Land Acquisition	100,000	100,000	100,000	100,000	100,000	100,000
Total Estimated Project Cost	**$2,132,000**	**$2,329,000**	**$2,531,000**	**$2,260,000**	**$2,495,000**	**$2,751,000**

TABLE 5-25

Estimated Annual O&M Cost for Package Plant with River Outfall (Alternative 4C)

	Phase 1 Flows			Phase 1 and 2 Flows		
	Minimum (27,800 gpd)	Middle (41,7000 gpd)	Maximum (55,600 gpd)	Minimum (35,400 gpd)	Middle (53,100 gpd)	Maximum (70,800 gpd)
Labor	$41,800	$48,500	$55,300	$45,500	$54,000	$62,600
Power	$9,200	$13,600	$18,100	$11,600	$17,300	$22,900
Biosolids Disposal	$8,700	$13,100	$17,500	$11,100	$16,700	$22,300
Membrane Replacement	$2,300	$3,400	$4,600	$2,900	$4,400	$5,800
Maintenance	$8,500	$9,300	$10,100	$8,900	$10,000	$11,000
Estimated Total Annual O&M Costs	**$70,500**	**$87,900**	**$105,600**	**$80,000**	**$102,400**	**$124,600**

TABLE 5-26

Required Area for Package Plant with Drainfield (Alternative 4D)

Flows (gpd)	Area in Acres			
	Wastewater Treatment	Drainfield (Active)	Drainfield (Reserve)	Total Area
Phase 1				
27,800	0.25	1.6	1.6	3.45
41,700	0.25	2.4	2.4	5.05
55,700	0.25	3.2	3.2	6.65
Phase 2				
35,400	0.25	2.0	2.0	4.25
53,100	0.25	3.0	3.0	6.25
70,800	0.25	4.0	4.0	8.45

The estimated capital costs for this alternative are presented in Table 5-27, while the estimated annual O & M costs are presented in Table 5-28.

TABLE 5-27

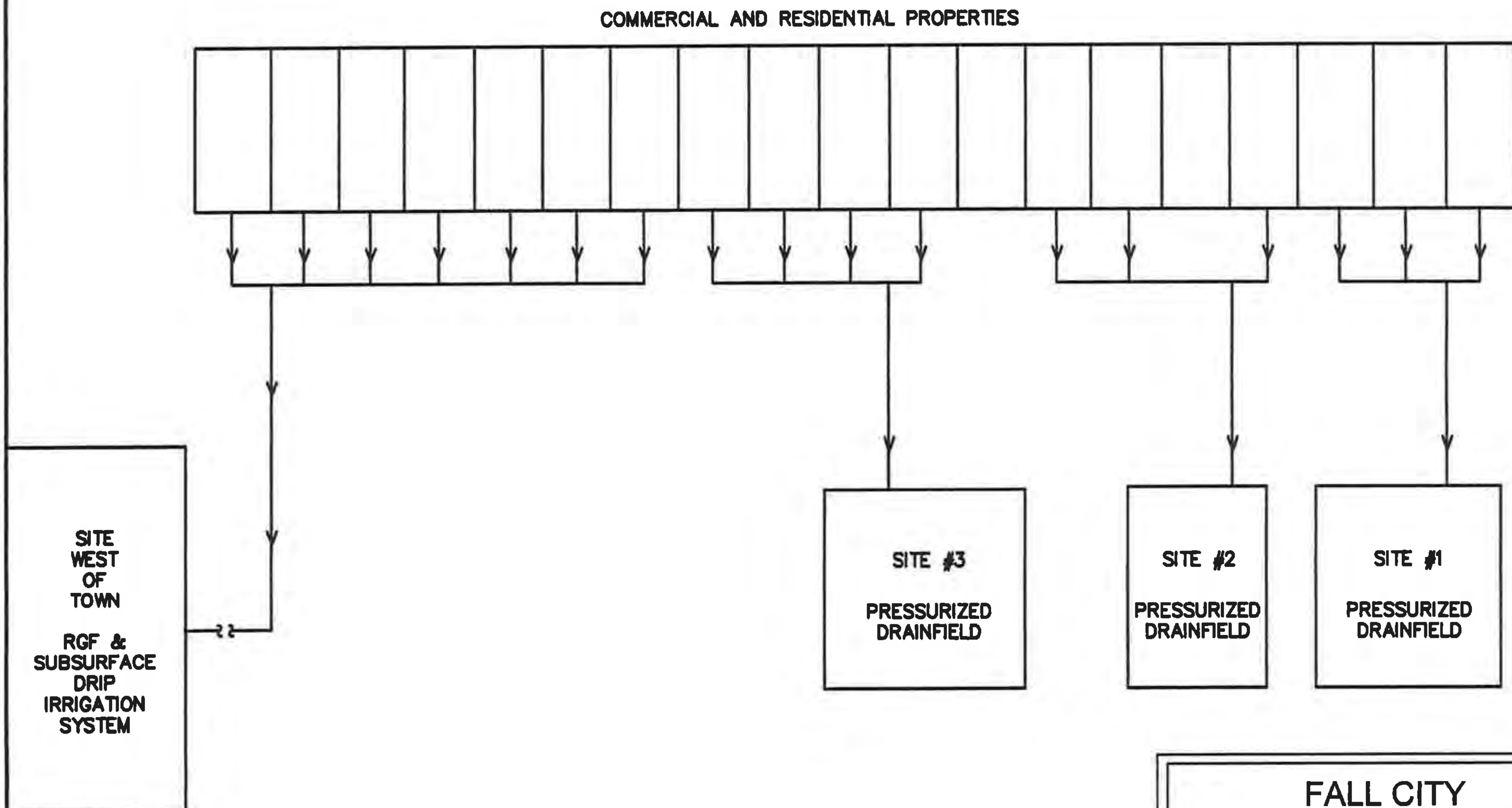
Estimated Capital Cost – Package Plant with Drainfield (Alternative 4D)

	Phase 1 Flows			Phase 1 and 2 Flows		
	Minimum (27,800 gpd)	Middle (41,7000 gpd)	Maximum (55,600 gpd)	Minimum (35,400 gpd)	Middle (53,100 gpd)	Maximum (70,800 gpd)
1. Influent Screen	$ 65,000	$ 65,000	$ 65,000	$ 65,000	$ 65,000	$ 65,000
2. Equalization Basin	27,000	30,000	33,000	29,000	32,000	36,000
3. Membrane Treatment Process	338,000	394,000	450,000	369,000	439,000	510,000
4. Building	150,000	166,000	182,000	159,000	179,000	200,000
5. UV Disinfection	22,000	23,000	23,000	22,000	23,000	24,000
6. Biosolids Storage	29,000	35,000	42,000	33,000	41,000	49,000
7. Generators	40,000	46,000	53,000	44,000	52,000	60,000
8. Effluent Pump Station	49,000	53,000	57,000	51,000	57,000	62,000
9. Drainfield	104,000	156,000	208,000	132,000	198,000	264,000
10. Piping and Valves (16%)	132,000	155,000	178,000	145,000	174,000	203,000
11. Electrical (13%)	107,000	126,000	145,000	118,000	141,000	165,000
12. Site Work	41,000	48,000	56,000	45,000	54,000	64,000
13. Mobilization/Demobilization (11%)	91,000	106,000	122,000	99,000	119,000	140,000
Subtotal	$1,195,000	$1,403,000	$1,614,000	$1,311,000	$1,574,000	$1,842,000
15% Construction Contingency	179,000	210,000	242,000	197,000	236,000	276,000
Subtotal	$1,374,000	$1,613,000	1,856,000	$1,508,000	$1,810,000	$2,118,000
8.4% Sales Tax	115,000	136,000	156,000	127,000	152,000	178,000
Estimated Construction Cost	**$1,489,000**	**$1,749,000**	**$2,012,000**	**$1,635,000**	**$1,962,000**	**$2,296,000**
20% Legal, Engineering, Administrative	299,000	350,000	402,000	326,000	392,000	459,000
Land Acquisition	100,000	126,000	166,000	106,000	156,000	211,000
Total Estimated Project Cost	**$1,888,000**	**$2,225,000**	**$2,580,000**	**$2,067,000**	**$2,510,000**	**$2,966,000**

TABLE 5-28

Estimated Annual O&M Cost - Package Plant with Drainfield (Alternative 4D)

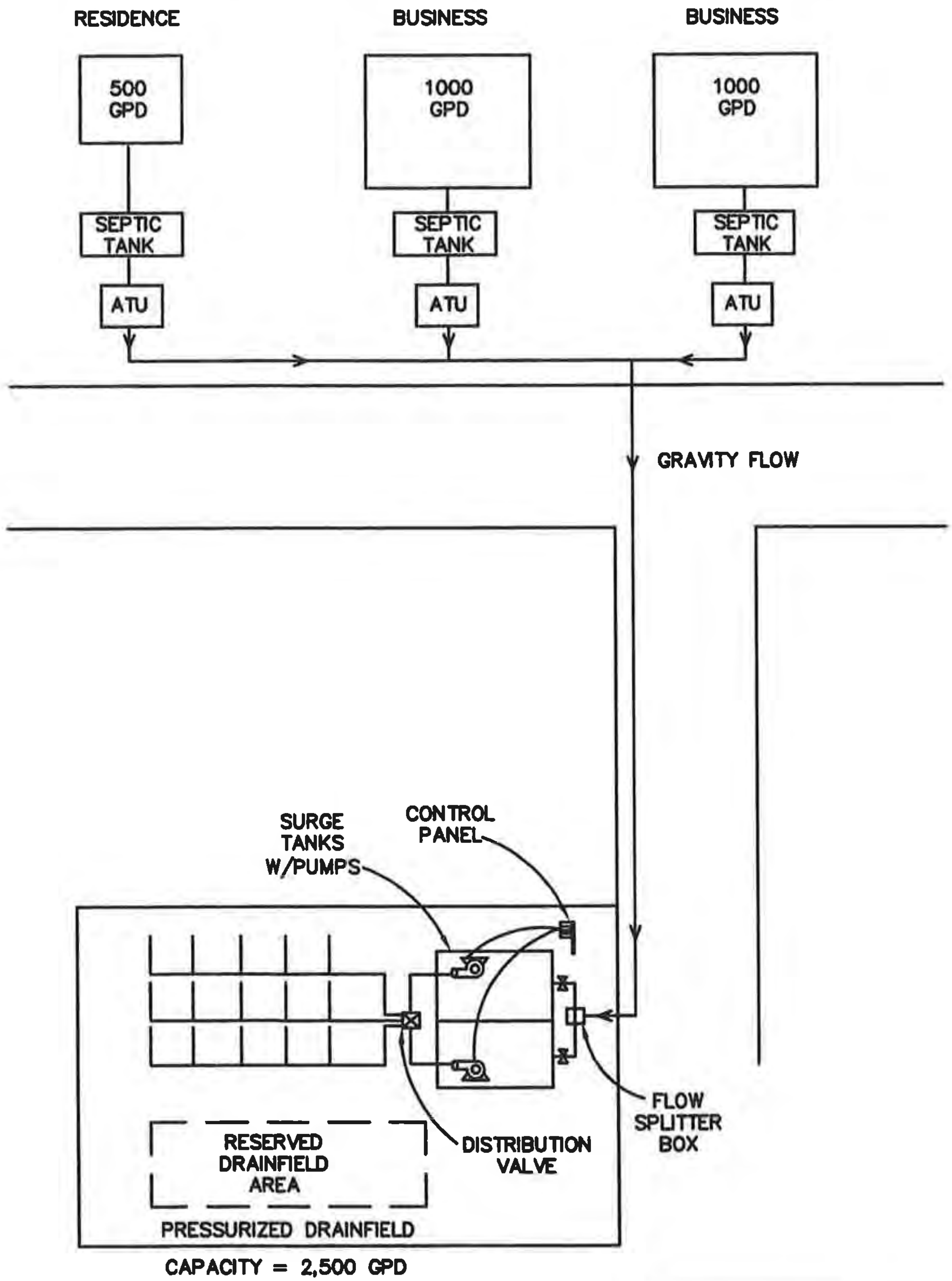
	Phase 1 Flows			Phase 1 & 2 Flows		
	Minimum (27,800 gpd)	Middle (41,7000 gpd)	Maximum (55,600 gpd)	Minimum (35,400 gpd)	Middle (53,100 gpd)	Maximum (70,800 gpd)
Labor	$41,800	$48,500	$55,300	$45,500	$54,000	$62,600
Power	$9,200	$13,600	$18,100	$11,600	$17,300	$22,900
Biosolids Disposal	$8,700	$13,100	$17,500	$11,100	$16,700	$22,300
Membrane Replacement	$2,300	$3,400	$4,600	$2,900	$4,400	$5,800
Maintenance	$8,500	$9,300	$10,100	$8,900	$10,000	$11,000
Estimated Total Annual O&M Costs	**$69,400**	**$87,300**	**$105,600**	**$79,300**	**$102,200**	**$125,100**



FALL CITY
ALTERNATIVE ONSITE WASTEWATER PROJECT

FIGURE 5-1
LAYOUT OF CLUSTER SYSTEM

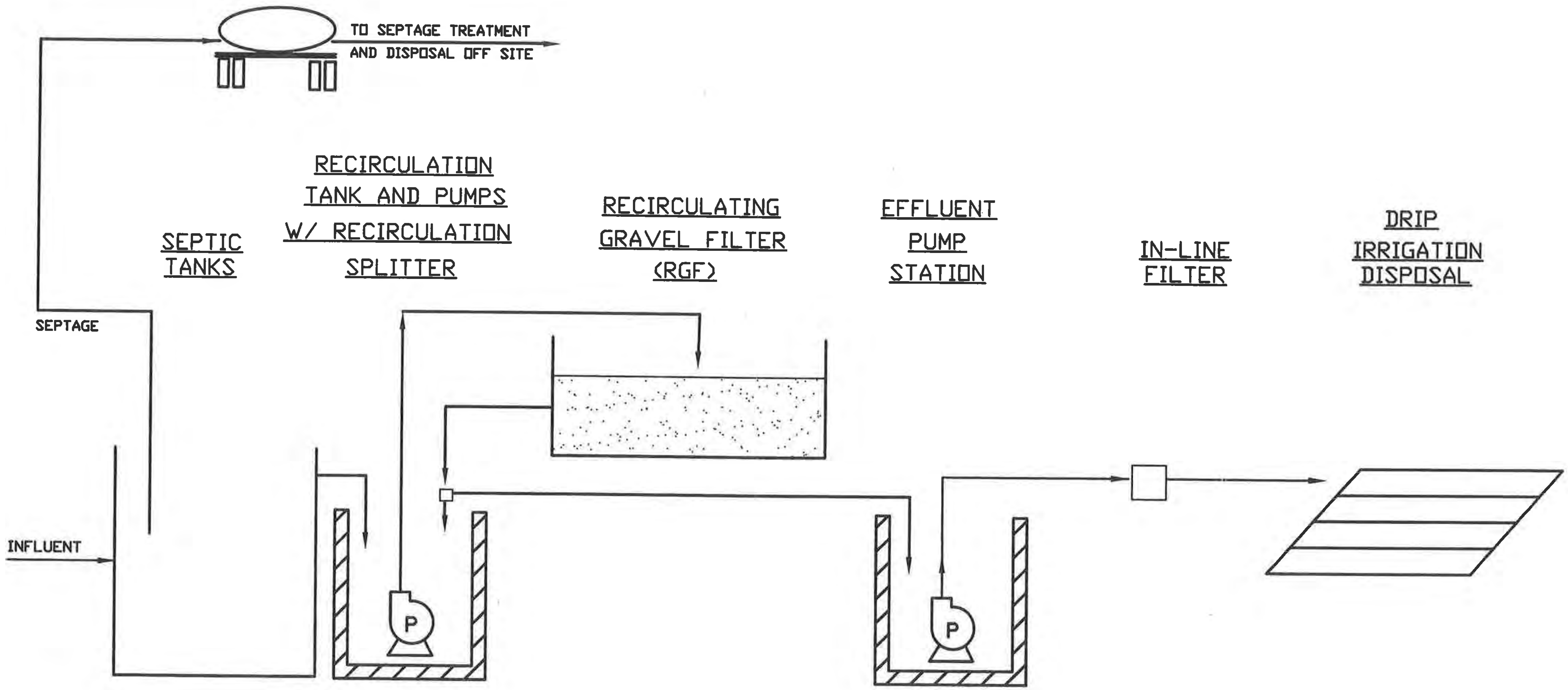
Gray & Osborne, Inc.
CONSULTING ENGINEERS



FALL CITY
ALTERNATIVE ONSITE
WASTEWATER PROJECT

FIGURE 5-2
TYPICAL CLUSTER SYSTEM SCHEMATIC

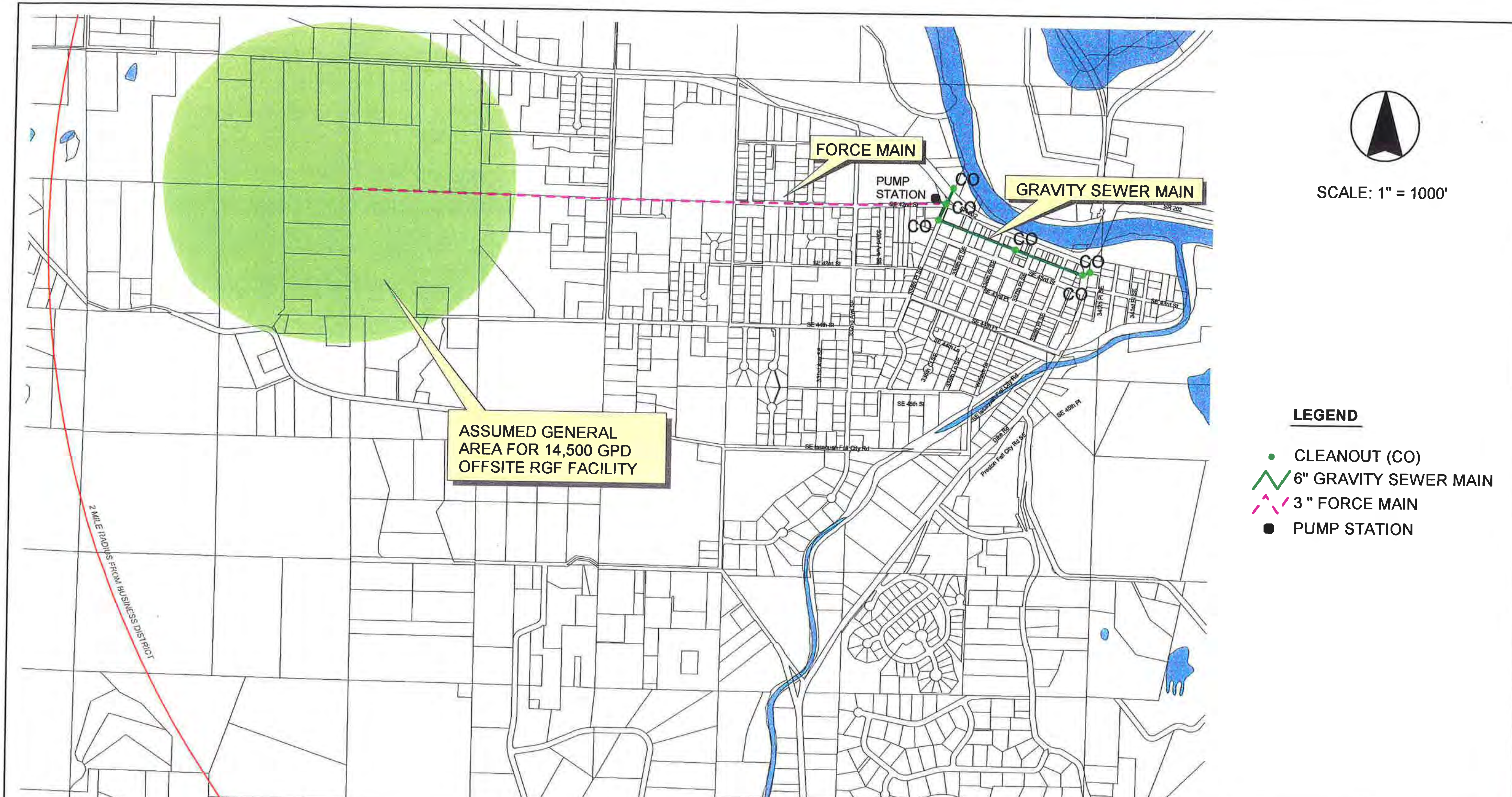
Gray & Osborne, Inc.
CONSULTING ENGINEERS



14,500 GPD CLUSTER RGF TREATMENT PROCESS SCHEMATIC

FALL CITY
ALTERNATIVE ONSITE
WASTEWATER PROJECT
FIGURE 5-3
14,500 GPD CLUSTER RGF SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS



FALL CITY

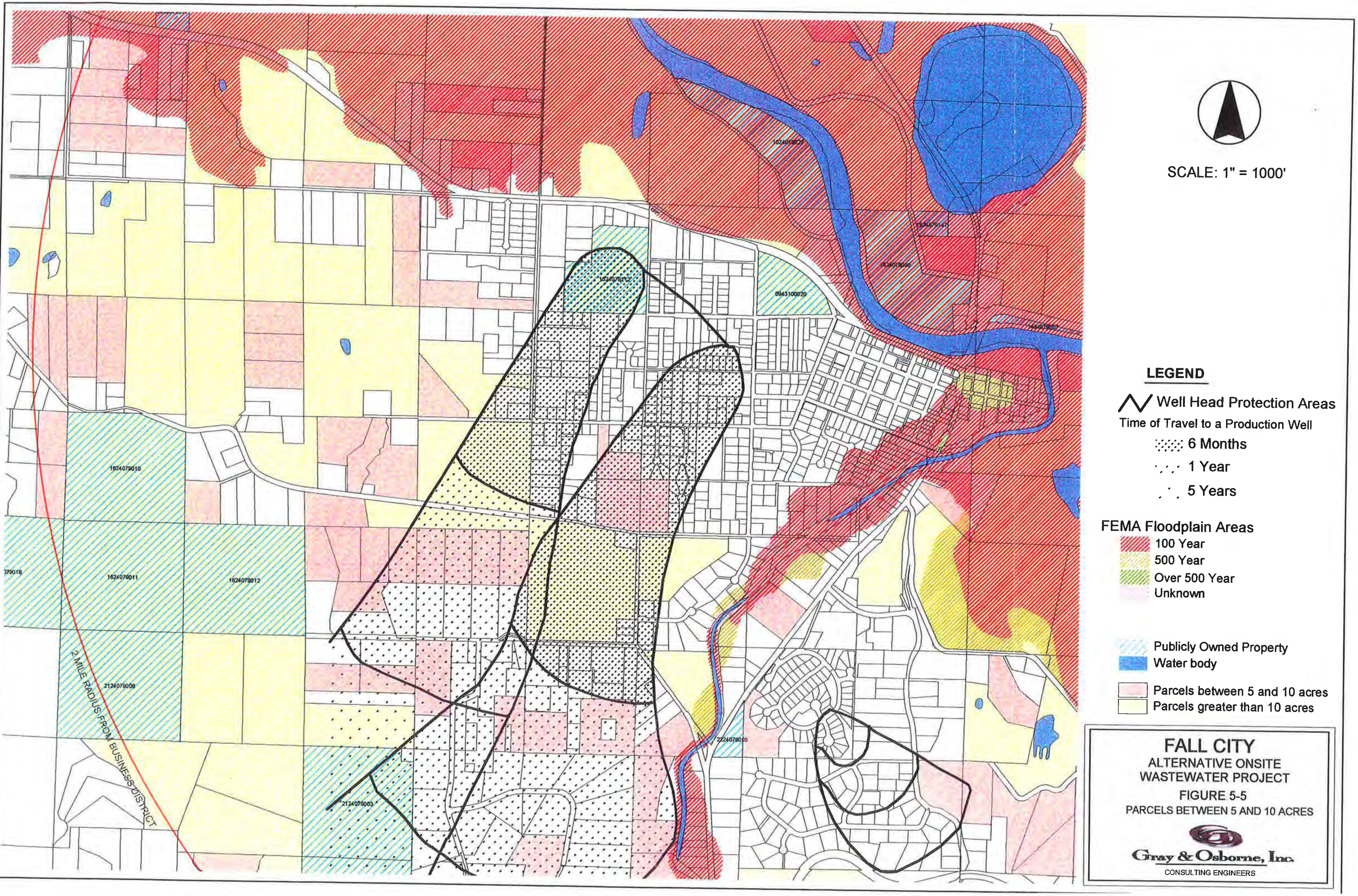
ALTERNATIVE ONSITE WASTEWATER PROJECT

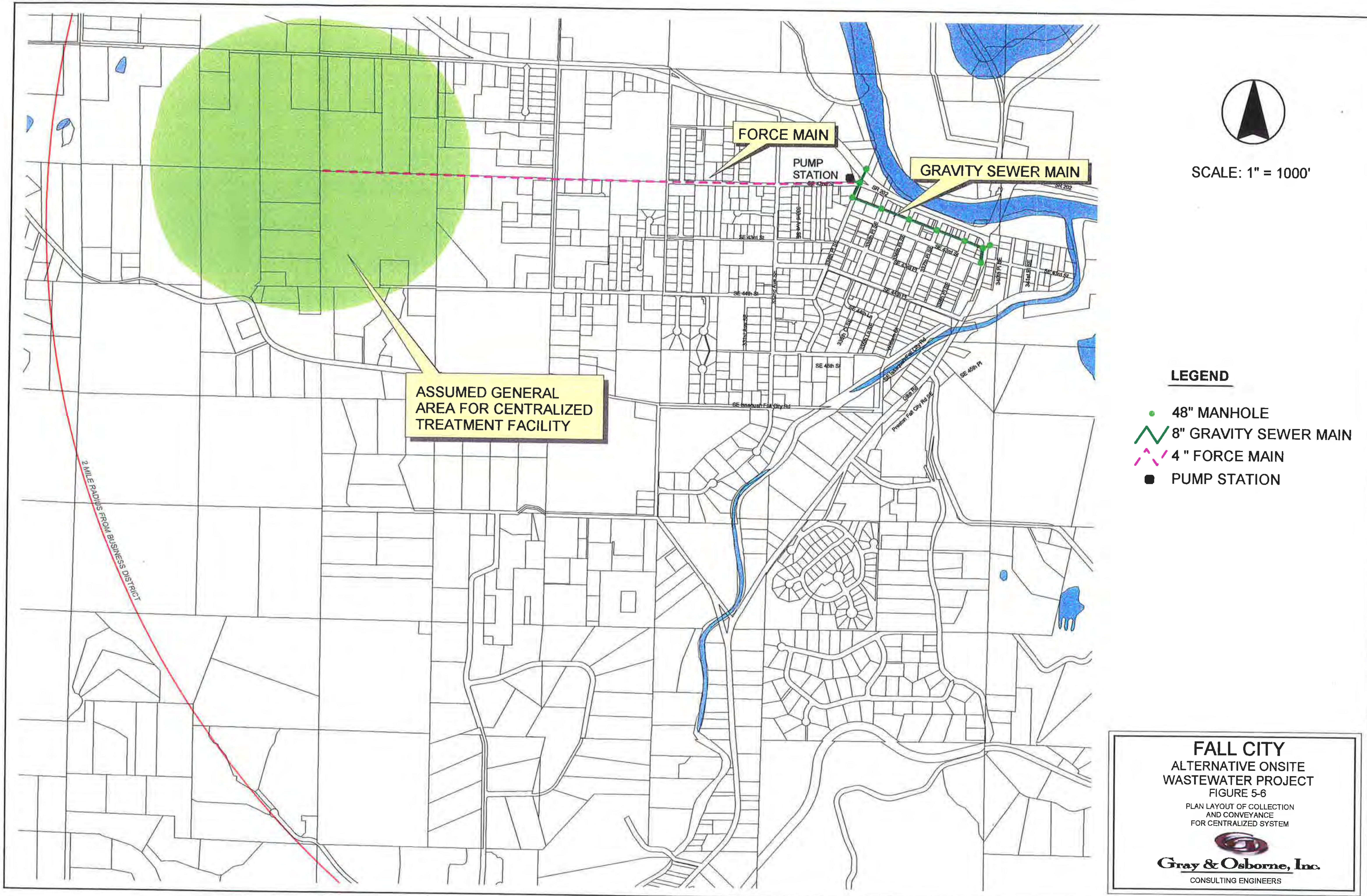
FIGURE 5-4

PLAN LAYOUT OF COLLECTION AND CONVEYANCE FOR 14,500 GPD OFFSITE RGF FACILITY

Gray & Osborne, Inc.

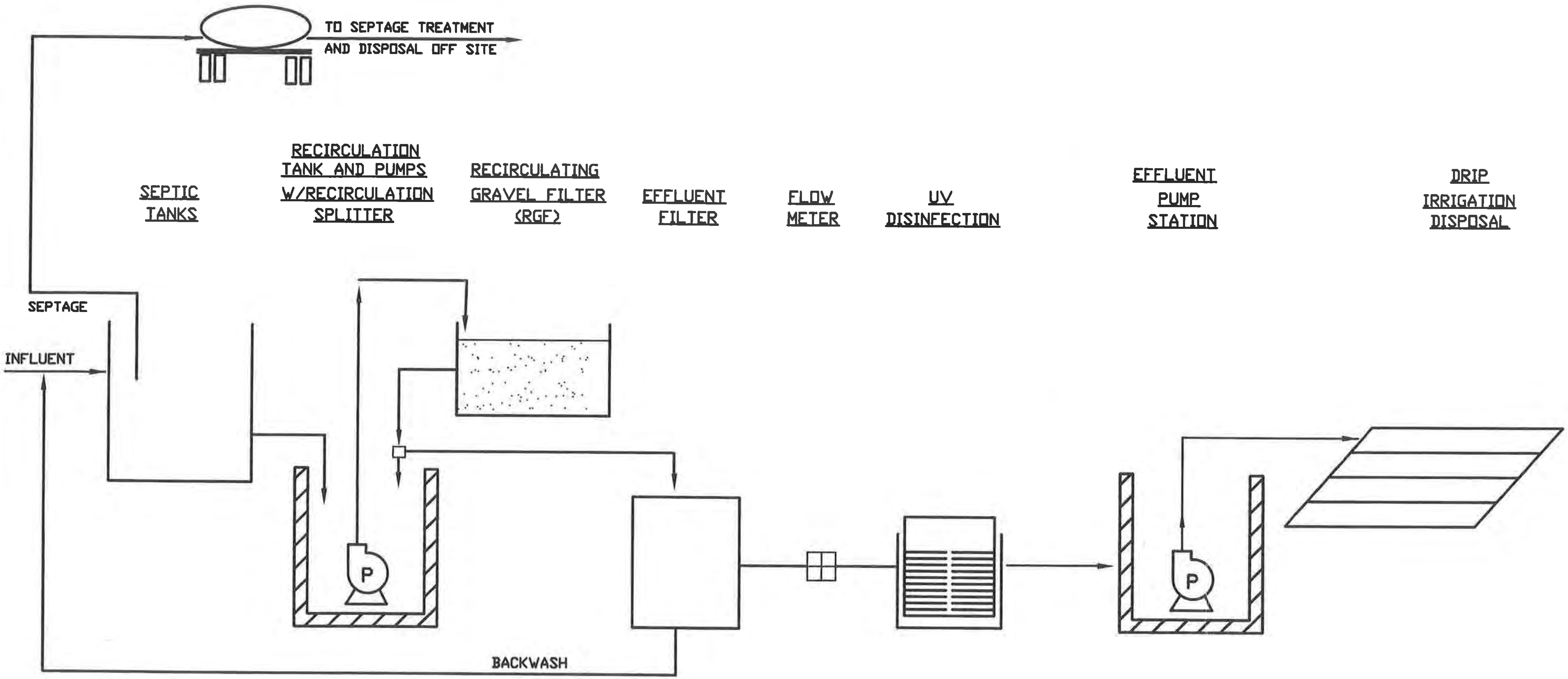
CONSULTING ENGINEERS


SCALE: 1" = 1000'
LEGEND
Well Head Protection Areas
Time of Travel to a Production Well
6 Months
1 Year
5 Years
FEMA Floodplain Areas
100 Year
500 Year
Over 500 Year
Unknown
Publicly Owned Property
Water body
Parcels between 5 and 10 acres
Parcels greater than 10 acres
2 MILE RADIUS FROM BUSINESS DISTRICT
FALL CITY
ALTERNATIVE ONSITE
WASTEWATER PROJECT
FIGURE 5-5
PARCELS BETWEEN 5 AND 10 ACRES
Gray & Osborne, Inc.
CONSULTING ENGINEERS



FALL CITY
ALTERNATIVE ONSITE WASTEWATER PROJECT
FIGURE 5-6
PLAN LAYOUT OF COLLECTION AND CONVEYANCE FOR CENTRALIZED SYSTEM

Gray & Osborne, Inc.
CONSULTING ENGINEERS

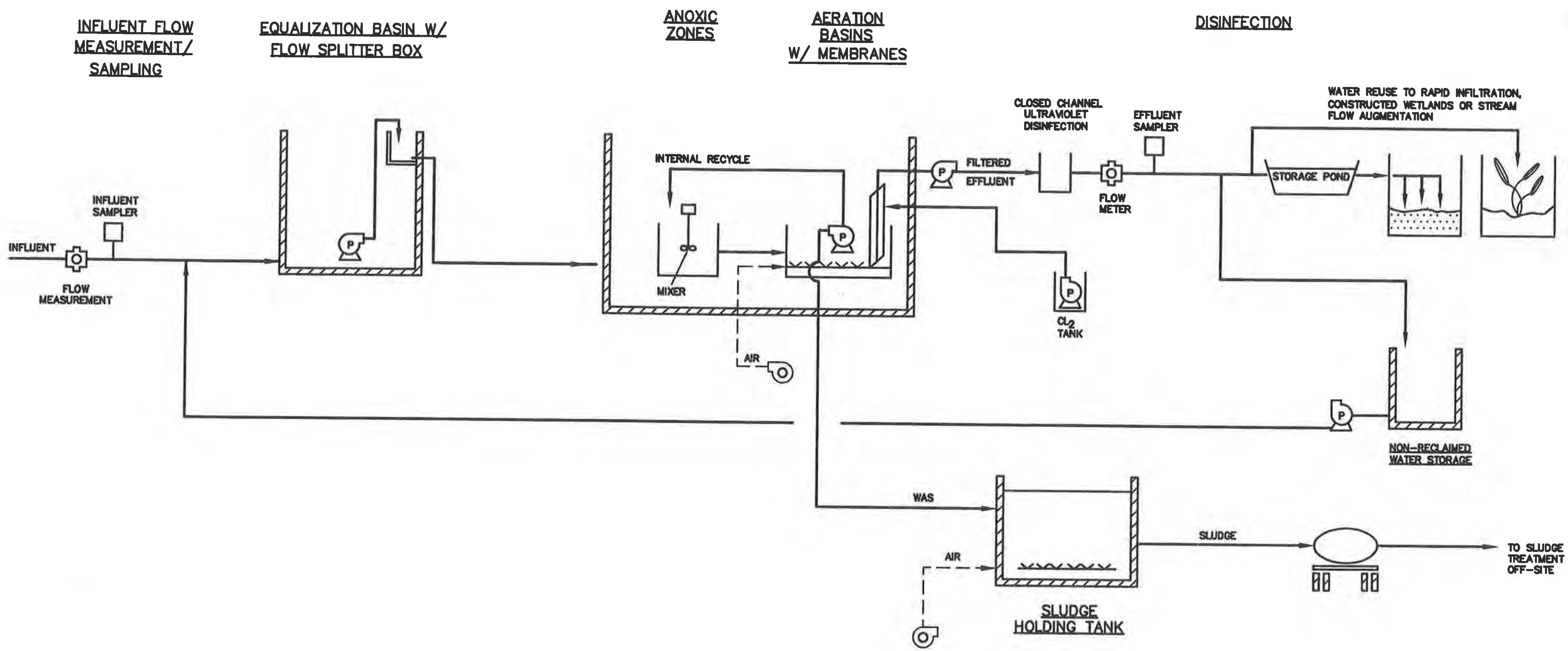


CENTRALIZED RGF TREATMENT PROCESS SCHEMATIC

FALL CITY
ALTERNATIVE ONSITE
WASTEWATER PROJECT
FIGURE 5-7
CENTRALIZED RGF SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS

BY: TEST CREATED: OCT 27 1994 10:04:16 UPDATED: APR 23 1998 17:49:26 PLOTTED: JUN 03 1998 13:11:54 FILE: K:\ACADLIB\GOFG-CVR\11X17TB.DWG



CLASS A RE-USE TREATMENT PROCESS SCHEMATIC

FALL CITY
ALTERNATIVE ONSITE
WASTEWATER PROJECT

FIGURE 5-8
CLASS A RE-USE SCHEMATIC

Gray & Osborne, Inc.
CONSULTING ENGINEERS

BY: MZ CREATED: OCT 31 1996 18:47:08 UPDATED: AUG 08 2000 11:50:00 PLOTTED: AUG 08 2000 11:50:43 FILE: M:\WASDNCDPUD1\99680\FIG7-4.DWG

CHAPTER 6

SUMMARY OF ESTIMATED ALTERNATIVE WASTEWATER SYSTEM COSTS

The three (3) tables in this chapter summarize the estimated capital and annual operations and maintenance (O&M) costs associated with the wastewater system alternatives described in Chapter 5. As directed by the Stakeholders Group at the July 11, 2001 meeting, Tables 6-1A, 6-1B, and 6-1C allow comparison of the various alternatives available for three (3) different flow projections:

- Phase 1 minimum flow of approximately 27,800 gpd, comprised of current average daily maximum month flow plus 20%, representing a minimum flow projection (See Table 6-1A);
- Phase 1 maximum flow of 55,600 gpd, representing an intermediate flow projection (See Table 6-1B); and
- Phase 1 and 2 maximum flow of 70,800 gpd, representing a maximum flow projection (See Table 6-1C).

