Sewer System Plan Update

Year 2002

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CITY OF ISSAQUAH

Sewer System Plan Update
Year 2002

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CERTIFICATION

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EXECUTIVE SUMMARY

The City of Issaquah Sewer System Plan Update has been prepared to serve as a guide for planning and designing future sewerage facilities. Identified in this Plan are sewer system improvements needed to provide adequate service within the City's service area through the year 2020, consistent with the 2000 City of Issaquah Comprehensive Plan, requirements of the Growth Management Act, and requirements of the Department of Ecology and King County.

Issaquah's Sewer System

The City of Issaquah Sanitary Sewer system is a municipally owned utility that is operated in conjunction with the City's water and stormwater utilities by the City of Issaquah Public Works Operations and Maintenance Department. The City's sewer system services approximately 2.7 square miles of developed properties within the current City boundary, plus 46 acres in the "Lakemont Triangle" located in unincorporated King County. (These areas do not include public roads). The total number of sewer utility accounts billed for service is approximately 3,170, of which 73% are single family residential or duplex. Additional developed land in the City limits, including North Issaquah and Providence Point, are served by the Sammamish Plateau Water and Sewer District.

The City's sewer system is a conveyance system only and functions mostly by gravity flow. Wastewater is sent to King County's Renton Wastewater Treatment Plan via a system of interceptors and pump stations that are also operated by King County. Effluent from the Renton plant is discharged into Elliot Bay. Up until 1969 the City operated a secondary treatment plant, which was abandoned when Metro constructed the Issaquah Interceptor to convey wastewater flows to Renton. In 1982, Metro constructed a second interceptor (Issaquah Creek Interceptor) to relieve the Issaquah Interceptor that was flowing near capacity during peak flow periods.

Only two significant industrial customers are located within the City. Both the Darigold Farms and Data I/O facilities have waste discharge permits administered by King County.

Service Area Growth Projection

The City's present service area that covers 2.7 square miles of developed properties could expand in the future to include up to an additional 3.9 square miles of currently unsewered land. The area of expansion includes both undeveloped land and existing developed land currently served by septic systems, located within the City limits and in two potential annexation areas on Cougar Mountain. (Most of Issaquah Highlands, all of Talus, and all of Park Pointe are included in this estimate, because it is based on 2000 land use). Another 2.6 square miles of land in the City will remain permanently unsewered (i.e., park land and open space).

The City of Issaquah population in 2000 was 11,056 in 5,813 households. Within the same area, the 2020 population forecast prepared by the State Office of Financial Management is 25,768 people in 11,713 households.

An Equivalent Residential Units (ERUs) is amount of drinking water used by a "typical" single family residence, and is used to estimate the flow in the sewer system under current and future land use conditions. One ERU in current development is assumed to equal 180 gallons per day (gpd) under average winter consumption, and for future development is assumed to equal 125 gpd. ERUs also represent wastewater flows from multi-family and non-residential land uses by applying conversion factors. For example, multi-family developments contribute 0.65 ERU per dwelling unit.

The amount of wastewater now entering the City's sewer system is based on a population equivalent of 5,229 ERUs. This could potentially increase to about 14,301 ERUs in the year 2020. This projection is based on zoning and population information for the projected sewer system service area, and is a conservative forecast because it represents the long-term potential buildout for the year 2020.

Inflow and Infiltration

In addition to wastewater flow from connections to residential, commercial, and other buildings, the sewer system intercepts a large amount of inflow and infiltration (I/I). Inflow refers to water that enters the sewers from gaps in manholes or improper stormwater connections to the sewer (such as roof downspouts), and infiltration refers to water that seeps into sewer pipes through cracks, separated joints and other flaws in the underground pipe system. The magnitude of I/I can be very high during wet storm conditions, dwarfing the actual wastewater flow (I/I is predicted to be about 84% of the total sewer flow during a 5-year rainfall event). Soil type, pipe age, pipe material type, quality of construction, and damage from natural and man-made activities are all factors that affect how much I/I enters the sewer system. Current construction and inspection procedures help lower I/I in new systems, but I/I contribution will still remain significant.

To evaluate the magnitude of I/I entering the regional treatment system, King County Wastewater Division conducted an extensive flow monitoring program at over 800 locations within city and county systems between 2000 and 2002. In Issaquah 13 of these flow meters were operated, collecting data on total wastewater flow in sewer mains at key points within the sewer system. These flow records indicate existing residential sewage flow rates vary, due to highly variable I/I conditions. Wastewater flows within the existing sewer system increase during wet weather and particularly in response to rainstorms. These Rain Dependant Infiltration/Inflow (RDII) rates vary, but appear to exceed 5,000 gallons per acre per day (gpad) in some areas of the City. During non-storm conditions, base infiltration ranges from about 100 gpad to over 800 gpad.

The City wastewater agreement with King County includes language based on infiltration and inflow rates averaging 1,100 gpad. Other sewer agencies connected to the County system have similar agreements. Few systems currently comply with these agreed rates, as evidenced by the recent collected monitoring data. King County is in the process of developing plans for future wastewater facilities and will be developing an approach to bring required capacity in line with the actual flows expected. This will likely require some degree of sewer rehabilitation by most agencies, including Issaquah.

Modeling of Wastewater Flows

Based on the wastewater flows measured in the existing sewer system, a computer model was developed that simulated existing conditions using the Hydra software package. Regulations state that sanitary sewer systems should not overflow more than once in five years. The City is not aware of any past wastewater overflow due to capacity constraints. Simulating rainstorms with 24-hour intensities equaling the five-year event for Issaquah verified that sufficient capacity currently exists in the sewer system to handle current wastewater flows. A minor amount of surcharging was predicted in some areas, but was less than one foot above the top of the pipe and well below the ground surface.

The model was then used to simulate conditions in the year 2020, based on the projected increase in ERUs served by the sewer system. The increase in flows from existing to future conditions was attributed to new sewer service provided to new development and to sewer extensions to areas not currently served. Under the future condition the sewered area more than doubles, from 1,726 acres to 4,268 acres. The existing average daily sewage flow of approximately 1.0 million gallons per day (mgd) also doubles to 2.2 mgd, due to the population increase. The resulting total wastewater flow increases from about 6.9 mgd under a 5-year storm to 13.7 mgd. Substantial surcharges would result in the existing pipe systems as a result. Capacity provided by existing facilities would accommodate dry weather flows; however, even during modest storm events up to five-year storms, minor surcharging occurs at some locations. For five-year events under future conditions, additional capacity will be needed in several trunk lines.

Improvements to Increase System Capacity

A recommended Capital Improvement Program was developed to address immediate capacity improvements, sewer extensions, sewer main rehabilitation (including I/I control), and other projects such as inspections, monitoring and plan updates. Total estimated projects costs for these improvements over a 6-year CIP period is estimated at about $5,510,000.

Special emphasis should be placed on I/I control as one strategy to meet wastewater flow capacity requirements. Rehabilitation of sewer systems to reduce I/I flows is most effective when the effort can target those pipe elements with the highest extraneous flows. Review of the base infiltration (BI) and rain dependent infiltration inflow (RDII) rates throughout the City system identified two subbasins with extraneous flow rates that noticeably exceeded other areas of the City. A flow monitoring program or other inspections such as smoke testing would be appropriate to verify these indications. If so, then rehabilitation efforts should be focused in these subbasins first. The resulting effectiveness can then guide future efforts towards achieving conformity with the rest of King County.

The analysis results in this Plan presented for the future full build-out conditions is a projection of possible sewer service requirements at the end of the 20-year planning window. Careful consideration is needed to determine how these results should be used to refine the Capital Improvement Program. Further analysis, including additional monitoring in the sewer system and a higher level of modeling detail, along with verification of the probable build-out land use condition should be performed as part of pre-design studies before specific projects are proposed.

CHAPTER 1
Purpose

The City of Issaquah Sewer System Plan Update has been prepared to serve as a guide for planning and designing future sewerage facilities. Identified in the Plan are sewer system improvements needed to provide adequate service within the City's service area through the year 2020. The specific objectives of the Plan include the following:

- Prepare a plan that is consistent with the Issaquah Comprehensive Plan and requirements of the Growth Management Act.
- Prepare a plan that is consistent with the requirements of the State Department of Ecology (Ecology) as set forth in WAC 173-240-050, which requires approval of general sewer plans.
- Prepare a plan that is consistent with the requirements of King County Code 13.24, which requires County Council approval of comprehensive plans for sewer collection facilities operated by other agencies in unincorporated King County.
- Provide the City with a guide to evaluate the impacts of proposed development and land use changes on the sewer system, and develop a document which can be updated periodically as additional information on the sewer system is obtained.
- Estimate the effect of future land uses and population trends on wastewater flows.
- Identify existing sewer system deficiencies.
- Identify locations of sewer system extensions necessary to serve major unsewered areas.
- Develop a capital improvement program which identifies priorities for construction and source of funding.

1.2 RELATIONSHIP TO THE GROWTH MANAGEMENT ACT (GMA)

The Sewer System Plan Update was prepared to fulfill the requirements of the Growth Management Act. Specifically, this plan includes the following required information:

- Inventory of existing facilities
- Forecast of future capital needs
- Locations and capacities of expanded or new capital facilities
- A six-year financing plan that identifies the source of public revenues

Pursuant to the GMA coordination requirements and other State and County requirements, the System Plan Update was distributed to the following organizations for review and comment:

- King County Department of Natural Resources, Division of Wastewater Treatment and Disposal
- Sammamish Plateau Water and Sewer District

- City of Sammamish
- City of Bellevue
- Washington State Department of Ecology

Finally, the Sewer Plan Update is consistent with the City of Issaquah Comprehensive Plan in that the calulations of Equivalent Residential Units (ERUs) and flow projections are based on the land use and population projections contained in the Comprehensive Plan.

1.3 SCOPE OF WORK

Preparation of the Sewer System Plan Update was conducted over the 2001-2002 time period, based on planning and engineering data available at the beginning of the project, and involved the following tasks:

- Verify planning area boundary and physical characteristics
- Update wastewater facility and sewered area maps
- Forecast future wastewater flows and loads
- Evaluate infiltration/inflow (I/I) data from King County and incorporate into modeling analysis
- Verify sewer system criteria, standards, and level of service
- Update sewer system hydraulic model
- Conduct capacity analysis of existing and future sewer system
- Develop a Capital Improvement Program containing recommended future improvements to meet level of service goals

1.4 ENVIRONMENTAL ASSESSMENT

The City has determined that this Plan does not have a probable significant adverse environmental impact on the environment and has issued a Determination of Non Significance under WAC 197-11-340(2). This review was made after review of the completed environmental checklist and other information on file with the lead agency. The environmental determination issued by the City of Issaquah for the Sewer System Plan Update Year 2002 is provided in Appendix A.

It should be noted, however, that each Capital Improvement Program (CIP) project presented in the plan will undergo subsequent project-specific environmental review as part of the preliminary and final design process.

1.5 PLAN ORGANIZATION

The subsequent sections of this plan are organized as follows:

Chapter 2 describes the planning considerations and assumptions used to formulate the plan, including system history, geology, topography, land use and population.

Chapter 3 provides the City's policy framework to guide the development and operation of sewer utility system, consistent with the 2002 Updates to the City of Issaquah Comprehensive Plan. The policies include the City's locally established minimum standards and criteria which are consistent with State regulations and standards.

Chapter 4 describes the City's existing sewer system facilities, as well as maintenance and operations.

Chapter 5 describes the development of estimates for existing wastewaste flows. Residential, and non-residential, and infiltration were included in the analysis.

Chapter 6 evaluates, using a computer model, the sewer facilities within the City and identifies existing system deficiencies.

Chapter 7 evaluates future conditions and system deficiencies based on population and land use projections from the Comprehensive Plan.

Chapter 8 evaluates infiltration and inflow (I/I) control, King County policies on I/I control, and rehabilitation options and recommendations.

Chapter 9 proposes the Capital Improvement Program (CIP), including construction priorities, cost estimates and potential funding sources.

CHAPTER 2
Planning Considerations

2.1 PLAN SERVICE AREA

The City's sewer service areas are illustrated on **Figure 2.1**. The existing service area is generally coincident with the Issaquah city limits. The North Issaquah area to the north and east of I-90 is currently served and maintained by the Sammamish Plateau Water and Sewer District. For future service areas, the City's general policy for sewer service requires entering into a pre-annexation agreement as a condition of service.

The future sewer service area was established in the City of Issaquah Comprehensive Plan based upon the following criteria:

- Inclusion in the Countywide Urban Growth Area Boundary and City of Issaquah Potential Annexation Area Boundary; and

- Feasibility of development based on topographical factors.

The area's natural topographic features include Cougar Mountain, Squak Mountain and Tiger Mountain and Grand Ridge, as well as the boundaries of adjacent sewer service providers, i.e., Sammamish Plateau Water and Sewer District and the City of Bellevue.

2.2 SEWERAGE COORDINATION

2.2.1 Adjacent Sewer Systems

To a great extent, Issaquah's future sewer service area follows natural drainage and topographic features except where service is already provided, or likely to be provided, by the two contiguous sewerage agencies discussed below:

1. ***City of Bellevue Sewer System***. The City of Bellevue Sewer System (formerly Lake Hills Sewer District) is contiguous to the northwest corporate limits of Issaquah. By agreement between the two cities, the east slope of Cougar Mountain is within Issaquah's service area, and Bellevue provides service on the west slope of Cougar Mountain. Under the terms of this agreement (reference **Appendix B**), a maximum of 600 multifamily units may be served within the Lakemont Triangle, unless it is mutually agreed that additional units may be served. The City does not utilize this agreement for wholesale sewer service, as the City currently provides direct sewer service to this area.

2. ***Sammamish Plateau Water and Sewer District (SPWSD)***. SPWSD serves the east side of Lake Sammamish from north of I-90 and east of Issaquah Creek north to approximately N.E. 8th Street. The District's plan for sewer service includes all of the area within the District's boundary. Long-range plans adopted by the District include providing service into the upper reaches of the North Fork of Issaquah Creek, in the vicinity of Yellow Lake and Beaver Lake, and into the lower reaches adjacent to Issaquah's northern boundary. SPWSD also plans to continue extending sewer service

into the lower reaches of the main Issaquah Creek basin, in the vicinity of 221st Place S.E. (Bush Lane).

2.2.2 Agency Coordination

King County Department of Natural Resources

As the regional sewerage authority, King County Department of Natural Resources, Division of Wastewater Treatment and Disposal (King County) provides sewage treatment and disposal as well as interception/transmission from the various component agencies. Copies of Issaquah's agreements with King County for sewage disposal are provided in **Appendix C**.

The sewage intercepted by King County from the Issaquah area is conveyed to King County's Sunset Pump Station, located adjacent to Lake Sammamish, and pumped through a series of interceptors and pump stations to King County's Renton Treatment Plant.

Sewage from the City is currently discharged into two King County interceptors that are located within the City limits, the Issaquah and the Issaquah Creek Interceptors. The Issaquah Interceptor was completed in 1969. In 1982, the Issaquah Creek Interceptor was completed to supplement the Issaquah Interceptor, which was flowing at capacity. Upon completion of the Issaquah Creek Interceptor, much of the Issaquah Interceptor was incorporated as part of Issaquah's sewer system.

King County is planning additional interceptor capacity to serve the Issaquah and Sammamish drainage basins. The new interceptor, which may be called the Southeast Lake Sammamish Interceptor, will serve both the City of Issaquah and Sammamish Plateau Water and Sewer District. The project may include construction of about 5,800 lineal feet of 42-inch-diameter interceptor sewer along S.E. 56th Street from King County's existing Issaquah Interceptor to the intersection of S.E. 56th Street and East Lake Sammamish Parkway. However, this is only one of 11 alternatives identified to date by King County.

In 1979, King County adopted their Sewerage General Plan as an element of the King County Comprehensive Plan (Ordinance 4034, adopted on January 15, 1979). A primary element of the Sewerage General Plan was to designate specific local service areas that comprised the maximum area where sewer service may be extended.

This maximum service area designation was amended by the adoption of the King County Comprehensive Plan in 1994, which established the Urban Growth Boundary. To be consistent with countywide policies and land use, all new developments in the Full Service Areas of the Urban Growth Area must be served by public sewers. On-site systems may be allowed on an interim basis within the designated Service Planning Areas. However, eventual connection to public sewers upon availability as defined in the City code will be required for failed septic systems. Issaquah presently has a franchise agreement with King County allowing the City to provide sewer service in unincorporated King County, which currently includes the Lakemont Triangle in the Greenwood Point PAA. A copy of the franchise agreement is provided in **Appendix D**.

2.3 VICINITY CHARACTERISTICS

2.3.1 Topography

The City of Issaquah lies within the Cedar River/Lake Washington Drainage Basin on the lower reaches of the Issaquah Creek Basin, which is a tributary to Lake Sammamish. The south Lake Sammamish area is drained by a series of small streams tributary to two creeks:

1. Tibbetts Creek, draining eastern Cougar and western Squak Mountains; and

2. Issaquah Creek, draining eastern Squak Mountain and Tiger Mountain, together with the north and south slopes of Grand Ridge.

The topography, including the subbasins of the Issaquah Service Area, is shown on **Figure 2.2**. Three distinct topographic features exist: lowland valleys, plateaus, and moderate to steep hillsides adjacent to the valleys. The valleys represent approximately 20 percent of the service area, the plateaus approximately 7 percent, and the hillsides the remaining 73 percent.

The lowland valley area is situated primarily in the northernmost part of the Issaquah Creek valley south of Lake Sammamish. This portion of the valley is approximately 4.5 miles long, with a maximum width of approximately 1.5 miles at the north and narrowing to a width of 0.5 miles at the south end. The valley slopes range from 1 to 6 percent, with high elevations of approximately 125 feet at the southern end and a low elevation of 26 feet along the shores of Lake Sammamish.

There are two large plateaus: Lake Tradition and Grand Ridge. These plateaus, east of the valley, are separated from the valley by 40 percent slopes. The typical slope on the plateaus is 6 percent, and the average elevation is approximately 500 feet. Hillsides, which represent a majority of the service area, have slopes ranging from 20 percent to greater than 40 percent. Most of the western slopes are approximately 20 percent. The steepest slopes exist in the southern and southeastern portions of the service area. The eastern hillsides contain fairly steep slopes ranging from 18 to 34 percent.

The remaining area is composed of hillsides, which partially surround the lowland valley area. This hillside area ranges from an elevation of 50 feet to the highest elevation of 1,300 feet on the upper slopes of Squak Mountain, which is situated in the southern portion of the service area and still with the City limits.

2.3.2 Geology

A detailed description of the Issaquah area's geology is provided in the *Lower Issaquah Valley Wellhead Protection Plan, Volume I Report*.[1]

An analysis of soils and topography is essential to determine the physical constraints on development within the service area. Five soil factors will affect development on both the valley floor and the hillsides:

1. Erosion.
2. Landslide hazard.
3. High water table.
4. Unsuitability for individual drain fields.
5. Flooding potential.

Erosion and landslide hazard will influence hillside development the most, whereas the other factors will be more instrumental in limiting development on the valley floor and on the plateaus.

[1] *Lower Issaquah Valley Wellhead Protection Plan, Volume I Report*, Golder Associates, November 1993.

2.3.3 Climate

The service area has a marine-type climate influenced by the Pacific Ocean, Olympic and Cascade mountain ranges. Regional climate information for the Seattle-Tacoma area, as collected at Sea-Tac International Airport[2], is summarized as follows:

Annual Average Maximum Temperature	=	59.3°F
Annual Average Minimum Temperature	=	44.1°F
Annual Average Total Precipitation	=	38.3 inches

The precipitation in the region tends to be of long-term with low intensities, averaging only 0.15 inch per day. Due to the prolonged duration of precipitation, the soils within the region tend to become saturated and have higher groundwater tables. However, significant storms may induce sizeable flow into the sewer system. Storm intensities as reported in the King County Surface Water Design Manual are shown below:

2-year	24 hours	2.8 inches
5-year	24 hours	3.4 inches
10-year	24 hours	3.8 inches

2.3.4 Rare and Endangered Species

Detailed information on species occurrence and habitat requirements of listed species is provided in the South SPAR/I-90 Sunset Interchange Final Biological Assessment Report (DEA, Revised April 23, 1999) and is excerpted below. (See Section 5.1 for bald eagle, and Sections 6.1 to 6.4.2 for fish species.)

In March 1999, Puget Sound Chinook salmon was listed as endangered under the Endangered Species Act (ESA) and are the primary focus of regional salmon recovery efforts. Chinook have been observed spawning 11 miles upstream on Issaquah Creek in Holder and Carey Creeks, and also in North Fork Issaquah Creek and East Fork Issaquah Creek. The Issaquah Salmon Hatchery supplements the Chinook run in Issaquah Creek, and Chinook in Issaquah Creek are entirely of hatchery origin (originally from Green River stock).

A char species, possibly a bull trout, was possibly observed in the upper Issaquah Creek basin (Holder and Carey Creeks) during the basin reconnaissance in 1989. While unlikely, bull trout may occur in East Fork Issaquah Creek. Bull trout require cold water (below 55°F) with clean cobble substrate for spawning. In December 1999, bull trout was listed as a threatened species under ESA. Because of the possible observation noted above, U.S. Fish and Wildlife Service (USFWS) believes that bull trout may spawn and rear in the upper Issaquah Creek basin; if so, these fish may migrate and forage at later stages of their lives throughout other parts of the Sammamish watershed.

In Washington State, the bald eagle is listed as a threatened species under the ESA. According to the USFWS, wintering bald eagles may occur in the vicinity from October 31 through March 31. The nearest documented occurrence of wintering bald eagles is in the vicinity of Lake Sammamish State Park.

2.3.5 Archaeological and Historical Significance

Detailed information on archaeological and historical significance is provided as excerpted from the SE Issaquah Bypass Draft EIS.

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[2] Western Regional Climate Center, wrcc@dri.edu

The oldest known evidence of human occupation in the central Puget Lowland indicates that human occupation dated back 12,000 years. Larger populations developed after 5,000 B.C. as people became more adapted to locally available resources. Euroamerican contact occurred in the eighteenth and nineteenth centuries, changing the native populations, community composition, and cultural traditions.

The Issaquah area and Snoqualmie Valley were occupied during the ethnohistoric period of the eighteenth and nineteenth centuries by the Sammamish and Snoqualmie tribes. The only recorded Sammamish village was at the south end of Lake Sammamish at the mouth of Issaquah Creek. The Snoqualmie occupied the Snoqualmie River Valley and surrounding hills east of Sammamish Falls, and Sallal Prairie near North Bend.

Like other Native American groups, the Sammamish and Snoqualmie suffered significant population loss due to epidemic disease of the eighteenth and nineteenth centuries. Smallpox apparently infected residents of Puget Sound in the mid-1770s, and several other epidemics further reduced populations in the nineteenth century.

The Issaquah area was originally known as Squak Valley, after the inhabitants of the Native American village on the south shore of Lake Sammamish. Non-Native American settlement on the area began in 1863, a year after coal was discovered at Squak Mountain. The community of Squak grew slowly until 1888, when the Seattle, Lake Shore & Eastern Railroad (SLS&E) built a rail line through the valley. The primary shipper in the Squak Valley was the Seattle Coal and Iron Company located in present-day Issaquah. By April 1892, the community incorporated into the Town of Gilman, changing its name to Issaquah in 1899.

Coal, hops, dairy farming and timber were all at various times major factors in the area economy from the mid-1880s to the mid-1920s. Efficient roads were slow in coming to the Squak Valley, as they were to most rural communities in the American West. Typically beginning as trails, the routes used by the area residents did not change in destination as much as they changed in appearance. Although road transportation would become the most important element in the growth of Issaquah in the late twentieth century, the railroad was the first mode of transportation to transform the area.

Six recorded archaeological/historical sites are located within the Issaquah area. These include a segment of the SLS&E Railroad grade, a.k.a. the Northern Pacific Railroad (site 45-KI-451); the Gilman Water Company/Old Issaquah Water Works (site 45-KI-452, located at the east end of E. Sunset Way); a poured concrete and block foundation (site 45-KI-); and the White Swan Inn (site 17-51453, located at 6th Avenue S.E. and E. Sunset Way) which were recorded as part of the S. Sammamish Plateau Access Road project. Also recorded are the Tradition Lake Peeled Cedar site (site 45-KI-430) and the Issaquah Sportsmen's Clubhouse (Hudson as Nelson, 1998a; King County Landmarks and Heritage Commission, 1997; Robinson and Rice, 1992).

2.4 WATER QUALITY

The natural surface water systems in the Issaquah area are of good quality and support fish populations. The main stem of Issaquah Creek is the site of the large Department of Fisheries salmon hatchery. Both natural and manmade fish runs depend on maintaining high water quality in the lake and streams. In addition, groundwater is one source of water supply for the City of Issaquah and the Sammamish Plateau Water and Sewer District. The City emphasizes protection of surface and groundwater quality through enforcement of local, state and federal laws.

Public sewers are not currently available throughout the City's sewer service area. Failing on-site wastewater disposal systems or installation of on-site systems in areas with unsuitable soils could jeopardize surface and/or groundwater quality. Monitoring of major streams in Issaquah have shown levels of fecal coliform concentrations that exceed state standards, placing Issaquah Creek and Tibbetts Creek on Ecology's 303(d) List of Impaired and Threatened Waterbodies. Indications of irreparable on-site systems or proposed development in areas with unsuitable soils trigger consideration of sewer system extensions. Our list of Capital Improvement Projects for sewer identify extensions in unsewered areas. It should be noted that to date, the Seattle-King County Health Department and the Washington State Department of Ecology have not identified any potential health hazard areas within the City.

2.5 POPULATION

Growth in Issaquah has consistently been greater than the King County average. This has been a continuing trend over the past four decades. From 1930 to 1950, Issaquah's population grew only 20 percent, from 763 to 955 inhabitants. Issaquah's population jumped 455 percent to 4,341 between 1950 and 1970, and grew by another 28 percent to 5,536 over the next decade. By 1990 the population was 7,786 residents, equating to a 41 percent growth increase, or an average growth rate of 3.5 percent per year. Applying King County projections, the Comprehensive Plan estimates population from 2001 to 2020 will have an annual growth rate of 0.5 percent. As of April 1, 2000, the Washington Office of Financial Management (OFM) estimated that 11,056 people resided within Issaquah's corporate limits, including the recently annexed North Issaquah Subarea. The 2001 population is estimated by OFM at 12,950 persons.

Table 2-1 summarizes the population growth as presented in the 2000 City of Issaquah Comprehensive Plan. (The 2000 Comprehensive Plan data were used for estimating future wastewater flows because the 2002 Updates were not available at the beginning of this study). Projections included in the Comprehensive Plan indicate that, within the current City boundary, the population will grow to 25,768 persons by the year 2020. A significant amount of this growth will occur within planned developments such as Issaquah Highlands and Talus. Including the City's Potential Annexation Areas, total City population can potentially grow to 42,183 by the year 2020. However, with minor exceptions, the PAA areas already have sewer service provided by the City of Bellevue and the Sammamish Plateau Water and Sewer District.