The following comments serve as background information for Table 6-1A. Most of these comments also apply to Tables 6-1B and 6-1C, as indicated.

1. Based on the technical consultant team's field assessments, and review of parcel data and metered water use data, the following conclusions were reached regarding the wastewater treatment and disposal capacity of each of the onsite and non-centralized alternatives:
   - The maximum flow treatable under Alternative 1 in Phase 1 is approximately 1,000 gpd (Table 5-2), which is the current maximum month flow from the single property with enough land for a conforming onsite system (no action required).
   - The maximum flow treatable under the onsite residential non-conforming repair column in Alternative 2 is approximately 400 gpd (Table 5-2). Only 1 of 31 active properties in Phase 1 has the option (if approved by the King County or the State Health Department) of a residential non-conforming repair. Out of a total of 36 parcels in Phase 1, five (5) parcels currently have no water service, and are considered inactive.
   - The maximum flow treatable under the onsite commercial non-conforming repair column in Alternative 2 is approximately 4,000 gpd (Table 5-2).

Twelve commercial properties of the 31 active Phase 1 properties could potentially make non-conforming repairs, each using aerobic treatment units (ATUs), and thus treat at least a portion of their wastewater flows onsite.

- The maximum flow treatable and disposable by the "close-in" cluster system (Alternative 3) is approximately 7,200 gpd, due to the limited amount of undeveloped land available adjacent (to the south) to the business district.

- The maximum flow treatable by the offsite recirculating gravel filter system (Alternative 3) under Department of Health jurisdiction with subsurface drip irrigation is approximately 14,500 gpd.

2. No single non-centralized alternative is capable of treating the entire Phase 1 minimum flow of 27,800 gpd. However, the sum of the flows treatable by Alternatives 2 and 3 together is approximately 27,100 gpd, only slightly less than the Phase 1 minimum flow projection of 27,800 gpd. Therefore the sum of the costs for Alternatives 2 and 3 together constitute a non-centralized alternative that can be compared to the centralized alternatives for this Phase 1 minimum flow projection. For the remaining flow projections, the non-centralized alternatives have insufficient capacity, due to land area constraints, and thus their estimated costs cannot be compared to those of the centralized alternatives. Therefore, only the estimated costs of the centralized alternatives are presented in Tables 6-1B and 6-1C for the intermediate and high flow projections, respectively.

3. For Alternative 4A, centralized recirculating gravel filter (RGF) facility with subsurface drip irrigation, it was assumed that installation of commercial ATUs would be required at the seven (7) existing commercial properties that discharge high strength wastewater (greater than 350 mg/L BOD). The total capital costs of these seven (7) ATUs ($397,900) has been included in the Treatment Plant and Drainfield Disposal Capital Costs items under the column for Alternative 4A. This was the total costs of all the alternatives are for comparable systems, however, the ATU cost for Alternative 4A would likely be borne by the individual property owners, rather than by the entire set of rate payers of the sewer management entity that is developed to construct and maintain the community system. The capital cost per commercial facility for the ATUs under Alternative 4A ($56,800 per commercial property) is less than the per-commercial facility capital costs under Alternative 2 ($68,800 per commercial property), because under Alternative 4A, onsite drainfields are not required. The annual operations and maintenance (O&M) cost for the seven (7) ATUs ($5,600) was added to the Annual O&M Costs for Treatment and Disposal Systems item in the column for Alternative 4A. The remaining centralized alternatives 4B, 4C, and 4D do not require the use of ATUs for pretreatment of high strength wastewater, so costs for

ATUs are not included in their capital or annual O&M cost estimates. This comment applies to Tables 6-1A, 6-1B, and 6-1C.

4. Land costs were calculated using a unit cost of $25,000 per acre for parcels greater than one acre in size, and a minimum cost of $100,000 was assumed for parcels smaller than one (1) acre, based on discussion at the June 11, 2001 Stakeholder Group meeting, and with a local realtor. This comment applies to Tables 6-1A, 6-1B, and 6-1C.

5. An equivalent residential unit (ERU) was defined as 250 gpd, with a waste strength of 350 mg/L BOD. The number of ERUs for a parcel was calculated by the formula: No. of ERUs = [Peak Month Flow (gpd)/250 gpd/ERU] x [Waste Strength (mg/L BOD)/350 mg/L BOD]. Peak month wastewater flow for a given parcel comes from applying the flow projection assumptions used in Tables 4-7 and 4-8, i.e., Phase 1 Minimum = Current Flow + 20%, Phase 1 Maximum = Phase 1 Minimum x 2, and Phase 1 and 2 Maximum = Phase 1 Maximum + Phase 2 Maximum, to the current metered maximum month flow for each parcel. Waste strength is an estimate by Aqua Test, Inc., based on waste strengths for similar facilities in other communities. In addition, the following assumptions were used for calculations of ERUs:

   - It was assumed that the minimum number of ERUs for any parcel for the Phase 1 Minimum Flow projection, and for greater flow projections, is one (1). Therefore, if current maximum month flow for a given parcel was zero, or less than 250 gpd, a value of one (1) ERU was assigned for the Phase 1 minimum flow projection.

   - For the parcels in the Phase 2 area, for which waste strength was not estimated by Aqua Test, a waste strength of 350 mg/L was assumed. As with Phase 1, all Phase 2 parcels were assigned a minimum value of one (1) ERU.

6. All costs shown in Tables 6-1A, 6-1B, and 6-1C are in current dollars, and do not include financing charges. The cost items are taken from the detailed cost estimate tables in Chapter 5.

SUMMARY

Over the course of this two-month study, the Consultant team met with the Stakeholder Group several times and presented data, answered questions, obtained comments and incorporated feedback from the Stakeholder Group into the draft and final reports. The Consultant team estimated waste strength for each parcels, determined current flows, defined ERUs, developed cost estimates per ERU, and developed detailed cost estimates for each alternative, and summary cost tables comparing the various alternatives considered (Tables 6-1A, 6-1B, and 6-1C).

Conclusions that can be drawn form the summary comparison tables include:

- The onsite non-centralized alternatives can only handle flows up to slightly less than the Phase 1 minimum flow projection of 27,800 gpd.
- For all flow projections, Alternative 4A, a centralized RGF treatment facility with subsurface drip irrigation system, including collection and conveyance systems has the highest capital cost of any of the Alternatives, but also has the lowest O&M cost. The highest capital cost is due in part to the inclusion of the ATU pretreatment costs, the large land area requirements and the subsurface drip irrigation fields and the expense of the drip tubing compared to conventional drainfield piping. However, the subsurface drip irrigation system potentially allows the omission of nitrogen removal from the treatment plant processes, allowing the use of a relatively simple RGF technology. This in turn allows for relatively low labor costs, and thus low O&M cost overall, since labor is the largest component of the annual O&M costs.

TABLE 6-1A

Summary of Comparison of Capital and Operations & Maintenance Cost Estimates for Alternative Wastewater Systems for Phase 1 Minimum Flow of 27,800 gpd(11)

Item	Alternatives									
	Non-centralized (See footnotes for design flow capacities; sum of Alt 2 & Alt 3 flows is 27,100 gpd)						Centralized (All alternatives sized for Phase 1 minimum flow of 27,800 gpd)			
	Alternative 1	Alternative 2		Alternative 3		Alt 2 + Alt 3	Alternate 4A	Alternate 4B	Alternate 4C	Alternate 4D
	No Action(1)	Onsite Residential Non-Conforming Repair(2)	Onsite Commercial Non-Conforming Repair(2)	Cluster System(9)	Offsite Subsurface RGF with Drip Irrigation(5)	Sum of Onsite	RGF with Subsurface Drip Irrigation(6)	Class A Reuse with Rapid Infiltration	Package Plant with River Outfall	Package Plant with Drainfield
No. of Parcels in Service Area (Phase 1)	36	36	36	36	36	36	36	36	36	36
No. of Potential Connections in Phase 1 Minimum Flow Case (Currently on metered water service)	0	1	12	6	12	31	31	31	31	31
No. of ERUs(10) (Max. number of ERUs if all customers connect)	238	238	238	238	238	238	238	238	238	238
Collection and Conveyance System Capital Costs	$0.00	$0.00	$0.00	$77,000.00	$479,000.00	$556,000.00	$636,000.00	$636,000.00	$636,000.00	$636,000.00
Collection and Conveyance System Capital Costs per Parcel (36 total parcels in Phase 1)	$0.00	$0.00	$0.00	$2,139.00	$13,306.00	$15,444.00	$17,667.00	$17,667.00	$17,667.00	$17,667.00
Treatment Plant and Drainfield Disposal Capital Costs	$0.00	$25,000.00	$825,600.00	$261,000.00	$899,000.00	$2,010,600.00	$2,034,900.00	$1,952,000.00	$1,562,500.00	$1,788,000.00
Land Costs(8)	$0.00	$0.00	$0.00	$100,000.00	$113,000.00	$213,000.00	$202,000.00	$100,000.00	$100,000.00	$100,000.00
Outfall Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$470,000.00	$0.00
Total Treatment & Disposal Capital Cost	$0.00	$25,000.00	$825,600.00	$361,000.00	$1,012,000.00	$2,223,600.00	$2,236,900.00	$2,052,000.00	$2,132,500.00	$1,888,000.00
Total Treatment & Disposal Capital Cost Per ERU	$0.00	N/A	N/A	N/A	N/A	$9,343.00	$9,399.00	$8,622.00	$8,960.00	$7,933.00
Total Capital Costs (Including Collection & Conveyance)	$0.00	$25,000.00	$825,600.00	$438,000.00	$1,491,000.00	$2,779,600.00	$2,872,900.00	$2,688,000.00	$2,768,500.00	$2,524,000.00
Annual O&M Costs for Collection and Conveyance Systems	$0.00	$0.00	$0.00	$6,300.00	$12,500.00	$18,800.00	$12,900.00	$12,900.00	$12,900.00	$12,900.00
Annual O&M Cost for Treatment and Disposal Systems	$0.00	$200.00	$9,600.00	$5,700.00	$12,800.00	$28,300.00	$24,700.00	$90,900.00	$70,500.00	$69,400.00

TABLE 6-1A – (continued)

Summary of Comparison of Capital and Operations & Maintenance Cost Estimates for Alternative Wastewater Systems for Phase 1 Minimum Flow of 27,800 gpd(11)

Item	Alternatives									
	Non-centralized (See footnotes for design flow capacities; sum of Alt 2 & Alt 3 flows is 27,100 gpd)						Centralized (All alternatives sized for Phase 1 minimum flow of 27,800 gpd)			
	Alternative 1	Alternative 2		Alternative 3		Alt 2 + Alt 3	Alternate 4A	Alternate 4B	Alternate 4C	Alternate 4D
	No Action(1)	Onsite Residential Non-Conforming Repair(2)	Onsite Commercial Non-Conforming Repair(3)	Cluster System(4)	Offsite Subsurface RGF with Drip Irrigation(5)	Sum of Onsite	RGF with Subsurface Drip Irrigation(6)(9)	Class A Reuse with Rapid Infiltration	Package Plant with River Outfall	Package Plant with Drainfield
Total Annual O&M Costs	$0.00	$200.00	$9,600.00	$12,000.00	$25,300.00	$47,100.00	$37,600.00	$103,800.00	$83,400.00	$82,300.00
Total Monthly O&M Cost per Potential Connection in Phase 1 (up to 31 connections)	$0.00	$17.00	$67.00	$167.00	$176.00	$127.00	$101.00	$279.00	$224.00	$221.00
Total Monthly O&M Cost per ERU (238 ERUs)	$0.00	$0.00	N/A	N/A	N/A	N/A	$13.00	$36.00	$29.00	$29.00

(1) No action alternative indicates that there is no change to existing individual onsite systems.
(2) This repair is applicable to only 1 of 31 active existing onsite systems in Phase 1.
(3) This repair is applicable to only 12 of 31 active existing onsite systems in Phase 1.
(4) The three community cluster drain fields together handle only 7, 200 gpd of the current wastewater flow of 23, 200 gpd.
(5) The offsite RGF system handles only 14,500 gpm maximum.
(6) For the RFG alternative, it is assumed that the seven properties currently discharging high strength waste (>350 mg/L BOD) will continue to do so and will require installation of aerobic treatment units on their sites to bring the waste strength down to below 350 mg/L BOD. The capital costs for the ATUs are included in the "Treatment Plant and Drainfield Disposal Capital Costs" in Alternative 4A (7 x $56,845.00 = $397,900.00). Note that these per-property ATU costs are less than for the onsite alternatives 2 and 3 because onsite drainfields are not needed.
(7) The costs for the onsite nonconforming repairs, the cluster system, and offsite RGF with drip irrigation columns (Alternatives 2 and 3) must be added together to obtain total costs for a combined system to treat 27,100 gpd total flow (5,400 + 7,200 + 14,500).
(8) Unit cost for land is assumed to be $25,000.00 per acre, with a minimum cost of $100,000.00 for parcels less than 1 acre, per discussion at stakeholder meeting July 11, 2001.
(9) For Alternative 4A, the O&M cost for the ATUs was added to the O&M cost for the RGF and subsurface drip irrigation disposal field (7 x $800.00 = $5,600.00).
(10) An Equivalent Residential Unit (ERU) was defined as 250 gpd, with a waste strength of 350 mg/L BOD. The number of ERUs for a parcel was calculated by the formula: # of ERUs = [Peak Month Flow (gpd)/(250 gpd/ERU)] x [Waste strength (mg/L BOD)/(350 mg/L BOD/ERU)], where peak month flow comes from current metered water use, and waste strength is as estimated by Aqua Test, based on waste strengths of sewage from similar facilities in other communities. (See Tables 4-5 and 4-6). The minimum number of ERUs per parcel is one. A typical residence might have a value of 1 ERU; a typical grocery store might have a value of 8 ERUs; a small restaurant/lounge might have a value of 37 ERUs; and a large restaurant might have a value of 75 ERUs.
(11) All costs are in current dollars, and do not include financing charges.

TABLE 6-1B

Summary Comparison of Capital and Operation & Maintenance Cost Estimates for Alternative Wastewater Systems for Phase 1 Maximum Flow of 55,600 gpd(6)

Item	Alternatives 4 Centralized (All alternatives sized for Phase 1 maximum flow of 55,600 gpd)			
	Alternate 4A RGF with Subsurface Drip Irrigation(2)	Alternate 4B Class A Reuse with Rapid Infiltration	Alternate 4C Package Plant with River Outfall	Alternate 4D Package Plant with Drainfield
No. of Parcels in Service Area (Phases 1 and 2)	52	52	52	52
No. of Potential Connections in Phase 1 Area (All Phase 1 parcels)	36	36	36	36
No. of ERUs(5) at Startup (at Build-out)	238 (463)	238 (463)	238 (463)	238 (463)
Collection and Conveyance System Capital Costs	$ 636,000.00	$ 636,000.00	$ 636,000.00	$ 636,000.00
Collection and Conveyance System Capital Costs per Parcel (52 parcels)	$ 12,231.00	$ 12,231.00	$ 12,231.00	$ 12,231.00
Treatment Plant and Drainfield Disposal Capital Costs	$3,300,900.00	$2,630,000.00	$1,961,000.00	$2,414,000.00
Land Costs(3)	$ 392,000.00	$ 100,000.00	$ 100,000.00	$ 166,000.00
Outfall Costs	$ 0.00	$ 0.00	$ 470,000.00	$ 0.00
Total Treatment & Disposal Cost	$3,692,900.00	$2,730,000.00	$2,531,000.00	$2,580,000.00
Treatment & Disposal Cost/Startup ERU (238 ERUs)	$ 15,516.00	$ 11,471.00	$ 10,634.00	$ 10,840.00
Total Capital Costs (Including Collection & Conveyance)	$4,328,900.00	$3,366,000.00	$3,169,000.00	$3,216,000.00
Annual O&M Costs for Collection and Conveyance Systems	$ 12,900.00	$ 12,900.00	$ 12,900.00	$ 12,900.00
Annual Costs for Treatment and Disposal Systems(4)	$ 32,200.00	$ 127,300.00	$ 105,600.00	$ 105,600.00
Total Annual O&M Costs	$ 45,100.00	$ 140,200.00	$ 118,500.00	$ 118,500.00
Total Monthly O&M Cost per Potential Connections in Phase 1 (36 connections)	$ 104.00	$ 325.00	$ 274.00	$ 274.00
Total Monthly O&M Cost per Startup ERU (238 ERUs)	$ 16.00	$ 49.00	$ 41.00	$ 41.00

(1) Onsite and cluster alternatives cannot accommodate this total amount of flow, so they are not included in this comparison.

(2) For the RGF alternative, it is assumed that the seven properties currently discharging high strength waste (>350 mg/L (BOD) will continue to do so and will require installation of aerobic treatment units on their sites to bring the waste strength down to below 350 mg/L BOD. The capital costs for these ATUs are included in the "Treatment Plant and Drainfield Disposal Capital Costs" in Alternative 4A (7 x $56,845.00 = $397,900.00). Note that these per property ATU costs are less than for the onsite Alternatives 2 and 3 because onsite drainfields are not needed.

(3) Unit cost for land is assumed to be $25,000.00 per acre, with a minimum cost of $100,000.00 for parcels less than 1 acre, per discussion at Stakeholder meeting July 11, 2001.

(4) For Alternative 4A, the O&M cost for the ATUs was added to the O&M cost for the RGF and drip irrigation disposal field (7 x $800.00 = $5,600.00).

(5) An Equivalent Residential Unit (ERU) was defined as 250 gpd, with a waste strength of 350 mg/L BOD. The number of ERUs for a parcel was calculated by the formula:
ERUs = [Peak Month Flow (gpd)/(250 gpd/ERU)] x [Waste Strength (mg/L BOD)/(350 mg/L BOD/ERU)], where peak month flow comes from current metered water use, and waste strength is as estimated by Aqua Test, based on waste strengths of sewage from similar facilities in other communities. (See Tables 4-5 and 4-6). The minimum number of ERUs per parcel is one.

(6) All costs are in current dollars, and do not include financing charges.

TABLE 6-1C

Summary Comparison of Capital and Operation & Maintenance Cost Estimates for Alternative Wastewater Systems for Phase 1 & 2 Maximum Flow of 70,800 gpd(6)

Item	Alternatives(1) Centralized (All alternatives sized for Phase 1 & 2 maximum flow of 70,800 gpd) Alternate 4A RGF with Subsurface Drip Irrigation(2)	Alternate 4B Class A Reuse with Rapid Infiltration	Alternate 4C Package Plant with River Outfall	Alternate 4D Package Plant with Drainfield
No. of Parcels in Service Area (Phases 1 and 2)	52	52	52	52
No. of Potential Connections in Phase 1 & 2	52	52	52	52
No. of ERUs(5) at Startup (at Build-out)	238 (524)	238 (524)	238 (524)	238 (524)
Collection and Conveyance System Capital Costs	$ 636,000.00	$ 636,000.00	$ 636,000.00	$ 636,000.00
Collection and Conveyance System Capital Costs per Parcel (52 parcels)	$ 12,231.00	$ 12,231.00	$ 12,231.00	$ 12,231.00
Treatment Plant and Drainfield Disposal Capital Costs	$3,989,900.00	$2,999,000.00	$2,181,000.00	$2,755,000.00
Land Costs(3)	$ 492,000.00	$ 100,000.00	$ 100,000.00	$ 211,000.00
Outfall Costs	$ 0.00	$ 0.00	$ 470,000.00	$ 0.00
Total Treatment & Disposal Cost	$4,481,900.00	$3,099,000.00	$2,751,000.00	$2,966,000.00
Treatment & Disposal Cost/Startup ERU (238 ERUs)	$ 18,832.00	$ 13,021.00	$ 11,558.00	$ 12,462.00
Total Capital Costs (Including Collection & Conveyance)	$5,117,900.00	$3,735,000.00	$3,388,000.00	$3,602,000.00
Annual O&M Costs for Collection and Conveyance Systems	$ 12,900.00	$ 12,900.00	$ 12,900.00	$ 12,900.00
Annual Costs for Treatment and Disposal Systems(4)	$ 39,300.00	$ 147,000.00	$ 124,600.00	$ 125,100.00
Total Annual O&M Costs	$ 52,200.00	$ 159,900.00	$ 137,500.00	$ 138,000.00
Total Monthly O&M Cost per Potential Connections in Phase 1 & 2 (52 connections)	$ 84.00	$ 256.00	$ 220.00	$ 221.00
Total Monthly O&M Cost per Startup ERU (238 ERUs)	$ 18.00	$ 56.00	$ 48.00	$ 48.00

(1) Onsite and cluster alternatives cannot accommodate this total amount of flow, so they are not included in this comparison.

(2) For the RGF alternative, it is assumed that the seven properties currently discharging high strength waste (>350 mg/L (BOD) will continue to do so and will require installation of aerobic treatment units on their sites to bring the waste strength down to below 350 mg/L BOD. The capital costs for these ATUs are included in the "Treatment and Disposal Plant Costs" in Alternative 4A. (7 x $56,845.00 = $397,900.00), Note that these per property ATU costs are less than for the onsite Alternatives 2 and 3 because onsite drainfields are not needed.

(3) Unit cost for land is assumed to be $25,000.00 per acre, with a minimum cost of $100,000.00 for parcels less than 1 acre, per discussion at Stakeholder meeting July 11, 2001.

(4) For Alternative 4A, the O&M cost for the ATUs was added to the O&M cost for the RGF and drip irrigation disposal field (7 x $800.00 = $5,600.00).

(5) An Equivalent Residential Unit (ERU) was defined as 250 gpd, with a waste strength of 350 mg/L BOD. The number of ERUs for a parcel was calculated by the formula:
ERUs = [Peak Month Flow (gpd)/(250 gpd/ERU)] x [Waste Strength (mg/L BOD)/(350 mg/L BOD/ERU)], where peak month flow comes from current metered water use, and waste strength is as estimated by Aqua Test, based on waste strengths of sewage from similar facilities in other communities. (See Tables 4-5 and 4-6). The minimum number of ERUs per parcel is one.

(6) All costs are in current dollars, and do not include financing charges.

CHAPTER 7

FUNDING SOURCES

AVAILABLE FUNDING SOURCES

The following is a brief discussion of the potential funding sources for financing the proposed Fall City business district wastewater system improvements. These funding sources are listed as follows:

The construction or rehabilitation of public infrastructure is generally funded through a combination of grant and loan programs provided through county, state, and federal agencies. While the following descriptions are general, notes have been included that describe potential funding sources for the Fall City business district wastewater system project. In the long term, however, it is recommended that the community pursue the formation of a sewer utility district. Utility districts can apply directly to most funding agencies, rather than going through a secondary eligible jurisdiction such as King County.

Grants:	Centennial Clean Water Fund (CCWF) Community Development Block Grant (CDBG) Community Investment Fund (CIF) US Economic Development Administration (US EDA) US EPA State and Tribal Assistance Grant (STAG) USDA Forest Service, Rural Assistance Program (USFS) USDA Rural Development (RD)
Loans:	Centennial Clean Water Fund (CCWF) State Revolving Fund (SRF) Public Works Trust Fund (PWTF) Community Economic Revitalization Board (CERB) Drinking Water State Revolving Fund (DWSRF) USDA Rural Development (RD)
Bonds:	Revenue Bonds General Obligation Bonds
Other:	Utility Local Improvement Districts

CENTENNIAL CLEAN WATER FUND (CCWF)

The Department of Ecology (Ecology) provides both grants and loans for measures to prevent and control water pollution through the Centennial Clean Water Fund. Each biennium, the funds that support the CCWF program are subject to legislative approval.

As of the 2002 funding cycle, grant money is available only to those who can document hardship. Where financial hardship is determined, the total eligible project cost cannot exceed $10,000,000 and the grant amount cannot be more than half, or $5,000,000. Hardship is demonstrated when project costs for construction of facilities result in total cost for debt service and operation and maintenance in excess of 1.5 percent of the median household income. A project may be phased and receive grant and loan moneys from several funding cycles to complete the project. In addition, a higher grant amount may be available if the three-year average local unemployment rate exceeds the three-year average statewide unemployment rate. Grants require a 50% matching fund, however, Centennial or SRF loans are used to match grants. If the project is enrolled in Ecology's Small Town Environmental Program, an in-kind match may be used.

Grant funds from the CCWF program are allocated on a competitive basis, therefore a decrease in available funds results in a more competitive arena for potential grantees. Ranking criteria for CCWF grants include the potential for ecological damage of the affected water body, the need for a facility to meet an enforcement or compliance order and the presence or absence of a health emergency based on the existing conditions. Projects with enforcement orders, compliance orders, or health emergency declarations are considered high priority and receive points in the ranking process.

Non-hardship construction projects are eligible for loans only, with eligibility up to 100 percent of project costs. Facility construction projects are eligible for up to 50 percent of the amount available to SRF, or $32,000,000 for fiscal year 2002.

Eligible reserve capacity is defined differently for the CCWF and SRF programs. Ecology's CCWF program provides funding for wastewater treatment facilities up to 110 percent of capacity to meet existing need and the SRF program provides funding for reserve capacity to handle flows identified for the 20-year projected growth within a service area. These programs may provide financial assistance for limited amounts of flow from commercial, industrial, or institutional facilities. Only 30 percent of the flow from these facilities are eligible and are limited to loan only.

STATE REVOLVING FUND (SRF)

The Department of Ecology also administers the SRF program, which provides low interest loans for water pollution control projects. Currently, SRF is offering 20-year loans at 1.5 percent interest rates, and 5-year loans at 0.5 percent interest rates. The primary program requirements are to have an approved facilities plan for treatment works and to demonstrate the ability to repay the loan through a dedicated funding source. The SRF can be used to finance sewer system replacement for the elimination of excessive infiltration and inflow and for the construction of facilities with reserve capacities to accommodate flows corresponding to the 20-year projected growth in the service area. Land acquisition is not eligible for SRF funding. SRF loans can also be utilized for the refinancing of existing (non-SRF) debts used to fund eligible projects started after May 5, 1985.

Eligible applicants for both the CCWF and SRF programs include any Washington state county, city, town, conservation district, or other political subdivision, municipal, or quasi-municipal corporation. Other State agencies are not eligible to apply. A summary of loan terms for CCWF and SRF loans is provided in the Table 7-1.

TABLE 7-1

CCWF/SRF Loan Terms

Term	Interest Rate
Up to five years	0.5 percent
More than five but less than 20 years	1.5 percent

Fall City may apply to the CCWF/SRF programs for 30 percent of their total flows. Applications are submitted in March each year.

COMMUNITY DEVELOPMENT BLOCK GRANT (CDBG)

The Community Development Block Grant program is a competitive source of federal funding for a broad range of community development projects. A primary requirement of the CDBG program is that the project must principally benefit at least 51 percent of the low-to-moderate income residents of the project area. The State expects to receive approximately $8 million in federal funds for fiscal year 2001. CDBG has two programs including General Purpose and Planning Only. The General Purpose program provides grant funds for the design, construction, or reconstruction of water and sewer systems up to the amount of $750,000. The Planning Only program includes projects such as comprehensive plans, community development plans, capital improvement plans, and other plans such as land use and urban environmental design, economic development, floodplain and wetlands management, transportation, and utilities. Planning only grants are limited to $24,000 for a single applicant or $40,000 for a joint applicant.

Eligible applicants for the CDBG programs include cities and towns with less than 50,000 people or counties with populations less than 200,000. Though port districts and economic development districts are not eligible to apply, the City can submit a joint application and include these entities as partners.

Fall City must contact the King County CDBG program to fund its wastewater project. The state provisions are similar, but the County maintains its own program. King County's CDBG program is a two-year program, therefore, applications will not be accepted until fiscal year 2004.

COMMUNITY INVESTMENT FUND (CIF)

The Community Investment Fund partners with CDBG to fund projects that benefit at least 51% low to moderate-income residents. An applicant would first apply to the CDGB General Purpose program, and meet the income limits of that program. At the discretion of the Public Work Board, an applicant may be asked to apply to the Community investment Fund. Additional grant funding, in the amount of $1,000,000 may be obtained.

To qualify for CIF, the project must be rated as one of the top three of the local WA-CERT Priority Rating Process and benefit at least 51% low-to-moderate income households.

The CIF program is open only for applicants to the State's CDBG program, therefore, Fall City would not be eligible.

PUBLIC WORKS TRUST FUND (PWTF)

The Public Works Trust Fund is a revolving loan fund designed to help local governments finance public works projects through low-interest loans and technical assistance. The PWTF, established in 1985 by legislative action, offers loans substantially below market rates, payable over periods ranging up to 20 years.

Interest rates range from 0.5, 1.0, or 2.0 percent, with lower interest rates obtained by a higher local financial share. To qualify for a 2.0 percent loan an applicant must provide a minimum of 5 percent of project costs. A 10 percent local share qualifies the applicant for 1.0 percent interest rate, and a 15 percent local share qualifies for a 0.5 percent loan. The local share can be met with other state loan funds if community funds are utilized to pay back the loan. The useful life of the project determines the loan term, with a maximum of 20 years.

An applicant must have a long-term plan for financing its public works needs. If the applicant is a county or city, it must adopt the ¼ percent real estate excise tax. Eligible public works projects include streets and roads, bridges, storm sewers, sanitary sewer collection and treatment systems, and domestic water. Loans are presently offered only for purposes of repair, replacement, rehabilitation, reconstruction, or improvement of existing eligible public works systems. Ineligible expenses include public works financing costs that arise from forecasted, speculative, or service area growth. Such costs do not make a project ineligible but must be excluded from the scope of the PWTF proposal.

Since substantially more trust fund dollars are requested than are available, local jurisdictions must compete for the available funds. The applications are carefully evaluated, and the Public Works Boards submits to the Legislature a prioritized list of those projects recommended receiving low-interest financing. The Legislature reviews the list and indicates its approval through the passage of an appropriation from the Public Works Assistance Account to cover the cost of the proposed loans. Once the Governor has signed the appropriation bill into law (an action that usually occurs by the following April), those local governments recommended to receive loans are offered a formal loan agreement with appropriate interest rates and terms as determined by the Public Works Board.

PWTF has three programs for Construction, Pre-Construction, and Planning. An applicant can apply for up to $10,000,000 under the Construction program, $1,000,000 for Pre-construction activities, and $50,000 for planning. The Planning program differs in that the terms are 0.0% for a 6-year term. PWTF loan terms are summarized in Table 7-2.

TABLE 7-2

PWTF Loan Terms

Construction and Pre-Construction	
Local Match	Interest Rate/Term
15%	0.5%, 20 years
10%	1.0%, 20 years
5%	2.0%, 20 years
Planning	
Local Match	Interest Rate
0%	0.5%, 6 years

To be eligible for the PWTF programs, an applicant must be a local government such as a city or county, or a special purpose utility district. Though Fall City is not directly eligible to apply to the PWTF, it can partner with an eligible jurisdiction such as King County. The contact for King County at the Public Works Board is Isaac Huang, who can be reached at (360) 725-5009.

COMMUNITY ECONOMIC REVITALIZATION BOARD (CERB) – INFRASTRUCTURE

The Community Economic Revitalization Board's prime mission is to partner with business and industry and local governments to maintain and create jobs. Established by the Legislature in 1982, CERB provides low-interest loans or, in unique circumstances, grants to help finance local public infrastructure necessary to develop or retain stable business and industrial activities. Projects eligible for funding include roads, domestic and industrial waters systems, sanitary and storm sewers, port facilities, and general purpose industrial buildings.

Typically, loans in the amount of $1,000,000 and, where applicable, grants in the amount of $300,000 are available. The interest rate is tied to the current cost of 10-year bonds and local match of 10% is required.

Eligible applicants include Washington state subdivisions in partnership with private enterprise. If there is no economic partner, a local government can produce a feasibility study that documents realistic job retention or creation. Applications must be submitted 45 days prior to a regularly scheduled CERB Meeting, which typically meets in January, May, July and November.

Fall City is not eligible to apply to the CERB program as it is has no status as a municipality. In addition, the CERB program provides funding to enhance economic development specifically for the industrial sector. The downtown commercial core would be not eligible.

USDA RURAL DEVELOPMENT, RURAL UTILITY SERVICES (RUS)

The Rural Utility Service administers a water and wastewater loan and grant program to improve the quality of life and promote economic development in rural area.

Rural Development has a loan program that, under certain conditions, includes a limited grant program. Grants may be awarded when the annual debt service portion of the utility rate exceeds 1.0 percent to 1.5 percent of the municipality's 1990 median household income.

In addition, RECD has a loan program for needy communities that cannot obtain funding by commercial means through the sale of revenue bonds. The loan program provides 30- to 40- year loans at an interest rate that is based on federal rates and varies with the commercial market. RECD loans are revenue bonds with a 1.1 debt coverage factor.

Eligible projects include the construction, expansion, extension or improvement of rural water, sanitary sewers, solid waste disposal, storm, and wastewater disposal facilities.

Basic criteria for RD funding follows:

- Dependent on inability to obtain funds from other sources at reasonable terms.
- 45% grant available if the median household income of the service area exceeds 80% of the statewide non-metropolitan median household income.
- 75% grant eligible if the service area is below the higher of the poverty line or 80% of the state non-metropolitan median household income, and the project is necessary to alleviate a health and safety issue.

Eligible applicants municipalities; counties; non-profit corporations, associations, or cooperatives; and federally-recognized Native American tribes in rural areas with populations less than 10,000.

Fall City is eligible to apply to the USDA RD. Though it not incorporated as a city, it can apply as long as it provides no wastewater services to urban areas. However, in order to receive grant funding an applicant's 1990 median household income must be at or below the state's MHI of $33,239. Fall City's 1990 MHI was $36,797. Therefore, the community would be eligible for loan only. RD will be using 2000 census data once the official version is published. Ms. Jan Cyr is the contact and can be reached at (360) 428-4322.

US ECONOMIC DEVELOPMENT ADMINISTRATION (US EDA)

US EDA offers competitive grants up to $1,000,000 for projects from Region 10. Projects are selected locally by an economic development district and submitted to Congress for competitive selection among other regions in the US. Similar to CERB, applicants must have an industrial partner ready to proceed or a feasibility study that establishes realistic job creation.

The local office that represents the US EDA is the Central Puget Sound Economic Development District. The contact person at the local office is Chuck Ede, Director, who can be reached at (206) 623-2744. To apply to the US EDA, Fall City would have to go through either King County or the local economic development district for their region. Similar, to the CERB program, this program requires an industrial partnership that creates or retains jobs.

US FOREST SERVICE

Forest Service grants are available through the Rural Community Assistance Program to assist rural communities that are dependent on natural resources. Project proposals must show a broad community benefit that result in greater ability to improve itself economically, socially, or environmentally. The project must have the potential for economic development. Grant funds are generally limited to $50,000.

The USFS is currently considering the potential for funding communities within urban counties. It is possible that a small grant could be obtained through the timber-dependent program. Even if Fall City has no existing timber-dependent businesses, if it can document past logging practices, it may be eligible to apply for funding. The Forest Service contact is Mr. Carl Dennison who can be reached at (360) 956-2306.

US EPA STATE AND TRIBAL ASSISTANCE GRANT

Local jurisdictions within the State of Washington can apply to the State and Tribal Assistance Grant program through the office of their local Congressional representative. For King County, the legislator is Congresswoman Jennifer Dunn. Congresswoman Dunn could attach the Fall City project as a line item to the VA/HUD Appropriations Bill. Applicants can obtain grant funds up to approximately $2,000,000. Fall City could contact Congresswoman Dunn's office to determine its eligibility for the STAG program.