Table 2-1: Population and Household Projections from 2000 Issaquah Comprehensive Plan

Based on an average 0.5% annual background growth[1] from 2000 to 2020[2] and Council Approved Projects

	Current Population and Households		Projected Population and Household Growth 2001 to 2020[3]							
Area	**Population 2000**	**Households 2000**	**Population 2005**	**Households 2005**	**Population 2010**	**Households 2010**	**Population 2015**	**Households 2015**	**Population 2020**	**Households 2020**
Issaquah [6] **4,760.5 ac**	**11,056[4]**	**5,813[5]**	**13,734[7]**	**6,243**	**14,080**	**6,400**	**14,436**	**6,562**	**14,801**	**6,728**
Council Approved Projects										
Issaquah Highlands[8] 870 ac			**5,940**	**2,700**	**7,150**	**3,250**	**7,150**	**3,250**	**7,150**	**3,250**
East Village[9] 660 ac			**3,817**	**1,735**	**3,817**	**1,735**	**3,817**	**1,735**	**3,817**	**1,735**
TOTAL **6,392.5 ac**	11,056[4]	5,813[5]	23,491	10,678	25,047	11,385	25,403	11,547	25,768	11,713
	30% Change 1995-2000		**83% Change 2000-2005**		**6% Change 2005-2010**		**1% Change 2010-2015**		**1% Change 2015-2020**	
Potential Annexation Areas (PAAs)										
Greenwood Point / South Cove[10]	*2,500*	*955*	*2,500*	*955*	*2,500*	*955*	*2,500*	*955*	*2,500*	*955*
338.5 ac **2.8 persons per HH**	*800*	*333*	*874*	*364*	*948*	*395*	*948*	*395*	*948*	*395*
Lakemont Triangle 46.5 ac **2.4 persons per HH**										
East Cougar Mountain 776 ac 2.75 persons per HH	*152*	*55*	*173*	*63*	*193*	*70*	*223*	*81*	*232*	*84*
Issaquah 69 40 ac 2.85 persons per HH	*0*	*0*	*0*	*0*	*142*	*50*	*171*	*60*	*171*	*60*
Klahanie[11] 1,100 ac 2.6 persons per HH	*9,746*	*3,858*	*9,746*	*3,858*	*9,746*	*3,858*	*9,746*	*3,858*	*9,746*	*3,858*
Aldarra Farms 657 ac 2.75 persons per HH	*352*	*128*	*352*	*128*	*352*	*128*	*352*	*128*	*352*	*128*
Providence Point/ Hans Jensen[12] 414 ac 1.5 Persons per HH	*1,472*	*1,129*	*2,446*	*1,572*	*2,446*	*1,572*	*2,446*	*1,572*	*2,466*	*1,572*
King County Island 68 ac	*0*	*0*								
PAAs Subtotal 3,440 ac	*15,022*	*6,458*	*16,091*	*6,940*	*16,327*	*7,028*	*16,386*	*7,049*	*16,415*	*7,052*
TOTAL: Issaquah + PAAs 9,832.5 ac	**26,078**	**12,271**	**39,582**	**17,618**	**41,374**	**18,413**	**41,789**	**18,596**	**42,183**	**18,765**

1. Background growth rate is the expected increase in housing density through development within certain areas and zones of the City.
2. 0.5% growth rate is averaged for the planning period. Issaquah population annual background growth rate: 2000 to 2020 = 0.5%.
3. All household projections are assumed as of December 31st of the listed year and are based off an assumed 0.5% infill and 2.2 Persons Per Household (PPH).
4. The Washington State Office of Financial Management (OFM) provided the 2000 Population figures as of April 1st, 2000. (10,260 people in Issaquah + 796 people in the recently annexed N. Issaquah Subarea). Please note that this number is not based off 2.2 persons per household of the City's projected 5,813 households as of December 31st, 2000.
5. The City's 2000 household estimate is based on an assumed 3,820 HH in 1995 + 720 units in Issaquah Highlands + 410 HH built from 1995 to 2000 + expected development in N. Issaquah to be completed between 5/00 and 12/00.
6. Includes SPAR (Ord. 2227 4/99) 20.5 acres and the N. Issaquah areas of Freegard, Overdale and SE 48th St. Neighborhoods. N. Issaquah data based on OFM data for April 1st, 2000 (481 units) + Completed Polygon MF Aspen Meadows Plat (100 units in Apartment development) + Park Hill at Issaquah (254 Units)
7. Includes N. Issaquah projection based on OFM HH data as of annexation and King County approved developments Derus/Wakefield; Paschal; Sammamish Cove; Pine View; Park Hill; and McLean expected to be completed by 2005.
8. Issaquah Highlands projection based on 1996 2-party development agreement. After completion, no further infill is expected in any of the urban villages.
9. East Village projection based on 12/16/99 development agreement. After completion, no further infill is expected in any of the urban villages.
10. Greenwood Point annexation area includes South Cove and Lakemont Triangle neighborhoods. South Cove development information based on 10/93 study (Kulits). Lakemont Triangle projection based on preannextion agreements and development by Derus (Lakemont Orchards Apt.) and I-90 Phase One Ltd. Partners (Sammamish Hills Condominiums).
11. Klahanie – Chandler Felt K.C. 12/98=3800 housing units. Proposed developments inc. Hunter Land and Ragland Townhomes.
12. Projection includes proposed developments: Mallard Bay, Autumn Meadows, Grant Plat, and Haldeman/Wakefield. (Starbard N. Issaquah annexation study, 4/99)

2.6 LAND USE

By 2000 the City comprised an area of approximately 9.9 square miles. Over the last several decades, Issaquah has evolved from a small, relatively independent community supported primarily by coal mining, agriculture, forest products, and fisheries, to a suburban community with an economy that is integral with and complementary to the economy of the Seattle metropolitan area. Issaquah has followed the general trend throughout Washington State, experiencing a marked decline in the percentages of people engaged in the four traditional industries. At the same time, the area has experienced rapid growth in the percentages of people employed in manufacturing, construction, services, finance, real estate, and wholesale and retail trade. Existing businesses include commercial and retail services for Issaquah area residents, office parks, hotels and motels, and limited light industry. Darigold Farms dairy processing plant has been a long-time employer in the Issaquah community. More recent employers include ZETEC; Boeing Computer Services; Seimens-Quantum; Polymer Technologies, Inc.; Microsoft; Baxter-Bartels; Costco and others.

Land use in the Issaquah area is governed by the City of Issaquah Comprehensive Plan and zoning. The unincorporated area adjacent to the City is governed by the King County Comprehensive Plan. The zoning for these land use areas is depicted in **Figure 2.3**. **Appendix E** presents the adopted land use plan maps for the City and King County.

During development of the Comprehensive Plan in 1995, the City set a 20-year housing target of 2,694 new housing units by the year 2015.[3] Because of a series of annexations, the City, in 1999, revised the 20-year housing target to 3,380 new units by 2015.

2.7 EQUIVALENT RESIDENTIAL UNITS

The basis for estimating wastewater flow contributions was through the use of unit flow contributions based on equivalent residential units (ERU). The flow contributed by an ERU is the demand or loading that is equivalent to the load or demand estimated for a "typical" single family residence. Flows estimated for the on-going update of the Water System Plan Update are expressed in terms of ERU. This study will also utilize ERU as the basis for expressing flows. **Table 2-2** presents the relative ERU factors applied to the major development categories pertinent to the Sewer Plan Update.

Updating the estimates for wastewater contributions to reflect current conditions was similar to the process used for the 1996 Sewer System Plan Update. The available City zoning and population information was evaluated for each of the model basins, i.e., current and future development within each model basin was determined. Future wastewater flow estimates were derived using the number of projected ERU in each model basin. **Table 2-3** presents the City's existing and potential development capacity summarized in terms of ERU.

The potential development shown in Table 2-3 is considerably more than the totals for the City, as shown in Table 2-1 because it depicts the long-term potential buildout beyond the year 2020, and is a very conservative forecast.

[3] Issaquah Comprehensive Plan (amended 2000), Housing Element, Section 6.1, Page H-2.

Table 2-2: ERU Values By Development Category

Development Category	ERU Value
Residential Development	
Single-Family	1 ERU/Parcel
Duplex	1 ERU/Unit
Multifamily	0.65 ERU/Unit
Apartment	0.65 ERU/Unit
Non-Residential Development	
Restaurant	3 ERUs per 1,000 sf
Retail	0.2 ERUs per 1,000 sf
Office	0.3 ERUs per 1,000 sf
Laundry	0.7 ERUs per machine
Car Wash	20 ERUs
Church	2 ERUs
Auto Service	1.5 ERUs
Elementary School	8 ERUs
Junior High School	12 ERUs
High School	16 ERUs
Hotel	0.5 ERUs
Recreation with Pool	4 ERUs

Figure 2.3:
City Zoning

Table 2-3: City of Issaquah Land Use Development Existing & Estimated ERUs by Subbasin

No.	Subbasin Name	Existing Development					Future Development				
		Res. Units		Non-Res. ERUs	Total ERUs	Pop. Equiv.	Res. Units		Non-Res. ERUs	Total ERUs	Pop. Equiv.
		SFR	MF				SFR	MF			
1	I-90 West	8			8	21	10			10	28
2	NW Pumped		132	11	97	259	6	220	73	222	591
3	Terra Highlands	119	60		158	420	255	60		294	783
4	NW Sammamish Trunk			111	111	296			111	111	296
5	NW 18th Street			7	7	18			140	140	372
6	I-90 East			39	39	103			82	82	217
7	I-90 South			107	107	285			121	121	321
8	Goodes Corner			3	3	7	242	22	36	292	778
9	Tibbetts Valley Park	1			1	3	9			9	23
10	Pickering Place			300	300	797			392	392	1,042
11	Central (Issaquah Commons)				132	352	133	129	140	357	949
12	Holiday Inn			37	37	97			37	37	97
13	Newport Interceptor	14	458	85	397	1,055	81	459	139	518	1,379
14	NE Trunk	32	200	67	229	608	37	202	70	239	635
15	The Woods	192	30		212	563	197	30		216	575
16	Morgan's Ridge	82			82	218	82	58		120	319
17	West Downtown	92	599	238	719	1,914	119	607	241	755	2,008
18	East Downtown	444	129	48	576	1,533	491	143	53	637	1,694
19	West Hillside	5			5	13	74			74	196
20	West Sunset	206			206	548	228			228	633
21	Mountain Park	370	165	4	481	1,280	407	165	4	518	1,378
22	Cherry Place	1			1	3	35			35	93
23	Wildwood	257	300		452	1,202	544	319		751	1,998
24	Foothills	36			36	96	50	46		80	213
25	Sycamore	23			23	61	728	3	5	735	1,954
26	Montreux	234	100	12	311	827	304	100	12	381	1,013
27	Lakemont Triangle				215	572	50	342		272	723
28	Lake Tradition										
29	S. Cougar Mountain	1			1	3	285		18	303	607
30	Issaquah 69						60			60	160
31	Talus	8			8	21	1,735			1,735	4,615
32	Tibbetts Valley						123		6	129	344
33	Talus Open Space										
34	County Island										
35	Issaquah Highlands	219		56	275	732	3,729		236	3,965	10,546
36	Park Pointe						483			483	1,285
	TOTAL	**2,244**	**2,173**	**1,125**	**5,229**	**13,907**	**10,497**	**2.905**	**1,916**	**14,301**	**38,041**

NOTE: The City's future development capacity, based on the City's adopted Comprehensive Plan ("City of Issauquah Comprehensive Plan" 2000), is estimated to be 14,301 ERUs.

Future developments are estimated to add 9,073 ERUs to the system.

Multifamily ERUs estimated at 0.65 ERUs per multifamily unit.

CHAPTER 3
Policies, Standards and Criteria

3.1 POLICIES

The Issaquah Comprehensive Plan established the following goals for utilities and public services, including the sewer utility system:

GOAL 1: Facilitate the development of all utilities and public services at the appropriate levels of service to accommodate Issaquah's planned growth.

GOAL 2: Facilitate the provision of reliable utility and public services that balance public concerns over safety and health impacts of utility and public service infrastructure; consumers' interest in paying a fair and reasonable price for the utility or public service provider's product or service; Issaquah's natural environment and the impacts that utility or public service infrastructures may have on it; and the community's desire that utility and public service projects be aesthetically compatible with surrounding land uses.

GOAL 3: Process permits and approvals for utility facilities in a fair and timely manner and in accordance with development regulations that encourage predictability.

Specific to the sewer utility system, Issaquah has the primary objective**:**

Objective U3: Sewer. *Provide and maintain a sanitary sewer collection system that protects public health and safety and water quality through implementation of the policies within the Comprehensive Sewer Plan Update (10/92 and subsequent updates).*

In order to achieve the above goals and objective, the City will implement the following adopted policies to guide the various facets of the sewer system utility operations.[4]

Sewer Connections: Require sewer connections for all new developments, provided that the connection does not cause significant adverse environmental impact. This requirement excludes single family residential on existing platted lots where connection to a public sewer within 200 feet is not available. (Policy U3.1)

Non-Failing Septic Systems: Allow existing single-family homes with septic systems to continue to use them, provided that the systems are functioning properly, as documented by the Seattle-King County Health Department. All septic systems in the City shall be monitored according to Seattle-King County Department of Health regulations. (Policy U3.2)

Failing Septic Systems*:* Require that property owners connect to the sewer system if a septic system is not functioning properly, as documented by the Seattle-King County Health Department. If the Seattle-King County Health Department determines that such connection is

[4] The policies are included in the City of Issaquah Final Comprehensive Plan, adopted in April 1995, amended 2002.

not feasible, Seattle-King County Department of Health inspectors shall identify equally mitigating corrective actions, which shall be required. (Policy U3.3)

Side Sewers*:* Side sewers shall be owned and maintained by the property owner up to and including the connection to the City-owned sewer main. (Policy U3.4)

Service Improvements, Reliability and Investment: Identify, prioritize, and provide sufficient funding for capital improvement projects and programs that meet one or more of the following criteria: (Policy U3.5)

1. Improve capacity for system growth,
2. Repair failing or deteriorated sewer lines,
3. Extend sewer lines into presently unsewered areas,
4. Maintain appropriate levels of service,
5. Improve system operations, or
6. Minimize health hazards from contamination of ground or surface waters

Work with other sewer providers to ensure adequate provision and maintenance of sewer facilities for properties not served by the City. (Policy U3.6)

Emergency Preparedness*:* Prepare an emergency plan, and update at appropriate intervals, for response to emergencies that threaten public health or the sewer system. (Policy U3.7)

Regional Coordination*:* Coordinate with Metro and adjacent jurisdictions in the planning of the City's sewer system, any interties with regional sewer systems, and future demands on wastewater treatment and conveyance. (Policy U3.8)

Enforcement*:* Termination of domestic water service to the subject property shall occur if the property owner fails to meet the sewer connection policy or pay utility charges. (Policy U3.9)

To address the City Council's policy direction on funding of sewer extensions, the following policy should be incorporated into the next update to the Issaquah Comprehensive Plan (utility element):

ULIDs for sewer extension*.* Require consideration of Utility Limited Improvement Districts (ULIDs), if supported by property owners, for funding sewer extensions as the preferred method of financing before authorizing Sewer Utility revenue bonds for such projects.

City financing of sewer extensions. Authorize the City to fund sewer extension through Sewer Utility revenue bonds if the City Council finds that it is in the public interest to extend sewer to 1) provide sewer service to one or more homes that become uninhabitable due to Health Department regulations on failed septic systems, 2) address contamination of surface waters if demonstrated to be caused by septic systems, and 3) meet the goals of the Growth Management Act (GMA) that require the City to provide utility service to support allowed development and to be consistent with the objectives of implementing service improvements, reliability, and investment in the Sewer Utility.

3.2 IMPLEMENTING CRITERIA

Various system design criteria and standards have been developed to ensure that a consistent minimum level of service is maintained throughout the sewer system and to facilitate planning, design, and construction of sewer system projects. A partial list of criteria affecting sizing and siting of facilities is provided in **Appendix F**. A detailed listing of design requirements for sewer systems is available in the latest revised publication of *Criteria for Sewage Works Design* prepared by the Department of Ecology with the principal points summarized below:

- Gravity Sewers
  - Sewers will be located in public rights-of-way where possible with easements held to a minimum.
  - Minimum depth of cover will be 3-feet to prevent freezing and physical damage from surface activity or other utilities, and deeper where needed to provide gravity service to adjacent properties.
  - Sewers will be of sufficient size to convey the maximum hourly wet weather flow, which shall be at least 400 percent of the average day wet weather flow.
- Manholes
  - Manholes are required at the end of each sewer to facilitate future extensions; cleanouts are not an acceptable substitute.
  - Maximum spacing allowed between manholes is 400 feet for sewers of 15-inches or less in diameter.
- Pump Stations
  - Variable speed pumps are preferred to minimize stagnant sewage accumulation in wet wells that might produce septic conditions with resulting odors.
  - Sewage flow meter, with at least a totalizer, will be provided in all new pumping facilities.
  - Provisions will be made to prevent a sewage overflow during the longest outage experienced locally in the past 10 years through emergency power, storage, or some combination.

In addition, all extensions of the sewer system shall conform to the criteria and standards set forth in the *City of Issaquah Public Works Department Developer Extension Agreement for Sewers,* 1988, or as amended thereafter.

Some design standard issues which the City may want to consider adding to their sewer design manual are as follows:

- Private residential pump station design criteria.

- City-owned pump station design criteria.

- Backup power for pump stations. Portable power connection requirements for pump station, without on-site backup power source, and stationary power source design criteria for pump station, with on-site backup power source.

CHAPTER 4
Existing Facilities

4.1 SEWER SYSTEM HISTORY

The City of Issaquah sanitary sewer system is a municipally owned utility that is operated in conjunction with the City's water utility by the City of Issaquah Public Works Operations and Maintenance Department. The existing system and service area is shown on **Figure 4.1**.

The business district along Front Street and the surrounding residential areas located on the valley floor were first sewered in 1939. The sewage was treated by a small secondary treatment plant located at the confluence of the main stem and East Fork of Issaquah Creek. The sewer service area was essentially static until 1967, and the formation of Metro. In 1969, Metro constructed the Issaquah Interceptor, and subsequently, the City abandoned its secondary treatment plant.

In 1982, Metro constructed the Issaquah Creek Interceptor to relieve the Issaquah Interceptor that was flowing near capacity during peak flow periods. In 1982, in accordance with an earlier agreement with Metro, a portion of the Issaquah Interceptor was incorporated into the City of Issaquah's sewer system. The METRO Issaquah and Issaquah Creek Interceptors are shown on **Figure 4.1**. (Note: That portion of the Issaquah Creek Interceptor located within the right-of-way of Gilman Boulevard is referred to in this plan as the King County /Gilman Interceptor.)

The majority of Issaquah's sewer system was built by Local Improvement Districts (LIDs) during the period of 1969 to 1979. Recent expansion of the system includes the following additions:

- Extension of the West Downtown Trunk Sewer to the intersection of South Front Street and 2nd Avenue S.E.
- Several extensions in the 18th Street and I-90 South subbasins.
- A trunk sewer was extended along N.W. Newport Way to the Lakemont subbasin to service the neighborhoods along Pinecone Drive and Oakcrest Drive.
- Montreaux development
- Issaquah Highlands development (formerly Grand Ridge)
- Talus development (formerly East Village)
- Foothills development (A portion of the system serving the Foothills development was condemned shortly after it was constructed [and prior to building construction] and abandoned as a result of landslides).

4.2 COLLECTION SYSTEM

The existing sewer system is best described in terms of the subbasins it is designed to serve. Subbasins are shown in **Figure 4.2** and are discussed below in terms of east, south, north and west. The subbasins were delineated to apportion existing flows to various trunk sewers within the system.

Sewage from the City's system flows by gravity to the northwest via the NW Sammamish Interceptor to the Sunset Pump Station. From the Sunset Pump Station, sewage is pumped through the Vasa Park Interceptor to the King County East Lake Washington Interceptor that flows southward to Metro King County's Renton wastewater treatment plant. Treated effluent from the Renton plant is conveyed via the effluent transfer system for discharge into Elliot Bay.

4.2.1 East

The eastern portion of the City's collection system is comprised of the following subbasins:

- East Downtown
- West Downtown
- Sycamore
- Northeast Trunk
- Issaquah Highlands
- Park Pointe
- Lake Tradition
- King County Island

Sewage flows from the East Downtown and West Downtown subbasins are collected in the Issaquah Creek Interceptor at its termination along Rainier Boulevard, near its intersection with East Fork Issaquah Creek. Flow from the Northeast Trunk subbasin is discharged to the Metro-King County System at N.W. Gilman and Rainier Boulevards. The Sycamore subbasin and a portion of the Northeast City subbasin are currently unsewered. The new Issaquah Highlands development ties directly into King County's Issaquah Creek Interceptor at Rainier Boulevard N. and N.W. Holly Street. Much of the Issaquah Highlands subbasin is still undeveloped and remains unsewered. Due to zoning constraints, it is expected that the King County Island and Lake Tradition subbasins will remain unsewered.

4.2.2 South

The southern portion of the City's collection system is comprised of the following subbasins:

- Goodes Corner
- I-90 South
- Cherry Place
- West Hillside
- West Sunset
- Morgan's Ridge
- Mt. Park
- Wildwood
- Foothills
- The Woods
- Central (Issaquah Commons)

Figure 4.1:
City Sewer System and Service Area

Figure 4.2:
Sewer System Subbasins

- Newport Interceptor
- Talus
- Talus Open Space
- Issaquah 69
- Tibbetts Valley Park
- Tibbetts Valley

Except for the Talus subbasin, sewage flows from this entire section of the collection system enters the King County system along N.W. 12th, between Newport Way and N.W. Mall Street via the following piping systems, which are not to be confused as "subbasins":

- Newport Way Trunk
- 7th Avenue Trunk
- Issaquah Interceptor
- 12th Avenue Trunk

Sewage from the Talus subbasin will flow north along SR-900 and enters King County's Issaquah Interceptor Section 2 at 12th Avenue N.W. and N.W. Maple Street.

Goodes Corner, I-90 South, and Newport Park are mostly unsewered except for the northern portions of I-90 South and Goodes Corner. Sewage flows from these subbasins enter Metro-King County's system at various points along the section of the Issaquah Interceptor retained as part of Metro-King County's system.

4.2.3 North

The northernmost section of the City's sewer system to the north of Interstate 90 is delineated by the following subbasins:

- I-90 West
- N.W. Sammamish Trunk
- Holiday Inn
- Pickering Place
- N.W. Pumped
- N.W. 18th Street
- I-90 East

Connections in the I-90 West subbasin are made directly to the 48-inch-diameter Issaquah Interceptor. The N.W. Sammamish Trunk subbasin is served by the 12-inch-diameter Sammamish Boulevard Trunk sewer. The Holiday Inn and Pickering Place subbasins are each served by a pump station and a 6-inch force main.

Three subbasins south of and adjacent to Interstate 90 are the N.W. Pumped subbasin, the 18th Street subbasin, and the I-90 East subbasin. Currently there is no service to the N.W. Pumped subbasin (any service would require pumping). Sewage flow from the western portion of the 18th Street subbasin is directed to the Issaquah Interceptor Section 2, and sewage flow from the eastern portion of the 18th Street subbasin is directed to the Issaquah Creek Interceptor. Sewage flow from the I-90 East subbasin – a long, narrow delineation between I-90 and N.W. Gilman Boulevard – is connected directly to the Issaquah Creek Interceptor.

4.2.4 West

The westernmost section of the City's existing sewer system currently serves the following subbasins:

- Terra Highlands
- Montreux
- Lakemont Triangle
- South Cougar Mountain

Each of these subbasins is served by the S.E. Newport Way Trunk.

4.3 INDUSTRIAL WASTE

Two industrial wastewater customers exist within the service area. Each has a waste strength that requires a separate King County waste discharge permit. These customers are:

- Darigold Process Plant at 611 N. Front Street, a milk and dairy foods processing facility.

- Data I/O Corporation at 1297 N.W. Mall Street, a printed wiring board manufacturing facility.

Each plant's waste discharge is subject to an industrial waste surcharge and pretreatment requirements. The enforcement and monitoring activities for these special permits are accomplished by King County staff; City personnel are not affected.

In addition to Darigold and Data I/O, there are several restaurants and drive-ins that have high grease discharge potentials, which could cause maintenance problems. Grease traps are required by City ordinance.

However, the grease traps should be inspected periodically and sewers in these vicinities should be checked frequently to verify the grease trap effectiveness. The City currently does not have a grease trap inspection program. Beyond the users mentioned above, the City presently does not have any special commercial or industrial waste discharges that are known to cause problems for sewer system maintenance.

4.4 MAINTENANCE AND OPERATIONS

Sewer maintenance functions are performed by the City of Issaquah's Public Works Operations Department, with sewer maintenance staffing levels annually reviewed.

Maintenance programs include high pressure cleaning of collection and truck lines on a triennial rotation. Debris collected from this operation is disposed of at the Cedar Hills landfill under a special permit.

Sewer lines that are inaccessible for high pressure cleaning are flushed semiannually. Since these lines are typically located on easements, this operation includes locating and inspecting the manholes.

The downtown sewer system (WPA), due to its low slopes, is also included in the semiannual flushing program. These sewers are also baited for rats.

Certain sections of the sewer system typically associated with restaurants require grease removal on a quarterly basis, and the associated grease traps should be inspected at that time.

Manhole maintenance consists of sealing leaking manholes, repairing damaged or eroded channels, and replacing perforated manhole lids with solid lids to prevent inflow.

The lift station maintenance program consists of weekly inspections with either weekly or monthly wet well cleaning, depending on grease concentrations. Pumps and generators are inspected and serviced annually.

Lift stations are connected to the City's telemetry system, which provides alarms and after-hours calls in the event of a lift station failure.

As noted in Section 5.1, the City's original sewer system was constructed in 1939. In order to ensure the integrity of these existing lines as well as to reduce the potential for I/I, the City has initiated a program of inspection and rehabilitation of these sewer mains and manholes. Additional information regarding the City's sewer rehabilitation efforts is presented in Section 8.

To date, no sewer over flows have been reported due to insufficient pipe capacity, even during severe storm conditions.

CHAPTER 5
Existing Wastewater Flows

5.1 WASTEWATER FLOW COMPONENTS

Total wastewater flow is generally estimated as the sum of several separate flow components. For this analysis, wastewater flows include the following components:

- Residential sanitary sewage
- Non-residential sanitary sewage
- Base infiltration
- Rainfall dependent inflow/infiltration

Infiltration and inflow (I/I) are sometimes considered separately, but are partially combined in this analysis because of their similar relationships to rainfall and limited information differentiating the two. The separation into base infiltration and rainfall dependent infiltration inflow was achieved through analysis of the rainfall record and the sewage flow hydrographs. Each of the flow components considered in this plan is described below.

5.1.1 Residential Sanitary Sewage

The wastewater generated by the residential population is referred to as residential sanitary sewage or, sometimes, domestic sewage. Residential sanitary sewage is often closely related to the volume of water used within a household (outdoor use excluded). The City of Issaquah's winter water consumption records, zoning, land use and census data were used to form an initial estimate of the per capita residential sanitary sewage flow. In addition, flow monitoring results from King County's Regional Infiltration/Inflow Control Program were evaluated as a check on the winter water consumption estimates.

5.1.2 Nonresidential Sanitary Sewage

Nonresidential wastewater generated by commercial businesses, industry, hospitals, public buildings, etc. is typically combined into a single category called nonresidential sewage. The nonresidential sewage component is typically computed on a flow-per-developed-acre or flow-per-building square footage basis. In order to standardize flow estimates for modeling, comparison of basins and consistency with the *City of Issaquah Water System Plan Update 2002*, nonresidential flows are also expressed in terms of ERUs. Winter water consumption records are often used to estimate nonresidential sewage flows provided that the service area does not include businesses that use City water in the production of a product, for irrigation or obtain water from sources other than the City such as private wells.

If a service area contains very large water or sewer customers with special contracts, individual estimates of sewage flow, rather than a uniform unit flow-factor (gpad or gpd/1000 sf) is often necessary. The City of Issaquah's present commercial/industrial base does not include such unusual industries. Therefore, winter water consumption records were used to provide an initial estimate of nonresidential sewage, and a uniform unit flow-rate. As with the residential estimates of flow-rate, flow monitoring results from King

County's Regional Infiltration/Inflow Control Program were then evaluated to define the actual wastewater flow contributions in each subbasin.

5.1.3 Infiltration/Inflow (I/I)

Infiltration is groundwater which enters the sewer system through misaligned joints, fractured or defective pipes, leaking manholes, or other places where seepage into the system from the surrounding soil can occur. Base infiltration is often defined as the dry weather flow present in a sewer system during the 2:00 to 4:00 a.m. period when little sanitary sewage is generated.

Inflow is surface water runoff that directly enters a sewer system from roof drains, foundation drains, street and area drains, perforated or leaking manhole covers, and other sources. In this document, the term "Rain Dependent Infiltration Inflow" (RDII) is used to describe all flows not sanitary or base infiltration

I/I is undesirable because it takes up capacity in pipes, pump stations and treatment plants that was designed to carry wastewater. In fact, I/I can greatly exceed the magnitude of the sanitary flow. System overflows, bypasses and moratoriums on building development can result from this loss of capacity to I/I.