REVENUE BONDS

The most common source of funds for construction of major utility improvements is the sale of revenue bonds. The tax-free bonds are issued by the city. The major source of funds for debt service on these revenue bonds is from monthly sewer service charges. In order to qualify to sell revenue bonds, the city must show that its net operating income (gross income less operation and maintenance expenses) is equal to or greater than a factor, typically 1.2 – 1.4 times the annual debt service on all par debt. If a coverage factor has not been specified it will be determined at the time of any future bond issues. This factor is commonly referred to as the coverage factor and is applicable to revenue bonds sold on the commercial market.

GENERAL OBLIGATION BONDS

A city may by special election issue general obligation bonds to finance almost any project of general benefit to the city. The bonds are paid off by assessments levied against all privately-owned properties within the city. This includes vacant property that would otherwise not contribute to the cost of such general improvements. This type of bond issue is usually reserved for municipal improvements that are of general benefit to the public, such as arterial streets, bridges, lighting, municipal buildings, fire fighting equipment, parks, and water and wastewater facilities. General obligation bonds have the best market value and carry the lowest rate of interest of all types of bonds available to the city.

Disadvantages of general obligation bonds include the following:

- Voter approval is required which may be time-consuming, with no guarantee of successful approval of the bond.
- The city would have a practical or legal limit for the total amount of general obligation debt. Financing large capital improvements through general obligation debt reduces the ability of the utility to issue further debt.

UTILITY LOCAL IMPROVEMENT DISTRICTS

Another potential source of funds for improvements comes through the formation of Utility Local Improvement Districts (ULIDs) involving an assessment made against properties benefiting by the improvements. ULID bonds are further guaranteed by revenues and are financed by issuance of revenue bonds.

ULID financing is frequently applied to sewer system expansions. Typically, ULIDs are formed by the city at the written request (by petition) of the property owners within a specific area of the city. Upon the receipt of a sufficient number of signatures or petitions, the local improvement area is defined, and a sewer system is designed for that particular area in accordance with the city's sewer comprehensive plan. Each separate property in the ULID is assessed in accordance with the special benefits the property receives from the water or wastewater system improvements. A citywide ULID could form part of a financing package for large-scale capital projects such as sewer line extensions or replacements that benefit all residents in the service area. The assessment places a lien on the property and must be paid in full upon sale of the property. Further, property owners may pay the assessment immediately upon receipt reducing the costs financed by the ULID.

The advantages of ULID financing, as opposed to rate financing, to the property owner include:

- The ability to avoid interest costs by early payment of assessments.
- If the ULID assessment is paid in installments, it may be eligible to be deducted from federal income taxes.
- Low-income senior citizens may be able to defer assessment payments until the property is sold.
- Some Community Block Grant funds are available to property owners with incomes near or below poverty level. Funds are available only to reduce assessments.

The major disadvantage to the ULID process is that it may be politically difficult to approve formation. The ULID process may be stopped if owners of 40 percent of the property area within the ULID boundary protest its formation. Also, utilization of a ULID increases total project costs by a factor of about 1.3.

SMALL TOWNS ENVIRONMENT PROGRAM (STEP)

Each of the states in partnership with STEP coordinates a self-help approach by which communities and their residents take the lead in both the planning and implementation of essential water and wastewater projects. This program includes a revolving loan fund and uses Community Development Block Grants, as well as state and foundation monies to support projects. Average cost saving over defined retail costs in the more than 200 completed projects is 45%. Washington State Department of Ecology coordinates STEP locally.

This is a process by which money is saved through local efforts rather than a funding mechanism.

Table 7-3 summarizes the requirements for the potential funding sources for the Fall City Alternative Onsite Wastewater Project.

TABLE 7-3

Fall City Wastewater Project Summary of Potential Funding Sources[1]

Funding Agency/Program	Application Cycle	Eligible Tasks	Grant	Loan	Terms
Dept of Ecology - Centennial Clean Water Fund and State Revolving Fund (CCWF/SRF)	January through May	Planning, Design, and Construction	Grants are only available where hardship can be documented.	Up to $45,000,000	Loan can serve as a match for US RD Loan. 1.5%/20 years
Community Development Block Grant (CDBG)	General Purpose: September through October Planning Only: Ongoing cycle	General Purpose Program (design/construction) Planning Only Program	$750,000 (GP) $40,000 (PO) (for joint applicants)		Project must principally benefit LMI residents
Public Works Trust Fund (PWTF)	Construction: May through May Pre-Construction: Ongoing Planning: Ongoing	Water and Sewer Planning, Design, Construction		Construction: $10,000,000 Pre-Construction: $1,000,000 Planning: $50,000	Construction & Pre Construction: 0.5% to 2% tied to local match Planning: 0.0%/6-year term
Community Economic Revitalization Board (CERB)	Applications are submitted to the Board at 4 different meetings during the year.	Construction	$300,000	$1,000,000	Requires economic development partner or feasibility study
USDA Rural Development (RD)	Ongoing. RD will require application one all other funding sources have been committed. Loan principal can be deferred for first two years.	Construction	$2.8 million (estimate)	$2.2 million (estimate)	

TABLE 7-3 – (continued)

Fall City Wastewater Project Summary of Potential Funding Sources[1]

Funding Agency/Program	Application Cycle	Eligible Tasks	Grant	Loan	Terms
US Economic Development Administration (US EDA)	At discretion of local technical assistance committee	Collection system design and construction	$1,200,000		Requires economic development partner or feasibility study
US Forest Service Olympic National Forest	Ongoing cycle	Small grants available for tasks associated with planning and design	$50,000		Requires 25% match

(1) Assumes a public entity is formed as the management group.

CHAPTER 8

ALTERNATIVE SELECTION

Per Metro King County Council Motion 10960, and based on the information provided in this report, the Stakeholder Group was charged to seek an agreement on a preferred wastewater system alternative and recommend that option to King County on August 1, 2001. Each proposed alternative has its own advantages and disadvantages. Table 8-1 is a matrix which lists criteria that the Stakeholders identified, against which the Alternatives were to be evaluated. This matrix was developed to be used as a tool by the Stakeholders to help evaluate the alternatives by rating how well each one satisfies the criteria.

TABLE 8-1

Wastewater System Alternatives Evaluation Matrix

	Alternatives						
Criteria	No Action (Alternative 1)	Onsite Individual Systems (Alternative 2)	Offsite Cluster System and Offsite, RGF 14,500 gpd (Alternative 3)	Recirculating Gravel Filter with Subsurface Drip Irrigation (Alternative 4A)	Class A Reuse Plant (Alternative 4B)	Package Plant with River Outfall (Alternative 4C)	Package Plant with Drainfield (Alternative 4D)
1. Solution appropriately responds to a real issue or problem, including an appropriate size							
2. Solution is easy to manage and maintain over time.							
3. Solution is affordable and costs are fairly distributed.							

TABLE 8-1 – (continued)

Wastewater System Alternatives Evaluation Matrix

Criteria	Alternatives						
	No Action (Alternative 1)	Onsite Individual Systems (Alternative 2)	Offsite Cluster System and Offsite, RGF 14,500 gpd (Alternative 3)	Recirculating Gravel Filter with Subsurface Drip Irrigation (Alternative 4A)	Class A Reuse Plant (Alternative 4B)	Package Plant with River Outfall (Alternative 4C)	Package Plant with Drainfield (Alternative 4D)
4. Solution does not adversely affect the community character.							
5. Solution is flexible. It supports stability of existing business tenants and provides for reasonable business property use and normal change of use and growth over time.							

Additional issues and criteria which the Stakeholders may utilize in their evaluation are as follows:

- **Siting**: Where will the necessary components of this alternative be located? Does this space exist within or near the Fall City business district?
- **Permitting**: What permits are required to implement this alternative?
- **Capital Cost**: What will construction of the alternative cost?
- **Operations and Maintenance Cost**: What will be the annual cost to operate and maintain this alternative.
- **Long-term Environmental Benefits**: How will this alternative affect the local environment in the next 5-50 years?

- **Short-term Environmental Benefits**: How will this alternative affect the local environment in the next 1-5 years?
- **Expandability**: Can the capacity of this alternative be modified easily to meet increased future demand?
- **Containability**: Will this alternative restrict growth and maintain the current character of Fall City?
- **Regulatory Impacts**: What regulatory process is required?
- **Grants/Loans**: Do funding sources exist that may help the Fall City business community pay for this alternative?
- **Operator Certification**: Will a certified operator be required to oversee this alternative?
- **Administrative Structure**: Who will the management entity be?
- **Land Value**: What is the cost of land acquisition required by this alternative?
- **Schedule**: How long will it take to get this alternative constructed and operating?
- **Fairness in Cost:** Will the management entity be able to use this system to distribute costs fairly such that participants will pay according to their contribution?

RECOMMENDED ALTERNATIVE

The Stakeholders evaluated the wastewater system alternatives described in Chapter 5 and summarized with cost estimates in Chapter 6, and submitted their recommendations and comments to the project facilitator. Their recommendations and comments were compiled and discussed at the July 25, 2001 Stakeholders meeting. A separate transmittal of the Stakeholder's recommendations will be delivered to King County.

IMPLEMENTATION ISSUES AND RECOMMENDATIONS (NEXT STEPS)

The following list represents Gray & Osborne's understanding of the Stakeholders recommendations, and parallels the recommendations in the Stakeholders letter.

1. Engage the Dept. of Ecology in the project planning process, to include discussion of environmental permitting, Snoqualmie River 303(d) listing and TMDL issues for both point and non-point sources.

2. Pursue water quality sampling and testing of groundwater and surface water in and around the downtown business district to characterize the nature and extent of any pollution arising from the existing onsite septic systems in the business district. Evaluate the results of the water quality characterization study for compliance with current regulations, including the Snoqualmie River Total Maximum Daily Load (TMDL), and its associated Nonpoint Action Plan (see Appendix J and K).

3. Resolve any planning and growth management issues with King County Department of Development and Environmental Services. Concerns expressed include: community vs. public sewers and the feasibility of alternatives under GMA. The Stakeholders requested at the July 25, 2001 meeting that the feasibility of a tightline (force main) connection to an existing sewer system, such as that of the Sammamish Plateau Water and Sewer District, be evaluated with respect to GMA, current regulations and technical requirements. This evaluation would be made prior to selection of the preferred alternative.

4. Develop and implement a Management Plan for the administration, planning, operations and funding for the selected alternative. This plan will identify and describe the management entity that would own and operate the new facilities.

5. Prepare a detailed Funding Options and Financing Study.

6. Prepare an Engineering Report/Facilities Plan per WAC 173-240-050 to evaluate and identify the site-specific alternative to meet the needs of the Fall City Stakeholders. The report will build on the existing technical report and provide site specific preliminary engineering evaluations to include phasing, financing, permitting, and SEPA. The report will address various treatment processes to include the process described in Mr. Bernard's letter of June 27, 2001. The detailed financing study will be included in the Engineering Report, after the preferred alternative is selected.

7. Once the Engineering Report is approved, apply for loans and grants from the Funding Agencies identified in the Report.

APPROXIMATE DURATION OF ACCOMPANYING MAJOR TASKS

INTRODUCTION

The Stakeholders at the July 25th meeting asked the Consultant to provide generalized estimated of the duration of the technical tasks and permitting issues, that may need to be addressed. The following represents our best estimate at this time.

ENGINEERING REPORT, DESIGN AND CONSTRUCTION

Task[1]	Estimated Duration
Water Quality Characterization Study	8 months
Biological Assessment	12 months
Engineering Report	10 months
Engineering Design	12 months
Construction	12 to 18 months

PERMITTING

Permit	Agency	Estimated Time Required
State Waste Discharge Permit[2]	Ecology	6 - 9 months
National Pollutant Discharge Elimination System Permit[3]	Ecology[4]	12 – 24 months
Clean Water Act Section 404 Permit	US Army Corps of Engineers	6 – 24 months[5]
401 Water Quality Certification	Ecology	3 – 6 months following Biological Assessment and Corps Permit
Hydraulic Project Approval (HPA)	Washington Dept. of Fish and Wildlife	40 – 60 day review
State Environmental Policy Act Compliance[6] (SEPA)	King County/Ecology	3 – 5 months for checklist, EIS up to 2 years
Flood Plain Management/Hazard Permit	King County	6 – 18 months
Shoreline Management Permit	King County/Ecology	3 – 6 months. All else must be done first. If EIS is required up to 2 years
National Environmental Policy Act (if federally funded or approved) (NEPA)	Funding/Approval Agency	4 – 6 months unless EIS is requested, in which case 2 years+

(1) Some tasks can be concurrent.
(2) Will normally require hydrogeological evaluation on the Project site.
(3) Only required for a river outfall.
(4) Approval of Design (Ecology).
(5) Requires ESA Consultation & Biological Assessment.
(6) Required for Shoreline and HPA.

APPENDIX A

KING COUNTY COUNCIL MOTION 10960

KING COUNTY

1200 King County Courthouse
516 Third Avenue
Seattle, WA 98104

Signature Report

April 16, 2001

Motion 10960

Proposed No. 2000-0363.2 **Sponsors** Irons

A MOTION directing the executive to convene a stakeholder group to research and recommend solutions to the existing wastewater treatment problem in the Fall City business district.

WHEREAS, adequate wastewater treatment in Fall City has been an issue of concern for residents, business owners and for King County for over ten years, and

WHEREAS, in 1990 King County participated in the development of a wastewater facilities plan (WFP) for the Fall City area, and

WHEREAS, the WFP concluded that most businesses in Fall City were built prior to the adoption of the health department's minimum lot size requirements, and that few septic tanks in the business district meet current health department design criteria; and

WHEREAS, the WFP further concluded that the Fall City business district should be sewered as soon as affected property owners deemed it financially feasible; and

WHEREAS, the Fall City community did not support the recommendations of the WFP due to concerns about future growth and, as a result, the plan was not implemented, and

WHEREAS, the Fall City community remains in need of long-term solutions to existing sewage disposal problems in order to protect public health and the environmental integrity of the Snoqualmie River, and

WHEREAS, King County comprehensive plan policy F-316 states that King County should monitor on-site systems that have shown evidence of failure or potential for failure, using the data to correct existing problems and prevent future problems, and that King County should analyze all funding options to correct on-site wastewater system failures which may include, where feasible and otherwise consistent with the plan, conversion to community sewage systems or installation of public sewers,

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

The county executive is hereby requested to convene a stakeholder group to research and recommend solutions to the existing wastewater treatment problem in the Fall City business district.

The stakeholder group shall use the 1990 Fall City Wastewater Facilities Plan as a baseline from which to approach their work, and shall consider a range of solutions, including but not limited to: 1) a septic tank management program, 2) a community drainfield, 3) alternative wastewater treatment technologies and 4) public sewers. Public sewers should only be considered if solutions #1-3 are proven to be technologically and/or financially infeasible.

The stakeholder group shall consist of three Fall City business owners, one citizen's advisory committee member, appointed by the executive and confirmed by the council, and one representative each from the following: the Seattle/King County department of public health, the King County department of development and environmental services, Fall City water district #127, and an expert in alternative wastewater treatment technology.

The executive shall transmit a report including the stakeholder group's recommendations to the King County council by September 1, 2001.

Motion 10960 was introduced on 6/12/00 and passed as amended by the Metropolitan King County Council on 6/12/00, by the following vote:

Yes: 13 - Mr. von Reichbauer, Ms. Miller, Ms. Fimia, Mr. Phillips, Mr. Pelz, Mr. McKenna, Ms. Sullivan, Mr. Nickels, Mr. Pullen, Mr. Gossett, Ms. Hague, Mr. Vance and Mr. Irons
No: 0
Excused: 0

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON

/s/

Pete von Reichbauer, Chair

ATTEST:

/s/

Anne Noris, Clerk of the Council

Attachments None

APPENDIX B

EXCERPTS FROM HYDROGEOLOGY FROM 1991 FACILITY PLAN

SECTION V

GROUNDWATER SYSTEM AND REGULATIONS

1. GROUNDWATER SYSTEM

Groundwater is present in most geologic deposits in the Puget Sound lowland areas. The best aquifers underlie coarser glacial sediments of the most recent glacial period. These sediments consist of sand and gravel laid down by both advancing and retreating glaciation. Other productive aquifers lie locally in coarse-grained shallow river alluvium. Groundwater flows are generally retarded by deposits of glacial till, lacustrine silt, and clay and bedrock.

Figure V-1 illustrates in simplified manner the likely groundwater system beneath the Fall City area. Data (Appendix A) indicate that the younger alluvium and alluvial fan deposits in the Fall City area probably form a shallow, water table aquifer system. The aquifer is also confined from beneath by fine grained, lacustrine recessional outwash deposits. As a result of the heterogeneous nature of the alluvial deposition, there is a great likelihood that the upper aquifer contains both confined and perched groundwater tables. The recessional outwash deposits retard downward flow to the lower aquifer. It is this lower aquifer from which the District obtains its water.

Study results indicate that groundwater flow between elevations of zero and 100 feet is generally to the north (Figure V-2). Water table elevations in at least one of the study wells is influenced by seasonal water levels in both the Raging River and Snoqualmie River. This indicates that water elevations vary seasonally, causing some slight change in groundwater contours and local flow directions. The rate of horizontal groundwater flow was estimated to vary from 0.23 to 111 feet per day, with an overall average estimate of 5 feet per day.

Upland areas located to the south of the Planning Area have higher groundwater elevations. Throughout the year these areas serve as recharge areas. Additionally, the Snoqualmie and Raging Rivers may seasonally recharge the shallow aquifer system.

2. ECOLOGY WATER QUALITY STANDARDS

For the first time in the State of Washington, groundwater standards are going to be adopted (WAC 173-290-010). Draft standards are under review and final standards are due for adoption before the end of 1990.

These standards set concentration criteria for over 50 water quality parameters. The concentrations are set to protect the groundwater source for drinking water conditions, even if the groundwater is not so used. Further, because of the State's Antidegradation Regulations (adopted in 1971), no groundwater of a quality greater than the standards will be allowed to degrade to the standards, except in those instances where "a demonstrated overriding consideration" exists, or "all (discharges) . . . shall be provided with all known, available, and reasonable methods of . . . treatment before discharge".

The possible implication for Fall City is a requirement that sewers be installed to prevent groundwater contamination if evidence indicates that either: (1) groundwater contamination is occurring; or (2) the existing septic tank systems are not adequately treating sewage and therefore are not the "known, available, and reasonable . . . method of treatment".

3. GROUNDWATER QUALITY

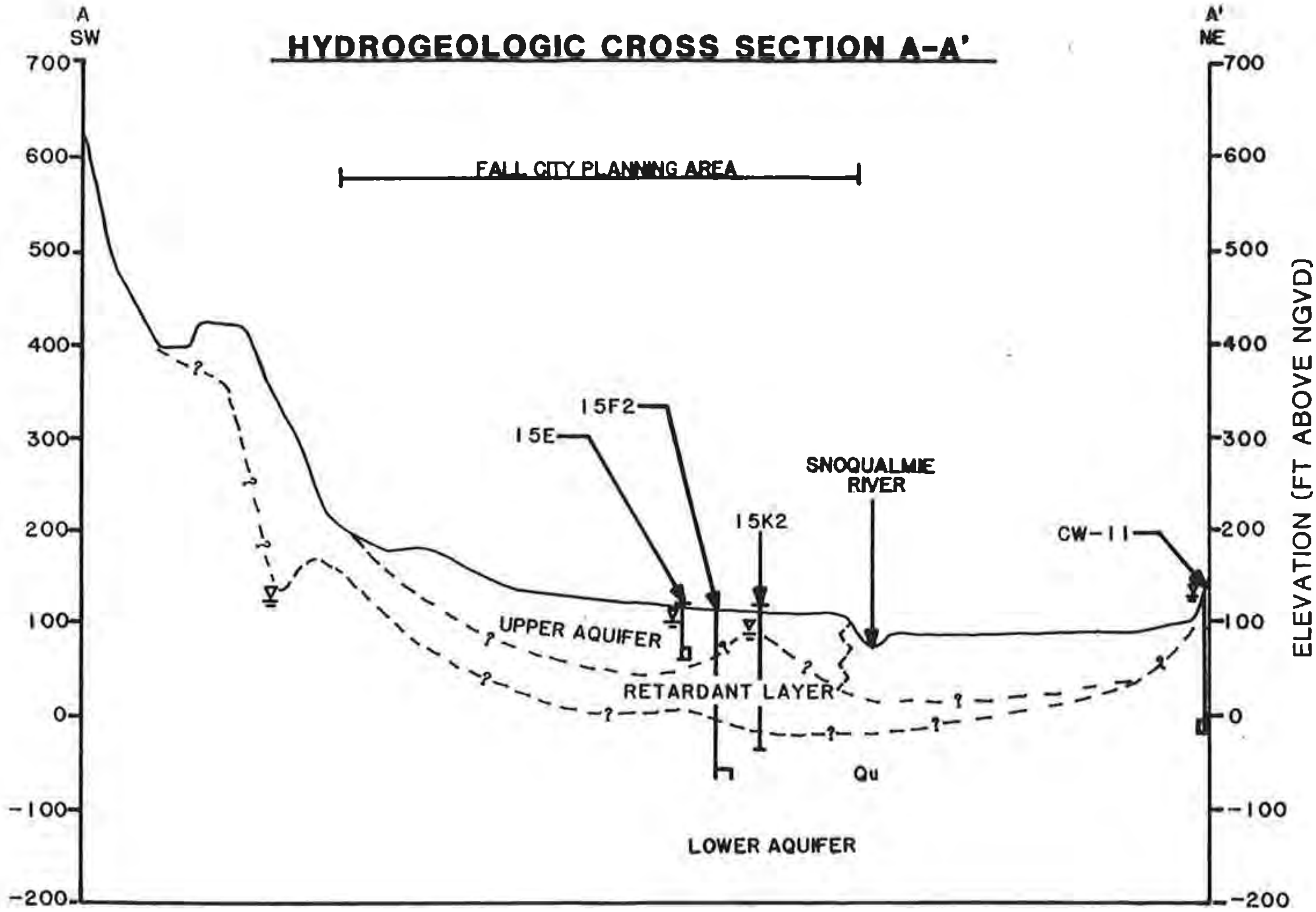
Four wells were sampled in the Planning Area to investigate groundwater quality conditions. Additionally, two storm drains were sampled to investigate the possibility of septic discharge or leakage into the storm drains. The water samples were analyzed for nitrate, nitrite, fecal coliform, and specific conductance. Specific source test results are included in Appendix A (Table 4). Locations of the wells and storm drains are shown in Figures V-1 and V-2.

Nitrite concentration was below laboratory detection limits in all tested water samples. Specific conductance was also low in all tested water samples. However, elevated levels of nitrate were found in one well and fecal coliform was found in a storm drain sampling location. These results indicate the potential for contamination of the upper portion of the shallow aquifer system.

4. SUMMARY

The shallow groundwater aquifer in the Fall City area is susceptible to contamination due to the relatively high permeability of the alluvium and the alluvial fan deposits, and the generally shallow depth of the groundwater. The adequacy of existing septic tanks and the potential for contamination of the shallow aquifer is presented in Section VI.

The District wells are not contaminated. The District obtains its water from the lower aquifer, which is protected from the shallow aquifer by an intervening layer of low permeable material (Section III-4.c.). Consequently, it is unlikely the wells will become contaminated by inadequately treated sewage from septic tanks. However, as the geologic information is incomplete, it cannot be said with complete confidence that there are no "gaps" in the retarding layer through which contaminants could move to the lower aquifer.



SCALE:

HORIZONTAL 1" = 1000'

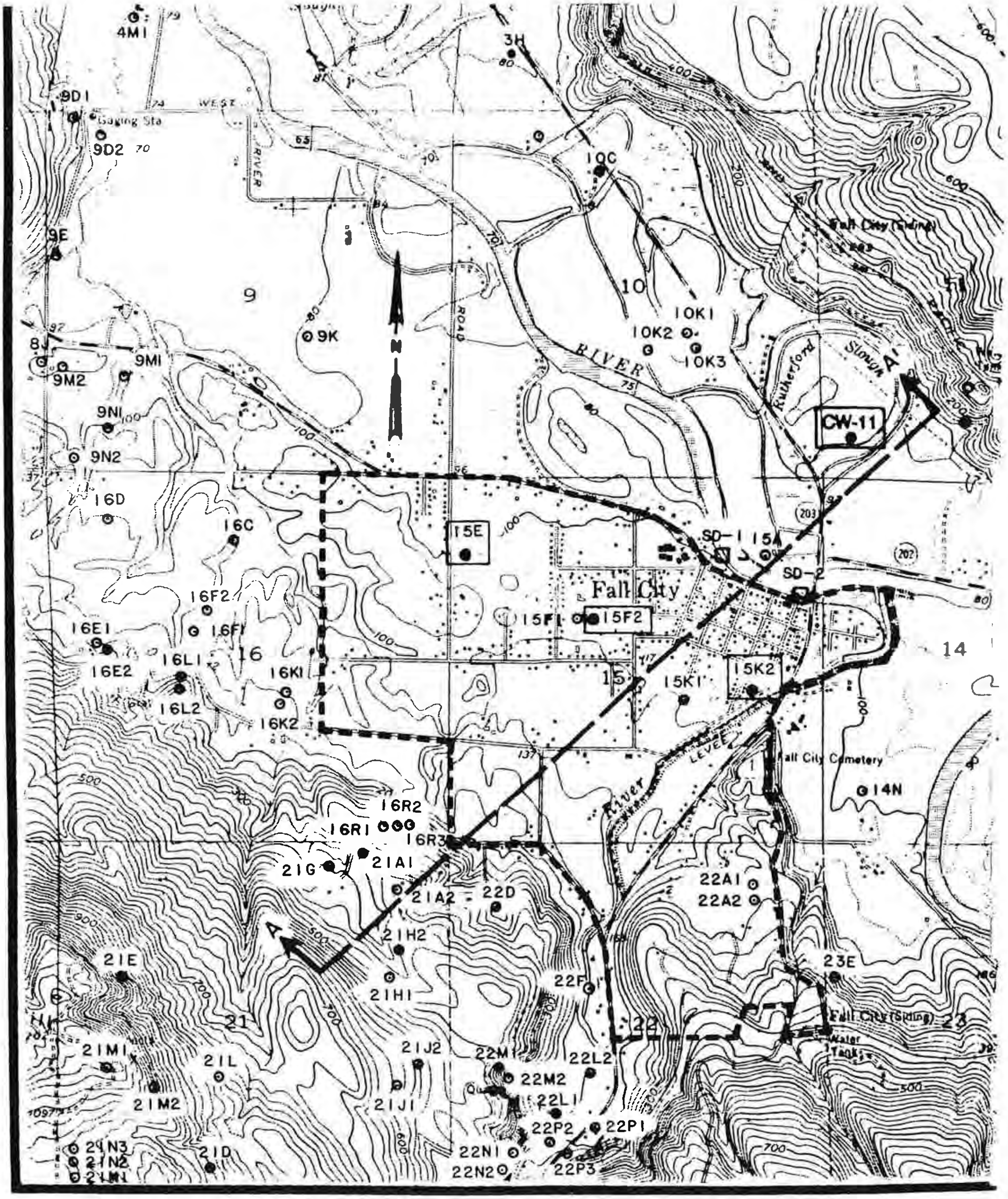
VERTICAL 1" = 100'

FALL CITY

FALL CITY AREA GROUNDWATER

FIGURE V-1

R.W. BECK AND ASSOCIATES



SCALE 1:24000

LEGEND

15A	WELL NUMBER
⊙	WELL LOCATION
▬ ▬ ▬	STUDY AREA BOUNDARY
	HYDROGEOLOGIC CROSS SECTION LOCATION (SEE FIGURE V-1)
SD-1	STORM DRAIN DESIGNATION
□	STORM DRAIN LOCATION
	WELLS SAMPLED FOR WATER QUALITY

FALL CITY

GROUNDWATER QUALIT SAMPLING WELLS

FIGURE V-2

R.W. BECK AND ASSOCIATES

APPENDIX C

EXCERPTS FROM CH2M HILL REPORT

Introduction

This engineering report describes the wastewater treatment and disposal facilities proposed for the Fall City Landing Development planned for Fall City. The report is organized in the format specified in Chapter 173-240 WAC.

Sewer Plan Elements (WAC 173-240-060 (1))

Fall City Landing, located on a six acre site immediately adjacent to the confluence of the Snoqualmie and Raging Rivers, will include a get-away inn, complete with guest rooms, a restaurant, meeting rooms, a spa, and possibly related items. This development will have its own independent on-site sewage disposal system because there is no sanitary sewage service available in Fall City. Thus, the elements of the sewer plan do not apply. A site plan showing the property location and approximate locations of wastewater infrastructure is included as Figure 1.

Additional Required Data (WAC 173-240-060 (3))

a) Name, address, and telephone number of Owner

South I-90 Limited Partnership (dba Fall City Landing)
General Partner, I-90 South, Inc. (dba Fall City Country Inn)
J. Thomas Bernard, President
8150 304th Ave. SE
Preston, WA 98050

Telephone: 425/222-7974
Fax: 425/222-7970
Email: BernardDev@aol.com

In the future, plans are to officially change the name of this ownership TO FALL CITY LANDING LIMITED PARTNERSHIP.
General Partner: FALL CITY COUNTY INN, INC.

b) Project description, location map, and service area map

See Figure 1 for the location map of the site. There is no service area, outside the property boundary.

c) Wastewater quantity and quality estimate

Tables 1 and 2 show estimates of the peak wastewater quality and quantity, respectively, based on the maximum estimated capacity of the Fall City Landing infrastructure. Fall City County Inn generated use estimates. From the use estimates and unit wasteflow factors from the EPA publication **Design Manual – Onsite Wastewater Treatment and Disposal Systems EPA 625/1-80-012**, both typical and maximum expected unit flows were generated. These values are from studies conducted in the 1970s. Due to the increasing use of water conservation devices, the hydraulic loadings may already be conservative. Based on this approach, the estimated typical and potential maximum flows are 10,762 and 13,610 gallons per day, respectively. A 40 percent contingency was applied to these values, due to uncertainty, yielding adjusted typical and potential maximum flows of 15,067 and 19,054 gallons per day, respectively.

The treatment plant has a design flow of 20,000 gallons per day, with a typical waste strength of 250 mg/l BOD. The design organic capacity of the system is 42 lb/day. Normal flows are anticipated to be much lower than 20,000 gallons per day. The capacity of the treatment plant can treat 14,400 gallons per day at a concentration of 350 mg/l BOD.

TABLE 1 – WASTELOAD AND FLOW ESTIMATES

Note: The occupancy levels and restaurant assumptions shown are peak-predicted levels. Typical loadings are predicted to be significantly lower than those shown.

Wastewater Flow							
			Range			Typical	Top of Range
	# units	Unit	Min	Max	Typical	Daily Rate (gpd)	Daily Rate (gpd)
Main Inn	36	Rooms	39.6	58	50.1	1804	2088
Back Inn	28	Rooms	39.6	58	50.1	1403	1624
Bridge Inn	8	Rooms	39.6	58	50.1	401	464
Cottages	10	Rooms	39.6	58	50.1	501	580
Coffee Shop	100	Customers	4	7.9	5.3	530	790
Restaurant	200	Meals	2.1	4	2.6	520	800
Meeting Rooms	100	Meals	10.6	21.1	15.9	1590	2110
Cabaret	100	Meals	2.1	4	2.6	260	400
Spa (swimming pool)	50	Customers	5.3	13.2	10.6	530	660
Store	60	Customers	1.3	5.3	2.6	156	318
Laundromat	3	Machines	476	687	581	1743	2061
Visitor Center	50	Visitors	4	7.9	5.3	265	395
Employees	100	Employees	7.9	13.2	10.6	1060	1320
					Totals	10762	13610
					Add 40 % Contingency	4305	5444
					Total w/ Contingency	15067	19054
						Use	20000

Data Source for Unit Wasteload Estimates: **Design Manual – Onsite Wastewater Treatment and Disposal Systems EPA 625/1-80-012.**

TABLE 2 – WASTE STRENGTH ESTIMATES
See Table 1 for Flow Estimates

1. Assume medium strength (with contingency and at high unit flows)

From Metcalf and Eddy, Third Edition, Table 3-16, page 109

				Design lb/day	
Medium Strength	BOD	220	mg/l	34.98	lb/day
	TSS	220	mg/l	34.98	lb/day

2. Assume high strength (without contingency and at typical unit flows)

				Design lb/day	
High Strength	BOD	400	mg/l	35.92	lb/day
	TSS	350	mg/l	31.43	lb/day

Use maximum value from above, with 10% contingency

	BOD	40	lb/day
	TSS	38	lb/day
Assume	TKN	6.7	lb/day (40 mg/l)

d) Degree of treatment required

Since this plant is not designed to reclaim wastewater, there are no precise limits for the treatment of this waste. Groundwater quality standards per WAC 173 200 prevail, and monitoring wells will be installed to measure upgradient and downgradient groundwater quality.

Also, all known, reasonable, and available treatment technologies will be used. Although not a reclamation project, the treatment standards applicable to Fall City Landing are assumed to be similar to California Title 22 standards, used for reclamation plants in the State of California.

Treatment will consist of pretreatment of the restaurant and laundry wastes, equalization and temperature equilibration, secondary treatment, including nitrification and de-nitrification for nitrogen removal, tertiary filtration, and ozone disinfection. Overall treatment efficiency levels are targeted to exceed 90 percent BOD and TSS removal. The system is designed to achieve a significant amount of nitrification and denitrification, and thus achieve removal of total nitrogen. Fecal coliforms are targeted to be less than 2.2 organisms per 100 milliliters.

e) Receiving water description

The treated wastewater will be discharged to a subsurface infiltration system.

f) Type of treatment process proposed, including a discussion of alternatives evaluated and why they are unacceptable

Municipal sewers are unavailable in Fall City, necessitating the use of an on-site treatment system. A traditional septic system and conventional drain field was also ruled out, since the on-site soils are not conducive to allowing this alternative. Mechanical treatment was selected in order to provide a level of treatment that would meet Ecology's anticipated requirements to allow rapid infiltration to subsurface soils.

Given the size of the system, a packaged treatment system was preferred over a custom-built system to achieve cost economies and to obtain a proven system concept. After an exhaustive review of available alternatives, the Intermittent-Cycle, Extended-Aeration System (ICEAS) system was selected over competing technologies, such as a standard single tank sequencing batch reactor (SBR), rotating biological contactors (RBC's), and other commercially available technologies. The ICEAS technology is termed Biopure®, and is represented locally by Environmental Concerns, Inc. in Issaquah. The Biopure® system has the following advantages:

- Over 404 installations throughout the United States
- Local sales and technical support
- Proven in very similar situations
- Proven ability and operating experience in meeting California Title 22 standards
- Inherent ability to achieve nitrification and denitrfication
- Ozone will be used to meet disinfection standards, avoiding chemical handling and increase in effluent total dissolved solids (TDS)
- The system will be designed for minimal operator attention during normal operation
- Controls will be automatic
- Batch process concept will prevent effluent quality impairment due to hydraulic flow rate surges

A technical description and data for the Biopure® system is included in Appendix A.

g) Basic design data and sizing calculations of the treatment works. Expected efficiencies of each unit and the character of effluent anticipated.

The Biopure 200-EOF treatment system will consist of the following unit processes:

Emergency Generator. An emergency generator and switchgear will be installed to maintain treatment system operation in the event of power failure.

Equalization (buffer) Tank: Capacity 20,000 gallons (24 hours of retention time at design flows). This tank will also provide an emergency reserve capacity(4,662 gallons of reserve capacity of the aeration chamber) of 24,662 gallons, or approximately 125 percent of the design flow. The contents of the tank will be aerated, to equalize and mix, keep suspended solids in suspension, and allow some pretreatment. The capability to pump from this tank to a truck will be maintained. A coarse screen will prevent any oversized objects present in the sewage from entering the tank. A back-up electrical generator will be installed sufficient to allow continued operation of vital components in the event of power failure.

Aeration Tank: Dimensions: 9 foot diameter by 34 feet long. Normal (design) volume is approximately 12,000 gallons, allowing an average retention time of 14 hours at design flow rates. The system has a reserve volume of 4,662 gallons. Normal MLSS concentration ranges from 3,000 to 6,000 mg/l. A medium screen will be installed on the influent to the aeration tank to prevent large solids present in the sewage from entering the tank.

Aeration Blowers: There will be a 5 hp Gast Regenair regenerative blower installed for the aeration basin. This is capable of delivering 125 cfm at 3 psig backpressure. A second blower will be installed to aerate and mix the contents of the buffer tank. A coarse bubble diffuser system will distribute the air in the aeration and buffer tanks. This amount of air should be adequate to meet the carbonaceous and nitrogenous demand of the wastewater.

Secondary Clarifier: Dimensions: 10-foot diameter by 10 feet 10 inches high. Volume is approximately 6,300 gallons. Clarification time will range from 60 to 70 minutes at design conditions. Equivalent surface overflow rate on a design influent loading basis is 250 gallons per day per square foot. After 60 minutes of clarification, 33 percent of the contents of the clarifier, the supernatant, is transferred to the ozone contact chamber. The remaining 66 percent of the contents of the clarifier is returned to the aeration chamber for recycling.