5.2 EXISTING FLOW INFORMATION

5.2.1 Background

In past years, limited studies of wastewater flows have been conducted on portions of the City's sewer system. Wet weather flow estimates for selected basins were presented in 1995 by Brown and Caldwell for the King County report, *Kent and Issaquah I/I Pilot Project.* In 1978, Hammond, Collier & Wade-Livingstone Associates, Inc., produced the report, *Infiltration and Inflow Study Considering Winter Flows*.

More recently, extensive wet weather flow monitoring was conducted in the City's sanitary sewer system by the King County Regional I/I Control Program during the 2000-2001 winter season. Wet and dry weather data from this study were evaluated to provide insight into the unit flow-rates for I/I, residential and nonresidential sanitary sewage components for the City's system.

Estimates of residential and nonresidential sanitary sewage flows derived from available wastewater flow data were also compared with water consumption records that were compiled for the City of Issaquah Water System Plan Update. Water consumption records for the City of Issaquah were available for the following categories:

- Single-Family Residential
- Multifamily Residential
- Commercial
- Public Authority

The water consumption rates for each category represented average water use across the service area for each general development category. In some cases, the available water consumption rates did not compare well with the measured wastewater flows. In general, water consumption rates and measured flows compared well for residential development. Variability in the water consumption and wastewater contribution for other development types at the subbasin level resulted in less correlation between measured wastewater flows and water consumption rates averaged across the service area.

5.2.2 Subbasins

The existing wastewater flows for this report were derived by dividing the total service area into subbasins and evaluating current wastewater flow measurements for each subbasin. These model subbasins and modeled sewers shown in **Figure 5.1** were developed to support the 1996 Sewer System Plan Update and then updated for the Plan to reflect annexation and newly identified PAA's. Service areas (or model basins) were delineated to partition the Issaquah wastewater service area and potential service areas into smaller pieces appropriate for analysis purposes. The boundaries of the model basins were, and still are, generally consistent with zoning boundaries. The relationship between the City's subbasins and County's flow monitoring minibasins is discussed in Section 5.2.3 and 5.3.4.

5.2.3 King County Flow Monitoring

King County completed an extensive flow monitoring effort during the 2000-2001 wet season to support countywide planning efforts. The May 2001 report by King County – *2000/2001 Wet Weather Flow Monitoring* – presenting the results of this effort, was distributed to the City of Issaquah and the other 33 local agencies tributary to the King County conveyance system. Over 800 flow meters were installed throughout the King County service area to measure wastewater flows. As shown in **Figure 5.2**, King County installed 13 flow meters in the Issaquah sewer system. Flows were also measured at three locations in King County interceptors immediately downstream of the Issaquah service area.

Figure 5.2 also shows the approximate limits of existing sewer tributary to each meter – designated as minibasins in the King County Program – and the position of these minibasins relative to the subbasins used by the City of Issaquah for modeling and planning purposes. While there is not a one-to-one match between the areas of the County's minibasins and Issaquah's subbasins, the results of the flow monitoring can be associated with most of the modeling subbasins that contain existing sewers.

Unfortunately the 2000 to 2001 "wet" season was unusually dry. No rainstorms of real significance were recorded. However, the data was used to define the sewage component of the total wastewater flow.

King County then decided to extend the flow monitoring program through the 2001 to 2002 wet season with one change in the location of their flow monitors. Several significant rain storms were recorded as shown in **Table 5-1**.

Table 5-1: Rain Storms Monitored by King County During 2001 to 2002 Season

Basin	Measured Rainfall in Inches and Total Measured Wastewater Flow in Gallons per Day									
Date:	4-Nov-01	13-Nov-01	19-Nov-01	21-Nov-01	28-Nov-01	12-Dec-01	15-Dec-01	1-Jan-02	6-Jan-02	12-Jan-02
Rain:	0.5 inch	4.6 inch	1.9 inch	2.1 inch	2.6 inch	2.2 inch	2.7 inch	0.7 inch	2.4 inch	0.5 inch
ISS001	49,464	63,869	36,430	60,635	56,814	N/A	68,965	54,560	61,811	45,250
ISS002	32,627	252,251	67,052	105,375	107,729	170,004	129,733	34,251	92,384	56,984
ISS003	89,536	598,813	197,348	241,611	242,913	309,553	304,508	287,665	221,188	111,424
ISS004	116,912	597,313	138,823	478,233	324,995	413,726	561,249	572,953	161,550	103,439
ISS005	93,692	262,689	116,726	171,159	276,389	283,056	326,336	100,723	291,179	156,005
ISS006	522,179	477,886	585,944	647,181	457,226	458,861	642,425	586,241	618,198	351,101
ISS007	234,729	482,148	298,605	367,604	616,338	971,908	850,361	175,836	483,793	268,947
ISS008	290,648	389,836	376,826	318,336	306,883	322,117	310,664	238,163	298,098	321,338
ISS009	92,934	177,785	162,084	220,863	131,250	58,755	118,327	82,731	1,010,259	86,982
ISS012	61,993	333,795	95,669	129,265	183,609	237,635	165,016	59,519	91,519	89,045
ISS013	57,544	88,610	59,615	73,756	101,501	120,533	134,174	68,721	74,863	49,224
ISS014	180,675	491,490	173,245	255,111	214,109	417,329	343,994	89,040	229,794	97,295
Totals	1,822,932	4,216,485	2,308,366	3,069,130	3,019,756	3,763,477	3,955,751	2,350,402	3,634,635	1,737,034

Figure 5.1:
Modeled Sewers and Subbasins

Figure 5-2:

Comparison of Previously Modeled Flows and Measured Flows

5.3 DEVELOPMENT OF EXISTING WASTEWATER FLOWS

5.3.1 Approach

The 1996 Sewer System Update was completed without the benefit of measured flow data. The 2002 Sewer Plan Update uses flow data collected by King County was valuable for determining flows actually contributed by existing development within the service area.

Figure 5.2 shows a comparison of flows modeled for the 1996 Sewer System Update with flows measured during the 2000-2001 wet season by King County. Measured and modeled flows were compared at five locations on the existing City and King County sewers. At all locations, the measured peak flow (WW Peak) exceeded the peak flow estimated with the 1996 model (Hydra Q). The most significant cause for the difference appears to be the King County assumption of an I/I rate of 1,100 gallons per acre per day (gpad) incorporated into the previous modeling for the 1996 Plan. As discussed in Section 5.3.4 below, measured flows during the 2000-2001 wet season, which had well below normal precipitation, showed actual contributions from I/I generally exceeded 1,100 gpad.

The use of measured flow data provided significant advantages over use of water consumption records. Measured flow data provided the opportunity to validate, or possibly refine, the unit values used to estimate wastewater contributions. The unit flow values are still necessary because measured data is not available for all modeled subbasins and is needed for future development.

The second advantage of using measured flow data was to calibrate the flow model so that flows were properly routed through the modeled sewer system. The available capacity of the sewer system is chiefly affected by the timing and magnitude of daily peak flows through the system. These characteristics of the daily peaks are represented in the diurnal flow patterns, or hydrographs, for each of the City's subbasins. Measured flows can be used to develop the diurnal flow patterns for each subbasin. In addition, the measured flows from flow meters located in downstream portions of the system show how the peak flow patterns from tributary subbasins combine.

Due to different subbasin hydraulic conditions and travel times, the peak flows do not usually occur simultaneously throughout all parts of the system. Consequently, measured data shows how the flows actually do combine and can thereby be used to check the model results and ensure that available capacity is accurately estimated for the modeled portions of the sewer system. The model does this by combining the diurnal curve of sewage flow as it varies through the day, with a constant input representing the infiltration/inflow component. Travel time down the pipe system is computed using the relevant parameters like slope and diameter. The resulting kinetic wave of peak flow is translated through the piping route without consideration of storage or attenuation. These waves are combined at pipe junctions, or nodes, to compute the resulting hydraulic gradeline.

5.3.2 Water Consumption Records

Available water records were reviewed to determine water consumption during the winter months. Winter water use is more likely to correlate with wastewater contributions, because during the summer months irrigation typically comprises a significant portion of water use, but does not enter the sanitary sewer system.

The average residential winter water consumption value within the City was found to be about 180 gallons per ERU per day (gpERUd). The average non-residential winter water consumption value was found to average about 126 gallons per 1,000 square feet of building floor space. By comparison, new residential construction at Snoqualmie Ridge averages about 140 gpd per ERU during the winter.

5.3.3 Existing Infiltration/Inflow Rates

Previous studies have reported widely varying I/I rates within the City's system, ranging from 300 to 10,000 gpad. The 10,000 gpad is for a relatively small area of the system that had suspected I/I problems and was contained in a report prepared in 1978 by Hammond, Collier & Wade – Livingstone Associates, Inc., *Infiltration and Inflow Study Considering Winter Flows.* Significant system changes and improvements have been accomplished since that time.

Flow monitoring conducted by King County from October 2000 through January 15, 2001, documented a range of I/I rates in Issaquah that are presented in the *2000/2001 Wet Weather Flow Monitoring Report* by King County. This work was extended another season as documented by the "2001/2002 Wet Weather Technical Memorandum." As shown in **Table 5-2**, the maximum reported I/I rates within King County minibasins ranged from about 704 to 41,356 gpad. For analysis of the Issaquah system, the infiltration/inflow defined for the various King County minibasins was used to define extraneous flows within the entire associated City subbasin or subbasins.

Table 5-2: Measured I/I Rates - 2001/2002 King County Data

King County Minibasin	Total Area (acres)	Sewered Area (acres)	Maximum Measured I/I Rate (gpad)[1]	Maximum Measured I/I Flow mgd	Associated Issaquah Subbasin
ISS001	139	74	704	0.05	90% of 26
ISS002	88	69	3,107	0.21	50% of 23
ISS003	132	80	7,359	0.59	50% of 23, 24
ISS004	149	126	4,389	0.55	20, 40% of 13
ISS005	137	98	2,692	0.26	17, 22, 25
ISS006	167	138	4,354	0.60	18
ISS007	89	151	41,356	6.24	35
ISS008	140	91	3,506	0.32	11, 50% of 13,16
ISS009	122	128	17,824	2.28	3, 10% of 26, 27
ISS010					
ISS011					
ISS012	83	53	4,183	0.22	4, 10, 12
ISS013	36	36	3,758	0.14	14
ISS014	177	170	3,572	0.16	21

NOTE: ISS010 and ISS011 were active King County monitoring sites during October 2000 to January 2001 study period, but were replaced by ISS014 for this monitoring period.

Because measured I/I data were not available in 1996, a combined I/I value of 1,100 gpad was applied in the 1996 Sewer Plan to estimate existing and future I/I flows within the overall Issaquah system. This value was derived from King County Ordinance (Chapter 28.84) that sets the defining threshold for "excessive" flows as any flow, other than residential and/or industrial wastewater, over 3.06 cubic feet per acre for any 30-minute period. The King County threshold is intended for application to the design and testing of new sewers. It also establishes a baseline flow over which financial surcharges may be applied in the future against "excessive" flows discharged to the King County trunk sewers. Such surcharges have never been assessed by King County, however.

One difficulty in applying this I/I rate for planning purposes is that pipes installed before 1961 are not subject to the surcharge threshold. Thus, while it may be appropriate to assign the mandated rate of 1,100 gpad to new pipe, or areas serviced since 1961, older areas may greatly exceed this value. Although Issaquah has initiated a program to rehabilitate many of it's pre-1961 pipe to reduce I/I, the recent flow monitoring indicates the total I/I flow from some of the basins that include non-rehaibilitated pre-1961 pipes still exceed the 1,100 gpad rate.

The appropriateness of 1,100 gpad as a threshold I/I rate is the subject of considerable ongoing discussion among the County and the 34 component wastewater agencies it serves. One question is whether or not the 1,100 gpad is economically achievable. One of the objectives of King County's Regional I/I Control Program is to establish consensus on appropriate regional and local threshold rates for excessive flow. The City's active participation in the County's Program will be critical to establishing an I/I rate that is practicable for Issaquah.

5.3.4 Unit Flow Rates for Existing Sewer System

Table 5-3 summarizes the wastewater flow data based on King County flow monitoring program in comparison with estimated average daily winter water use. The percent difference is the average daily sewage flow computed divided by the estimated average daily winter water used. The resulting percentage provides an indication of the accuracy of the data.

Table 5-3: Wastewater Flow Monitoring Data Comparisons Based on King County Data

King County Minibasin	Average Daily Sewage Flow – Computed (MGD)[1]	Estimated Average Daily – Winter Water Use (MGD)[2]	Percent Difference	No. of ERUs Estimated From GIS	Total Pipe Length (ft)	Total Minibasin Area (acres)
ISS001	0.011	0.050	22%	290	28,820	139
ISS002	0.014	0.030	47%	165	11,862	88
ISS003	0.069	0.083	83%	477	13,422	132
ISS004	0.129	0.080	161%	493	20,736	149
ISS005	0.080	0.141	57%	870	18,938	137
ISS006	0.211	0.096	220%	593	24,122	167
ISS007[3]	0.094	0.056	168%	347	11,408	89
ISS008	0.151	0.064	236%	394	21,670	140
ISS009	0.045	0.062	73%	381	20,285	122
ISS012	0.093	0.030	310%	186	13,333	83
ISS013	0.041	0.037	127%	228	5,668	36
ISS014	0.985	0.084	49%	521	31,972	177
TOTAL	**0.985**	**0.813**	**121%**	**4,945**	**222,236**	**1,459**

[1]Average daily sewage flow - computed excludes base infiltration.
[2]Winter water use per ERU was assumed to be 162 gpd; 90% of average winter consumption.
[3]Mobile home park estimated to have 87 units; from 1996 orthophotos

The Table 5-3 data was used to define unit wastewater flow values by minibasin, as shown in **Table 5-4**. Minimum flows recorded at 5 minute intervals by King County for each minibasin during early morning hours of days without rain were averaged to define Base Infiltration (BI). Computed Sewage Flow plus Estimated Base Infiltration equals Average Dry Weather Flow.