The BioPure® system recycles approximately two thirds of the settled mixed liquor from the clarifier back to the aeration basin after each settling cycle. The remaining third will be discharged to the ozone contact chamber.

Process control for wasting excess biosolids is by a 1 liter 60 minute settled sludge volume (SSV-60) test. Frequency wasting rate will be based on experience, and may vary over time. Normal wasting rates at other operating facilities is 5 percent of the sludge inventory or about once per month.

Ozone contact chamber: Dimensions: 6 foot diameter by 8 feet 11 inches high. The dosage of ozone at design production rates will be 40 grams per hour, which is half of the design capacity of ozone generation. The ozone contact time will be 40 minutes, twice as much as required to achieve the target of 2.2 colonies per 100 milliliters assumed for the final effluent. A fine screen will be installed on the influent to the tank to prevent any undegraded material present in the clarifier supernatant from entering the contact chamber.

Final filters: Dual multimedia pressure filters, each 36-inch diameter, will be used for tertiary polishing of the ozonated effluent. Five different types of media will be used in the filters to achieve extended filter runs. During normal operation, both will be operational. The surface loading will be 2.5 gpm/ft^2. The filters will normally treat a 1,371 gallon batch before shutting down and waiting for the next batch to be ozonated.

Backwash will occur for each filter once every 24 hours. No external source of water is required for backwash, as the filtered water from the other unit will be used. The filtered effluent will be discharged directly to the rapid infiltration system, with the solids contained in the backwash returned to the aeration chamber or to the buffer tank.

Character of Effluent Quality Anticipated:

BOD_5: less than 10 mg/l

TSS: less than 10 mg/l

Total and nitrate nitrogen: less than 10 mg/l

Fecal coliforms: less than 2.2 colonies/100 mls

This level of effluent quality is achieved at similar installations in California and is warranted by Biopure®.

h) Discussion of the various sites available and advantages and disadvantages of the sites recommended.

As shown on Figure 1, the treatment facility will be located on the 6-acre site. The selected location will allow for easy access for servicing and residuals removal.

i) Flow diagram and a hydraulic profile of the system

Figure 2 shows the overall flow diagram for the complete system. Figure 3 shows the flow diagram for the package treatment plant components.

j) A discussion of infiltration and inflow problems, overflows, and bypasses, and proposed corrections and controls

The sewers to be installed at Fall City Landing will be completely new and will be designed to prevent any groundwater leakage (infiltration). All stormwater plumbing will be kept separate from sanitary sewers. No stormwater (inflow) will be admitted into the wastewater treatment system.

k) A discussion of special provisions for industrial wastes

There will be no industrial wastes introduced to this facility. However, special provisions have been incorporated into the system to handle the specific nuances of the wastes anticipated for this facility. These include separate grease traps located at the discharge of both the laundry and the kitchen discharges. Separate grease traps will minimize the potential for overloading a) an individual grease trap and b) emulsification of the collected grease in the trap, avoiding a potential carryover into the biological treatment process.

A 20,000-gallon aerated equalization tank will be installed in front of the Biopure® treatment process. This tank will serve to equalize the feed to the Biopure® treatment system and in particular will dampen the impact of high or variable temperatures. Aeration will also result in a certain amount of pretreatment..

l) Detailed outfall analysis

Since there is no direct discharge to surface water, a detailed outfall analysis has not been completed.

m) A discussion of the method of final sludge disposal and any alternatives considered

A contract to dispose of excess sludge will be negotiated with a licensed septage hauling company. The ultimate fate of the excess biosolids from this facility will likely be the King County sewerage system.

n) Provision for future needs

Fall City Landing does not anticipate expansion of this facility beyond what is described in this engineering report, so no expansion capabilities are built into the system. If unexpectedly high organics wasteloads from the restaurant or laundry are present that cannot be controlled through operational changes, the provisions to install a Nibbler® will be incorporated into the final layout of the facility. The Nibbler® will not be installed initially. Details of the Nibbler®, which has been used extensively for on-site systems, are provided in Appendix B.

o) Staffing and testing requirements for the facilities

Environmental Concerns, Inc estimates that a licensed operator will be on hand for one to two hours per day Monday through Friday for approximately the first 6 months of operation. This will allow tuning and adjustments to be made to system performance, and sampling of the influent and effluent.

Following this start-up period, normal operator attention will be approximately two days per week. On-site maintenance staff will be on-site on a regular basis and will monitor and respond to alarms from the wastewater treatment. Critical spare parts will be stocked. Replacement of major mechanical and electrical components can be accomplished in less than 1 hour.

Testing of the SSV-60 will be performed and sludge wasting scheduled if necessary. Screens will be cleaned at least once per month and more frequently if required. The grease traps and wastewater treatment components will be inspected weekly. Preventative maintenance will be carried out in accordance with manufacturer's instructions.

Compliance samples will be obtained and sent to a certified laboratory on the schedule required by the waste discharge permit.

p) An estimate of the costs and expenses of the proposed facilities and the method of assessing costs and expenses

This will be a privately owned and operated facility. Fall City Landing has sufficient financial resources to fund the capital and operating costs of the facility.

q) A statement regarding compliance with any applicable state or local water quality management plan

Through the Department of Ecology granting a State Waste Discharge Permit, this facility will comply with applicable state or local water quality management plans

r) A statement regarding compliance with NEPA and SEPA, if applicable

NEPA does not apply to this project. If necessary, a SEPA environmental checklist for Wastewater Facilities Construction will be submitted.

3. Additional Required Data for Subsurface Disposal of Treated Effluent (WAC 173-240-060 (4)

a) Soils and their permeability

Surface soil at the site identified in the soil survey for King County (USDA Soil Conservation Service, 1973) is the Puyallup fine sandy loam (symbol Py). This soil ranges from fine sandy loam to very fine sandy loam and silty loam. Permeability is moderately rapid, runoff is slow, and the seasonal water table is at a depth of 4 to 5 feet. Permeability of a fine sandy loam ranges from 10^{-3} to 10^{-5} cm/sec. Available water capacity is moderately high.

Native soils at the site are overlain by variable amounts of fill soil. The fill thickness ranges from about 3 to 9 feet over the site. Fill soil consists of silty fine to medium sand with gravel. The fill is medium dense to dense and permeability is somewhat variable.

b) Geohydrologic Factors

i) Groundwater

Geology

The site is situated in the alluvial valley of the Snoqualmie River. It is underlain by Quaternary alluvium (Holocene) that consists of moderately sorted cobble gravel to pebbly sand (Surficial Geologic Map of the Skykomish and Snoqualmie Rivers Area, Snohomish and King Counties, Washington. USGS MI Map I-1745, D.Booth, 1990). This unit shows gradational characteristics consistent with Quaternary alluvial fan deposits that crop out about 1/8 mile west and southwest of the site. The origin of the alluvial fan deposit south and west of the site is the steep side-stream valley currently occupied by the Raging River. The alluvial deposits extend northwest and southeast of the site greater than one mile from the site. Within one mile of the site to the northeast and southwest, deposits of the Vashon glaciation cover the valley sidewalls. Glacial till and ice contact units are northeast of the site. Southwest of the site are both fine-grained and gravelly recessional deposits. Pleistocene transitional beds, pre- and early-Vashon age silt and clay deposits, are exposed in the slope approximately 1 mile southeast of the site.

Site geology and hydrogeology were characterized by completing 11 test pit explorations on March 17, 1997, and installing three monitoring wells on November 13, 1997. Test pit depths ranged from 10 to 17.5 feet below the ground surface. The depths of the borings ranged from 25 to 26 feet below the ground surface. Copies of the boring logs, monitoring well construction diagrams, and test pit logs are in Appendix C. Well and test pit locations are shown on Figure 1.

As mentioned above, the upper 3 to 9 feet at the site consists of silty sand fill material. A former topsoil horizon was noted in some of the test pits below the fill. Native sand and gravel with cobbles (alluvial fan materials referenced above) were encountered below the fill horizon at the west end of the site at a depth of between 3 and 9 feet below ground. Below the central and eastern portions of the site, a unit of interlayered silty sand and silt is present below the fill horizon and above the sand and gravel layer. Depths to the sand and gravel layer range from approximately 10 to 17 feet below ground.

Area Groundwater Use

Well logs for wells located within a one-mile radius have been obtained from Department of Ecology records and are included as Appendix D. Over 50 well logs were reviewed. The majority of these wells are completed at depths greater than 100 feet. Because of the proximity of the site to the Snoqualmie River, no wells exist immediately downgradient of the site. None of the wells are located upgradient of the site within ¼ mile. The closest wells screened within a similar depth interval are located across the Raging River to the east. Figure 4 is a USGS topographic map of the site and surrounding area.

A door-to-door survey was conducted by Bernard Development Company October 10, 1998, to look for wells located in the site vicinity. The area surveyed is bordered by the Raging River on the east, the Snoqualmie River on the north, and the Preston-Fall City Road on the south and west. Residences and businesses in the area currently are served by the Fall City Water District. Twenty-five homes were visited and the owners of the Fall City Mobile Home Park were contacted. Sixteen residents and the mobile home park owners were contacted directly and indicated there were no wells at their homes or elsewhere in the neighborhood. Letters were left at ten homes requesting the owners to contact Bernard Development Company if they were aware of any wells. One resident, Mr. Bob Jones, indicated that two wells previously were located on 340th Street just south of the site. One well was a shallow, dug well that Mr. Jones helped dig. A garage was built over the well, and the current owner, Mr. Dick Widen, is not aware of there ever having been a well on his property. The well apparently is not being used. The second "well" was a steel drive point that is no longer operable.

Bernard Development also contacted the Fall City Water District and reviewed local water rights and the wellhead influence and protection areas for the District's wells. None of the water rights are wells located within ¼ mile of the site; however, the location of two of the rights for wells could not be confirmed. The rights with uncertain locations are owned by D.W. Baird (irrigation use) and Harvey Koeplin (general domestic and stock watering use). The areas of influence for the six Fall City Water District wells are either across the Snoqualmie River from the site or south and west of the site in upland areas.

Groundwater Occurrence and Movement
Groundwater generally is encountered in the zones of higher permeability beneath the site. Seepage was noted in the test pits at the contact between the silty sand/silt unit and the underlying sand and gravel unit. Depths to groundwater ranged from 3 to 13 feet below ground in the test pits; however, some of the test pits did not encounter groundwater above a depth of 17 feet. The groundwater monitoring wells were completed with the screened interval in the water-bearing sand and gravel unit. The bottom of this unit was not encountered in the monitoring well borings. (Boring and monitoring well depths were determined by limitations of the drilling equipment.) The minimum thickness of the sand and gravel unit is 16 feet in MW1, and 12 feet in MW2 and MW3.

Groundwater elevations measured in the three monitoring wells indicate that the groundwater gradient is relatively flat and groundwater flow is toward the Snoqualmie River. A comparison of four sets of groundwater elevation measurements to the river level elevation indicate that groundwater is in hydraulic communication with the river and elevations fluctuate with the river level. Groundwater elevations measured in the wells are presented in Table 3. Groundwater elevations and the groundwater flow direction for November 1997, and September and October 1998 are shown in Figures 5, 6, and 7, respectively.

Hydraulic conductivity (K) was estimated by conducting single well slug tests in each of the monitoring wells. Two or three replicate rising head tests were conducted in each well. The Bouwer and Rice solution was applied to the data using AQTESOLV for Windows. Hydraulic conductivity averages 2.05×10^{-2} cm/sec for the site and ranges from 2.88×10^{-3} cm/sec to 3.18×10^{-2} cm/sec. Based on these estimated K values and a hydraulic gradient (i) of 0.003 based on elevation measurements, average linear groundwater flow velocity is estimated to be approximately 2×10^{-4} cm/s or 0.58 ft/day (based on $V = Ki/n$, where n (porosity) = 0.25).

Groundwater Quality
Initial groundwater samples were collected from each of the three monitoring wells (MW-1, MW-2, MW-3) on November 25, 1997 and submitted for laboratory analysis to Analytical Resources, Inc. in Seattle, Washington. The samples were analyzed for the parameters outlined in the *Application for a Wastewater Permit for Discharge of Municipal Wastewater to Groundwater,* Section D. The parameters and the analysis results are presented in Table 4.Bernard Development has implemented a groundwater monitoring program at the site to gather background water quality data. Groundwater samples from the three existing monitoring wells will be obtained monthly for 1 year beginning in September 1998. The samples will be analyzed for nitrate/nitrite, ammonia, total phosphorus, total coliform, and specific conductance. Field parameters of pH, electrical conductivity, dissolved oxygen, temperature, and turbidity also are collected. The data will be used to establish site groundwater compliance monitoring values.

Table 3
Depths to Water and Groundwater Elevations

Station	MW1		MW2		MW3		Snoqualmie River	
Ground Elevation (feet NGVD)	99.10		95.37		95.45		NA	
Measuring Point Elevation (feet NGVD)	101.57		98.13		98.32		110.82	
Date	Depth to Water (feet)	Groundwater Elevation (feet NGVD)	Depth to Water (feet)	Groundwater Elevation (feet NGVD)	Depth to Water (feet)	Groundwater Elevation (feet NGVD)	Depth to Water (feet)	Water Surface Elevation (feet NGVD)
Nov. 20, 1997	22.37	79.20	19.16	78.97	18.85	79.47	33.69	77.13
Nov. 25, 1997	20.87	80.70	17.88	80.25	17.57	80.75	32.25	78.57
Sept. 3, 1998	24.62	76.95	22.15	75.98	21.98	76.34	35.85	74.97
Oct. 8, 1998	24.68	76.89	21.78	76.35	21.64	76.68	35.50	75.32

Data from the November 1997 and September 1998 sampling are presented in Tables 4 and 5. Table 4 includes results for all parameters tested in November 1997. Table 5 includes results from both the November 1997 and September 1998 sampling for the field parameters and 5 parameters listed above for background water quality monitoring. Both tables include the Ground Water Quality Standards (WAC 173-200) for comparison.

ii) Water balance analysis of the proposed discharge area

Treated effluent will be discharged to groundwater by rapid infiltration through the unsaturated zone. To evaluate whether the proposed discharge area will be able to accommodate the discharge volume without surface flooding, predicted groundwater mounding effects were calculated following a model developed by Hantush (1967). Parameters obtained during the site hydrogeologic investigation were input into the model. Some parameters had to be estimated because data were incomplete or unavailable. The depth to the first aquitard beneath the site was not explored and wet season water levels have not yet been obtained. A "worst-case" scenario was devised using the most conservative estimates of uncertain parameters combined with the known site parameters.

Native materials that comprise the unsaturated zone consist of coarse sand and gravel deposited by the Snoqualmie and Raging Rivers. The permeabilty of the native materials in the saturated zone is estimated to be 2.05×10^{-2} cm/sec or 129 gpd/ft^2. Non-native fill material in the unsaturated zone consists of silt and silty sand that has a lower permeability than the native alluvial deposits. This material will be removed and replaced with a material similar to the native material. Because disposal will involve rapid inflitration, the permeability of the replacement material should be similar or greater than the natural permeability. Based on this assumption, the permeability measured for the saturated zone is used for the entire discharge area.

To estimate the transmissivity of the aquifer required for the model, the thickness of the saturated zone is needed. The deepest geologic explorations completed for this project reached 26 feet below ground surface. An aquitard was not encountered in any of the explorations below the surface fill material. For the mound modeling, it is assumed that an aquitard is present 26 feet below ground. This value is very conservative since the underlying geology of the site is known to be an alluvial deposit underlain by coarse glacial deposits. This indicates it is likely that the first aquitard of any significance is much deeper than 26 feet below ground. The upper boundary of the saturated zone is the depth to water in the season of highest water levels. Water level measurements from the site have been obtained in September, October, and November. Water table elevations range from 1 to 2 feet below the Snoqualmie River elevation, measured at the SR 202 bridge. The elevation of the ordinary high water mark surveyed by Eastside Consultants nearest the bridge is 83.4 feet NGVD. The ground surface elevation at the proposed infiltration area is about 96 feet (see Plate 1) and the expected high groundwater elevation is 82.4 feet. This corresponds to a water depth of 13.6 feet below ground surface, rounded up (conservatively) to 13 feet, and an aquifer thickness of 13 feet. The transmissivity is 1,677 gpd/ft.

The specific yield is estimated to be 0.15, which is the lowest value for an unconfined aquifer consisting of sand and gravel (Driscoll, 1986). The estimated discharge used is 20,000 gpd. As stated above, section (3) c), this is the design flow and conservative

Table 4 (page 1 of 3)
Groundwater Quality Data, November 1997
Monitoring Well No. 1

SAMPLE NUMBER	COMPOUND	RESULT	UNITS	WQ CRITERIA
FCL-MW-1	Barium	0.005	mg/L	2.0 mg/L
FCL-MW-1	Cadmium	0.002	mg/L	0.005 mg/L
FCL-MW-1	Calcium	8.90	mg/L	
FCL-MW-1	Chromium	0.005	mg/L	0.1 mg/L
FCL-MW-1	Copper	0.002	mg/L	1.0 mg/L
FCL-MW-1	Iron	0.06	mg/L	0.30 mg/L
FCL-MW-1	Lead	0.02	mg/L	0.015 mg/L
FCL-MW-1	Magnesium	2.57	mg/L	
FCL-MW-1	Manganese	0.057	mg/L	0.05 mg/L
FCL-MW-1	Mercury	0.0001	mg/L	0.002 mg/L
FCL-MW-1	Potassium	1.0	mg/L	
FCL-MW-1	Selenium	0.05	mg/L	0.05 mg/L
FCL-MW-1	Silver	0.003	mg/L	0.1 mg/L
FCL-MW-1	Sodium	6.99	mg/L	
FCL-MW-1	Zinc	0.004	mg/L	5 mg/L
FCL-MW-1	Hardness (by Calculation)	33	mg/L CaCO3	
FCL-MW-1	Conductivity	99	umhos/cm	700 umhos/cm
FCL-MW-1	Total Dissolved Solids	80	mg/L	500
FCL-MW-1	Total Suspended Solids	1.9	mg/L	
FCL-MW-1	Fluoride	0.30	mg/L	2.0 mg/L
FCL-MW-1	Chloride	3.1	mg/L	250 mg/L
FCL-MW-1	N-Ammonia	<0.010	mg-N/L	
FCL-MW-1	Nitrate + Nitrite (NO2+NO3)	0.83	mg-N/L	10 mg/L
FCL-MW-1	Total Kjeldahl Nitrogen	<0.25	mg-N/L	
FCL-MW-1	Total Phosphorous	<0.016	mg-P/L	
FCL-MW-1	Ortho-Phosphorous	<0.004	mg-P/L	
FCL-MW-1	Sulfate	5.4	mg/L	
FCL-MW-1	Chemical Oxygen Demand	<5.0	mg/L	
FCL-MW-1	Biological Oxygen Demand	<1	mg/L	
FCL-MW-1	Total Organic Carbon	<1.5	mg/L	
FCL-MW-1	Total Oil & Grease	<1.0	mg/L	
FCL-MW-1	Total Coliform	<2	CFU/100 mL	1
FCL-MW-1	Fecal Coliform	<2	CFU/100 mL	

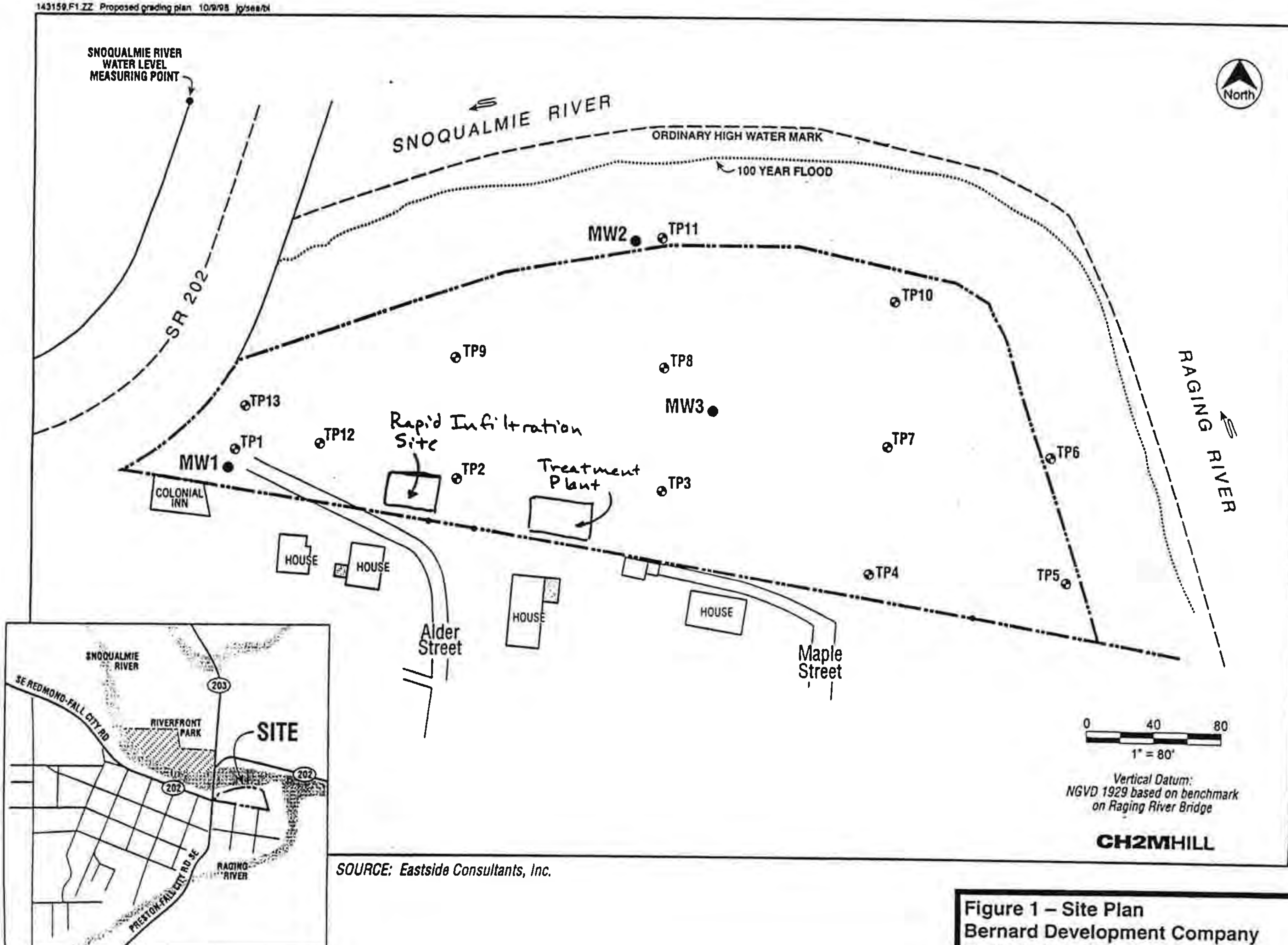
Table 4 (page 2 of 3)
Groundwater Quality Data, November 1997
Monitoring Well No. 2

SAMPLE NUMBER	COMPOUND	RESULT	UNITS	WQ CRITERIA
FCL-MW-2	Barium	0.022	mg/L	2.0 mg/L
FCL-MW-2	Cadmium	0.002	mg/L	0.005 mg/L
FCL-MW-2	Calcium	21.9	mg/L	
FCL-MW-2	Chromium	0.005	mg/L	0.1 mg/L
FCL-MW-2	Copper	0.002	mg/L	1.0 mg/L
FCL-MW-2	Iron	7.92	mg/L	0.30 mg/L
FCL-MW-2	Lead	0.02	mg/L	0.015 mg/L
FCL-MW-2	Magnesium	5.54	mg/L	
FCL-MW-2	Manganese	0.630	mg/L	0.05 mg/L
FCL-MW-2	Mercury	0.0001	mg/L	0.002 mg/L
FCL-MW-2	Potassium	7.9	mg/L	
FCL-MW-2	Selenium	0.05	mg/L	0.05 mg/L
FCL-MW-2	Silver	0.003	mg/L	0.1 mg/L
FCL-MW-2	Sodium	48.4	mg/L	
FCL-MW-2	Zinc	0.005	mg/L	5 mg/L
FCL-MW-2	Hardness (by Calculation)	78	mg/L CaCO3	
FCL-MW-2	Conductivity	400	umhos/cm	700 umhos/cm
FCL-MW-2	Total Dissolved Solids	240	mg/L	500
FCL-MW-2	Total Suspended Solids	22	mg/L	
FCL-MW-2	Fluoride	0.48	mg/L	2.0 mg/L
FCL-MW-2	Chloride	27	mg/L	250 mg/L
FCL-MW-2	N-Ammonia	5.1	mg-N/L	
FCL-MW-2	Nitrate + Nitrite (NO2+NO3)	0.35	mg-N/L	10 mg/L
FCL-MW-2	Total Kjeldahl Nitrogen	4.4	mg-N/L	
FCL-MW-2	Total Phosphorous	3.6	mg-P/L	
FCL-MW-2	Ortho-Phosphorous	2.7	mg-P/L	
FCL-MW-2	Sulfate	4.9	mg/L	
FCL-MW-2	Chemical Oxygen Demand	13	mg/L	
FCL-MW-2	Biological Oxygen Demand	4	mg/L	
FCL-MW-2	Total Organic Carbon	4.7	mg/L	
FCL-MW-2	Total Oil & Grease	<1.0	mg/L	
FCL-MW-2	Total Coliform	1,100	CFU/100 mL	1
FCL-MW-2	Fecal Coliform	340	CFU/100 mL	

Table 4 (page 3 of 3)
Groundwater Quality Data, November 1997
Monitoring Well No. 3

SAMPLE NUMBER	COMPOUND	RESULT	UNITS	WQ CRITERIA
FCL-MW-3	Barium	0.006	mg/L	2.0 mg/L
FCL-MW-3	Cadmium	0.002	mg/L	0.005 mg/L
FCL-MW-3	Calcium	6.33	mg/L	
FCL-MW-3	Chromium	0.005	mg/L	0.1 mg/L
FCL-MW-3	Copper	0.002	mg/L	1.0 mg/L
FCL-MW-3	Iron	0.35	mg/L	0.30 mg/L
FCL-MW-3	Lead	0.02	mg/L	0.015 mg/L
FCL-MW-3	Magnesium	1.96	mg/L	
FCL-MW-3	Manganese	0.073	mg/L	0.05 mg/L
FCL-MW-3	Mercury	0.0001	mg/L	0.002 mg/L
FCL-MW-3	Potassium	0.7	mg/L	
FCL-MW-3	Selenium	0.05	mg/L	0.05 mg/L
FCL-MW-3	Silver	0.003	mg/L	0.1 mg/L
FCL-MW-3	Sodium	5.15	mg/L	
FCL-MW-3	Zinc	0.004	mg/L	5 mg/L
FCL-MW-3	Hardness (by Calculation)	24	mg/L CaCO3	
FCL-MW-3	Conductivity	74	umhos/cm	700 umhos/cm
FCL-MW-3	Total Dissolved Solids	67	mg/L	500
FCL-MW-3	Total Suspended Solids	2.5	mg/L	
FCL-MW-3	Fluoride	0.32	mg/L	2.0 mg/L
FCL-MW-3	Chloride	3.8	mg/L	250 mg/L
FCL-MW-3	N-Ammonia	0.13	mg-N/L	
FCL-MW-3	Nitrate + Nitrite (NO2+NO3)	0.53	mg-N/L	10 mg/L
FCL-MW-3	Total Kjeldahl Nitrogen	<0.25	mg-N/L	
FCL-MW-3	Total Phosphorous	<0.016	mg-P/L	
FCL-MW-3	Ortho-Phosphorous	<0.004	mg-P/L	
FCL-MW-3	Sulfate	3.2	mg/L	
FCL-MW-3	Chemical Oxygen Demand	<5.0	mg/L	
FCL-MW-3	Biological Oxygen Demand	<1	mg/L	
FCL-MW-3	Total Organic Carbon	<1.5	mg/L	
FCL-MW-3	Total Oil & Grease	<1.0	mg/L	
FCL-MW-3	Total Coliform	<2	CFU/100 mL	1
FCL-MW-3	Fecal Coliform	<2	CFU/100 mL	

143159.F1.ZZ Proposed grading plan 10/9/98 jg/sea/bl



SOURCE: Eastside Consultants, Inc.

Figure 1 – Site Plan
Bernard Development Company
Fall City Landing

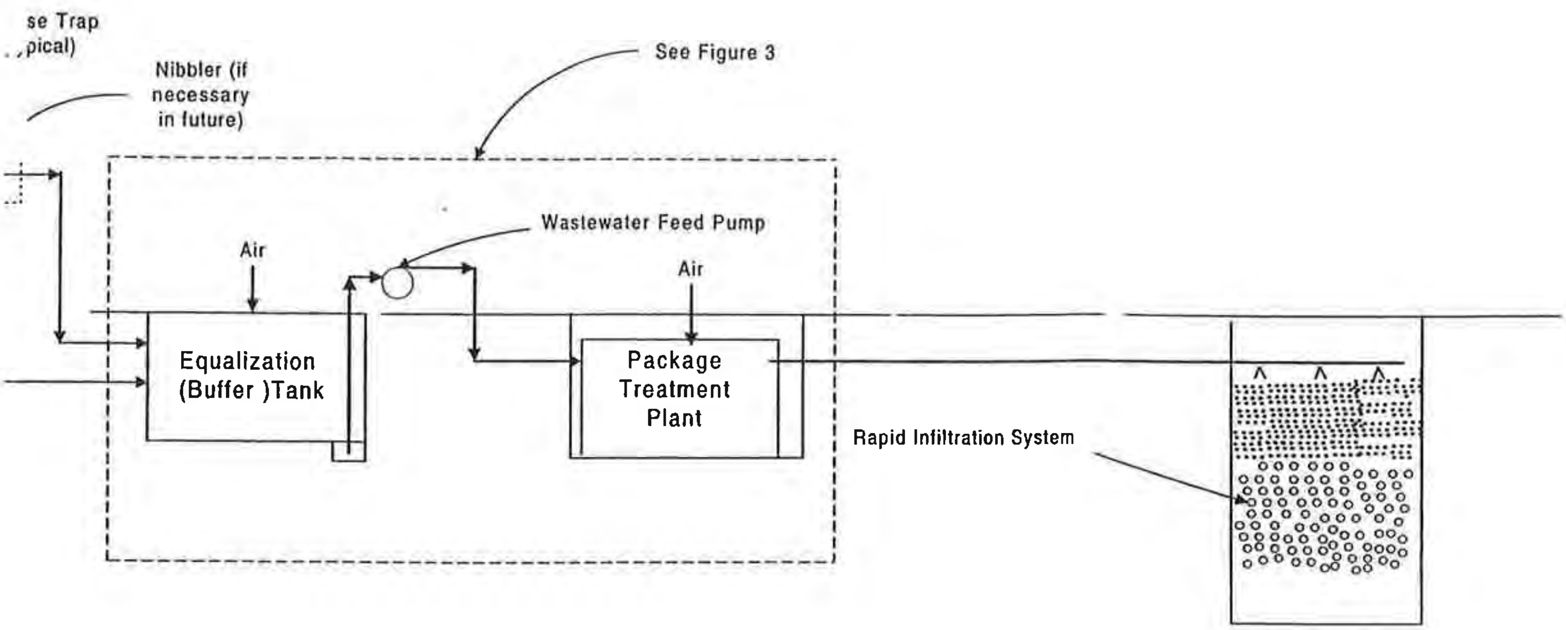


Figure 2 – Overall Wastewater Management System
Bernard Development Company
Fall City Landing

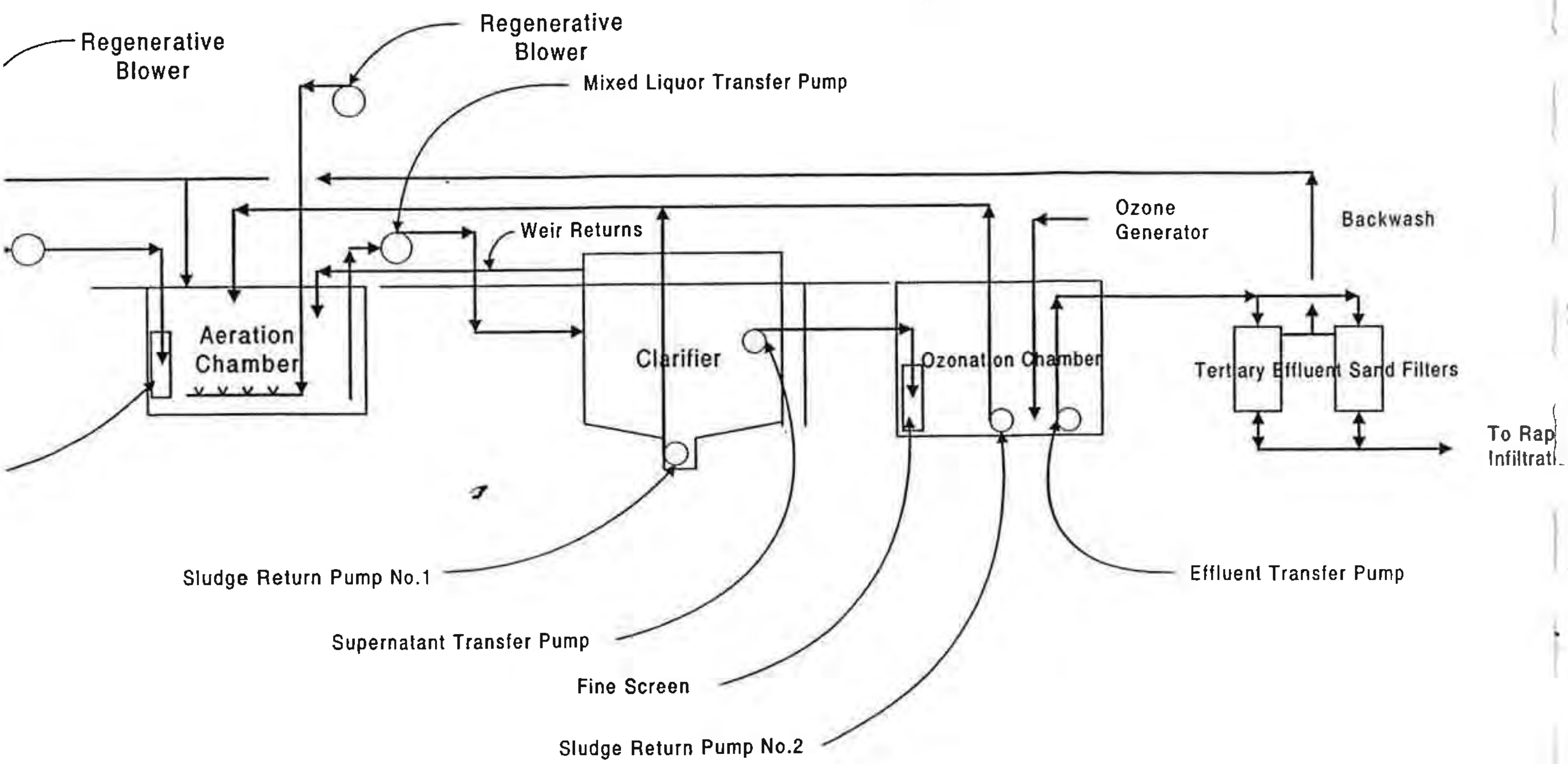


Figure 3 – Flow Diagram, BioPure Package Plant
Bernard Development Company
Fall City Landing