Table 5-4: Unit Sewage Flow Values (in mgd)

King County Minibasin	Measured Average Dry Weather Flow (mgd)[1]	Estimated Base Infiltration (mgd)[1]	Computed Sewage Flow (mgd)	No. of ERU's Estimated from GIS	Sewage Flow per ERU (gpd)
ISS001	0.020	0.009	0.011	290	38
ISS002	0.023	0.009	0.014	185	76
ISS003	0.090	0.021	0.069	515	134
ISS004	0.138	0.009	0.129	493	262
ISS005	0.094	0.014	0.080	870	92
ISS006	0.421	0.210	0.211	693	304
ISS007[3]	0.163	0.069	0.094	347	271
ISS008	0.207	0.056	0.151	394	383
ISS009	0.058	0.013	0.045	381	118
ISS012	0.112	0.019	0.093	186	500
ISS013	0.017	0.024	0.047	228	206
ISS014	0.070	0.029	0.041	521	79
	1.467	0.482	Total Sewage **0.985**	Total ERU's **5,103**	Average Flow per ERU **193**

1. Based on King County 2002 data file.

Data from Table 5-4 was then translated from King County minibasins into City subbasins, as shown in **Table 5-5**.

5.4 FUTURE CONSIDERATIONS

5.4.1 Water Conservation

As indicated in the Water System Plan Update, the City will be implementing a water conservation program as required by the Washington State Department of Health and in accordance with the East King County Coordinated Water Supply Plan. By 2000, the City had achieved an 8 percent reduction in water demand through its conservation program resulting in a consumption rate of 209 gpd/ERU.

The effect of additional water conservation on wastewater flow rates is expected to be minimal. Demand is expected to fall by only 1.5 percent by the year 2015. Although there may be some reduction in wastewater flow through the use of low-flow shower heads, low-flush toilets, etc., the majority of the decrease in water consumption will probably result from changes in water use patterns for irrigation and other outdoor water uses. Because these activities do not contribute to wastewater flows, and because infiltration and inflow from other sources are relatively large flow components, reduction of wastewater flows due to water conservation was not considered to be significant.

Table 5-5: Sewage Flows for Existing City System

Subbasin Number	Mini-Basins Applicable to Each Subbasin	Subbasin ERU	Mini-Basin ERU	Mini-Basin Measured Flows (mgd)[2]	Sewage Flow Determined for Subbasin (mgd)[3]	Sewage Flow per ERU (gpd/ERU)
1						
2	Average	97			0.0183	189
3	ISS009	158	381	0.069	0.0286	181
4	ISS012	111	186	0.093	0.0555	500
5	Average	7			0.0013	189
6	Average	39		0.253	0.0074	189
7	Average	107			0.0202	189
8						
9	Average	1			0.0002	189
10	ISS012	300	186	0.093	0.1500	500
11	ISS008	132	394	0.151	0.0506	383
12	ISS012	37	186	0.093	0.0185	500
13	ISS004 (50%), ISS008 (50%)[1]	397	444	0.140	0.1252	315
14	ISS013	229	228	0.011	0.0110	48
15	Average	212			0.0401	189
16	ISS008	82	394	0.151	0.0314	383
17	ISS005	719	870	0.080	0.0661	92
18	ISS006	576	593	0.211	0.2050	356
19						
20	ISS004	206	493	0.129	0.0539	262
21	ISS014	481	521	0.041	0.0379	79
22	ISS004	1	493	0.129	0.0003	262
23	ISS002, ISS003	452	642	0.083	0.0584	129
24	ISS003	36	477	0.069	0.0052	145
25	ISS005	23	870	0.080	0.0021	92
26	ISS001	311	290	0.011	0.0118	38
27	ISS009	215	381	0.045	0.0254	118
28						
29						
30						
31						
32						
33						
34						
35	ISS007	275	347	0.094	0.0745	271
36						
Totals		**5,204**			**1.099**	**211**

[1] Basin 13 is half in ISS004 and ISS008 – represents average of the two mini-basins.
[2] Measured Flows do not include base infiltration.
[3] Flows per subbasin were estimated by multiplying the fraction of subbasin ERUs and mini-basin ERUs with measured mini-basin flows.

5.4.2 Wastewater Reuse

As described in the Water System Plan Update (2001), potable water supply for the Issaquah area is a significant issue for future growth. The existing supply source from the local groundwater aquifer is limited and future supply sources will need to be investigated. One option for reducing potable water demand is reuse of reclaimed wastewater. It is possible to remove wastewater from portions of the existing or future sewer system, treat it to reduce organic pollutants and pathogens, and reuse the reclaimed wastewater for non-potable uses such as landscape irrigation. The Washington State Department of Ecology has developed guidelines for such reuse projects and interest in such projects in the Puget Sound area is growing as region-wide water supply sources are becoming stressed.

Examination of the feasibility of wastewater reuse is beyond the scope of this Plan Update. The effect of reuse on wastewater flow rates to King County could be significant depending on the extent of proposed reuse projects. Although it is impossible to estimate the effect as part of the Sewer System Plan Update, possible revisions to the wastewater flow rates developed in this section should be examined if and when reuse projects are proposed in the future.

5.4.3 Federal Regulations

The United States Environmental Protection Agency (EPA) has proposed revisions to the National Pollution Discharge Elimination System (NPDES) permit regulations that may affect municipalities tributary to treatment facilities such as King County's conveyance and treatment system. The planned revisions should be considered in any long-range planning Issaquah does for the construction, operation and maintenance of their collection system. These revisions are entitled the *Sanitary Sewer Overflow (SSO) Rule*. The SSO Rule address the following four primary issues:

1. ***Capacity Assurance, Management, Operation and Maintenance Program (CMOM)***. Agencies must develop a formal program for collection system capacity assurance, management, operation and maintenance. The program is to provide adequate capacity for base and peak flows to prevent SSOs; stop and mitigate the impacts of sewage overflows in portions of the collection system; provide program audits evaluating the program and measuring its effectiveness.

2. ***Notification of Public Health Authorities***. Requires a formal plan for notification of the public of overflows according to the associated risk, including annual summaries of sewer overflows.

3. ***Prohibition of Overflows***. Provides limited protection to communities from enforcement where overflows were caused by circumstances beyond their reasonable control.

4. ***Expanding Permit Coverage to Satellite Systems***. Communities with collection systems tributary to a system owned and operated by permitted treatment facilities will be required to obtain their own NPDES permit.

Practices addressing each of these issues are to be described in the formal program required under capacity, management, operation and maintenance. Hence, the entire rule is now colloquially known as CMOM. A more detailed summary of CMOM, prepared by the Federal Advisory Committee on the SSO Rule is included in **Appendix G**.

The proposed SSO Rule passed through the public review and comment phase in 2000 and was recalled from the Federal Register in January 2001 for review by the new EPA Director. If the Rule is passed on to the Federal Register again, one immediate concern for Issaquah will be how to managed the NPDES permitting requirements for satellite systems. One option would be to negotiate terms with King County for coverage under their NPDES permit. Presumably, inclusion under the County"s permit would involve compliance with prevailing King County I/I standards.

CHAPTER 6
Existing System Evaluation

6.1 MODELING APPROACH

This evaluation of the available capacity in the City's existing sewer system was completed using Version 5.85s of the sanitary sewer routing software HYDRA, developed by Pizer, Inc. Detailed input describes the flows and physical aspects of the sewer system. The model software uses these inputs to determine hydraulic capacity and to route generated flows through the defined sewer system.

As described in Sections 4 and 5, the City service area was divided into subbasins. The development contained within each subbasin provided the basis for quantifying flows contributed to the sewer base infiltration, and rainfall-dependent flows reported in Section 5. One of the objectives of generating flows for evaluating sewer capacity was to quantify the peak flow at every modeled location in the sewer system. The approach used to represent each type of flow was selected with this in mind.

The average daily sewage flow from each subbasin was applied to a daily diurnal flow pattern to consider the daily peak flow from sewage contributed to the wastewater system. The diurnal flow pattern was developed from the available flow data and was representative of flow data collected at multiple sites throughout the existing service area. This diurnal pattern is shown in **Figure 6.1**.

The base infiltration and rain-dependent infiltration and inflow were represented in HYDRA as constant flows. Base infiltration was input as a constant flow because it changes slowly over the course of many days. For a single day, which was the duration of the model simulation, it was appropriate to represent base infiltration as a constant flow. Rain dependent infiltration and inflow varies of the course of a single storm. In fact, the timing of the peak and shape of the hydrograph is different with each rainfall event. Since the objective of the analysis was to evaluate sewer capacity for peak flow conditions, the peak rain dependent infiltration and inflow was input to the HYDRA model as a constant flow. This approach was selected because the amount of available peak RDII flow data was minimal, and could not be used to accurately generate hydrograph shapes for different subbasins.

A detailed description of the subbasins used for analysis was provided in Sections 4 and 5. Detailed input to HYDRA was also developed to describe the existing sewer system. The portion of the sewer system represented in HYDRA was limited to the major trunk sewers. All of these ultimately convey flows to the King County sewer system. This approach was selected to limit the effort required for the analysis and because the smaller lateral sewers should not be affected in the future as flows increase from additional development. However, it may be necessary to expand the model in the future to consider future service alternatives or newly constructed trunk sewers.

The trunk sewers that were modeled are shown in **Figure 6.2** together with smaller sewers not included in the model. The following trunk sewers in the City's sewer system were included in the model:

- East Downtown Trunk
- West Downtown Trunk
- Newport Way Trunk
- Northeast Trunk

Figure 6.1:
Sewage Flow Diurnal Pattern

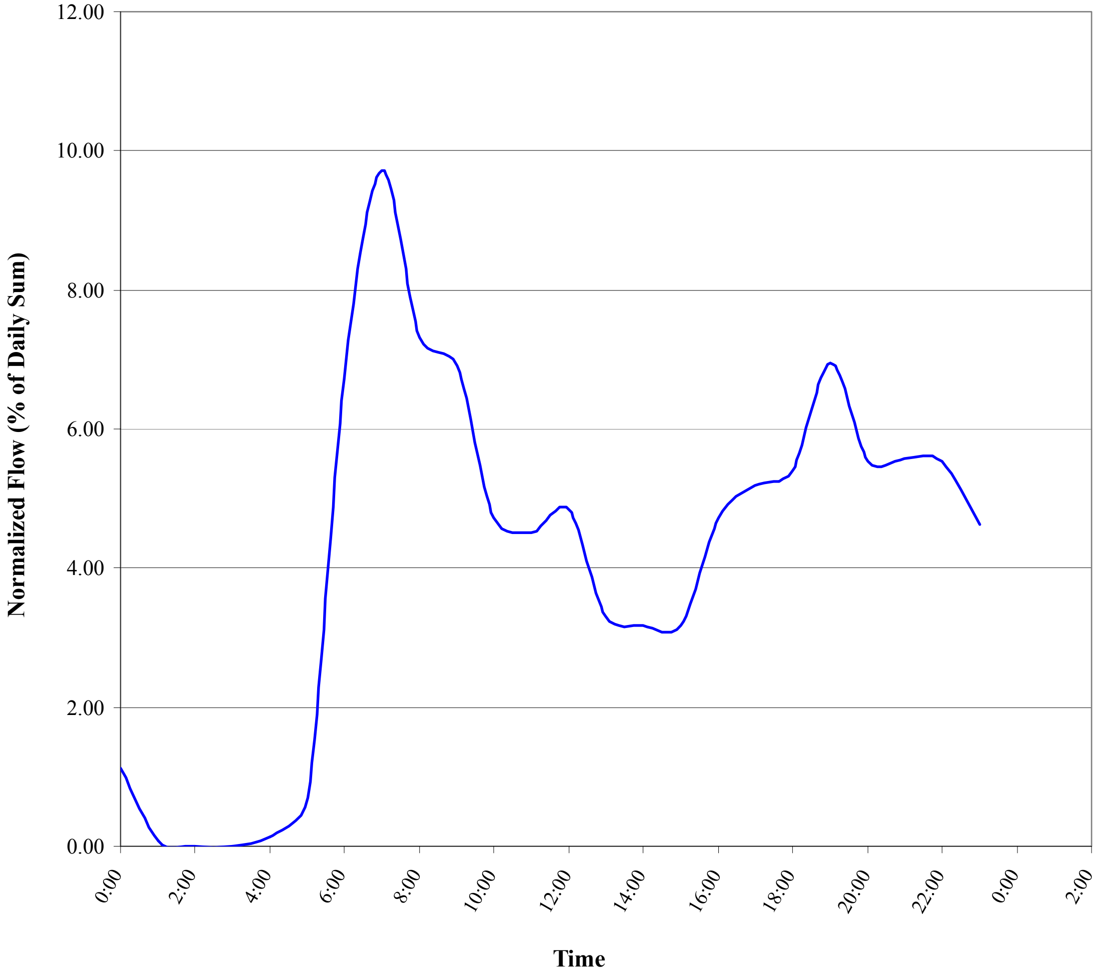

Figure 6.2:
Modeled Sewer Trunk System

The following King County interceptors that collect flows from portions of the City were also included in the model:

- King County Issaquah Creek Interceptor
- King County Issaquah Interceptor

6.2 EXISTING WASTEWATER FLOWS

As described in Section 5, sewage flow, base infiltration and rain dependent infiltration and inflow contributed by existing development was determined from the measured flows collected by King County during the November 2001 to January 2002 monitoring period. The flows measured from King County's minibasins were transferred to the City subbasins modeled for this analysis. The RDII flow used for the model in each sub-basin was a composite of the maximum flows measured in each applicable minibasin from the four storms during the monitoring period. This approach is believed to provide the largest RDII flow appropriate to each subbasin from available flow data, which unfortunately did not include any large storms.

For the purpose of analyzing capacity, I/I flows (BI + RDII) are expressed in terms of mgd. I/I flows are also expressed in terms of area, or gpapd, for comparisons among basins. The area used to express I/I flows in gpad was defined as the parcels plus adjacent roads and right-of-ways that are currently sewered or could be provided sewer service in the future. Dedicated open space and parks were excluded from the delineated sewered area. **Figure 6.3** illustrates the delineation of the study area as currently sewered area, potential future sewered area and permanently unsewered area.

Table 6-1 displays the input wastewater flows data to the HYDRA model for the existing pipe system and current land development under a 5-year storm event.

6.3 EXISTING SYSTEM MODEL RESULTS

The major trunks of the existing sewer system were evaluated using HYDRA with the flows from existing development, as derived from available flow monitoring data. **Figure 6-4** presents an overview of the major trunks in the City sewer system and summarizes the surcharges required to convey existing sewage plus the base infiltration plus the rain dependent I/I resulting from a 5-year storm event.

In general, with BI and RDII flows of a 5-year event as documented through flow monitoring during the 2001-2002 wet season, all of the major trunk sewers have adequate capacity to convey existing flows with minimal surcharging.

Table 6-1: Modeled Wastewater Flows for Existing Conditions with 5-Year Storm

Subbasin	Sewage Flow from Table 5-5 (mgd)	Subbasin Sewered Area (ac)	Base Infiltration (gpad)	5-Year Peak I/I (gpad)	Subtotal BI & RDII (gpad)	Total Modeled Flow mgd
1						
2	0.0183	17.8	397	2875	3272	0.0766
3	0.0286	49.8	102	922	1023	0.0796
4	0.055	28.2	361	3399	3760	0.1611
5	0.0013	8.9	397	2875	3272	0.0304
6	0.0074	44.3	397	2875	3272	0.1522
7	0.0202	74.2	397	2875	3272	0.2631
8						
9	0.0002	5.5	397	2875	3272	0.0183
10	0.15	109.2	361	3399	3760	0.5607
11	0.0506	58.3	615	2967	3582	0.2596
12	0.0185	9.7	361	3399	3760	0.0550
13	0.1252	126.2	343	3702	4045	0.6357
14	0.011	62.9	667	2836	3503	0.2312
15	0.0401	66.6	397	2875	3272	0.2581
16	0.0314	27.9	615	2967	3582	0.1312
17	0.0661	140.8	143	3051	3194	0.5157
18	0.205	171.7	1522	2906	4427	0.9650
19						
20	0.0539	77.6	71	4437	4509	0.4038
21	0.0379	194.8	171	2033	2203	0.4671
22	0.0003	0.7	71	4437	4509	0.0033
23	0.0584	158.6	196	3179	3376	0.5936
24	0.0052	11.6	263	4259	4521	0.0575
25	0.0021	17.3	143	3051	3194	0.0572
26	0.0118	122.9	121	797	919	0.1247
27	0.0254	22.7	102	922	1023	0.0487
34						
35	0.0745	117.3	457	5253	5710	0.7441
36						
Total		**1725**				6.893

Figure 6-3:
City Sewer Service Area Delineation

Figure 6.4:
Existing Condition 5-Year Event

CHAPTER 7
Evaluation of Future Conditions

7.1 FLOWS FROM EXISTING DEVELOPMENT

For the future conditions analysis, wastewater, BI, and RDII flows from existing development were assumed to remain the same. This approached can be viewed as assuming that the existing sewer system will not experience further deterioration. The increase in flows from existing to future conditions was attributed only to sewer service being provided to currently unsewered development and to new development in currently undeveloped areas. Typically, over time, it is expected that I/I flow increases due to the deterioration of facilities will occur, and no significant rehabilitation will be done beyond normal maintenance. A detailed tabulation of flows from existing and future development is presented in **Table 7-1**.

7.2 FLOWS FROM FUTURE DEVELOPMENT

None of the flow monitored subbasins within the City provided clear guidance regarding what wastewater flows can be achieved from new, properly designed, built and inspected systems, with particular attention to water conservation. However, monitored data is available from tests within the City of Seattle, and from Snoqualmie Ridge. Snoqualmie Ridge now has hundreds of homes in service on several hundred acres in terrain and climate that is similar to Issaquah. Data exists only for the past two years, however, and does not include wastewater flows during any major storm events. Accordingly, we used Snoqualmie Ridge as the basis for forecasting future Issaquah flows, with some reservations.

Future Sewage Flows

Projected equivalent residential units in new developments provided the basis for estimating future wastewater flows. Wastewater flow from future development in each subbasin was derived from the projected ERU in each subbasin at an average daily contribution of 125 gallons per day per ERU. The 125 gpd per ERU is the measured flow data from new development at Snoqualmie Ridge. Flows from exising development were assumed to retain the values derived from flows measured in each subbasin.

Base Infiltration

BI flow contributed from future development was considered in two ways, depending on whether or not the sewer mains serving the future development were already constructed. BI rates (gpad) determined from measured flow data were applied in subbasins where existing development dominates and new development consists of connecting currently unsewered development or the development of various individual parcels or small subdivisions. An assumed BI rate of 120 gpad was used for subbasins which will be comprised of completely new development with newly constructed sewers. This 120 gpad rate was derived from flow data collected at Snoqualmie Ridge.

Rainfall-Dependent Infiltration and Inflow

RDII flow expected from future development was estimated in a manner similar to estimation of BI. RDII rates (gpad) determined from measured 2001 to 2002 flow data were applied to new development in subbasins where most of the development has already occurred. For subbasins that will contain completely new development, an assumed RDII rate based on flow data collected at Snoqualmie Ridge

Table 7-1: Modeled Wastewater Flows for Future Conditions with a 5-Year Storm

Subbasin	Existing Sewered Area (acres)	Total Future Sewered Area (acres)	[1]New Sewered Area (acres)	BI from Existing Sewered Area (gpad)	RDII from Existing Sewered Area (gpad)	Sewage Flow from Existing Sewered Area (mgd)	Total Flow from Existing Sewered Area (mgd)	BI from New Sewered Area (gpad)	[2]RDII from New Sewered Area (gpad)	Sewage Flow from New Sewered Area (mgd)	Total Flow from New Sewered Area (mgd)	Total Future I/I (mgd)	Total Future Sewage Flow (mgd)	[3]Flow from Total Future Sewered Area (mgd)
1	0.0	23.2	23.2	0	0	0.0000	0.0000	120	2090	0.0003	0.0515	0.0512	0.0003	0.0515
2	17.8	45.8	28.0	397	2875	0.0189	0.0772	120	2090	0.0156	0.0775	0.1202	0.0345	0.1547
3	49.8	87.2	37.4	102	922	0.0187	0.0696	120	2090	0.0171	0.0996	0.1336	0.0357	0.1693
4	28.2	28.2	0.0	361	3399	0.0555	0.1616	120	2090	0.0000	0.0000	0.1061	0.0555	0.1616
5	8.9	37.8	28.9	397	2875	0.0014	0.0305	120	2090	0.0166	0.0805	0.0930	0.0180	0.1110
6	44.3	45.3	1.1	397	2875	0.0076	0.1524	120	2090	0.0054	0.0078	0.1472	0.0130	0.1602
7	74.2	78.3	4.1	397	2875	0.0209	0.2638	120	2090	0.0017	0.0107	0.2519	0.0226	0.2745
8	0.0	76.7	76.7	0	0	0.0000	0.0000	120	2090	0.0362	0.2057	0.1695	0.0362	0.2057
9	5.5	11.2	5.6	397	2875	0.0002	0.0183	120	2090	0.0010	0.0134	0.0305	0.0011	0.0317
10	109.2	110.2	0.9	361	3399	0.1500	0.5607	120	2090	0.0115	0.0136	0.4127	0.1615	0.5742
11	58.3	87.6	29.3	615	2967	0.0506	0.2595	615	2967	0.0280	0.1329	0.3138	0.0786	0.3924
12	9.7	9.7	0.0	361	3399	0.0185	0.0550	120	2090	0.0000	0.0000	0.0365	0.0185	0.0550
13	126.2	149.0	22.8	343	3702	0.1252	0.6357	343	3702	0.0152	0.1074	0.6026	0.1404	0.7431
14	62.9	73.0	10.2	667	2836	0.0472	0.2674	667	2836	0.0013	0.0368	0.2557	0.0485	0.3042
15	66.6	67.7	1.1	397	2875	0.0413	0.2594	120	2090	0.0006	0.0030	0.2204	0.0419	0.2623
16	27.9	30.5	2.6	615	2967	0.0314	0.1313	615	2967	0.0048	0.0141	0.1092	0.0362	0.1454
17	140.8	143.8	3.1	143	3051	0.0661	0.5157	143	3051	0.0044	0.0143	0.4595	0.0705	0.5300
18	171.6	181.9	10.2	1522	2906	0.1754	0.9353	1522	2906	0.0076	0.0529	0.8053	0.1829	0.9882
19	0.0	21.6	21.6	0	0	0.0000	0.0000	120	2090	0.0086	0.0563	0.0477	0.0086	0.0563
20	77.6	82.1	4.5	71	4437	0.0539	0.4037	120	2090	0.0028	0.0127	0.3597	0.0567	0.4164
21	194.8	237.3	42.5	171	2033	0.0379	0.4671	171	2033	0.0046	0.0982	0.5228	0.0425	0.5653
22	0.7	6.5	5.8	71	4437	0.0003	0.0033	120	2090	0.0043	0.0171	0.0158	0.0045	0.0204
23	158.6	231.0	72.5	196	3179	0.0584	0.5937	120	2090	0.0374	0.1975	0.6953	0.0958	0.7911
24	11.6	24.5	13.0	263	4259	0.0052	0.0575	120	2090	0.0055	0.0341	0.0809	0.0107	0.0916
25	17.3	182.5	165.3	143	3051	0.0021	0.0572	120	2090	0.0890	0.4542	0.4204	0.0911	0.5114
26	122.9	154.9	32.0	121	797	0.0118	0.1247	121	797	0.0088	0.0382	0.1423	0.0205	0.1628
27	22.7	34.7	12.0	102	922	0.0254	0.0486	120	2090	0.0072	0.0337	0.0497	0.0326	0.0823
28	0.0	0.5	0.5	0	0	0.0000	0.0000	120	2090	0.0000	0.0011	0.0011	0.0000	0.0011
29	0.0	511.0	511.0	0	0	0.0000	0.0000	120	2090	0.0378	1.1671	1.1293	0.0378	1.1671
30	0.0	40.1	40.1	0	0	0.0000	0.0000	120	2090	0.0075	0.0962	0.0887	0.0075	0.0962
31	0.0	263.2	263.2	0	0	0.0000	0.0000	120	2090	0.2159	0.7975	0.5816	0.2159	0.7975
32	0.1	105.6	105.6	0	0	0.0000	0.0000	120	2090	0.0162	0.2495	0.2333	0.0162	0.2495
33	0.0	24.2	24.2	0	0	0.0000	0.0000	120	2090	0.0000	0.0534	0.0534	0.0000	0.0534
34	0.4	70.6	70.6	0	0	0.0000	0.0000	120	2090	0.0000	0.1560	0.1559	0.0000	0.1560
35	117.3	924.7	807.5	457	5253	0.0745	0.7441	120	2090	0.4612	2.2457	2.4541	0.5357	2.9898
36	0.0	66.5	66.5	0	0	0.0000	0.0000	120	2090	0.0604	0.2073	0.1470	0.0604	0.2073
Totals	1726	4268	2543			1.10	6.89			1.134	6.84	11.50	2.23	13.73

Notes to Table 7-1:

1. New sewered area defined as the difference between total future sewered area and existing sewered area.
2. RDII from new sewered area defined using assumed rate of 550 gpad x 3.8 = 2090. Factor of 3.8 based on difference in rainfall depth and location between measured data collected at Issaquah vs. Snoqualmie.
3. Flow from total future sewered area, which includes sewage flow, BI and RDII, defined as sum of total flow from existing sewered area and total flow from new sewered area.

was used. RDII of 550 gpad was measured at Snoqualmie Ridge in response to a 24-hour, 0.9-inch rainfall. However, the rainfall quantity observed at Snoqualmie Ridge required adjustment to consider the difference in rainfall probability in Issaquah. This adjustment factor of 3.8 is the ratio of measured rainfall at Snoqualmie Ridge to the 5-year storm event in Issaquah.

7.3 COMPARISON WITH KING COUNTY FLOW ESTIMATES

King County is in the process of developing a plan for conveyance system improvements for their South Sammamish Basin, which includes the Issaquah service area. Their approach uses continuous simulation modeling of multiple flow components to represent I/I flows. King County has developed flow and I/I estimates for the Issaquah service area using this approach. A comparison between flow estimates developed by King County and flow estimates developed for this analysis to support the update of the Sewer System Plan Update is presented in **Table 7-2** below:

Table 7-2: Estimated Wastewater Flows[1] (in mgd)

Development Conditions	5-Year Flows	20-Year Flows
Existing Conditions		
Estimate for Issaquah	6.9	
King County Estimate	4.7	5.6
Future Conditions (Full Build-Out)		
Estimate for Issaquah	13.7	
King County Estimate	10.0	11.6

Note[1]: Presented flows include estimated wastewater, BI, and RDII flows.

King County has long assumed a design criteria of 1,100 gpapd for infiltration and inflow. This is the value that continues to form the basis for their modeling results. There is information, including the 2000-2001 flow data as well as the more significant 2001-2002 data, that suggests much of the King County service area exceeds this threshold.They are currently considering whether and how this criteria could be enforced, and how the issue should be addressed for future improvements.

7.4 ANALYSIS RESULTS FOR FUTURE CONDITIONS

Resulting pipe capacities required were derived for a 5-year storm event and future development conditions using the same hydraulic simulation model described in Section 6. These results provide a basis for identifying likely deficiencies and improvements that may be needed at some future date to accommodate flows from future development.

As presented in Section 6, all of the modeled trunk sewers appear to have adequate capacity to convey flows from existing development with I/I flows from a 5-year storm event with only minor surcharges. However, under full build-out conditions, the sewered area more than doubles, from approximately 1,726 acres to 4,268 acres. The existing average daily sewage flow of approximately 1.0 mgd also doubles to 2.2 mgd, due to the population increase. The resulting total wastewater flow increases from about 6.9 mgd under a 5-year storm to 13.7 mgd. Substantial surcharges would result in the existing pipe systems.

It should be noted that trunk sewers included in the model represent only main trunks, a small portion of the overall sewer system. It is possible that additional sewer mains may require improvement to convey the estimated flows. However, considering the limited data used for this evaluation, extension of the model at this time is not justified. A future update may be able to use more appropriate data and produce a more accurate result.

Figure 7.1 shows the modeled results for a 5-year storm event from the entire future developed area according to present land use plans, with all wastewater flows routed through the existing trunk sewers. Pipe segments that would be under capacity for this flow scenario are indicated, together with the resulting surcharged pipes due to these capacity limitations. Approximate depths of surcharge are indicated for the affected pipe segments. In one location the surcharge would overflow onto the existing ground. Several other locations show surcharge depths exceeding 10 feet.