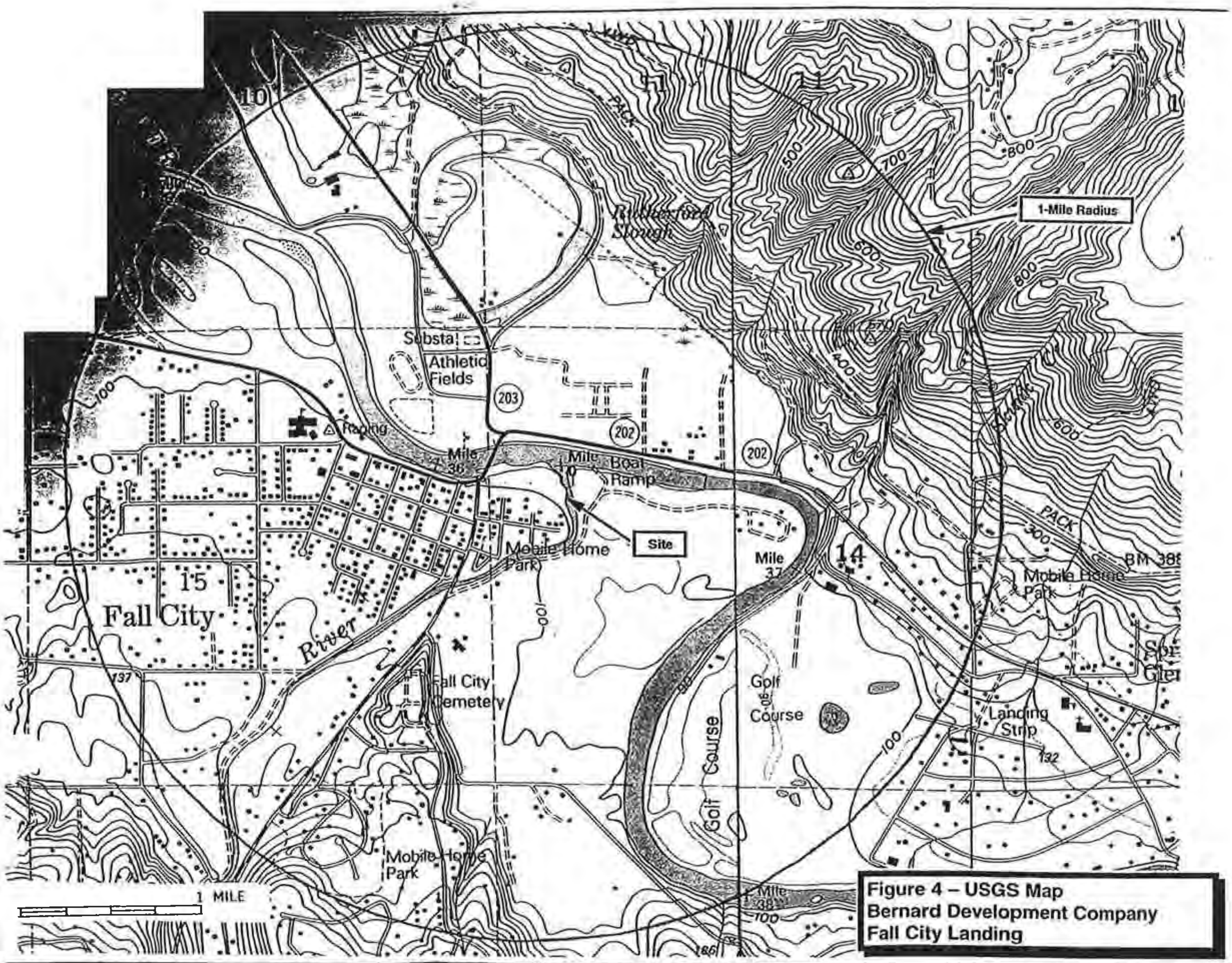
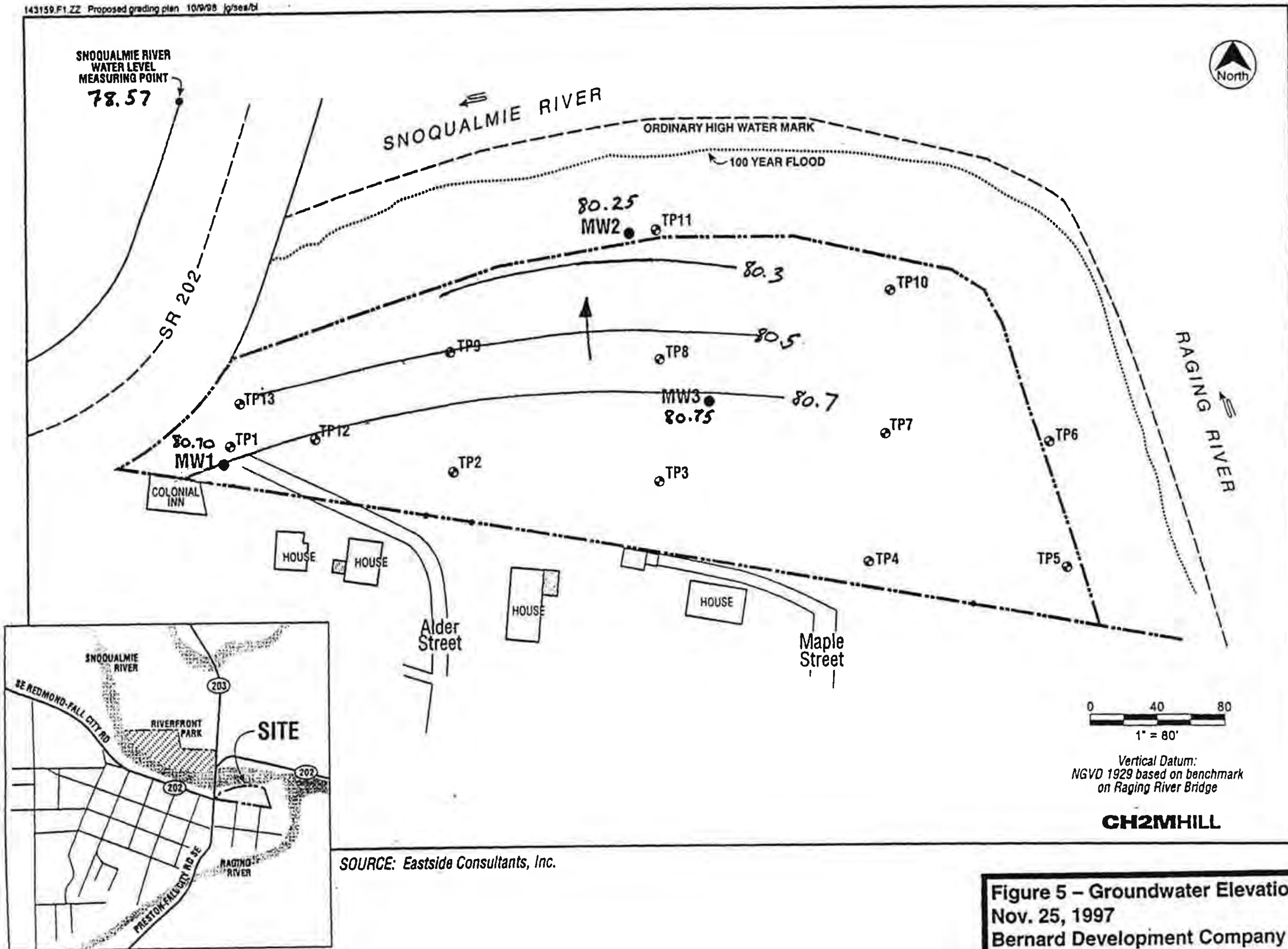


Figure 4 – USGS Map
Bernard Development Company
Fall City Landing

143159.F1.ZZ Proposed grading plan 10/9/98 lg/sea/bl

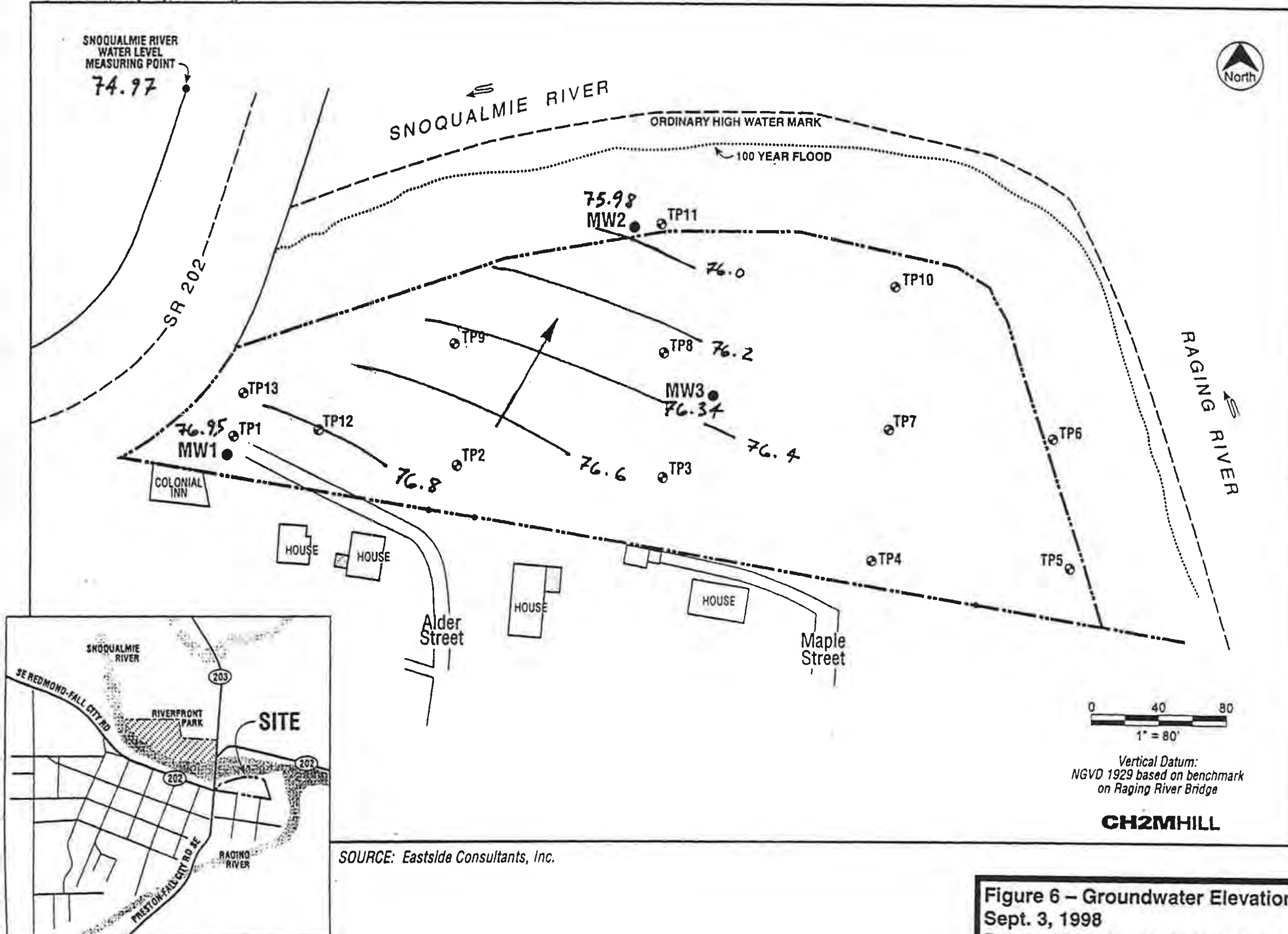


CH2MHILL

SOURCE: Eastside Consultants, Inc.

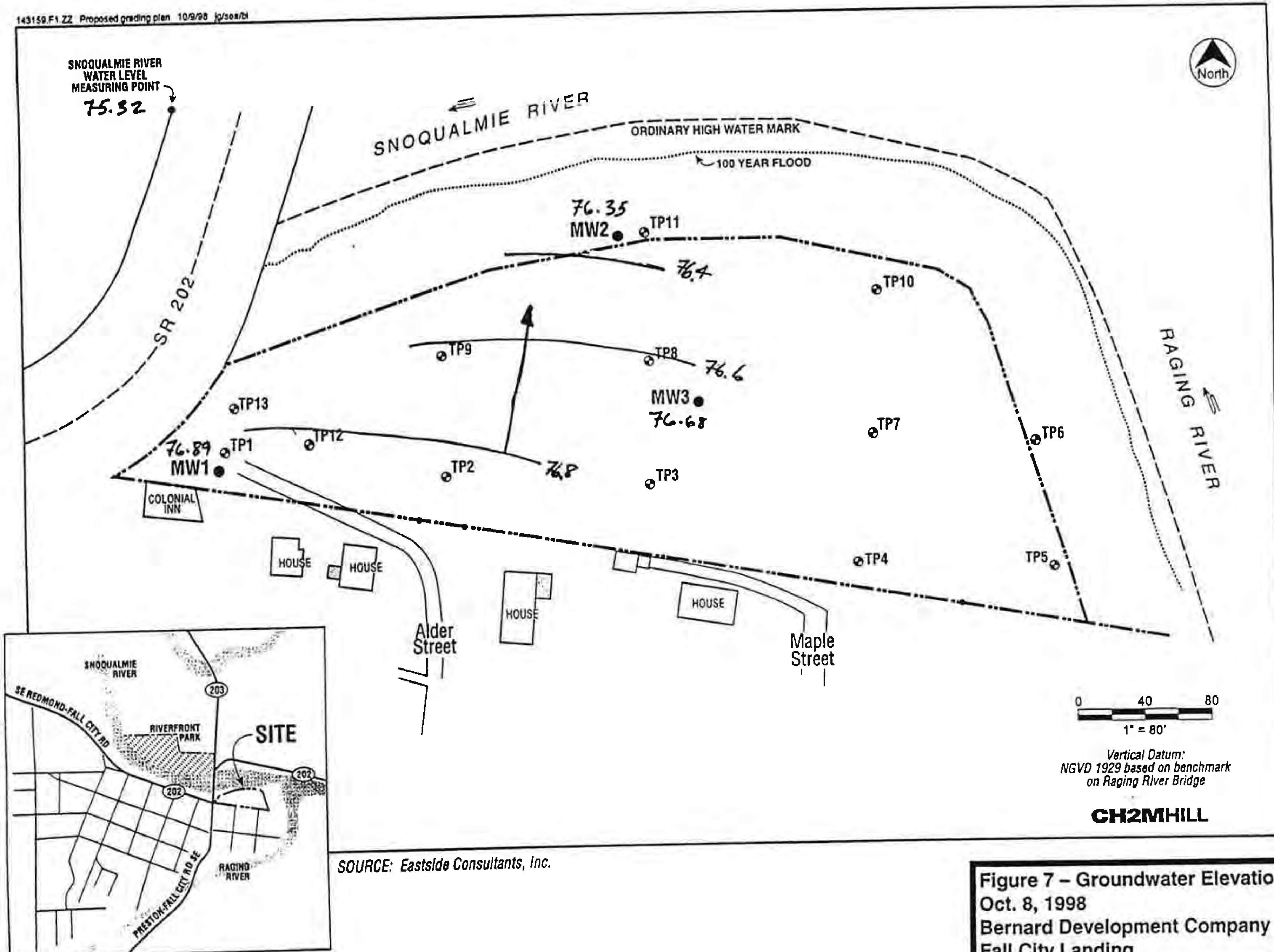
Figure 5 – Groundwater Elevations, Nov. 25, 1997
Bernard Development Company
Fall City Landing

143159.F1.ZZ Proposed grading plan 10/9/98 jg/sea/bi



SOURCE: Eastside Consultants, Inc.

Figure 6 – Groundwater Elevations, Sept. 3, 1998
Bernard Development Company
Fall City Landing



SOURCE: Eastside Consultants, Inc.

Figure 7 – Groundwater Elevations, Oct. 8, 1998
Bernard Development Company
Fall City Landing

APPENDIX D

LETTER REGARDING SURVEY OF GREG FAWCETT'S PROPERTY

Fall City Family Dental Clinic, Inc.

Greg M. Fawcett, D.D.S.
Sabra S. Fawcett, D.D.S.

June 14th, 2001

Mr. Brian E. Duncan, E.I.T.
Grey and Osborne, Inc.
701 Dexter Ave. N.
Suite 200
Seattle WA.98109

Re: elevation of Fall City Commercial Strip and discrepancy from FEMA map

Dear Brian,

Per the FEMA map the elevation of my property in Fall City was listed at 93 feet and six inches. This placed my property in the flood plain and as such certain additional restrictions would apply. As a result I had my property surveyed and the survey indicated that the elevation was considerably higher. I understand this is not an uncommon event. As you look at other parcels they too may be in actuality higher then indicated on the FEMA map. I mention this just for your consideration. I have enclosed a copy of my elevation certificate for you information. Please pass it on to Tony.

Sincerely,

Greg Fawcett, D.D.S.

P.O. Box 1029 33609 Redmond-Fall City Road Fall City, WA 98024 425-222-7011

October 31, 2000

RE: Property of Greg & Sabra Fawcett at 33609 SE Fall City-Redmond Road (SR-202) in Fall City, Washington

LEGAL DESCRIPTION

Lot 5 – 10, Block 3 of Fall City Addition located in the NE ¼ of Section 15, Township 24 North, Range 7 East, W.M. in King County, Washington

To Whom It May Concern:

This is to certify that the elevation of the NE property corner is 100.44 feet and the elevation of the NW property corner is 100.61 feet.

These elevations were established by running different levels from FEMA benchmark RM-426.

"Ram set nail in pavement set at the southeasterly corner of the SR-202 bridge over the Snoqualmie River at Fall City within the SE ¼ of the NE ¼ of Section 15, Township 24 North, Range 7 East." (Elevation = 103.59 feet)

To the site of said property and closing back on the FEMA bench. The data of this benchmark is NGVD 29.

Note: The above property is level with no swales or significant differences in elevation from the 100-foot elevation as noted above.

2/01/01

APPENDIX E

AQUA TEST, INC.'S ESTIMATED PHASE 1 HYDRAULIC FLOWS AND BIOLOGICAL LOADING RATES

Aqua Test Inc.'s Phase 1 Commercial District Estimated Hydraulic Flows and Biological Loading Rates

Designation (A/X/ _)	Property Type	Lot SqFt	Gross SqFt	Conforming Repair On Site	Non Conforming Repair On Site	Some On Site and Some Off Site	All Treatment and Disposal Off Site	Design Flow GPD	Organic Waste Strength BOD_5	Organic Load LBS BOD_5/Day	Equivalent Residential Units
A	COMMERCIAL	27300	2842		α	α		615	350	1.80	2.0
A	COMMERCIAL	15000	6328			α	α	600	400	2.00	2.2
A	COMMERCIAL	11563	5400				α	1008	600	5.04	5.5
A	COMMERCIAL	10125	1380		α			150	350	0.44	0.5
A	COMMERCIAL	4500	3736				α	100	350	0.29	0.3
A	COMMERCIAL	13500	2022	α				350	200	0.58	0.6
A	COMMERCIAL	4500	1656		α	α		295	350	0.86	0.9
A	COMMERCIAL	4500	2160		α			150	350	0.44	0.5
A	COMMERCIAL	2925	NA			α	α	0	0	0.00	0.0
A	COMMERCIAL	6750	4004		α			1205	2479	24.91	27.1
A	COMMERCIAL	3525	448			α	α	738	350	2.15	2.3
A	COMMERCIAL	15000	6816		α	α		4992	1100	45.80	49.8
A	COMMERCIAL	4298	3036				α	2238	1200	22.40	24.3
A	COMMERCIAL	2250	1224			α	α	100	350	0.29	0.3
A	COMMERCIAL	2250	1440				α	100	250	0.21	0.2
A	COMMERCIAL	2250	676			α	α	100	350	0.29	0.3
A	COMMERCIAL	4875	4036				α	934	350	2.73	3.0
A	COMMERCIAL	5100	5040				α	100	350	0.29	0.3
A	COMMERCIAL	4500	1600		α			100	350	0.29	0.3
A	COMMERCIAL	9000	3568			α		350	250	0.73	0.8
A	COMMERCIAL	5725	1076				α	500	350	1.46	1.6
A	COMMERCIAL	1900	1104			α	α	271	350	0.79	0.9
A	RESIDENTIAL	19536	NA		α	α		0	0	0.00	0.0
A	COMMERCIAL	2250	756				α	350	400	1.17	1.3
A	COMMERCIAL	4703	2836				α	295	500	1.23	1.3
A	COMMERCIAL	7880	1277				α	812	250	1.69	1.8
A	COMMERCIAL	290109	NA					0	0	0.00	0.0

Average Daily Flow GPD	16,453	Total System Organic load LBS BOD5/Day	117.89

The equivalent residential units are based on a maximum BOD5 of 230 mg/L and a design flow of 480 gallons per day.

APPENDIX F

HWA GEOSCIENCES, INC. TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM

TO: Brian Duncan / Gray & Osborne, Seattle

PREPARED BY: Larry West / HWA GeoSciences Inc.

SUBJECT: **PRELIMINARY HYDROGEOLOGIC EVALUATION**
FALL CITY ALTERNATIVE/ONSITE WASTEWATER
MANAGEMENT R&D PROJECT
King County, Washington

PROJECT NO.: 2001094-100

DATE: June 12, 2001

This memorandum provides a summary of relevant existing hydrogeologic and soils information for the Fall City business district in regards to:

- Existing Conditions,
- Potential for Retrofit/Improvements to Onsite Systems, and
- Potential for Cluster or Centralized Alternative Wastewater Treatment Technologies and Management Approaches

Sources of information included:

- 2nd Draft, Wastewater Facility Plan, Fall City Washington, May 1991 by R.W. Beck
- Wellhead Protection Plan, Fall City Water District, September 2, 1998 by Compass Geographics Inc.
- Design Manual, Onsite Wastewater Treatment And Disposal Systems, October 1980 by U.S. Environmental Protection Agency

EXISTING CONDITIONS

The geology and ground water conditions directly influencing the suitability of onsite systems in the Fall City business district result from the complex prehistoric glacial activity as well as past and recent fluvial deposition by the Snoqualmie and Raging Rivers.

GEOLOGY

- The business district is located on alluvial fan that includes a wide assortment of materials.
- North and east of the business district younger alluvium consisting of floodplain cobble gravel and pebbly sand occur along the river.
- West of the business district, glacial outwash and fine-grained deposits of Pleistocene ice dammed lakes.

SOILS

- Soils in the east half of the business district include Alderwood soils with marginal suitability for on-site disposal due to poor drainage.
- Soils in the west half of the business district generally consist of Puyallup fine sandy Loam, type 2 to type 4 soils typically suitable for 12,500-18,000 square foot minimum lot sizes. Based on EPA design guidelines, these soils should support wastewater loading rates upto 0.6 gallons/day/square foot (gpd/ft^2).
- Soils immediately west of the business district consist primarily of Everett Gravelly Sandy Loam. These type 1 soils have very high infiltration rates and require use of advanced treatment technologies (mound/fill, sand filters etc.).
- Further west of downtown, Type 5 Sammamish Silt Loam dominates and is generally unsuitable for on-site sewage systems. However, is some cases, these soils are suitable with the use of mound systems. Loading rates typically range from about 0.2 to 0.4 gpd/ft^2.

GROUND WATER

- The available data indicate two distinct ground water systems, a deep ground water system that serves as the source of water supply for the Fall City Water District and a shallow ground water system. In both systems, ground water flows due north originating as recharge by precipitation on the flanks of the mountains then flows subsurface beneath the business district and then discharges into the Snoqualmie and Raging Rivers.

- Depths to shallow ground water vary and are not well defined. Available well data indicate ground water in the area exhibits low to not detectable nitrate concentrations.

- The Fall City Water District has 3 wells (No. 1, 2 & 5) over 1,000 feet west, southwest of the Fall City business district. The wells range from 177 to 206 feet deep. The production zones range from 161 to 206 feet deep. Logs for all three wells indicate relatively thick low permeability aquitards (clay and silt) separate the deep production zones from shallow aquifers and the ground surface.

- The contaminant capture zones for Wells No. 1,2 & 5, extend to the south and southwest of the business district. While onsite septic systems constitute one of the major sources of pollution potential in these well's capture zones, onsite systems in the business district and north of the wells do not appear a threat to the wells' water quality. However, the Chief Kanim Middle School's septic system has been identified in the wellhead protection plan as a *potential* non-point source of contamination.

POTENTIAL FOR RETROFIT/IMPROVEMENT TO ONSITE SYSTEMS

- Soils very dramatically in the business district and retrofit or improvement to onsite systems to adequately match soil conditions will require site specific analyses and design.

- As indicated above, due to poor soils, the eastern half of the business district have the lowest potential for successful retrofit or system improvement. Exceptions include using advanced disposal technologies (mounds, sand filters etc.) and may prove feasible on a case by case basis. The available data indicate a greater potential for retrofit/improvement to systems in the western half of the business district.

POTENTIAL FOR CLUSTER OR CENTRALIZED ALTERNATIVE WASTEWATER TREATMENT TECHNOLOGIES AND MANAGEMENT APPROACHES

- Cluster or centralized systems may provide limited disposal opportunity in the western half of the business district. However, these facilities will require fairly large sites on the order of ¾-acre and larger per 14,500 gallons/day of wastewater disposal.

- The coarse grained soils west of the business district may provide opportunity for an alternative type of system using slow or possibly rapid infiltration combined with advanced wastewater treatment. The controlling factor would be the depth and hydraulic gradient of the ground water table. Insufficient unsaturated material and a relatively flat hydraulic gradient would result in ground water mounding and subsequent failure of the system. Test pit data indicate water levels greater than 5 feet deep. However, an effective infiltration system will likely require water levels greater than 10 feet deep (below the base of the infiltration facility). Insufficient data exist to determine if sufficient unsaturated depth and hydraulic gradient occur in the vicinity west of the business district.

- A combined, land application/infiltration system employing phreatophytes (i.e. hybrid poplars etc.) also warrants consideration. Treatment requirements might not be as rigorous if the plants could use the nutrients during the summer and increased ground water flow provided increased dilution during the winter.

APPENDIX G

SOILS DATA REGARDING GOLF COURSE ON EAST SIDE OF RAGING RIVER

Gray & Osborne, Inc.
CONSULTING ENGINEERS

FAX COVER SHEET

DATE: 6/14/01

TO: Larry West
HWA GeoSciences Inc.

FAX NO: *Local:* (425) 774-2714
or
Long Distance: 1 - ( ) ____

FROM: Brian Duncan
Telephone No: (206) 284-0860 *Fax No: (206) 283-3206*

We are transmitting 14 pages, including this cover sheet. If you do not receive all of the pages, please call us as soon as possible.

Also sent original document via U.S. Mail this date: ☐

Also sent original document via U.P.S. this date: ☐

Also sent original document via Federal Express this date: ☐

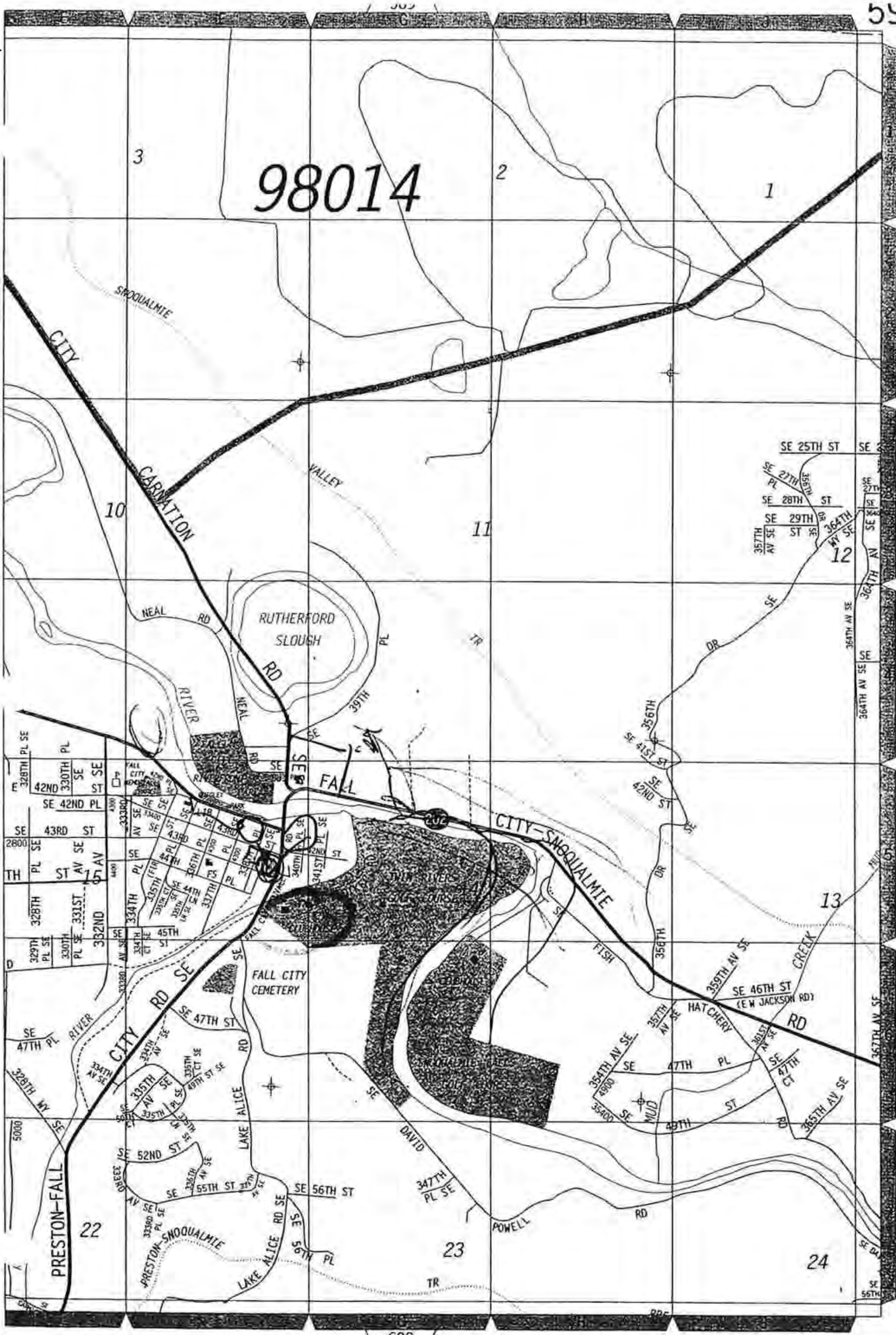
Client: King County G&O No. 01841

Project: Fall City

MESSAGE/COMMENTS:

Attached is additional soils data provided by Ken Elliott of King Co. Public Health regarding golf course on east side of Raging River. Shows a loading rate of 0.6 gal/ft²-day.

701 Dexter Avenue N., Suite 200 Seattle, Washington 98109 (206) 284-0860 Fax (206) 283-3206


98014
CARNATION CITY RD
RUTHERFORD SLOUGH
NEAL RD
SNOQUALMIE VALLEY TR
RIVER
SE FALL CITY-SNOQUALMIE RD
202
FALL CITY CEMETERY
SE FISH HATCHERY RD
SE 46TH ST (E W JACKSON RD)
SE 356TH DR
SE 41ST ST
SE 42ND ST
SE 25TH ST
SE 27TH PL
SE 28TH ST
SE 29TH ST
364TH WY SE
357TH AV SE
364TH AV SE
MUD CREEK
SE 47TH PL
SE 47TH ST
SE 49TH ST
354TH AV SE
365TH AV SE
359TH AV SE
367TH AV SE
SE DAVID POWELL RD
347TH PL SE
LAKE ALICE RD
SE 52ND ST
SE 55TH ST
SE 56TH ST
SE 56TH PL
PRESTON-FALL CITY RD SE
PRESTON-SNOQUALMIE TR
328TH WY SE
SE 42ND PL
SE 43RD ST
SE 45TH ST
332ND
334TH
328TH
SEE 600 MAP
SEE 629 MAP
1
2
3
10
11
12
13
15
22
23
24

SEATTLE-KING COUNTY DEPARTMENT OF PUBLIC HEALTH
ENVIRONMENTAL HEALTH SERVICES

ON-SITE SEWAGE DISPOSAL SYSTEM
AS-BUILT/CERTIFICATION OF COMPLETION
(Submit in Quadruplicate)

RECEIVED
FEB 16 1995
EASTGATE

ADDRESS OF PROPERTY 9446 Preston-Fall City (Street)
Fall City (City) 98024 (Zip)
LEGAL DESCRIPTION: Fall City Golf Course
PARCEL #: 152407 031

SYSTEM TYPE Pressure Distr.
PERMIT NO. ~~H94R.0211~~ #94P05

Owner Twin Rivers Golf Club Address 33613 SE 47th St. Fall City 98024 Phone 222-5176
Designer Dennis Joule PE Address 32729 SE 44th St Fall City Phone 222-4661
Master Installer Ath. Septic Address Fall City Phone 222-5388

INSTRUCTIONS TO DESIGNER: ATTACH A SEPARATE SHEET FOR THE AS-BUILT DRAWING PLAN. USE A SCALE OF 1" = 20' OR 1" = 30'. ALSO COMPLETE AND SUBMIT THE AS-BUILT CHECKLIST/SYSTEM INFORMATION SHEET, INSTALLATION PERMIT, AND DOCUMENTATION OF FINAL COVER.

I hereby certify that the accompanying drawing and check list accurately represent the system installed at the address/parcel indicated above, and that all requirements and conditions (concerning plumbing.stub elevations; maintenance of grades; fills; surface drains; etc.) indicated on the approved site plan (or latest approved revision thereof) dated ______________, have been complied with. I further certify that this system meets all requirements of the Rules and Regulations established under the Code of King County Board of Health Title 13 or City of Seattle Municipal Code, Chapter 21.32 (whichever is applicable).

PE 16173 (CERTIFICATE NO.) ______ [signature] (SIGNATURE OF DESIGNER) ______ 2-16-95 (DATE)

TO BE FILLED IN BY HEALTH DEPARTMENT ONLY

APPROVED 02/16/95 (date) BY: Mike Kempner

Remarks: supplimental AS BUILT including food service facility per Review Board Application # 94-132

DISAPPROVED ______ (date) BY: ______

Actions Subsequent to As-Built Approval

Date | Action | Sanitarian

INSTRUCTIONS TO THE HOMEOWNER/SYSTEM USER

Your septic system has limitations! It was designed and installed to serve an average-sized family. Overloading the septic tank or disturbing the drainfield or mound may cause the system to fail. Points to remember:

1. Conserve water - use water saving devices; repair leaky fixtures, wash only full loads of laundry and dishes.
2. Keep accurate records - maintain a file for your as-built (system location) diagram, and records of maintenance performed on the system.
3. Inspect your system once each year and have your septic tank pumped out when need - NEVER ENTER A SEPTIC TANK.
4. Never flush the following into the septic tank: coffee grounds; greases; cooking fats; facial tissue; cigarette butts; sanitary napkins; tampons; paper towels; disposable diapers or harmful materials. Restrict the use of garbage disposals.
5. Keep surface water runoff, roof drainage, and groundwater away from all septic system components (i.e. septic tank, dose tank, sand filter, mound system, drainfield and reserve area). Do not install sprinkler systems in these areas.
6. Protect the sewage system from physical damage - keep vehicles, heavy equipment, and livestock off the drainfield/mound, and reserve area.
7. Use extreme care in landscaping - don't excavate; fill; terrace; place a structure; driveway; patio; deck or impermeable material on/over the drainfield/mound.

FOR FURTHER INFORMATION CONTACT YOUR LOCAL HEALTH DEPARTMENT SERVICE CENTER

CS 13 15 111

9501270349

RESTRICTIVE AND INFORMATIONAL COVENANT

Twin Rivers Golf Course - Parcel No. 1524079031

Also Known As

4446 Preston-Fall City Road, Fall City, Washington

The undersigned owners of the property described above do hereby acknowledge that the golf course club house and food service facility is served by a conventional on-site sewage disposal system and therefore, authorized food service activities are limited.

NOW, Therefore, the grantors, their heirs, and successors agree and covenant that:

1) No garbage grinder shall be installed until public sewers become available,

2) There is to be no on-site food service preparation activities such as cooking, roasting, frying, frozen dessert dispensing, or other activities which could add to the hydraulic and/or waste strength loading of the sewage system, and

3) The system is to be managed and monitored by a certified on-site system designer, professional engineer, or other qualified individual to be the system manager.

This agreement shall run with the land and shall be binding on any parties having or acquiring any right, title, or interest thereto or any part thereof. This covenant shall terminate when the facility is served by public sewers.

WITNESS, this 25 day of January 1995.

Richard E. Rutledge PRES. (Owner)

RECEIVED
FEB 16 1995
EASTGATE

________________ (Owner)

Grantor(s)

State of Washington, County of King

I, the undersigned, a Notary Public in and for the above named State and County, do hereby certify that on this 25 day of January, 1995, personally appeared before me to me known to be the individual(s) described in and who executed the within instrument, and acknowledge that (he) (they) signed and sealed the same as a free and voluntary act and deed, for the uses and purposes therein mentioned.

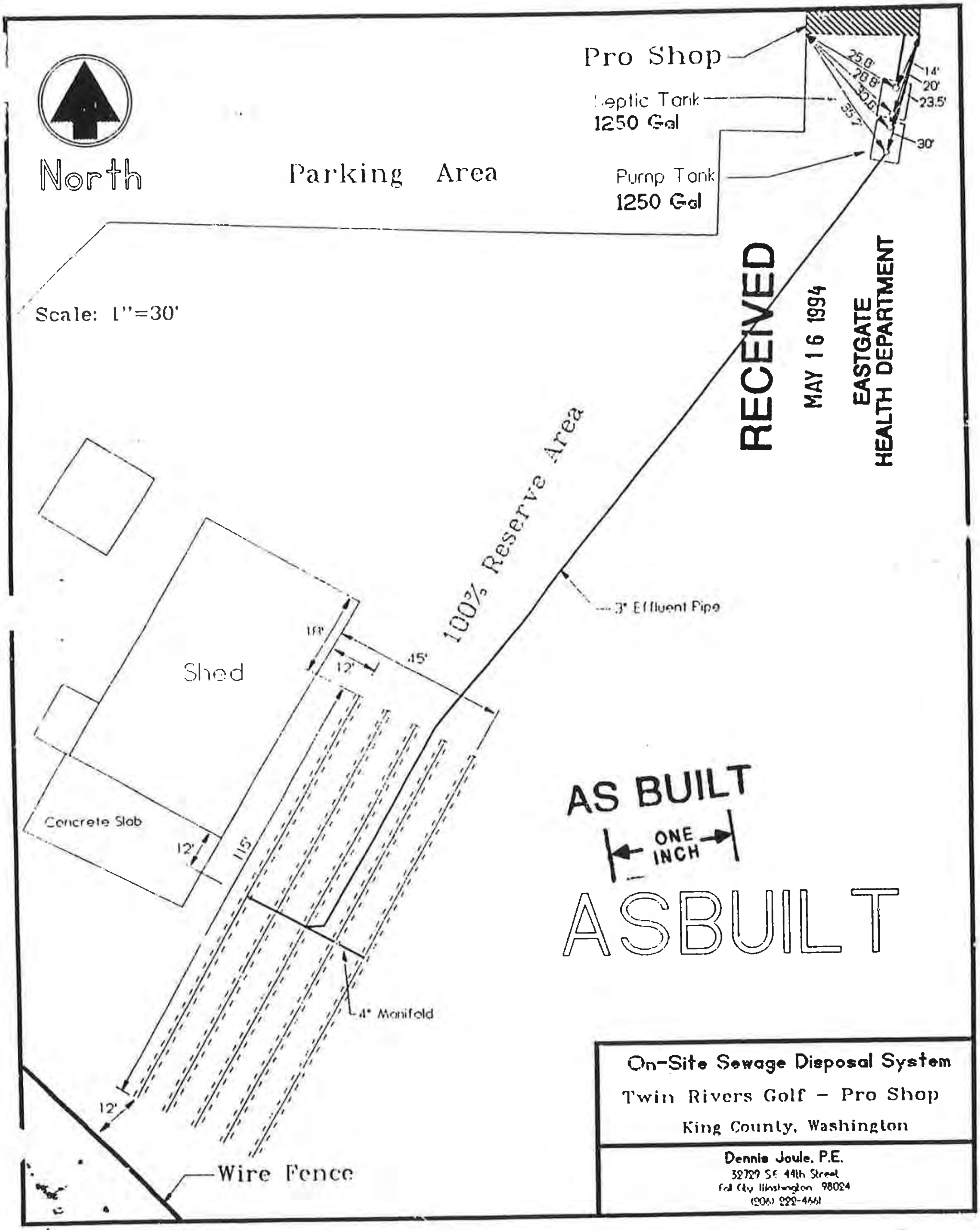
GIVEN under my hand and official seal the day and year last above written.

____

Notary in and for the State of Washington,

Residing at Preston WA

RECEIVED
FEB 15 1995
EASTGATE


Pro Shop
Septic Tank
1250 Gal
Pump Tank
1250 Gal
25.8'
20.8'
30.6'
35.7'
14'
20'
23.5'
30'
North
Parking Area
Scale: 1"=30'
RECEIVED
MAY 16 1994
EASTGATE
HEALTH DEPARTMENT
100% Reserve Area
3" Effluent Pipe
Shed
18'
12'
45'
Concrete Slab
12'
115'
4" Manifold
12'
Wire Fence
AS BUILT
ONE INCH
ASBUILT
On-Site Sewage Disposal System
Twin Rivers Golf – Pro Shop
King County, Washington
Dennis Joule, P.E.
32729 SE 44th Street
Fall City Washington 98024
(206) 222-4661

Office Copy

Seattle-King County Depa... f Public Health

Site Application for On-Site Sewage Disposal System
(Submit 5 copies of application with 4 copies of plans)

Activity Number: H94R0211 (Department Use Only) MK

Approximate Site Address: 4436 Preston-Fall City Rd

ATTACH A DETAILED ROUTE/ DIRECTION MAP FOR LOCATING THE PROPERTY.

Applicant Name: Twin Rivers Golf Club, Inc. (Last / First)
Street Address: 33613 SE 47th Street
City-Zip Code: Fall City 98024 Phone: 222-5176
call for plu

Designer: Dennis Joule, PE
Street Address: 32726 SE 44th Street
City-Zip Code: Fall City 98024 Phone: 222-4661

PROPERTY INFORMATION:

Parcel #: 152407 9031 Section: 14 Township: 24 Range: 7
Subdivision Name: Lot: Block:
Property Size: sq. ft. Acreage: 141 ac
Distance from property line to nearest sewer: miles ft. Within ULID? no (Y?N)
Water Supply: P (IP) I = Individual P = Public (More than One Connection)
Public Water Supply Name: KCWD 127 ID#
Sensitive Area: N (Y?N) If yes, specify (L,W,O) (L = Landslide W = Wetlands O = Other)

4436 Preston-Fall City Rd

SYSTEM INFORMATION:

New System: X Repair Design: Detailed Plans Attached: (4 sets) Y (Y/N)
Type of Building: comm SF = Single Family MF = Multiple Family COMM = Commercial INST = Institutional
Type of System Proposed: PD G = Gravity GP = Gravity with pump M = Mound
PD = Pressure Distribution SF = Sand Filter HT = Holding Tank CT = Composting Toilet E = Experimental O = Other
Dates Soils Logged: 6 5 91 Soil Logs Data Attached: (Min. 4/lot) Y (Y/N)
Depth to Watertable or Restrictive Layer: 60+ inches Maximum Slope in Drainfield/Reserve Area: 1 %

CALCULATIONS:

Number of bedrooms: — Total Gallons/Day (450 minimum): 690 gal. Soil Texture Type (1-5): 4
Application Rate: 0.6 gal/sq ft/day Total Absorption Area: 1150 sq. ft.
Total Drainfield Length: 575 ft. Septic Tank Size: 1035 gal.
Pump Chamber Size (if needed): 690 gal. Trench Depth (min/max): 12 / 14 inches

I understand that failure to comply with the Code of King County Board of Health Title 13 may result in the disapproval of the sewage system being proposed in this application. Non-compliance may also lead to revocation of my Designer's Certificate of Competency and/or appropriate legal action by the Health Department.

Designer's Signature: [signature] K.C.ID# PE Date 3-31-94

FOR HEALTH DEPARTMENT USE ONLY

APPROVED 04/04/94 (date) BY: Mike Kaup

Comments/Conditions: Cluster installation, No Food Service

pd 240.00

SYSTEM MUST BE INSTALLED BY A KING COUNTY CERTIFIED INSTALLER UNLESS OTHERWISE PROVIDED BY CODE

APPROVAL OF THIS DESIGN APPLICATION IS BASED SOLELY ON INFORMATION PROVIDED IN THIS APPLICATION AND DOES NOT CONSTITUTE PERMISSION TO BEGIN CONSTRUCTION OF THE PROPOSED SEWAGE DISPOSAL SYSTEM OR ANY OTHER IMPROVEMENTS ON THE SITE. THIS APPROVAL SHALL NOT BE CONSIDERED AN ASSURANCE, EITHER EXPRESSED OR IMPLIED, THAT DEVELOPMENT PERMITS FOR THE SITE WILL BE ISSUED.

THIS APPLICATION EXPIRES TWO YEARS FROM DATE OF APPROVAL.

DISAPPROVED (date) BY:

RECEIVED
APR 01 1994
EASTGATE
HEALTH DEPARTMENT

See attached Site Deficiency Sheet.
Any person aggrieved by any decision or final order of the Health Officer may make written application for appeal to the King County Board of Sewage Review if done so within 60 days of the above decision.

WHITE - DISTRICT/GREEN - AUDIT/YELLOW - DESIGNER/PINK - OWNER/YELLOW - LICENSES & PERMITS CS 13.15.97 REV. 6/90

DENNIS JOULE, P.E.
CIVIL ENGINEER

2729 S.E. 44th Street
Fall City, WA 98024
(206) 222-4661

Ground & Surface Water Hydraulics
Geotechnical Engineering

TWIN RIVERS GOLF COURSE - PRO SHOP

King County, Washington

March 30, 1994

A. INTRODUCTION

Application for a *King County Conditional Use Permit* for this project was approved by the Health Department in 1991. No changes have been made to the project since the approval. The new clubhouse would have bathrooms for golf course patrons. There is to be an over-the-counter snack bar but all food will be purchased outside, no food will be prepared on the premises. Much of the golf course is within the designated flood plain, however, the clubhouse and all parts of the on-site sewage disposal system will outside the flood plain.

B. DOMESTIC WATER SERVICE

The site is served by public water from K.C.W.D. 127.

C. SITE CONDITIONS

1. *Site Topography*

The ground in the drainfield area is nearly level. No standing water or drainage facilities are located within 100 feet of the proposed drainfield area. The proposed drainfield area is outside the designated Flood Plain.

2. *Site Soils*

The drainfield area is shown on the site plans. Test pit logs show Type 4 Soil over Type 1 Soil. The drainfield is to be constructed in the upper 12 inches of soil, keeping the at least 24 inches of Type 4 Soil between the trench bottom and the Type 1 Soil. Type 4 Soil has a sewage application rate of 0.6 GPD/ft^2. The site is over 40 acres in area.

3. *Seasonal Water Table*

There is no evidence of a seasonal water table within the upper five feet of soil.

D. DAILY WASTEWATER FLOW

There will be a average of about 50 patrons per day with a maximum of 90 patrons per day on holidays and peak weekends. Using a three gallon flush toilets, assuming one gallon for hand wash each toilet use = 360 GPD. One cleaning sink at 100 GPD. Add 50 percent factor of safety = **690 GPD sewage flow.**

E. SEPTIC TANK SIZE

1.5 times the daily flow of 690 is 1035 gallons. First chamber to be 2/3 capacity = 690 gallons. Second chamber to be 1/3 capacity = 345 gallons.

F. HOLDING / PUMP TANK VOLUME

Volume should equal at least the dose volume plus one day storage. Dose two times per day, 345 gallons per dose. One days storage is 690 gallons. Total required is 1035 gallons.

G. DRAINFIELD

The proposed drainfield area is shown on the site plans. Test pit logs show Type 4 Soil over Type 1 Soil. The draintrenches are to be constructed in the upper 12 inches of soil, keeping the at least 24 inches of Type 4 Soil between the trench bottom and the Type 1 Soil.

Site soils in the drainfield area are Type 4, with an allowable application rate of 0.6 GPD/ft^2.

(690 GPD) / (0.6 GPD/ft^2) (2 ft wide trench) = **575 lineal feet**

The drainfield is to have a pressure distribution system. Use 5 draintrenches, 115 feet long each.

H. PRESSURE DISTRIBUTION SYSTEM

(Based on the State of Washington Guidelines, Sept. 1984)

1. Lateral length, central manifold = 115 ft / 2 = 57 ft

2. Orifice spacing = 3 ft O.C.

3. Holes per lateral = (57 ft / 3 ft) + (1 hole) = 20 holes

4. Selected orifice size = 3/16 in. dia.
   Orifice discharge = 0.6 GPM at 2 ft head

5. Maximum lateral length (3/16" orifice, 1.25" dia. lateral pipe, Schedule 40 PVC = 60 ft *OK (Pressure System Guidl. Table A1-1, Pg 34)*

6. Lateral discharge rate = (20 holes)(0.6 GPM/hole) = 12 GPM/lateral

7. Five trenches, two laterals per trench = 10 laterals

8. **Use 4" dia. manifold,** maximum length = 36 ft *OK (Pressure System Guidl. Table 1, Pg 13)*

9. Required pump discharge rate = 120 GPM

11. Head loss in the delivery pipe (from pump to manifold), use 2.5" diameter pipe.

Friction loss(Max.Pipe length=200 ft)	4 ft
Elevation difference	6 ft
Residual pressure at manifold	*3 ft
*This accounts for friction loss in the lateral	
TOTAL head required	13 ft

Control flow to each lateral with one valve on each lateral.

I. PUMP SELECTION

Required: 120 GPD at 13 ft total head. Use Hydromatic SP-100AH or approved equivalent effluent pump.

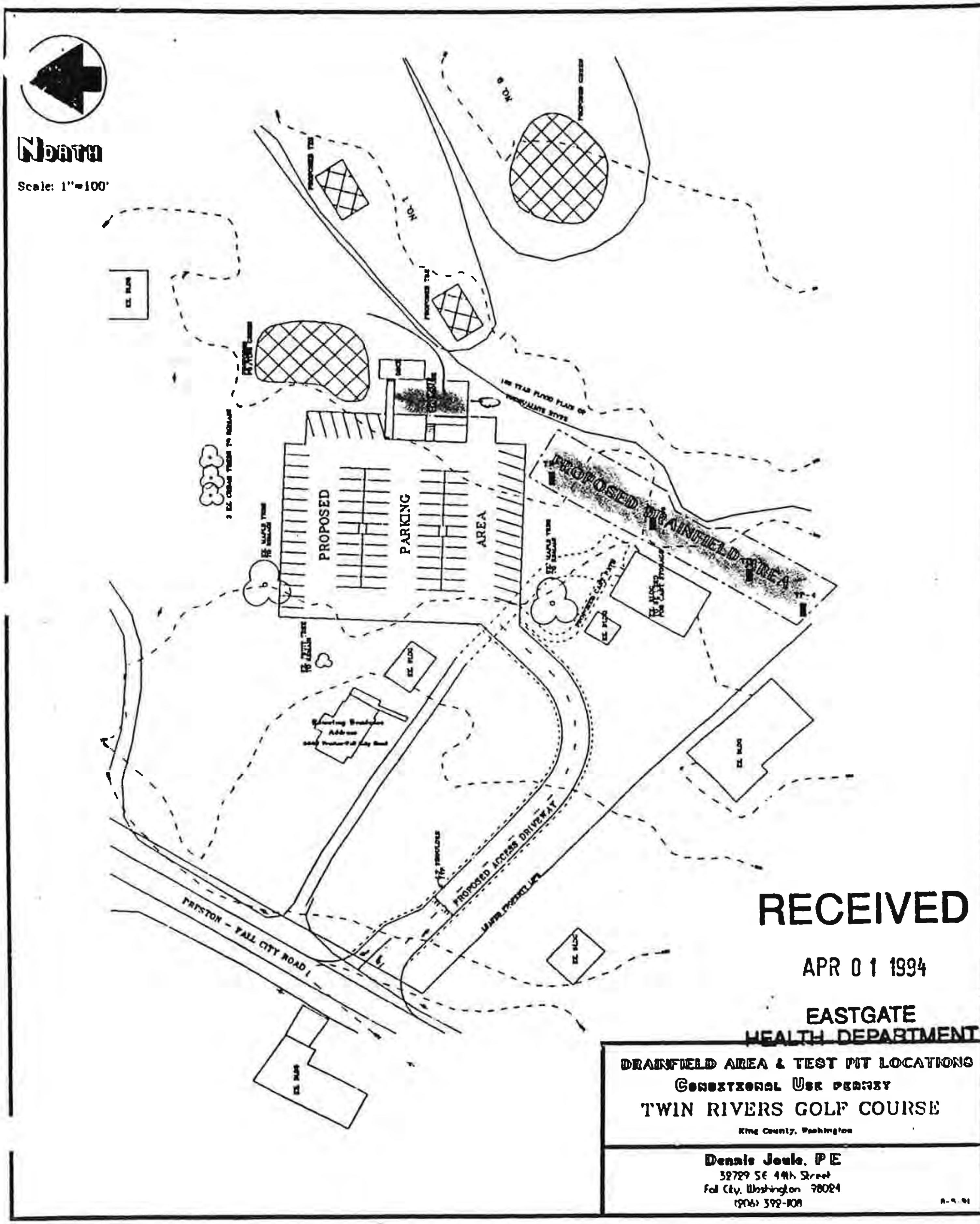
J. RESERVE AREA

A **100 percent reserve area** is located south of the drainfield.

Report prepared by:

Dennis Joule, P.E.

DENNIS JOULE
STATE OF WASHINGTON
16171
REGISTERED
PROFESSIONAL ENGINEER



NORTH
Scale: 1"=100'
PROPOSED PARKING AREA
PROPOSED DRAINFIELD AREA
PROPOSED ACCESS DRIVEWAY
PRESTON - FALL CITY ROAD
RECEIVED
APR 01 1994
EASTGATE
HEALTH DEPARTMENT
DRAINFIELD AREA & TEST PIT LOCATIONS
Conditional Use Permit
TWIN RIVERS GOLF COURSE
King County, Washington
Dennis Joule, PE
32729 SE 44th Street
Fall City, Washington 98024
(206) 392-1101

TEST PIT LOGS

Twin Rivers Golf Course

Logged By: *Dennis Joule, P.E.*
Date Logged: *June 5, 1991*

General Soil Classification: *TYPE 4 Soil over TYPE 1 Soil*
Seasonal Water Table: *Below 5 feet*

Test Pit #1

0-60" Red Brown, Silty Fine Grained SAND
(Pocket of Well Graded SAND with River Gravel at 3')

Test Pit #2

0-36" Red Brown, Silty Fine Grained SAND

36"-60" Gray Brown, Silty Well Graded SAND with Rounded Gravel

Test Pit #3

0-60" Red Brown, Silty Fine Grained SAND

Test Pit #4

0-60" Red Brown, Silty Fine Grained SAND
(Intermittent Pockets of Well Graded SAND with River)

TEST PIT LOGS

Twin Rivers Golf Course

other side
0-6" TS
6-27" ③
27-39" 2/3
39+ SM
39-60" ②

Logged By: *Dennis Joule, P.E.*
Date Logged: *June 5, 1991*

General Soil Classification: *TYPE 4 Soil over TYPE 1 Soil*
Seasonal Water Table: *Below 5 feet*

TP-1
0-6" topsoil
6-20" 3/4
20-36" 2/3
36+" ①

Test Pit #1

0-60" Red Brown, Silty Fine Grained SAND
(Pocket of Well Graded SAND with River Gravel at 3')

Test Pit #2

TP-2 N side
0-7" dk topsoil
7-16" ④
16-28" 2/3
28+" ① ②

0-36" Red Brown, Silty Fine Grained SAND
36"-60" Gray Brown, Silty Well Graded SAND with Rounded Gravel

TP-2
0-6" dk topsoil
6-17" ④
17-34" 2/3
34-48" ①
48+" wet, hard to dig

abundant [illegible] plants TP1-TP2 area

Test Pit #3

0-60" Red Brown, Silty Fine Grained SAND

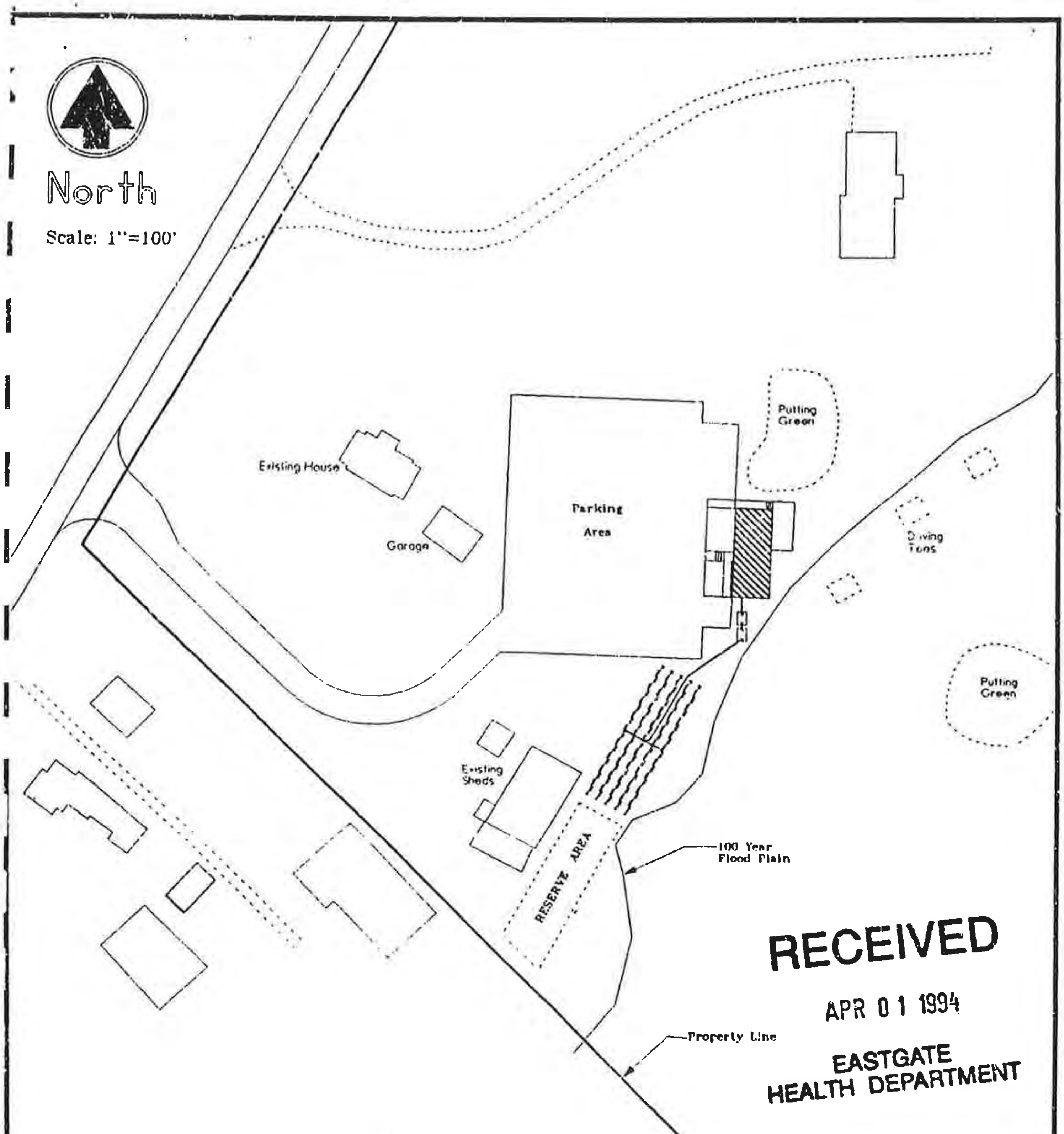
TP-3 ① side
0-12" dk topsoil
12-24" ④
24-48" 2/3
48+" slt mottle
48-60"
60+" SM-④
no seas. H2O @ 72"

Test Pit #4

0-60" Red Brown, Silty Fine Grained SAND
(Intermittent Pockets of Well Graded SAND with River)

TP-4
0-12" dk [illegible]
12" charcoal layer
12-20" 2/3
20-[illegible]" ① [illegible]
[illegible]-36" ①

36-48" slt mottle 2/3
48-66+ 2+



RECEIVED

APR 01 1994

EASTGATE
HEALTH DEPARTMENT

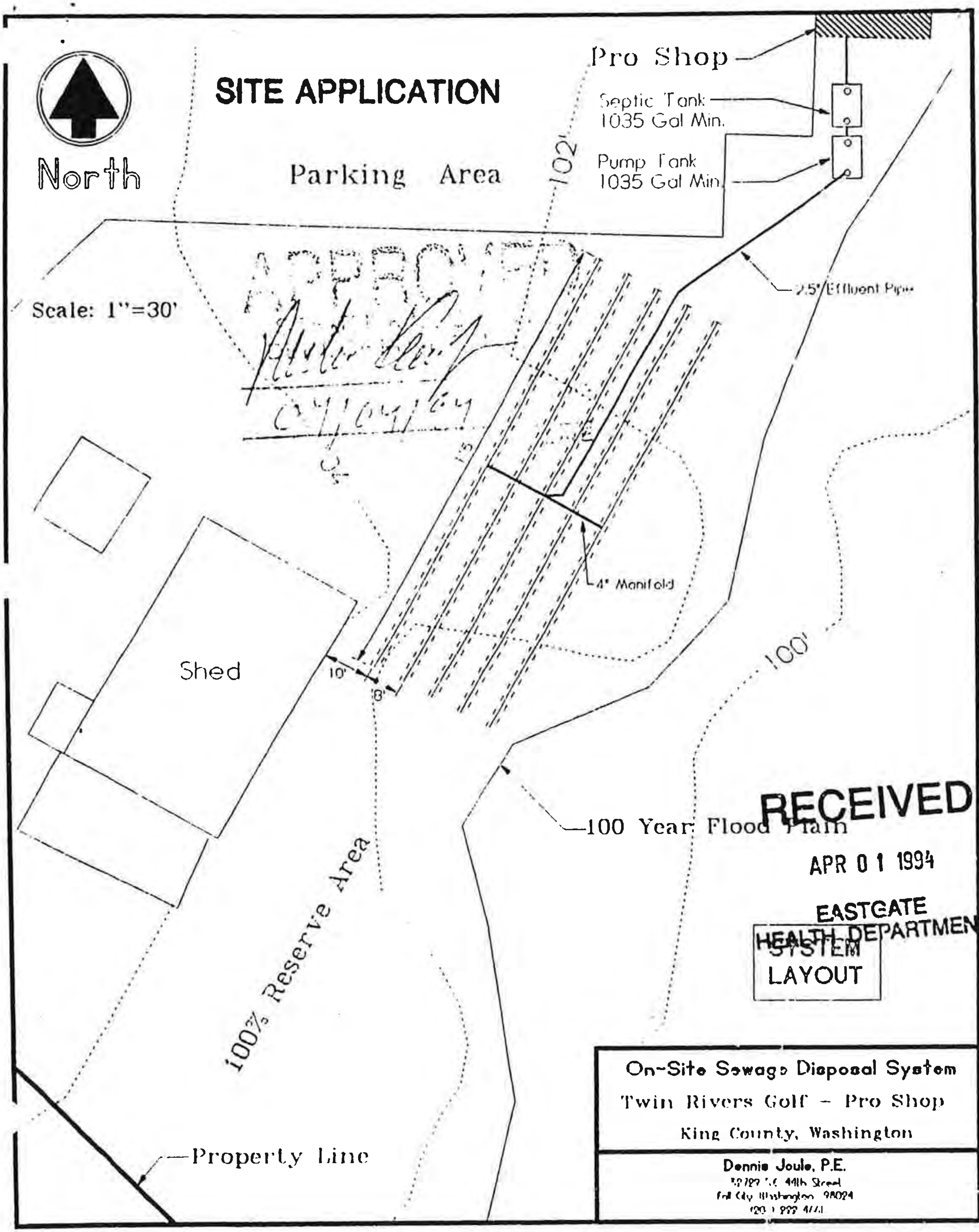
On-Site Sewage Disposal System

Twin Rivers Golf – Pro Shop

King County, Washington

Dennis Joule, P.E.
32729 SE 44th Street
Fall City Washington 98024
(206) 222-4561

SITE PLAN


SITE APPLICATION
North
Parking Area
Scale: 1"=30'
Pro Shop
Septic Tank
1035 Gal Min.
Pump Tank
1035 Gal Min.
102'
2.5" Effluent Pipe
4" Manifold
Shed
10'
8'
100'
100 Year Flood Plain
100% Reserve Area
Property Line
RECEIVED
APR 0 1 1994
EASTGATE
HEALTH DEPARTMENT
SYSTEM
LAYOUT
On-Site Sewage Disposal System
Twin Rivers Golf - Pro Shop
King County, Washington
Dennis Joule, P.E.

APPENDIX H

ATU COST TABLE

ALTERNATIVE AEROBIC TREATMENT UNITS

NAME/MODEL	COST	INCLUDES
Advantex Ax10	$3,000	attached growth filter contro panel, pumps, recirculating splitter valve
Bestep 10	lease $30-$35/month	monitoring, service, parts and sludgepumping
Chemstream	$2,300	small tank, clearstream treatment unit, blower, alarm panel, drip irrigation
Cajun Aire CA00500	$2,350-$10,000	tank, internal plumbing, alarm, aerator kit, control panel
EnviroServer	$11,900	1,300 tank, computer, 3 small pumps, blower
Five Star 505 KA	$7,500	tank, alarm panel, telephone callout station, RBC w/ drive unit
MicroFAST 23-001-750	$11,500-$13,500	1,600 gallon tank, installation, UV disinfection, drainfield, installation
Mighty Mac 5080S	$2,350-$10,000	tank, internal plumbing, alarm, aerator kit, control panel
Singular System	$7,500	concrete tank, disinfection-dry chlorine tablet, biodinetic filtration, timer/alarm
TRD-1000-500	$12,000-$14,000	TRD tank, hoses, aerobic unity, control box, junction box UV system, autodialer, alarm, installation
Whitewater ATE DF50-CF	$4,000-$5,000	tank electrical controls, blower, installation

NOTE:
Range: $2,300 - $14,000
O&M: $200 - $280 per year

APPENDIX I

LETTERS FROM TOM BERNARD

John Wilson
Tony Iwolo

BERNARD
DEVELOPMENT COMPANY

June 20, 2001

The Honorable Ron Sims
King County Executive
King County Courthouse
516 Third Avenue, Room 400
Seattle, WA 98104-3217

RE: Motion#10960 Fall City Stakeholder Meeting Wastewater Treatment
In the Fall City Business District
Work of the Fall City Stakeholder Committee

Dear Ron:

I am a Fall City Stakeholder, appointed to this committee by the King County Council. We are reviewing possible sewage wastewater treatment technology and disposal methods for the Fall City Business District. As required by the King County Comprehensive Plan, this new sewer work is limited to serve only the Fall City Business District. At our June 13th Stakeholder meeting, a fellow Stakeholder, Greg Fawcett, provided me with a draft copy of the June 13th, 2001 letter that he was planning to send you.

Basically, Greg's letter states he reviewed the 1991 wastewater facilities plan (for Fall City) by R.W. Beck and Associates, and that in his opinion (based on his review of this report and his other research), no wastewater treatment/disposal problems exist in the Fall City Business District. Greg states, "I feel government must be cautious not to base decisions that would have severe economic impact on a few individuals without considering the community as a whole." Greg is a Fall City business and property owner. He operates his dental business here.

My interpretation is that Greg is concerned that unaffordable costs, hook-up and operating charges might be forced on some business property owners, like himself, even if they do not need any upgrade or improvement to their own septic system. Like many of us, Greg does not want to have long and costly remedies imposed on his business or property, if no sanitary treatment or disposal problems exist with their own sanitary treatment system. Greg claims that no identified wastewater septic treatment or disposal problems exist anywhere in the Fall City business district, so no government action is needed to solve a problem that does not exist.

Greg goes at length through sections of the 1991 Beck report, a sanitary treatment study done at the time, in an attempt to show that no septic treatment or disposal problems exist in Fall City.

Frankly, I am impressed that Greg took the time to read the background materials and write such a detailed analysis of the 1991 Beck report. I am also impressed with Greg's effective writing. However, I think Greg's letter needs to be rebutted. There are existing problems with wastewater treatment and disposal systems in the Fall City Business District. Obviously, the work of the Committee is not to solve problems that do not exist. But wastewater treatment and disposal problems do exist in the Fall City Business District. These problems need curative actions.

Using his own letter language as my rebuttal, Greg even points out that the Beck Report states, "on-site sewage disposal systems serving commercial and institutional facilities in the Fall City study area suffer from the same basic design flaws as many of the residential on-site systems, specifically, dubious long-term disposal capacity and limited treatment efficiency."

Well, these are problems, aren't they? These same problems still exist, 10 years later.

I-90 / Preston Industrial Park
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Preston, Washington 98050
425-222-7979 Fax: 425-222-7970
e-mail: BernardDev@aol.com

At our June 13th meeting of Fall City Stakeholders, a very experienced sanitary consultant (engaged by the County in this process, Bill Stuth, Sr.) reported the results of his site-by-site visual inspection of 68 sites in the business district. He stated that only 13 (19%) are conforming systems that appear to be "conforming repairable" and 26 systems (38%) appear to be repairable with "non-conforming" repair. Thirteen (13) sites can only take a portion of their disposal water on site (limited disposal area), and 16 sites (23%) have no legal practical way to dispose of <u>any</u> sewage on site (this means point source loading and almost certain contamination of ground water is occurring on those sites). He calculated that 55% of the business sites fronting SR202 (the Preston/Fall City Road) have sewage treatment disposal problems.

Well, these are problems too.

In addition, there is no way the 20 year time horizon/permissible business development planned for accommodation in the Fall City Comprehensive plan can be implemented without having new sewage treatment and disposal improvements made here; including consideration for future development of the small amount of vacant undeveloped business zoned land that still exists in Fall City. Good planning should also consider likely use changes and redevelopment reasonably expected as one permitted business use changes to another, over time. As another consultant pointed out at our meeting, with such a small business base the change of only a few business uses can dramatically increase overall wastewater disposal volumes and concentrate peak load times when much greater sewage disposal volumes will occur.

Well, these are also problems.

Bill Stuth also pointed out (from his inspection) that "few septic tanks in the Fall City Business District are accessible for pumping." This means required and proper septic system maintenance cannot occur.

Well, this is a problem too.

There are sewage treatment and disposal problems aplenty. More than listed above. Additionally, this is not a wealthy business district with lots of ready cash to spend to resolve to sanitary system wastewater treatment and disposal problems. Some practical problems for our committee are how to sort through technologies and solutions and affordably design, finance and implement the various fixes that might occur; without burdening those business property owners (like Greg Fawcett) that apparently do not have a problem and prefer to be left alone. The bottom line is that obvious problems exist here, even to the extent that (while Greg would dispute this) sewage must be entering the ground water, insufficiently treated. Sites with zero open disposal areas are presently disposing of their sewage directly in to the ground, beneath building pads, paved areas and into inadequately sized drain fields. This is documented, and a significant violation of design codes, health regulations, and approved operating procedures.

The good news is that as Bill Stuth stated, these existing problems are solvable problems.

Greg makes a strong point that since the Fall City water source wells are not polluted, there is no problem, and that since the Snoqualmie River (tested in 1991), met quality standards, there is no problem. Well, it happens that in Fall City, ground water flows toward the river (away from water wells), and yes, with great river dilution the quality of the Snoqualmie River probably still meets water quality standards. But this does not mean it is okay to have even the possibility of insufficiently treated raw sewage entering the ground water, or to have inadequate wastewater treatment and inadequate disposal capacity to meet both existing and future needs with no fix now. We could have a time bomb here. By extension, is it okay to have radioactive waste going into ground water that is below the elevation where it might not yet be detected in surface waters?

Of course not. This is why we have wastewater code treatment and disposal requirements and why only properly cleaned up/treated sanitary sewer waste effluent should be disposed of into ground water. Our committee prefers to avoid treated wastewater disposal into the Snoqualmie River, and those complex Federal issues.

The good news is the consultants and various government specialists working on this issue with the Stakeholder Committee appear to be very capable. We are making good progress on defining the issues and possible solutions.

Thank you for recommending that the County Council support a process to resolve sanitary treatment and disposal problems in the Fall City Business District, and for implementing the process approved by the Council. As shown above, multiple sanitary treatment and disposal problems do exist in the Fall City business district. Ignoring these problems is not the way to achieve and maintain good clean ground water or to have a successful business community in Fall City. I hope we are on the trail to workable and affordable solutions.

Two of the several goals our Committee has adopted are that 1) business property owners will not be forced to connect or install new sanitary systems when they are not the source of a problem, and 2) any new sewage wastewater treatment and disposal solutions be reasonably affordable. We hope to meet these goals. Some property owners might implement their own independent (but properly approved) solutions to provide proper sewage treatment and disposal on their own site, or in clusters with owners combined for common treatment or disposal. We are exploring lots of possible solutions to compatibly resolve and affordably provide wastewater treatment and disposal systems here. We hope this effort is successful, and this process finally resolves those existing Fall City business district wastewater treatment and disposal problems listed above.

Sincerely,

Tom Bernard

J. Thomas Bernard
President

CC: Greg Fawcett/Fall City Stakeholders Committee
Other Stakeholder Committee members
Ruth Siguenza/EnviroIssues
David Irons/King County Council

BERNARD
DEVELOPMENT COMPANY

June 27, 2001

Bob Peterson
Conveyance Project Manager
King County Department of Natural Resources
201 S. Jackson Street, MS KSC-NR-0503
Seattle, WA 98104

Re: Fall City Wastewater Treatment and Disposal Study/ Stakeholder Group

Dear Bob:

As you know, I am a member of the Fall City Stakeholders Group, appointed by the King County Council to identify and recommend sewage treatment and disposal systems to resolve problems in the Fall City Business District. These problems range from likely failed and failing septic systems, point source sewage loading into ground water, and insufficient capacity to accommodate future uses, change of uses, and future limited growth in the existing Fall City Business District. As a member, you are aware that our group includes a few other "residents and users" and representatives from the Washington State Department of Health, Seattle-King County Health Department, and the King County Department of Natural Resources. We are rapidly moving toward recommendations for a wastewater treatment and disposal methods to use.

This letter includes background information that you are already well aware of, because this letter is also being copied to Alec Purcell, President of ECI and John W. Lee at CH2M Hill, whom I have asked to provide input to technical members of our Committee. I am concerned that some wastewater treatment technology and disposal methods are not being explored as they should be, because technical members of our committee and our consultant may not have extensive design experience and comfort with small sanitary wastewater treatment systems (like we are dealing with) to meet needs in Fall City. It is apparent to me that if we deal with a scaled down version of larger treatment systems and standard "septic type" disposal systems, the result will be a business district wastewater treatment and disposal (resulting from our study) that we business property owners cannot afford and needed remedial action will be frustrated, delayed, and prevented. This happened once before in Fall City (ten years ago), and we wish to avoid that result.

As I understand this, our Committee recommendations will go to the King County Executive, then his recommendations to the County Council, then and the Council's approval of the wastewater program for the Fall City Business District. Then conceptual design, environmental approval processing, a financial plan, financial commitments from participants (all business properties may not choose to participate, and various grant and financing methods will be explored), property acquisitions, actual design, permits, and construction.

As one alternative, I figure if we can start with the work already done for the on-site system already designed for the Bernard property located in the Fall City Business District (this is within Phase 1 of our Committee study area), This "real world" system could easily be adapted to sufficient wastewater treatment and disposal quantities. By using this approach, the time from committee recommendations to construction might be reduced from what could be five to eight years to two or three years; maybe less. And costs might be reduced considerably. For example, we already have land, site sub-surface exploration, test wells, groundwater test results, a technology that works, the design and environmental work already done by CH2M Hill as a model (simply increase the size system from 20,000 gpd to about 60,000 gpd). Significant time and cost savings can result, and dependability of our committee cost and design assumptions will improve dramatically.

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Preston, Washington 98050
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e-mail; BernardDev@aol.com

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In addition to time savings and reducing the risk of pursuing a dragging process that ultimately is not feasible, this approach (modeling on a small system already conceptually designed with proven technology, to be simply modified and upgraded) might even make this more of an affordable/ready program for use in Fall City. At least this should be considered. Treated wastewater disposal could be either directly into the Snoqualmie River or the ground water beneath the site. Both disposal methods are feasible. Necessary disposal water quality can be easily and dependably attained, using this existing technology. The State Department of Health simply has to quickly define the regulatory disposal water quality that is required.

This is not pioneering technology. For example, this company (ECI) has six "newest technology" wastewater treatment and disposal systems now operating in California (size 15,000 to 70,000 gpd). In Mexico City, several of their wastewater treatment installations are actually used for primary drinking water (in police stations). ECI also has hundreds of older less advanced technology systems operating. **Please contact Alec Purcell, President of ECI, directly at (206) 232-6791 or purcellab@home.com.** His address is 8630 S.E. 78,Th Mercer Island, 98040. Most of ECI's business is not in Washington.

The Fall City Business District is not a wealthy place. The cost numbers we looked at so far (without going into significant grant and government subsidy possibilities) look prohibitive for these small Fall City business landowners and business tenants to afford. This is why I believe we must consider treatment and disposal systems and methods that are already aimed at these small volumes, without the burden of force mains (six thousand of feet long) and large acreage land acquisitions; even if this technology is a little new to the Washington State Department of Health. Fortunately, we already have a model, already designed for use in Fall City. The field and engineering work is already done.

For the record, I am not promoting our Fall City site to be the location to locate this treatment and outfall or rapid infiltration installation. I have no ownership or financial interest in ECI, their products, their technology, what business they do, or sales they make. But as a Stakeholder, I do think this is worth considering. We can save years of time and uncertainty, as well as money. This is a reasonable possibility, located at one end of the collection line already proposed, and most fieldwork and much engineering and other evaluation work is already done. A treatment plant and either rapid infiltration or river outfall location could also be located elsewhere in the Fall City Business District. The important issue is that by using this design and technology approach, site costs, utility extension costs, engineering costs, design costs, and time to installation would be minimal. Certainty of results is also defined. This is worth exploring as one alternative. As a Stakeholder, I would like to see these exploration results included at our next meeting.

Finally, checking with my own design volume for my anticipated use, I see our design volume is 20,000 gpd, not 14,000 gpd as reported by Gray and Osborne in our last meeting (the 20,000 gpd figure includes a 40% contingency, which is recommended by the designer and (as I understand supported by the Department of Ecology), a wise conservative measure with this type of design. This means the upper design range of total disposal treatment and disposal we consider should be increased accordingly for both Phase 1 and Phase 1+ Phase 2. The Bernard Community Business zoned property is located in Phase 1, and is not yet developed. While some would prefer that our site not ever be developed, our Committee's 20 year Phase 1 and Phase 1 + 2 Plans should both assume 20,000 gpd sewage volumes from this six acre site, within the planning time horizon. It is poor planning and poor engineering to consider otherwise, even though some people in Fall City (and some Stakeholders) would like to see our land use restricted by artificially limiting sewage treatment capacity. **Please insure that the 20,000 gpd design use for the Bernard Phase 1 six acre Community Business (CB) zoned property is included in both the Phase 1 and Phase 1 +**

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Phase 2 design projections. If this is not done, we will just have a big messy political bru-ha-ha when the Gray & Osborne report is finished, absence of proper planning, and a hassle over under-planning to restrict our land use. Our Committee is not for the purpose of controlling land use. Absence of sufficient sewer capacity to accommodate reasonably anticipated growth in the Fall City Business District was an existing problem in Fall City, back when the 1991 Beck Report was done (as reported in that report), and is still a problem today.

I have already provided two copies of the 1998 CH2M Hill Engineering Report for Wastewater Facilities Construction to Gray and Osborne, for their reference and use. This report was submitted to the Washington State Department of Ecology with Application for a Wastewater Discharge Permit for Discharge of Municipal Wastewater to Ground Water on November 13, 1998 (Application No. ST 7410). In addition to this, we have available results from many months groundwater quality testing (from three on-site test wells). These samples taken by CH2M Hill, with approved laboratory testing. Infiltration examination is also already complete, using actual drill log information.

My request is for Gray and Osborne and the County to include this treatment system and disposal approach (rapid infiltration or direct river discharge) as an alternate in the Fall City Business District wastewater treatment/disposal plan. Without this wastewater treatment technology and disposal combination included in our study, our process is deficient. **Time is of the essence; Gray and Osborne's work is to be complete and delivered before our next meeting, Wednesday, July 11**.

The projection of 5 to 8 years or more (for design, environmental, and permit processing for a new wastewater treatment and disposal system to serve the Fall City Business District, as was mentioned in our last Stockholder's meeting) is simply not acceptable. And the cost estimates given to us (based on other technology and disposal methods) seem far from affordable (unless some unidentified outside source pays most all costs).

So rather than having a design and disposal system (and costs) and too low disposal volumes that are not feasible or timely, my request is that the ECI technology and both rapid infiltration and direct river discharge (from this treatment technology) be considered. At least this gives us one real small volume system to consider.

If this scope of work is beyond whatever King County has contracted for (I don't believe this is extra work), I am offering to have CH2M Hill provide their extra input and expertise to the Committee and our consultants as "extra work" (dealing with design and regulator officials regarding the ECI type systems as a feasible alternate for an overall Fall City "business district: sanitary system") on a time and materials basis. Bernard Development Company will either pay the cost for CH2M Hill's participation, either directly, or as a reimbursement to King County. Please use the study work CH2M Hill has already produced for us (and that we have already provided) as background material. I gave two copies of the CH2M Hill report to Gray and Osborne to make this process easy. Alec Purcell has also agreed to provide ECI technology references, regulatory references; up-to-date cost information, operating references, and other support at no cost.

BERNARD
DEVELOPMENT COMPANY

Obviously, if King County gets to the stage of actual design of a small sanitary treatment and disposal system here, that would be a separate "actual project cost" item, probably contracted for by the entity that will operate this small treatment/disposal system.

Please contact me directly (425) 222-7974 or BernardDev@aol.com to let me know what is being done.

Thank you Bob, for your attention.

Sincerely,

J. Thomas Bernard
President

CC: CH2M Hill – John W. Lee
ECI – Alec Purcell
Bill Stuth, Sr.
EnviroIssues – Ruth Siguenza
Fall City Stakeholder Group - D. Jay Bluher
Greg Fawcett
Steve Greninger
Ken Elliott
Richard Benson
Diane Fjarlie

July 25, 2001

Ruth Siguenza,
EnviroIssues

VIA E-mail: rsiguenza@earthlink.net

Re: Comments and Recommendations for Fall City Stakeholder's Committee
Business District Sewers
5 Pages

As demonstrated by professional site-by-site technical reviews related to our Committee review process, most existing wastewater disposal systems in the Fall City Business District (Phase 1 and Phase 2) do not meet current health and code requirements or today's standards for new septic installations. It appears that for a variety of reasons, most of the individual lot-by-lot wastewater treatment and disposal systems in the Business District are incapable of meeting those standards. Due to restricted land areas for proper on-site treatment and disposal by septic systems, overload of existing system capacities, and deficiencies such as under-building floor slab and under paved parking lot disposal of wastewater, it is clear that it is not possible or feasible to upgrade most existing waste disposal systems to meet current health and construction standards for proper on-site disposal of properly treated wastewater. This upgrading is needed to prevent continued groundwater pollution. While Snoqualmie river water testing has not demonstrated excessive pollution levels, insufficiently treated waste can only be draining into the groundwater. There is no other place for the waste to go.

System deficiencies are not the fault of existing property owners, these systems were built years ago and under different standards and practices of the times. Most of the Fall City business district is a relic of the past. Most of these septic systems were built when the business buildings were legally constructed; in the teens, '20's, '30's, 40's and '50's. The state highway 202 installation (between the Snoqualmie River and the main street frontage for business buildings) pushed the front row of business buildings back from the river, onto lots now too small to accommodate full size septic fields, and no reserve areas exist. These were times when little attention was paid to wastewater treatment and disposal, and today's "better treatment and disposal" standards did not exist. Most presently existing septic systems likely followed common building practices at the time they were built, when sewage disposal was considered acceptable as long as there was no back up into the business. What is considered safe and clean wastewater treatment and disposal today (for good science reasons) was not part of past culture or building practices.

Past and present Fall City business property owners did not knowingly cause the insufficiencies that exist today. But this no-fault situation does not remove the fact that health problems exist, not just for a few properties, but throughout the Fall City Business District. The challenge now is how to fix the problem equitably, affordably, soon, and without causing undue and unaffordable costs to property and business owners. For good planning, the fix needs to be in such a method so as to both provide for future development of undeveloped and vacant business property (just a few lots in Phase 1 property and more lots in Phase 2). The fix needs to accommodate normal redevelopment and legal change of uses for Phase 1 and Phase 2 business properties over time. Shutting down businesses and blocking legal business property uses in the Fall City business district by government action (because of sewage treatment and disposal problems these property and businesses owners did not cause or create) is not a fair or viable option. Ignoring the issue (one more time) is also not a good thing to do. Sewage treatment and disposal problems existing today will only be bigger problems tomorrow. Leadership and affordable actions are needed.

One of the most practical problems is the <u>cost</u> of replacing and building a clean and sufficient wastewater treatment and disposal sewer system for the Fall City Business District. Cost budgets prepared by Gray and Osborne are all unaffordable for existing property owners and businesses. Closing down businesses that have insufficient and non-conforming wastewater treatment and disposal systems, and preventing normal change of legal business uses and preventing development of the single undeveloped property in Phase 1 and blocking normal redevelopment and change of uses throughout the district will still not solve the wastewater treatment and disposal problems that exist today. Enforcement of existing wastewater treatment and disposal regulations and standards that now exist would only result in economic disaster for existing businesses and those property owners. These people did not create or cause present insufficiencies. Closing continued use of their properties would not be fair, it would be a taking with those legal issues.

Even replacing just the low volume Business District wastewater treatment and disposal systems that presently exist (with a new central system that can be properly built, operated, maintained and managed) is cost prohibitive and infeasible. At $2,000,000 for 36 properties, that cost would be at least in the range of $55,000 or more, for properties that typically sell for $200,000 (land and building). Some properties might pay two hundred thousand dollars or more for new sewers, and much more for operation of the new system. Driving business property values down to half or less of their present value and shuttering businesses is also not a good solution.

Refinancing of these properties would also not bring sufficient funds to pay for the new sewer system. Existing insufficiently sewer served properties will not qualify for refinancing (because sufficient sewage systems do not yet exist), and little or no new business would be gained by owners or business operators that add new sewers to save existing businesses.

From a political standpoint, does anyone in King County want to preside over shutting down most of the Fall City business district? If a shut-down were enforced (until a new sewer system was installed and those "unaffordable" costs charged to property owners), the end result would be major redevelopment of the Fall City business district into new much higher volume businesses and consolidated ownership's, like a retail strip mall. This not a good idea. It is better to save Fall City's Rural Town character and charm of existing small shops, restaurants, inns and stores. In a business shutdown, some owners would loose their entire property; others would sell to re-developers of new upscale projects that might afford new sewers. In the meantime, there would be few existing business or property owners able to pay the bill for new business district sewers. Something better is needed to save this Rural Town Business District from the suburban business district syndrome.

In other words, simply providing a new sewer system to replace existing insufficient systems (charged to existing property and business) is the worst alternative. This is infeasible. In the practical real world, present business septic system users cannot pay for the needed new sewer system. Even the smallest system explored is far too costly to be affordable. Attempting to charge those property owners (and tenants) for a new sewage system they cannot afford simply defeats the environmental purpose for which this project is aimed (achieving a clean environment by providing sufficient sewage capacity to replace existing sufficient systems). Building an insufficient new sewer system also defeats the planning purposes which a sufficient new sewer system should serve [providing sufficient sewer capacity for normal change of legal business uses, and providing sufficient sewage capacity for build-out completion of the Fall City Business District (Phases 1 and 2)]. It is also not the charge of the King County Comprehensive Plan to expand sewer service beyond the Business District. Quite the opposite, the sewer service use is to be limited to the existing Fall City Business District (both Phases 1 and 2).

The business of the Stakeholders Committee is to come up with a new sewer system or alternatives that are affordable and can actually be implemented; accommodating normal change of business uses, and normal growth within the existing (Phase 1 and Phase 2) Fall City Business District. **This is not just choosing a sewage treatment volume, disposal volume, and a technology system**. This is also choosing a sewer system program that has some feasibility to be built and paid for without expansion or sewer charges to any Fall City property outside of the existing (Phase 1 and Phase 2) Fall City Business District.

In order to have a feasible sewer system and to preserve and protect Rural Town rural character, we must have a Business District sewer system that is affordable for the type of businesses that are in Fall City now, plus normal change of business use and compatible growth that may occur within the existing Fall City Business District (Phase 1 and 2) in the foreseeable future; the next 20 year period for which the Comprehensive Plan applies. If we are successful, Fall City is much more likely to remain a small Rural Town for the long term. If we are not successful, Fall City is most likely to change to be somewhat like Kirkland, Redmond, Woodinville, and Issaquah; definitely not rural. In my opinion, affordably accommodating some changes in the business district (supported by an environmentally acceptable sewer system) is a key measure to retain Fall City as a small Rural Town. Big sewer costs on small business properties would change that. And yes, a no action to clean up the existing sewage problems (including the problem of insufficient capacity for future uses) would also result in major changes sooner, rather than later, because existing Fall City Business District sewage problems cannot be tolerated, long term. And shutting down businesses for problems they did not create would be a property taking, costly for the County.

MY RECOMMENDATIONS:

1) **Select a sewage treatment and disposal system (or alternatives) that is limited in location and technology installation to the existing Fall City Business District (Phase 1 and Phase 2).** This means a package treatment system with rapid infiltration or river outfall (**Alternative 4B or 4C**). The lot behind the Masonic Hall (or some other nearby property) could be the location for rapid infiltration installation. The six-acre Bernard property (next to the Colonial Inn) already has drill tests completed, demonstrating that rapid infiltration is completely feasible there. That geology is similar to the remaining Fall City Business District. This drill test information has been provided to Gray and Osborne. Water test well information has also been provided to Gray and Osborne; and more test well information is also available (tests taken from the Bernard property test wells over a one-year time period). This test information shows existing ground water below Class A standards. The Snoqualmie River is class A water.

2) **Find financing for a system (a combination of sources) that will minimize costs and is affordable to existing Fall City business and business property owners.** Simply stated, an investment of special attention and money in order to preserve the present small Rural Town Character is worthwhile. We believe that supporting Rural Dependent Economic uses (farming, rural tourism, use of natural resources, rural recreation, the diversity of a Rural Town community, and the like) will benefit everyone living and doing business in King County. Indeed, preserving a small rural town here in King County is a challenge. Fall City is unique. Providing a clean and viable sewer system for the small Fall City Business District is part of that challenge, and part of that special preservation effort. Unleash the creative financing people.

   Here are some creative thoughts. I understand (from information provided in our Stakeholder meetings) there are grant sources available, if local matching funds are provided. Well, maybe Bernard will provide funds to pay for 20,000 gpd treatment and disposal capacity to serve the Fall City Country Inn we plan. For example, with a 60,000 gpd plant built, having 20,000 gpd capacity reserved for the Bernard property, and a 50/50 match, two-thirds of the total cost would already be paid for.

   Another possibility is if the existing Fall City Business District sewage system inadequacies and deficiencies are made known, and enforced, a health emergency can be declared; thereby qualifying for more fix-the-problem funds. Maybe the last third of the cost can be paid for by these funds. Even if these are $2 million or $3 million costs, these are not break-the-bank expenses to preserve the rural character and Rural Town of Fall City. Fish will also likely benefit in this process, and could provide other grant sources.

   This all takes government and political vision, leadership, and commitment to find workable solutions to septic and sewer system problems that exist in the Fall City Business District.

3) **Provide sufficient capacity in the new sewer system design for treatment and disposal adequate for normal change in business uses, and buildout of the entire Fall City Business District (Phase 1 and Phase 2), but not sized or extended to serve residential areas.** Again, this element can be retained by restricting the sewer system elements to the boundaries of the Fall City Business District (Phase 1 and Phase 2), or quite nearby. Extending a force main 6, 500 feet (over a mile away) as the consultants have suggested in the scenarios they have favored is an invitation to future expansion of the Business District, multi-family housing, and similar future urban growth uses that require sewer use. For Rural Town preservation, it is better to limit the location of the new sewer improvements, including the disposal system, to the Business District area.

4) **Check the costs with actual vendors. Re-check cost estimates. Get another professional opinion from people that have built and operated these package plant systems. Bid this project on a design-build basis**. My information about the cost of package plant systems is these costs are not nearly as high as those costs provided in the cost comparisons by Gray and Osborne. For example, their comparison costs show the same Collection and Conveyance System Capital Costs ($636,000) for those systems having a 6,500 foot force main (ALT 4A/ Recalculating Gravel Filter with drip irrigation) and for ALT 4D/ Package Plant with Drainfield) as for ALT 4B (Class A reuse with rapid infiltration) and ALT 4C (package plant with river outfall). Only ALT 4B need have no force main, and Alt 4C would be a very short outfall, if the package plant were located in the Business District. There is no need to have an infiltration system outside of the Business District; the infiltration point can easily be taken vertically out of the flood plane, as CH2M Hill did with the package plant design for the Bernard site.

   Further, the consultants showed small system (27,800 gpd) Treatment Plant (with drainfield) and Disposal Capital Costs for package plant systems (with no drainfield) (ALTs 4B and 4C) more than three times above those costs provided to me by a package plant supplier. And package plant systems should not cost $700,000 more for going from 27,800 gpd to 55,700 gpd, and then another $360,000 to add another 15,100 gpd treatment capacity (going from 55,700 gpd to 70,800 gpd). Something is wrong with these numbers. These cost increases seem far out of line for what cost increases should be for simply upsizing equipment and a bigger infiltration hole in the ground. There is no need to have rapid infiltration in a remote location 6,500 feet away. One wonders if the numbers have been slanted to support drainfield and drip systems that regulators and our sewer system consultants are more familiar with. Hmmm.

   There may be similar too-high cost estimates for O&M costs for package plant systems. We see no need for an on-site operator six hours a day, every day. We understand that in a package plant/rapid infiltration system, disposal water (treated to Class A standards) is tested once a day in the plant storage tank, before disposal; this is not a continuous running water system needing constant oversight. Equipment maintenance is by a simple mechanic. Back up overflow and back-up emergency storage is provided in an extra reserve on site tank or tanks, as part of normal design. These tanks can be located above or below ground, or partially buried. This is not rocket science engineering or high cost work. We question the O&M cost estimate provided in the analysis, as being far too high for the package plant systems.

   Checking for cost estimate inaccuracies is pretty important in the selection of treatment and disposal technologies. Inaccuracies (if they exist) do not mean there is intentional slanting of the data. Good planning and good decision making and good cost estimates require checking and re-checking, sometimes using third party double-check sources or actual bids in an issue as important and costly as this one.

5) **How to allocate costs, one creative approach.**

   As I see this, we have **Basic System Costs**. These are costs to design and construct the basic collection, and conveyance, system, and plan and permit the entire system; including all land costs. All those overhead and the property costs are included as Basic System costs. I think these Basic System costs should be equitably paid by all users of the system; **including only those property owners and others wishing to reserve the right for their property (now or in the future) to have the right to connect to the sewer system to only serve Phase 1 or Phase 2 Fall City Business District property during the next 20 years following completion and operation of the Basic System**. Those property owners that choose to not participate should not be required or permitted to connect to this sewer service system for the next 20 years following completion of the Basic System; unless they buy a connection ticket from someone else. As I see this, anyone could buy a ticket to play, even if they own no property in the Fall City Business District. Each ticket would be good for one connection to the Basic System of the Fall City Business District Sewer System, anytime within the twenty years following completion of the Basic System. Any property owner (or anyone else) could purchase as many connection tickets as they want. I would expect almost every property owner would purchase at least one Basic System Cost ticket, to provide basic sewer system connection rights to their property. Others might purchase some tickets on an investment basis, and these tickets should be freely transferable. Those not purchasing a connection ticket initially would be at the mercy of marketplace in trying to purchase a sewer connection ticket from someone else in the future. This Basic System connection money can then also be used as a local contribution for matching grant purposes, doubling its value and reducing the local cost for the Basic System by 50%. A business property owner would have to be an idiot or destitute to not purchase a connection ticket, because this "property use right" would preserve much future value of their property. And yet, no one, even with a connection ticket, would be required to connect.

The **treatment and disposal plant capital costs** (and those financing expenses remaining after local contributions and grants and similar third partly contributions are made) should be financed (for a 20 year term) and paid by those actually using the system. Hopefully, these costs are minimal, after all financing and grant sources and local payments are established and funded. What I have in mind here is that property owners (or others) could buy the right to process a given volume of wastewater, on a daily volume basis, averaged monthly. Peak months could be offset by slow months, settled annually. But the overall system would never be required to accept flows beyond its treatment capacity. Like the connection tickets, "**Volume Disposal Use Rights**" could be privately purchased, sold, or transferred. Again, this right to dispose a given volume of wastewater would not have to be used. If a property owner does not purchase disposal rights initially, they might purchase and transfer those rights from someone else sometime in the future.

Waste Strength tickets would be treated the same as **Volume Disposal Use Rights**, allocating the waste system waste strength treatment capacity of the plant between those ticket purchasers.

To use the Fall City Business District sanitary sewer system, one would need a **Connection Ticket, Treatment and Disposal Use Rights**, and a **Waste Strength Ticke**t. A connected user could not exceed the rights they own.

Operating, maintenance, and repair, replacement, and administrative costs would be charged to users on a simple basis, say simply budgeting for each year and dividing budget costs by the volume use rights held and charging accordingly. People would be charged their share of operating costs, whether or not they actually used them. If they exceed their volume or waste strength use rights, a users service could be curtailed until they either purchase those rights from someone else, or reduce their use volume. Or, overusers could be charged at a very high rate (two times the cost for others or ten times that cost; whatever system is established). The system should keep some capacity in reserve, for emergency and contingency use purposes.

Well, I hope this letter adequately addresses the assignment you gave us. This is different than simply placing the alternatives in some order. This is my attempt to get sewers for the Fall City Business District in at an affordable and workable basis. Feel free to call me if you have any questions. As I said earlier, I stand ready to commit to purchase a 20,000 gpd **Volume Disposal Use Right** for our property, a **connection ticket**, and a **waste strength disposal ticket**. As long as I have these, and the ability to purchase other adequate tickets and rights for our purposes, it does not matter to me what total volume capacity system Fall City adopts. However, the design volume should be at least 60,000 gpd, plus about a 20% contingency . Nobody wants to revisit sewer expansion for the Fall city business District. Our opinion is that other than restricting this sewer system to the Fall City Business District (Phase 1 and Phase 2), the new system should not be used as a growth control tool. Some people might have trouble with that, but only an adequate system will solve existing sewage problems in the Fall City Business District. There needs to be sufficient capacity for normal change of business uses over time, and sufficient capacity for growth of business and customer and visitor use within the Fall City Business District. A new Business District sewer system of adequate capacity will solve existing problems here.

Sincerely,

J. Thomas Bernard
FALL CITY STAKEHOLDER

APPENDIX J

EXCERPTS FROM TMDL STUDY FOR THE SNOQUALMIE RIVER

A Department of Ecology Report

Snoqualmie River Total Maximum Daily Load Study

Abstract

The Snoqualmie is a river system with high water quality and multiple aquatic resources located within 15 miles (24 km) of the Seattle-Bellevue metropolitan area. The Snoqualmie River Valley is undergoing rapid changes in land use with additional waste load discharges projected for the river. Since 1989, the Washington State Department of Ecology has conducted several water quality investigations on 44.5 mi (71.6 km) of the lower river basin to define present and potential water quality problems during the summer low flow season. These investigations and water quality simulations, using the model QUAL2E, have resulted in estimating load capacities for biochemical oxygen demand (BOD), ammonia, and fecal coliform during the critical low flow months of August through October. Additional monitoring is also recommended to develop soluble reactive phosphorus (SRP) loading capacities in the future. The loading capacities will require waste load allocations (WLAs) of BOD and ammonia when the three existing municipal wastewater treatment plants (WWTPs) expand. Implementation of a nonpoint source (NPS) management plan for the mainstem and some tributaries will be necessary immediately to meet Class A fecal coliform criteria, and to meet BOD and ammonia load allocations (LAs). Interim point and nonpoint source SRP monitoring and future water quality-based effluent limits on phosphorus are likely to maintain high quality surface waters. A phased total maximum daily load (TMDL) was recommended to make adjustments to the WLAs/LAs as NPS controls are implemented, and as additional water quality and growth pattern data become available.

Background

Total Maximum Daily Loads (TMDLs)

Section 303(d) of the federal Clean Water Act requires states to identify waterbodies that are water quality limited (*i.e.* waterbodies that do not meet, or are not expected to meet, applicable water quality standards after sources have undergone technology-based controls). The United States Environmental Protection Agency (USEPA) also encourages states to protect good quality waters which are threatened with degradation (USEPA, 1991a). Both types of waterbodies are primary candidates for total maximum daily load (TMDL) evaluations.

by Joe Joy
May 1994

Waterbody Numbers WA-07-1060, -1062, -1066, -1100, -1102, -1104, -1106, -1108, -1110

Ecology Report #94-71

Table 5. Snoqualmie River QUAL2E model critical conditions for selected parameters from major river, tributary, point and nonpoint sources. River and tributary flows are seven-day, 20-year lows for August through October.

LOCATION	Flow cfs	Temp. °C	pH s.u.	D.O. mg/L	NH3-N mg/L	Organic N mg/L	BOD5 mg/L	SRP µg/L	Total P µg/L	Fecal Coli. cfu/100mL
S.F. Snoqualmie R.	81	18.1	7.9	9.5	0.012	0.001	0.7	4.5	15	27
North Bend WWTP *	0.62	--	--	6	15	5	45	4000	7000	400
North Bend WWTP **	2.16	--	--	6	11	5	45	4000	7000	400
N.F.& M.F. Snoqualmie R.	260	18.6	8.1	9.2	0.011	0.001	0.5	2	5	21
Mainstem Nonpoint Source	0.02	--	--	2	1.5	3	90	1400	4000	300000
Kimball Creek	0.95	--	--	8	0.018	--	1.4	8	16	1448
Snoqualmie RM 40.6	343	19.2	7.7	--	--	--	--	--	--	--
Snoqualmie WWTP *	0.4	--	--	6	15	9	90	1300	6000	400
Snoqualmie WWTP **	2.55	--	--	6	15	5	45	4000	7000	400
Tokul Creek	16.6	--	--	9.8	0.041	0.05	0.6	20	42	10
Raging River	8	--	--	8.8	0.015	0.1	1.4	5	5	31
Fall City WWTP **	0.31	--	--	6	15	5	45	4000	7000	400
Mainstem Nonpoint Source	0.1	18	--	2	15	30	90	1400	4000	300000
Patterson Creek	7.4	--	--	8	0.03	0.15	2	50	63	207
Mainstem Nonpoint Source	0.1	--	--	2	15	30	90	1400	4000	300000
Snoqualmie RM 25.2	385	19.9	7.8	--	--	--	--	--	--	--
Tolt River	66	--	--	9.9	0.01	0.001	0.6	2	5	15
Carnation WWTP **	0.31	--	--	6	15	5	45	4000	7000	400
Ames-Sikes Creek	2.1	--	--	8	0.19	0.54	3	300	870	6550
Mainstem Nonpoint Source	0.3	--	--	2	15	30	90	1400	4000	300000
Snoqualmie RM 10.7	465	20.3	7.8	--	--	--	--	--	--	--
Duvall WWTP***	0.54	--	--	6	8	5	45	4000	7000	400
Duvall WWTP***	1.16	--	--	6	8	5	45	4000	7000	400
Mainstem Nonpoint Source	0.15	--	--	2	15	30	90	1400	4000	300000
Cherry Creek	5	--	--	8.5	0.041	0.2	1.4	13	37	530
Mainstem Nonpoint Source	0.1	--	--	2	15	30	90	1400	4000	300000
Snoqualmie RM 0.2	475	20.5	7.8	--	--		--	--	--	--

* Maximum monthly average flow observed in the months of August through October (1989 - 1993).
** Proposed or projected growth scenario: dry weather monthly average flow.
*** Duvall WWTP has recently expanded and is permitted to discharge 1.39 cfs (0.9 MGD). Maximum monthly dry weather flows for near and far future were estimated.

Although intensive, site-specific mixing zone analyses are needed for permits, an estimate is presented here to judge whether mixing zone or far-field limits would be more restrictive for ammonia loads from the three municipal WWTPs. The information gained in the evaluation can be considered for the overall TMDL evaluation. Total residual chlorine (TRC) toxicity and effluent limits to meet mixing zone criteria are also estimated.

Dilution factors (DF) for Snoqualmie River point sources allowed under WAC 173-201A-100 were calculated using the following equations:

$$\text{Chronic criteria DF} = (Q_{NPDESc} + (0.25 \times 7Q10)) / Q_{NPDESc}$$

$$\text{Acute criteria DF} = (Q_{NPDESa} + (0.025 \times 7Q10)) / Q_{NPDESa}$$

where Q_{NPDESc} is the seasonal maximum monthly design flow, and $_{NPDESa}$ is the maximum daily seasonal flow. The 0.25 and 0.025 are the proportions of critical receiving water flow (7Q10 low flow) allowed by WAC 173-201A-100 for the mixing zone and acute criteria zone, respectively.

(Note: The percentage of critical flow mixing zone criterion was used for the general purposes of this report. An actual mixing zone study would need to evaluate whether flow volume, width, or downstream distance would be the most restricting factor for an individual mixing zone. Joy *et al.*, (1991) performed an idealized preliminary assessment (center outfall diffuser) of these factors for Snoqualmie River point sources. All three municipal WWTPs now have side-bank discharges rather than center diffusers, but will probably be asked to modify them within the next 10 years.)

A simple mass balance equation was used with the dilution factor to calculate TRC and ammonia (acute and chronic) mixing zone WLAs for the individual WWTP as follows:

$$\text{Mixing Zone WLA} = (WQS \times DF) - (CA \times (DF - 1))$$

where the WQS is the acute or chronic water quality standard, and the CA is background receiving water concentration of pollutant in question. Critical temperatures, pH values, and background concentrations used to calculate the ammonia criteria are listed in Table 5.

The long-term average concentrations needed to meet mixing zone WLAs were then calculated with consideration for effluent variability, sampling frequency, and criterion duration (USEPA, 1991b). The resultant estimated permit concentrations based on this analysis are presented in Table 6.

With the exception of North Bend, the long-term average ammonia concentrations necessary for the existing WWTPs at seasonal capacity to meet the mixing zone WLA are generally higher than technology-based concentrations. The North Bend estimated monthly average ammonia permit limit would be near the 15 mg/L technology-based concentration. Future expansion may require ammonia limits for mixing zone considerations, especially at North Bend and Snoqualmie. However, North Bend and Snoqualmie WWTPs have demonstrated nitrification capabilities, and have achieved effluent concentrations of less than 1 mg/L ammonia (Heffner, 1991; Das, 1992). In conclusion, these ammonia mixing zone WLAs may prevent near-field aquatic toxicity, but they may be inadequate for deterring far-field D.O. deficits created by nitrogenous oxygen demand. This will be evaluated in the D.O. discussion in the next section.

Because the municipal plants using chlorine disinfection are distant, TRC has no cumulative effect in any reach of the river and no TMDL is required. The municipal WWTPs may have difficulty meeting the long-term average TRC effluent concentrations in Table 6. At existing seasonal capacity, all WWTPs will require TRC of less than 0.2 mg/L based on the assumptions of this analysis. The expanded WWTPs will need to purchase more sophisticated TRC monitoring equipment or they may need to dechlorinate effluent as TRC limits drop below 0.1 mg/L.

Recommended Waste Load Allocations

The BOD_5, ammonia, SRP, and fecal coliform loading capacities and WLA/LAs for low flow conditions on the Snoqualmie River are summarized in Tables 7, 8, and 9. These WLA/LAs apply to the months of August, September, and October when the critical conditions defined for the river are likely to occur. Water quality problems in the Snoqualmie River system have not been identified and investigated by Ecology for other seasons of the year.

A phased TMDL approach is recommended for the Snoqualmie River system as defined by USEPA guidance (USEPA, 1991a). The phased approach is appropriate where a large NPS component is included in the TMDL, or where some data contain a high degree of uncertainty. The TMDL is refined as specific NPS problems undergo control measures, or as additional data are obtained. The approach should work well with the five year basin review cycle being used by Ecology's Water Quality Program. Four major reasons a phased approach is recommended for this system are:

1. The Snoqualmie River LAs have "gross allotments" to NPS loads both along the mainstem and as portions of the tributary loads. A systematic identification of specific nonpoint loading sources will take an altogether different type of monitoring effort to separate livestock access, manure management, on-site septic system failure, golf course runoff, general agriculture, and residential runoff impacts. Once a NPS source is located, it is subject to intensive education, negotiation, or enforcement procedures which require a large commitment of resources from local agencies and Ecology regional staff. It is difficult to estimate the effectiveness of nonpoint source controls since data are not readily available, and effectiveness may vary greatly between locations.

2. The basin is in a uncertain state of population growth and land development. The water quality of the river will respond differently to equivalent additional waste loads depending on their point of entry. For example, increased waste loads at North Bend have different impacts and considerations than waste load increases in the lower valley. In addition to location-specific impacts, different NBOD and CBOD combinations will affect downstream D.O. differently. The scenarios simulated here approximate future development, but revised projections based on project specific engineering will be needed.

3. A TMDL effort is currently underway for the Snohomish River (Cusimano, 1993). This effort could result in modifications of the TMDLs on the Snoqualmie River in order to meet Snohomish River water quality goals.

Table 9. Summary of estimated contaminant loads to the Snoqualmie River during critical low flow: August, September, and October (units of lbs/day). Expansion of three municipal wastewater treatment plant (WWTP) to projected seasonal capacity and nonpoint sources are evaluated. Recommended controls are outlined.

PROJECTED WWTP EXPANSION WITH CONTROLS - NO NPS CONTROLS
Loads
Flow s/d)) (lbs Colifor

WWTP AND NPS CONTROLS
Concentrations
BOD5 NH3-N SRP Fecal*
(cfs)
Loads
BOD5 NH3-N SRP Fecal*

Table 7. Summary of estimated contaminant loads to the Snoqualmie River during critical low flow: August, September, and October (units of lbs/day). Existing (1994) municipal wastewater treatment plant (WWTP) at seasonal capacity and nonpoint sources are evaluated. Recommended permit or loading changes are outlined.

CURRENT CONDITIONS NO LIMITS

	Concentrations					Loads			
	Flow (cfs)	BOD5 (mg/L)	NH3-N (mg/L)	SRP (mg/L)	Fecal* Coliform	BOD5 (lbs/d)	NH3-N (lbs/d)	SRP (lbs/d)	Fecal* Coliform
POINT SOURCES									
North Bend	0.62	45	15	4	400	150	50.1	13	6.1E+09
Weyerhaeuser	0.01	4.7	0.08	0.03	6	0.25	0.004	0.002	1.5E+06
Snoqualmie	0.4	45	15	1.3	400	97	32.3	3	3.9E+09
Duvall	0.54	45	8	4	400	131	23.3	12	5.3E+09
Point Source Loads						379	106	28	1.5E+10
MAINSTEM NONPOINT SOURCES									
Three forks area	0.02	60	1.5	1.4	3E+05	6	0.2	0.2	1.5E+11
Below Fall City	0.1	60	15	1.4	3E+05	32	8.1	0.8	7.4E+11
Below Patterson Cr.	0.1	60	15	1.4	3E+05	32	8.1	0.8	7.4E+11
Novelty Hill Bridge	0.3	60	15	1.4	3E+05	97	24.3	2.3	2.2E+12
Cherry Creek area	0.15	60	15	1.4	3E+05	49	12.1	1.1	1.1E+12
High Bridge Area	0.1	60	15	1.4	3E+05	32	8.1	0.8	7.4E+11
Mainstem Nonpoint Loads						249	61	6	5.7E+12
BACKGROUND & TRIBUTARIES									
S.F. Background	81	0.6	0.012	0.0045	27	262	5.2	2.0	5.4E+10
Middle Fork	187	0.6	0.011	0.002	21	605	11.1	2.0	9.7E+10
North Fork	73	0.6	0.011	0.002	21	236	4.3	0.8	3.8E+10
Kimball Cr.	0.95	1.4	0.018	0.008	1448	7	0.1	0.0	3.4E+10
Tokul Cr.	16.6	0.6	0.041	0.02	10	54	3.7	1.8	4.1E+09
Raging R.	8	1.4	0.015	0.005	31	60	0.6	0.2	6.1E+09
Patterson Cr.	7.4	2	0.03	0.05	207	80	1.2	2.0	3.8E+10
Griffin Cr.	1.75	1.4	0.031	0.008	238	13	0.3	0.1	1.0E+10
Tolt R.	66	0.6	0.014	0.002	15	213	5.0	0.7	2.4E+10
Harris Cr.	1.46	1.4	0.016	0.015	50	11	0.1	0.1	1.8E+09
Ames-Sikes Cr.	2.1	3	0.19	0.3	6550	34	2.2	3.4	3.4E+11
Tuck Cr.	0.34	1.4	0.051	0.067	74	3	0.1	0.1	6.2E+08
Cherry Cr.	5	1.4	0.041	0.013	530	38	1.1	0.4	6.5E+10
Tributary and Background Loads						1616	35	14	7.1E+11
Total Load						2243	202	47	6.4E+12

NPS AND SRP CONTROLS

	Concentrations					Loads			
	Flow (cfs)	BOD5 (mg/L)	NH3-N (mg/L)	SRP (mg/L)	Fecal* Coliform	BOD5 (lbs/d)	NH3-N (lbs/d)	SRP (lbs/d)	Fecal* Coliform
North Bend	0.62	45	15	**0.73**	400	150	50.1	**2**	6.1E+09
Weyerhaeuser	0.01	4.7	0.08	0.03	6	0.25	0.004	0.002	1.5E+06
Snoqualmie	0.4	45	15	1.3	400	97	32.3	3	3.9E+09
Duvall	0.54	45	8	4	400	131	23.3	12	5.3E+09
Point Source Loads						379	106	17	1.5E+10
Three forks area	0.02	60	1.5	1.4	3E+05	6	0.2	0.2	1.5E+11
Below Fall City	**0.08**	60	15	1.4	3E+05	**24**	**6.1**	**0.6**	**5.5E+11**
Below Patterson Cr.	**0.07**	60	15	1.4	3E+05	**23**	**5.7**	**0.5**	**5.2E+11**
Novelty Hill Bridge	**0.1**	60	15	1.4	3E+05	**32**	**8.1**	**0.8**	**7.4E+11**
Cherry Creek area	**0.1**	60	15	1.4	3E+05	**32**	**8.1**	**0.8**	**7.4E+11**
High Bridge Area	0.1	60	15	1.4	3E+05	**32**	**8.1**	**0.8**	**7.4E+11**
Mainstem Nonpoint Loads						150	36	4	3.4E+12
S.F. Background	81	0.6	0.012	0.005	27	262	5.2	2.0	5.4E+10
Middle Fork	187	0.6	0.011	0.002	21	605	11.1	2.0	9.7E+10
North Fork	73	0.6	0.011	0.002	21	236	4.3	0.8	3.8E+10
Kimball Cr.	0.95	1.4	0.018	0.008	**80**	7	0.1	0.0	**1.9E+09**
Tokul Cr.	16.6	0.6	0.041	0.02	10	54	3.7	1.8	4.1E+09
Raging R.	8	1.4	0.015	0.005	31	60	0.6	0.2	6.1E+09
Patterson Cr.	7.4	**1.4**	0.03	**0.02**	**80**	**56**	1.2	**0.8**	**1.5E+10**
Griffin Cr.	1.75	1.4	0.031	0.008	**80**	13	0.3	0.1	**3.4E+09**
Tolt R.	66	0.6	0.014	0.002	15	213	5.0	0.7	2.4E+10
Harris Cr.	1.46	1.4	0.02	0.015	50	11	0.2	0.1	1.8E+09
Ames-Sikes Cr.	2.1	**2**	**0.03**	**0.02**	**80**	**23**	**0.3**	**0.2**	**4.1E+09**
Tuck Cr.	0.34	1.4	**0.03**	**0.02**	**74**	3	**0.1**	**0.0**	**6.2E+08**
Cherry Cr.	5	1.4	**0.03**	0.013	**80**	38	**0.8**	0.4	**9.8E+09**
Tributary and Background Loads						1580	33	9	2.6E+11
Total Load						2109	175	30	3.7E+12

* Fecal coliform units of ...

4. The response of the river to increased nutrient loading is uncertain. For example, additional nutrient loads may create a greater range in diurnal D.O. concentrations through increased primary productivity. On the other hand, a larger macroinvertebrate population or other factors may control the biomass growth and prevent excessive productivity. The SRP guideline and D.O. margins of safety in this assessment may need adjustment as monitoring data reveals the river's response.

The loading capacities and WLAs/LAs discussed in the following sections should be incorporated into current NPDES permits and any upcoming NPS management plans as part of the TMDL. The long-term average concentrations for the NPDES permit limits may vary from the WLAs when effluent variability and design flow data are used in the limit calculation (USEPA, 1991b). Modifications and refinements (*i.e.*, the phased TMDL) may be required after implementing the WLAs and LAs to more effectively meet water quality goals as new data are obtained through ongoing monitoring and pollution control activities.

Dissolved Oxygen: BOD and Ammonia

The target D.O. concentrations and Class A criterion in the Snoqualmie River will be met with existing NPS and permitted municipal loads of approximately 2,243 lbs/day BOD_5 and 202 lbs/day ammonia (Table 7). The loads assume existing municipal WWTPs will perform at maximum seasonal monthly average capacities with weekly averages of 45 mg/L BOD_5 and technology-based or permit ammonia concentrations of 8 to 15 mg/L. Mixing zone ammonia WLA concentrations calculated earlier in this report to avoid aquatic toxicity are similar or less restrictive than the technology based concentrations. Approximately 13% of the BOD_5 load and 31% of the ammonia load are contributed by NPS. If 135 lbs/day BOD_5 and 27 lbs./day ammonia are eliminated from mainstem and tributary NPS loads through fecal coliform source control measures (see discussion below), a small D.O. improvement may occur in the lowest river reaches.

Several future scenarios were modeled to estimate the loading capacity of the river as municipal WWTPs expand. Based on these results, approximately 96 to 254 lbs/day BOD_5, and 69 to 203 lbs/day ammonia may be available for additional municipal loading. The available loads are dependent on source location, effluent BOD and ammonia characteristics, and NPS management activities in the study area. Headwater ammonia, BOD, organic nitrogen loads (e.g., Middle and North Forks), or good quality tributary loads (e.g., Tolt R. and Tokul Creek) were considered constant in all scenarios modeled.

D.O. model results indicate unacceptable deficits will occur at the two compliance points in the river if additional wastewater volumes are discharged from municipal WWTPs at a standard secondary treatment weekly average BOD_5 concentration of 45 mg/L (Figure 6). Additional oxygen demand loads from new WWTPs or from the expansion of existing WWTPs can meet D.O. target concentrations if NPS LAs and point source WLAs of BOD_5 and ammonia are allocated carefully. Several combinations of BOD_5 and ammonia allocation are possible depending upon the expansion pattern in the valley. Two examples of WLA/LAs under greater waste loads in the future are demonstrated.

In the first scenario, where the future growth capacity is allocated to two additional WWTPs and to expansion of existing WWTPs, effluent BOD_5 concentrations of 15 mg/L and ammonia concentrations of 5 mg/L will be needed (Table 8). This assumes no NPS controls were implemented. The allowable loads from all sources would be 2,390 lbs/day BOD_5 and 271 lbs/day ammonia. Mainstem and tributary NPS controls to meet fecal coliform criteria could reduce BOD and ammonia loads by 40%. If reallocated to the WWTPs, effluent ammonia could be increased to 9 mg/L.

The municipal treatment plants would have little difficulty meeting these limits during the low flow season if they perform as well as they did in 1991 (Das, 1992). Literature values also suggest that extraordinary technological measures to meet these WLAs would be unnecessary if the activated sludge plants were run with single stage nitrification (Metcalf and Eddy, 1991: Table 11-3).

The second scenario assumes expansion of only the three existing WWTPs (Figure 6 and Table 9). To meet the target D.O. concentrations at the compliance points, effluent BOD_5 concentrations of 15 mg/L and ammonia concentrations of 7 mg/L would be required if no NPS controls were in place. The total load capacity from all sources would be 2,340 lbs/day BOD_5 and 317 lbs/day ammonia. With NPS control and reallocation of pollutant loads to the WWTPs, an effluent BOD_5 of 20 mg/L and ammonia of 8 to 10 mg/L would be allowable at the WWTPs. As with the first scenario, well-run activated sludge plants with single stage nitrification should not have difficulty meeting these effluent concentrations in the low flow period.

The two scenarios demonstrate the reason the load capacities and WLAs/LAs are expressed as approximate values. Several combinations of BOD and ammonia loading will result in D.O. compliance. The specific combinations need to be evaluated for each new plant or plant expansion, since it is the combination of these two effluent components along with the discharge location which affect downstream D.O. concentrations. Permit managers also need to be aware that there is not a simple one to one equivalence between the BOD and NBOD components.

Further control of mainstem and tributary nonpoint sources, or limits on point sources beyond what is projected in the scenarios will provide additional BOD and ammonia loads for reallocation. They could be reallocated as an additional margin of safety for meeting D.O. criteria at the confluence, as support for future growth, as adjustment for increases in diurnal D.O. ranges if instream productivity rises, or for Snohomish River TMDL requirements. Residential development and resultant NPS loads along the three forks above the study area may require modification of the upstream background conditions assumed in the model. These adjustments and reallocations would be a normal part of the phased TMDL process.

Fecal Coliform

As discussed earlier, a target fecal coliform model result of 80 cfu/100 mL would likely meet the Class A fecal coliform criteria geometric mean of 100 cfu/100 mL with not more than ten percent over the 200 cfu/100 mL). This target count would be met in mainstem reaches if mainstem NPS fecal coliform loads were reduced by 40% (Table 7 and Figure 7). Reducing the fecal coliform load in a few tributaries would further reduce mainstem concentrations and bring the tributaries into compliance with standards. The latter would be accomplished by setting LAs for each of five tributaries:

- Kimball Creek
- Ames-Sikes Creek
- Patterson Creek
- Cherry Creek
- Griffin Creek

The LAs would be based on compliance with the 80 cfu/100 mL fecal coliform target.

A nonpoint management plan is necessary to accomplish the LA goal and improve water quality by bringing NPS on mainstem reaches and tributaries into compliance with best management practice standards. The two priority mainstem areas are located between Fall City and Griffin Creek, and between Duvall and the confluence with the Skykomish River (Figure 7). Kimball Creek and Ames-Sikes Creek are tributaries with the highest fecal coliform counts. To improve bacterial water quality, the plan should address controls for livestock access to waterbodies, manure management, and on-site septic system maintenance. Controls for these waste sources would reduce fecal coliform and other contaminants such as BOD, ammonia, and SRP.

In addition, point source discharges should maintain low fecal coliform effluent counts to protect public health at downstream beaches (Patterson and Dickes, 1993). It is promising that Das (1992) reported improved disinfection in 1991 compared to 1989 results reported by Heffner (1991). As discussed earlier, however, the low TRC values necessary to meet mixing zone WLAs may compromise effective disinfection unless the system is closely managed or dechlorination units are installed.

Soluble Reactive Phosphorus

Washington State does not have specific water quality criteria for phosphorus, nitrogen, or algal biomass. Eutrophication can be indirectly controlled using D.O. and pH criteria, or by using references in WAC 173-201A-030 to "deleterious materials . . . adversely affecting characteristic water uses" and impairment of "aesthetic values." More direct criteria are used by other states for nutrient and eutrophication control. Phosphorus standards for rivers and streams range from 5μg/L in British Columbia to 100 μg/L in several states. Wastewater discharges to the Great Lakes in Michigan are limited to 1 mg/L total phosphorus to prevent eutrophication.

The data review earlier in this report indicated the Snoqualmie River system may have several physical attributes making it sensitive to nuisance growths of periphyton and macrophytes during the low flow period. Joy *et al.* (1991) reported nuisance growths of periphyton on the South Fork Snoqualmie River below the North Bend WWTP, where average concentrations of SRP were greater than 10 μg/L. This concentration is consistent with reports from British Columbia (B.C.) rivers where SRP concentrations as low as 5 μg/L have stimulated heavy algal biomass accumulations (Nordin, 1985).

The biomass response to SRP on the mainstem river may be quite different from the South Fork and some B.C. rivers. For example, depth and velocity characteristics may limit periphyton accumulations more than nutrient availability. However, the aquatic life and aesthetic resources of the Snoqualmie River system require careful consideration before damage is caused by additional nutrient loading. Therefore, to protect these resources we propose a maximum instream concentration guideline of 10 μg/L SRP during the low flow season. In river reaches where one or more point and nonpoint discharges are in close proximity, the 10 μg/L limit would need to be met below the discharge site located the farthest downstream.

If the guideline is exceeded, dischargers would need to demonstrate the increased SRP load has no deleterious effect on the river. Increased algal biomass monitoring during the low flow period would be initiated, and alternative ways to reduce phosphorus loads would be investigated.

The cumulative SRP load for the Snoqualmie River system is about 46 lbs/day under critical flow and current source loading conditions. The only study reach out of compliance with the 10 μg/L SRP guideline in this scenario is the South Fork (Figure 8). The allowable SRP capacity for the South Fork Snoqualmie River below North Bend is 4.25 lbs/day. Forty-seven percent of this is allocated to background, and 54% is available to North Bend WWTP or other sources. North Bend would need to reduce its 4 mg/L effluent SRP concentration to 0.84 mg/L, or reduce its SRP load by 10 lbs/day to comply with the instream guideline (Table 7).

Future growth scenarios were explored (Table 8 and 9). The cumulative SRP load from all sources for these scenarios is around 50 lbs/day. All WWTPs would need SRP effluent concentrations less than 2.5 mg/L (or commensurate load reductions) to meet the 10 μg/L SRP instream guideline. For example, the waste load allocation for North Bend WWTP would not change as the WWTP expanded so the effluent SRP concentration would need to be reduced to 0.22 mg/L. The Snoqualmie WWTP loads could increase from 2 lbs/day to 14 lbs/day if SRP effluent concentrations were reduced from 1.3 mg/L (as the current lagoon system) to 1.05 mg/L (new facility). Duvall, Fall City, and Carnation WWTPs would need to have a final mixed SRP concentration lower than 10 μg/L because of their close proximity to mainstem and tributary NPS (Figure 8). Resultant effluent SRP concentrations of 1.4 to 2.5 mg/L would be necessary. NB

The most restrictive effluent concentrations and loads for Fall City, Carnation, and Duvall WWTPs would occur if NPS control measures were not implemented, or if the measures used to control bacteria were not effective on SRP loads. Controlling NPS phosphorus loads in the lower river would obviously provide relief to these point source dischargers. Removing 2 lbs/day SRP from mainstem NPS and 5 lbs/day from the problem tributaries would reduce reach concentrations and allow approximately 8 lbs/day SRP for WWTP use. On the other hand, upstream development, NPS, and background SRP increases above Snoqualmie Falls may increase background SRP and further limit North Bend and Snoqualmie WWTP loads. This could eventually expand NPS management actions into the greater North Bend/Snoqualmie area.

The relative locations of the nutrient sources are important since SRP uptake rates vary along the river, and inputs are not strictly additive. In the phased TMDL process, the dischargers and regulators could negotiate the priority of nonpoint control actions and point source permit limits, and the resultant allocation of the SRP loads. As nonpoint source controls are established, the removed NPS loads of SRP could be reserved for future growth, held for a measure of safety, or reallocated to an existing discharger.

Monitoring

Monitoring will be an essential part of maintaining the Snoqualmie TMDLs. A phased TMDL approach relies on monitoring data to refine WLAs and determine effectiveness of control actions. Several types of monitoring programs are needed, and should be coordinated within the TMDL/WLA/LA program structure, and within the five-year basin cycle Ecology is using for water quality management.

Effluent flow, BOD_5, ammonia, phosphorus, and TRC data will be needed as a part of an expanded NPDES discharger monitoring program during August, September, and October. Instream data above and below the plants will be also important for establishing equitable WLAs, and checking compliance. A twice monthly frequency for water column samples, and a weekly effluent monitoring program will probably be adequate. If phosphorus loading exceeds the guideline, benthic biomass needs to be measured a few times through the low flow season at sites with similar physical characteristics above and below the discharge.

Monitoring and synoptic investigations of nonpoint sources in the priority areas will be needed to formulate meaningful nonpoint source management plans. The monitoring can be used to help conservation district staff with farm plans, help local agencies justify funding for control projects, or help with enforcement actions. Monitoring will also be needed to measure effectiveness of the controls once they are implemented. This monitoring will be important for checking the goals and assumptions set in the TMDLs for nonpoint source LAs, and also for refining WLAs. Land use monitoring and evaluation will be an important component of the NPS management portion of the TMDL as well.

As currently placed, ambient monitoring stations on the Snoqualmie River do not provide the best data to check WLA and LA compliance. Additional or modified monitoring programs should build from analyses of the ambient network and synoptic survey data. Diurnal D.O. monitoring should be conducted at the Highway 202 bridge above the Falls (RM 40.7) and at the High Rock bridge at RM 2.7. Fecal coliform ambient sampling would best be concentrated in the lower valley in coordination with the nonpoint source monitoring. An integrated monitoring program using periphyton and macrophyte biomass measurements would be important to evaluate the effectiveness of the SRP guideline in preventing eutrophication.

Conclusions and Recommendations

- Most reaches of the Snoqualmie River study area currently meet applicable Class A or Class AA water quality standards during low flow periods. Temperatures and dissolved oxygen concentrations at some mainstem sites do not meet Class A criteria, but the contribution from human activities to these problems compared to natural background sources is not well understood. NPS and poorly dispersed WWTP effluent create most of the localized bacterial and nutrient enrichment problems on the mainstem, and in some tributaries.

- Municipal point sources at existing seasonal discharge capacities require few additional controls to meet dissolved oxygen (D.O.), fecal coliform, ammonia and nutrient criteria or target concentrations in the receiving water during the critical low flow period of August, September, and October. Existing mainstem and tributary nonpoint sources (NPS) require controls to ensure that all parts of the Snoqualmie River will meet Class A fecal coliform criteria.

- Field data and model results show dissolved oxygen concentrations in the pool above Snoqualmie Falls drop below the Class A criterion of 8.0 mg/L during critical conditions when a diurnal range of 1 mg/L is applied. Model results further indicate the loss also occurs without upstream municipal wastewater loading. A target minimum daily D.O. concentration of 7.9 mg/L was suggested for the pool, with not more than an additional 0.1 mg/L deficit allowed for human-caused sources. For the purposes of interpreting water quality model results, a model concentration of 8.3 mg/L was used as the minimum acceptable mean value to evaluate waste load effects on D.O. in the pool.

- Field data and model results for the Snoqualmie River reaches at the confluence with the Skykomish River also indicate susceptibility to Class A D.O. criterion violations. To interpret model results and waste loading estimates, a 0.7 mg/L margin of safety was recommended in these lower reaches. Model concentrations of 8.7 mg/L were considered minimum acceptable mean values that would account for model uncertainty caused by diurnal range estimates and NPS source variability.

- Fecal coliform bacteria field data and model results clearly showed that instream counts were driven by nonpoint sources located on the mainstem and on several problem tributaries. Existing and projected municipal point source loads (within permit limits) were inconsequential by comparison. Several reaches of the river experience frequent, but unpredictable, fecal coliform criteria violations. As a result of this unpredictability, a model result of 80 cfu/100 mL was used as a target to acheive fecal coliform criteria compliance.

- Effluent phosphorus controls will be needed at North Bend WWTP to eliminate nuisance growths of periphyton in the South Fork Snoqualmie River. Model results of projected phosphorus loads from expanded municipal sources within the study area showed elevated levels of SRP capable of stimulating unacceptable periphyton and macrophyte growth in other areas of the river. Washington State has no phosphorus or eutrophication criteria to manage this potential source of degradation. A 10 μg/L SRP guideline is recommended as a trigger for increased monitoring and facilities planning until more is known about the biomass response to increased nutrient loading.

- A general mixing zone analysis of ammonia and total residual chlorine (TRC) for the municipal discharges was presented using idealized outfall construction assumptions. Low TRC concentrations or dechlorination will be required in the near future to prevent toxicity to aquatic organisms. The effluent ammonia limits needed to prevent ammonia toxicity in the WWTP mixing zones for current seasonal capacities are less restrictive than expected technology-based effluent quality, or concentrations needed to control far-field oxygen demands. North Bend and Snoqualmie WWTPs may need to reduce ammonia loads for mixing zone considerations as their capacity expands.

- WLA/LAs for BOD_5, ammonia, fecal coliform and SRP should apply only to the months of August, September, and October when the critical conditions defined for the model are likely to occur. Water quality problems in the Snoqualmie River system have not been identified and investigated by Ecology for other seasons of the year.

- A phased TMDL approach is recommended for the Snoqualmie River system as defined by USEPA guidance. The phased approach is recommended because NPS is a large component of the TMDL, population growth (and wastewater discharge) patterns in the basin are uncertain, the Snohomish River TMDL effort may affect Snoqualmie River load allocations, and high uncertainty remains concerning water column D.O. and benthic biomass response to increased nutrient loading. The phased TMDL requires periodic checking and adjustment as specific NPS control measures are implemented, or as additional water quality and growth projection data become available. The requirements of a phased TMDL need to be incorporated into Ecology's five-year basin cycle.

- The sum of WLAs/LAs and background to maintain adequate D.O. at the two compliance points in the river for current source conditions are approximately 2,243 lbs/day BOD_5 and 202 lbs/day ammonia. The WLAs assume municipal effluent limits of 45 mg/L BOD_5, and 8-15 mg/L ammonia. The reserve load capacity for the river will be increased if controls placed on fecal coliform loading remove 135 lbs/day BOD_5 and 27 lbs/day ammonia from mainstem and tributary NPS.

- Projected WWTP expansion scenarios were modeled for D.O. response. Several combinations of BOD and ammonia loads will result in continued D.O. target concentration compliance. Lower permitted effluent concentrations of BOD_5 (15-20 mg/L) and ammonia (5-10 mg/L) will be necessary, especially if NPS controls are not implemented. However, all the resulting concentrations appeared to be achievable using activated sludge plants with single-stage nitrification. Both BOD and ammonia loads will need to be evaluated for each new plant or plant expansion, since it is the combination of the two along with the discharge location which affect downstream D.O. concentrations. However, there is not a simple one to one equivalence between the two components to assure D.O. compliance.

- Mainstem and tributary NPS will require LAs implemented through a nonpoint management plan to reduce the current fecal coliform load and achieve Class A compliance. Mainstem nonpoint source loads need to be reduced by 40%, and instream concentration reductions to 80 cfu/100mL are necessary in the following tributaries: Kimball Creek, Patterson Creek, Griffin Creek, Ames-Sikes Creek, and Cherry Creek. Control measures implemented to reduce bacterial loading may also significantly reduce BOD, ammonia, and phosphorus loads.

- Using the recommended maximum instream concentration of 10 μg/L SRP for all river reaches during the low flow season, the estimated SRP load capacity from all sources is 50 lbs/day. A portion of that is an allowable South Fork Snoqualmie River SRP load capacity below North Bend WWTP of 4.25 lbs/day. North Bend WWTP will have difficulty meeting the 10 μg/L criterion at its current seasonal discharge capacity. Monitoring programs and facility options need to be explored. According to model results of projected future waste loads, the other WWTPs (Snoqualmie, Fall City, Carnation, and Duvall) will need to reduce SRP effluent concentrations to less than 2.5 mg/L to comply with the guideline. They will also need to adjust their SRP loads in response to nearby NPS loads.

- Monitoring will be an essential part of maintaining the Snoqualmie TMDLs. A phased TMDL approach relies on monitoring data to refine WLAs and determine effectiveness of control actions. Several types of monitoring programs are needed, and should be coordinated within the TMDL/WLA/LA program and five-year cycle structures.

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APPENDIX K

NON-POINT ACTION PLAN FOR THE SNOQUALMIE RIVER

WASHINGTON DEPARTMENT OF ECOLOGY

SNOQUALMIE RIVER TMDL

NONPOINT ACTION PLAN

-PHASED APPROACH-

JULY 1994

Prepared by Nonpoint Source Unit
Water Quality Section, Northwest Regional Office
Bellevue, Washington

CONTENTS

INTRODUCTION

As a key element of the Snoqualmie River TMDL, the nonpoint action plan is focused on reducing fecal coliform loading on the river mainstem and tributary streams. The intent is to use a phased approach to reduce or eliminate known and identifiable nonpoint sources of pollutants. Often originating from domestic animals, agricultural activities, and on-site sewage systems, these waste impacts can be corrected by application and installation of best management practices (BMP's). Quantifiable measures of water quality improvement are demonstrated when fecal coliform concentrations in water samples are reduced over time. The success target in this TMDL is to achieve concentrations of fecal coliform at or below the water quality criteria.

BENEFICIAL USES

Beneficial uses of the Snoqualmie River are numerous and include all of the following:

- Swimming, wading, beach use (at least five locations)
- Boating, rafting, floating
- Fishing
- Wildlife habitat
- Recreation, including shore-based activities of walking, camping, golf, and associated access to the river.
- Aesthetic enjoyment, including wildlife observation
- Agricultural water supply, including crop irrigation and golf course irrigation
- Industrial water supply, including power generation
- Stock watering

While this list is not all-inclusive, it does reflect primary uses of the river, its water, and immediate environs. Many of these uses occur mainly during the summer low-flow season, which is the focus of the TMDL.

Most of the above uses are at risk, or may be impaired, at those times and under such conditions when the fecal coliform water quality criteria is not met in the river. Primary contact recreation, such as swimming, wading, rafting, boating, and irrigation of direct human consumption food crops which might be eaten in the field, are uses most likely impacted.

Task - Mapping of beneficial uses.

The location of particular types of beneficial uses of the river on a base map will provide a better picture of uses that may be at risk or are being impaired. The water quality sample results found at various locations can then be more easily compared with, and possibly related to, specific beneficial use locations.

Sources of information -

King County Department of Development and Environmental Services
King County Parks and Recreation
WA Department of Ecology, Water Resources - Water Rights
WA Department of Fish and Wildlife
King Conservation District

Schedule of Completion -

September, 1995

FACTORS CONTRIBUTING TO IMPAIRMENT OR POLLUTION

The Snoqualamie River Mainstream has four potential significant nonpoint sources of fecal coliform, loading, based on monitoring data and mass balance calculations, at the following locations:

	Proximity of River Mile
• Below Fall City	34.5
• Below Patterson Creek	30.5
• Below Ames/Sikes Creek	15.0
• Below Duvall	8.0

These locations represent areas where unidentified inputs of fecal coliforms are occurring.

Tributary streams where they enter the Snoqualmie River, are also considered nonpoint sources of fecal coliform loading. Five of these tributaries experienced regular violation of the water quality criteria:

	River Mile
• Kimball Creek	41.1
• Patterson Creek	31.2
• Griffin Creek	27.2
• Ames/Sikes Creek	17.5
• Cherry Creek	6.7

Factors and activities that are likely sources of the fecal coliform bacterial loading at both mainstream and tributaries include:

- <u>Livestock Waste Sources</u>

  - Direct animal access to river and tributaries.
  - Run-off of excessive land-applied animal wastes.
  - Improper manure application techniques.
  - Poor manure storage facilities/poor maintenance.
  - Lack of manure storage facilities.
  - Proximity of dry stacked manure storage to river.
  - Run-off of manure-contaminated stormwaters from barn slabs, confinement areas, walkways.
  - Flushing and hosing off manure waste from buildings into drainages to streams and rivers.

  Sites where these sources may occur include dairy farms, cattle feedlots, horse farms, hobby farms, and other concentrations of animals.

- <u>Residential/Commercial Sanitary Waste Sources</u>

  - Direct discharge of household sanitary waste to ditches, streams, or the river.
  - Failing septic tank drainfields.
  - Septic drainfields constructed too close to the river.
  - Drainfield material too coarse and permeable.
  - Outhouse pit privies close to river or streams.

- <u>Wild Animal Waste Sources</u>

  - Wild waterfowl and other bird populations congregating or nesting along riverbanks, side channels, sloughs, and tributary streams.
  - Wildlife reserves.

- <u>Pet Waste Sources</u>

    - Dog training areas with access to water.

    - Horse riding to or along river bottom.

- <u>General Contaminated Stormwater Run-off</u>

    - Identify multiple, diffuse sources.

Task - mapping of factors contributing to impairment:

The location of specific sources of the various waste factors on a base map will help concentrate and prioritize corrective efforts within available resources.

INDICATORS

<u>Quantitative - Fecal coliform</u>

Fecal coliform is commonly used as an indicator organism of bacterial contamination in water. It signals the presence of fecal waste matter from warm blooded animals, including possible human fecal waste.

Concentrations of fecal coliform organisms are <u>Measured</u> as numbers of organisms per 100 ml. of sample water.

Fecal coliform is one of the six quantitative, or numerical, water quality criteria used for waterbody classification, such as Class A waters. It will be the primary indicator used in this nonpoint action plan to direct efforts and document results of water quality improvement.

It is the <u>TARGET</u> of these combined nonpoint actions and control measures to result in future water samples achieving the fecal coliform criteria specified for the waterbody and its assigned classification on a consistent basis.

Use of the fecal coliform indicator directly relates to why attaining and maintaining acceptably low levels of fecal coliform organisms in waterbodies used for primary contact recreation and other high priority uses is so important.

<u>Qualitative</u>

- Gross manure solids in river and tributaries

- Greenish-brown water discoloration

- Presence of unnatural, gray filamentous sphraerotelus growth
- Manure odor of water

The above indicators are often identifiable and associated with manure wastes in water, and are a rough indicator of pollutant presence. They are not easily quantifiable and measurement is meaningless.

CONTROL MEASURES

- Best Management Practices (BMP's) for dairy farms

  Task:

  - Identify and eliminate gross run-off of manure from concentrated facilities
  - Implement immediate, interim improvements

  Task:

  - Animals with direct access to river and tributaries
    - Provide upland/off-river and off-stream drinking water for animals.
    - Fence off access to river

  Task:

  - Determine need of individual farms for Dairy Waste Permit Coverage
    - Request application for permit be completed, if required
    - Issue permit with schedules; require improvements and waste management plan
    - Conduct compliance inspections
    - Formal enforcement action, if required

  Task:

  - Determine need of individual farms for voluntary waste management plan development
    - Prepare plan
    - Implement plan
    - Conduct compliance inspections
    - Formal enforcement action, if required

- BMP's for Horse Farms, Hobby Farms, and Concentrated Pastures

  Tasks:

  - Implement immediate BMP's to eliminate direct discharges of manure wastes

  Tasks:

  - Eliminate animal direct access to streams with fencing

  Tasks:

  - Develop waste management plans

  Tasks:

  - Implement waste management plans

  Tasks:

  - Conduct compliance inspections

  Tasks:

  - Formal enforcement actions, if necessary

- Sanitary survey of septic tank drainfields

  Tasks:

  - Conduct survey for drainfield adequacy and performance

  Tasks:

  - Document problems areas and failures

  Tasks:

  - Identify and propose corrective actions
    - Individual drainfield replacement
    - Community septic tanks and drainfield systems
    - Connection to sanitary sewer
    - Elimination of water flush toilets
    - Assure proper graywater disposal

Tasks:

- Inventory and map waterfowl and other bird life concentrations on, or adjacent to, river, sloughs, streams, and ponds tributary to flowing waters, etc.

Tasks:

- Identify and map domestic animal access to river and banks
  - Horse Riding
  - Dog training in river
    - provide dog poop collection containers and post clean-up signs in areas of high use.

Schedule:

Tasks	River Mile	Date of Initiation
Water Quality Complaint Investigation		currently ongoing
Dairy Waste Permit Issuance		September, 1994 continuing
BMP's Dairies		
BMP Horse/Hobby Farms		
Snoqualmie mainstem	34.5	Summer, 1995
Snoqualmie mainstem	30.5	Summer, 1995
Patterson Creek	31.2	Summer, 1995
Ames/Sikes Creek	17.5	Summer, 1995
Snoqualmie mainstem	15.0	Summer, 1996
Snoqualmie mainstem	8.0	Summer, 1996
Cherry Creek	6.7	Summer, 1996
Griffen Creek	27.2	Summer, 1996
Kimball Creek	41.1	Summer, 1996

- Initial Water Quality Surveys

  - Mainstem of Snoqualmie River
    - Locate and sample drainage ditches, piped out falls, and pumped discharges along main stem segments where high fecal coliform loadings were identified or calculated by model.
    - Locate and sample river immediately below animal access locations.
    - Locate and sample river immediately below residential and commercial areas, if septic tank drainfield failures are a possibility.
    - Identify/document/photograph/map these discharges and sampling locations.

  - Tributary Streams

    - Sample individual tributary streams at mouth, key junctions, and below identified waste impact locations.
    - Identify/document/photograph/map these discharges and sampling locations.

- Routine Sample Collections

    - At original TMDL study's mainstream and tributary streams sampling locations.
    - Annually during same season as original study.
    - To detect, develop, trend information to document improved water quality conditions.

- Survey after major set(s) of controls are implemented

    - Sample mainstem, mainstem "through-bank" discharges, direct outfalls, ditches to mainstem, tributary streams at mainstem and key junctions.
    - Document improvements
    - If meeting water quality criteria, remove from 303d list and discontinue routine sampling.
    - Assess areas and locations <u>not</u> meeting water quality criteria.

ADJUST CONTROLS

- Consider additional, site-specific monitoring to isolate sources.
- Identify likely specific sources of fecal coliform.
- Develop additional waste control/waste treatment methods.
- Implement additional waste control/waste treatment methods.
- Use Ecology formal enforcement action, if required.

PUBLIC INVOLVEMENT

- Identify Key Interested Parties:
  - Individuals - main interest (for interaction with others)
  - Groups - Representatives/Spokespersons
  - Tribal Councils
  - Elected Officials - Decision-makers
  - Agencies with jurisdiction - assigned staff contacts
- Establish mailing list(s) for specific uses/activities
- Collect Published Information
  - Establish one or more sites where copies of all information is available to interested parties; i.e., Ecology NWRO Central Records, Carnation Public Library.
- Identify complaint/trouble-call telephone numbers
  - Describe likely response (limitations/time of response)
  - Describe need for self-help/community help/documentation
- Establish need for regular or periodic meetings
  - Key new information is available
  - Controls are complete (for a defined area)
  - Significant adjustments in controls, schedules or commitments, are necessary for further progress
  - Water quality listing designation is to be changed
  - Major decisions are required
- Define additional work effort(s)
  - Assign (volunteer) responsibilities for tasks and outputs
  - Set realistic, practical schedules for completion of outputs

- Provide public information/education/training
  - Document/data releases/bulletins
  - News stories
  - Work groups
  - Site visits
  - Field training

- Celebrate accomplishments and successes
  - Tag on to existing events/fairs/etc.
  - Booths
  - Seminars (at schools, institutions, clubs)
  - Media documentaries
  - Permanent public displays.