The analysis results presented for the future full build-out conditions is simply a projection of possible sewer service requirements at the end of the 20-year planning window. Careful consideration is needed to determine how these results should be used to develop a capital improvement plan. After all, the available data and the modeling analysis were quite limited. As with any analysis of this type, there is uncertainty associated with the flow estimates, meaning that the estimated future flows could be high or low. However, the estimated future flows for both existing and future development were developed from measured data, and provide an indication of the improvements that will be needed if development in the service area occurs according to the densities allowed under current zoning.

The analysis results indicate needed improvements may be limited to an increase of only one pipe size in selected portions of the sewer system. With only this magnitude of improvement needed, alternatives to conventional sewer re-construction may be cost effective and technically feasible. Pipe bursting may be an option to obtain the needed pipe size increase.

It may also be possible to complete sewer system rehabilitation in targeted areas to reduce flows to levels that can be conveyed by the existing sewer capacity. King County will be seeking to encourage or require tributary agencies to meet some yet to be defined criteria.

Figure 7.1:
Capacity Analysis Results Future Condition with 5-Year Event

CHAPTER 8
Infiltration and Inflow Control

8.1 PREVIOUS REHABILITATION EFFORTS

Several areas within the existing City sewer system were identified in the 1996 Plan as requiring maintenance or rehabilitation due to deterioration and apparently high extraneous flows. This work was intended to ensure the integrity of the existing pipe lines, with particular emphasis on the older portions of the system. Some sewer lines were installed as far back as 1939 with pipe materials that have proven particularly vulnerable to I/I in some communities. The status of this proposed work is summarized in **Table 8-1**.

Table 8-1: Previously Identified Sewer Rehabilitation/Maintenance Projects

Identified Project	Implementation Status
North Basin No. 2	Complete
Rainier South	Complete
1st Avenue N.W.	Proposed CIP
1st Place N.W.	Proposed CIP
Front Street North	Proposed CIP
Rainier Boulevard West	Complete
South Basin 1	Complete
South Basin 2	Complete
South Basin 3	Complete
South Basin 4	Complete
North Basin 3	Proposed CIP
N.E. Creek Way	Future
N.E. Birch/3rd Avenue N.E.	Future

Additional projects are identified through the following subsections.

8.2 CONSIDERATION OF KING COUNTY POLICIES

Results from the King County flow monitoring program for 2001 to 2002 are summarized in **Table 8-2**. This table shows the calculated peak 30-minute infiltration/inflow (meaning, sewage is excluded) for 10 measured storm events from the 12 mini-basins within the Issaquah system. This flow data is presented both in relation to acreage and in terms of lineal feet to allow comparisons among the mini-basins.

Table 8-2 indicates that ISS007 consistently has the highest I/I rates. These results should be compared with the summary comparison shown in **Table 8-3** for all King County mini-basins. This table shows ISS007 is among the highest 5 percent of all 834 mini-basins within King County, while other Issaquah mini-basins are essentially average or typical for all of King County.

Table 8-2: Peak Infiltration/Inflow for Issaquah Mini-Basins from 2001 to 2002 King County Data

Basin Name	Acres	Calculated 30-minute Peak Total I/I gpd per acre for Precipitation Shown in Inches									
		4-Nov-01 0.5 inch	13-Nov-01 4.6 inch	19-Nov-01 1.9 inch	21-Nov-01 2.1 inch	28-Nov-01 2.6 inch	12-Dec-01 2.2 inch	15-Dec-01 2.7 inch	1-Jan-02 0.7 inch	6-Jan-02 2.4 inch	12-Jan-02 0.5 inch
ISS001	98	505	652	372	619	580	n/a	704	557	631	462
ISS002	81	402	3,107	826	1,298	1,327	2,094	1,598	422	1,138	702
ISS003	81	1,100	7,359	2,425	2,969	2,985	3,804	3,742	3,535	2,718	1,369
ISS004	136	859	4,389	1,020	3,514	2,388	3,040	4,124	4,210	1,187	760
ISS005	121	773	2,167	963	1,412	2,280	2,335	2,692	831	2,402	1,287
ISS006	149	3,513	3,215	3,942	4,354	3,076	3,087	4,322	3,944	4,159	2,362
ISS007	24	9,988	20,516	12,706	15,642	26,226	41,356	36,184	7,482	20,586	11,444
ISS008	111	2,614	3,506	3,389	2,863	2,760	2,897	2,794	2,142	2,681	2,890
ISS009	57	1,640	3,137	2,860	3,897	2,316	1,037	2,088	1,460	17,824	1,535
ISS012	80	777	4,183	1,199	1,620	2,301	2,978	2,068	746	1,147	1,116
ISS013	36	1,612	2,482	1,670	2,066	2,843	3,376	3,758	1,925	2,097	1,379
ISS014	138	1,313	3,572	1,259	1,854	1,556	3,033	2,500	647	1,670	707
Total Acres	1111										

	Footage	Calculated 30-minute Total I/I per Lineal Foot in Mini Bason									
ISS001	28,655	1.7	2.2	1.3	2.1	2.0	n/a	2.4	1.9	2.2	1.6
ISS002	11,862	2.7	21.2	5.6	8.9	9.1	14.3	10.9	2.9	7.8	4.8
ISS003	13,419	6.7	44.4	14.7	17.9	18.0	23.0	22.6	21.3	16.4	8.3
ISS004	24,335	4.8	24.5	5.7	19.6	13.3	17.0	23.0	23.5	6.6	4.2
ISS005	18,917	4.9	13.9	6.2	9.0	14.6	14.9	17.2	5.3	15.4	8.2
ISS006	24,111	21.7	19.9	24.3	26.9	19.0	19.1	26.7	24.4	25.7	14.6
ISS007	11,407	20.9	43.0	26.6	32.8	55.0	86.9	76.0	15.6	43.2	23.9
ISS008	21,673	13.4	18.0	17.4	14.7	14.1	14.8	14.3	11.0	13.7	14.8
ISS009	20,232	4.6	8.8	8.0	11.0	6.5	3.2	5.9	4.1	50.2	4.3
ISS012	13,300	4.7	25.2	7.2	9.7	13.8	17.9	12.4	4.5	6.9	6.7
ISS013	5,668	10.2	15.7	10.6	13.1	18.0	21.4	23.8	12.2	13.3	8.7
ISS014	28,530	6.3	17.3	6.1	9.0	7.5	14.7	12.1	3.1	8.1	3.4
Total Footage	222,110										

Table 8-3: Summary Comparisons of Measured 2001 to 2002 Storm Data Among 834 King County Mini-Basins

Calculated 30-Minute Peak Total I/I per Acre (Peak I/I plus Estimated B1 in Gal/Day/Acre)										
Event Date	11/4/01	11/13/01	11/19/01	11/21/01	11/28/01	12/12/01	12/15/01	1/1/02	1/6/02	1/12/02
Maximum	138,111	170,513	191,969	170,956	137,936	239,746	120,134	90,666	70,016	141,447
Minimum	82	239	214	78	212	118	304	17	176	17
Average	1,679	4,489	2,558	3,408	2,953	4,149	3,874	2,114	3,075	2,232
High 95%	4,132	11,548	5,656	8,142	7,580	10,254	10,391	4,989	8,163	5,331
Low 95%	416	768	560	811	685	778	770	496	718	543

King County is in the process of developing a plan for conveyance system improvements for their South Sammamish Basin, which includes the Issaquah service area. Through their own approach, King County has developed wastewater flow estimates through their system for what they define as the maximum 20-year event that includes infiltration and inflow. So far, King County has identified at least 11 possible alternatives for providing needed capacity for their conveyance system.

A key component for these alternatives is the control of extraneous wastewater flow from infiltration and inflow sources. Current King County policy assumes that I/I flows from post 1961 sewers is or will be limited to an average of 1,100 gpd per acre. However, the County also recognizes that many connecting systems do not meet this standard. Present County planning efforts are directed towards how I/I reduction and control can be effectively incorporated into the overall plan for providing future regional sewer service.

Issaquah is merely one of over 30 sewerage agencies tributary to the King County sewer system. Equity considerations suggest that the County will need a management approach that fairly distributes the I/I reduction and control efforts fairly among all agencies. Whether this will result in the application of the as-yet-to-be-determined standard on a county-wide basis, an agency-wide basis, or to each specific connection point to the County system is unknown at this time.

For management purposes by the City of Issaquah, it seems most appropriate to direct the City effort at towards prioritization of the systems comprising several subbasins connected at a single point to the County system. Ten such systems exist, each connected to King County at a single point. This approach provides the most flexibility in addressing potential King County requirements. Mini-basin ISS007 includes Issaquah subbasin 35 and has the highest measured I/I flow rate within the City.

In addition to providing adequate capacity to serve continued development within the City sewer service area and meet the requirements of King County, Issaquah must also maintain compliance with state and federal requirements. Continued reduction and control of extraneous I/I wastewater flows is an important element in satisfying all of these needs.

King County conducted the "Kent and Issaquah I/I Pilot Project" on 1995 to analyze the cost effectiveness of I/I rehabilitation. They found flow reductions of 70 percent in Kent at a cost of $0.54 per gpd. However, in Issaquah the reduction was only about 50 percent and cost $1.26 per gpd removed.

8.3 SUGGESTED APPROACH

Rehabilitation of sewer systems to reduce I/I flows is most effective when the effort can target those pipe elements with the highest extraneous flows. Data from the 2000 to 2001 monitoring period as displayed in **Table 8-4** is directed towards that goal. The acreage of each City subbasin is identified, then the Base Infiltration is estimated show for the existing and future area, and finally the Rain Dependent I/I is estimated. From this data, the sub-basins can be ranked to establish which have the highest Base Infiltration flows, and which have the highest RDII.

Some degree of flow monitoring is then likely to be appropriate to verify these rather cursory indications. Alternative rehabilitation methods can be considered for the subbasins with the highest extraneous flows, reduction effectiveness estimated, costs estimated, and the likely cost-effectiveness for these selected sub-basins then determined. These results would indicate a reasonable priority listing of where the City can expect to experience the greatest flow reductions for the least total expenditure.

Table 8-4: Flow Estimate by Subbasin and Connection to King County Collection System - Estimated 5-Year Peak I/I Included

Connection to King County	Tributary Subbasins	Existing Sewered Area (acres)	Total Future Sewered Area (acres)	New Sewered Area (acres)	BI from Existing Sewered Area (gpad)	RDII from Existing Sewered Area (gpad)	Sewage Flow from Existing Sewered Area (mgd)	Total Flow from Existing Sewered Area (mgd)	BI from New Sewered Area (gpad)	RDII from New Sewered Area (gpad)	Sewage Flow from New Sewered Area (mgd)	Total Flow from New Sewered Area (mgd)	Total Future I/I (mgd)	Total Future Sewage Flow (mgd)	Flow from Total Future Sewered Area (mgd)
East/West Downtown Trunk (Gilman)	17	141	144	3	197	2745	0.10	0.51	197	2745	0.00	0.01	1.02	0.10	0.53
	18	172	182	10	**868**	**6185**	0.15	1.36	**868**	**6185**	0.01	0.08	2.97	0.16	1.44
	28		0	0					120	2100	0.00	0.00	0.00	0.00	0.00
	35		71	71					120	2100	0.00	0.16	0.15	0.00	0.16
	37		66	66					120	2100	0.06	0.21	0.14	0.06	0.21
	Subtotal	312	463	151	566	4635	0.25	1.88	172	2390	0.07	0.46	4.27	0.32	2.34
NE Trunk (Issaquah Sect. 2)	11	58	88	29	314	**5163**	0.04	0.36	314	**5163**	0.03	0.19	1.16	0.07	0.55
	13	126	149	23	261	**4300**	0.08	0.65	261	**4300**	0.02	0.12	1.64	0.09	0.77
	14	63	73	10	144	1043	0.04	0.11	144	1043	0.00	0.01	0.20	0.04	0.12
	16	28	30	3	314	**5163**	0.02	0.17	314	**5163**	0.00	0.02	0.40	0.02	0.19
	19		22	22					120	2100	0.01	0.06	0.05	0.01	0.06
	20	78	82	4	208	3438	0.04	0.33	120	2100	0.00	0.01	0.69	0.05	0.34
	21	195	237	42	123	2858	0.03	0.61	123	2858	0.00	0.13	1.72	0.03	0.74
	22	1	6	6	208	3438	0.00	0.00	120	2100	0.00	0.02	0.02	0.00	0.02
	23	159	231	72	170	2331	0.06	0.46	120	2100	0.04	0.20	1.10	0.10	0.65
	24	12	25	13	45	2243	0.01	0.03	120	2100	0.01	0.03	0.09	0.01	0.07
	25	17	183	165	197	2745	0.00	0.06	120	2100	0.09	0.46	0.47	0.09	0.51
	30		40	40					120	2100	0.01	0.10	0.08	0.01	0.10
	Subtotal	736	1166	430	191	3156	0.31	2.78	143	2494	0.21	1.34	7.63	0.52	4.12
Issaquah Highlands (Issaquah Creek)	36	117	925	807	180	2341	0.04	0.34	120	2100	0.46	2.25	2.40	0.50	2.59
SE 56th St. (via SPWSD to Issaquah Int.)	4	28	28	0	**542**	2733	0.06	0.15	120	2100	0.00	0.00	0.21	0.06	0.15
	10	109	110	1	**542**	2733	0.06	0.41	120	2100	0.01	0.01	0.81	0.07	0.43
	12	10	10	0	**542**	2733	0.01	0.04	120	2100	0.00	0.00	0.07	0.01	0.04
	Subtotal	147	148	1	542	2733	0.12	0.60	120	2100	0.01	0.01	1.09	0.13	0.62

Table 8-4 (Continued)

Connection to King County	Tributary Subbasins	Existing Sewered Area (acres)	Total Future Sewered Area (acres)	New Sewered Area (acres)	BI from Existing Sewered Area (gpad)	RDII from Existing Sewered Area (gpad)	Sewage Flow from Existing Sewered Area (mgd)	Total Flow from Existing Sewered Area (mgd)	BI from New Sewered Area (gpad)	RDII from New Sewered Area (gpad)	Sewage Flow from New Sewered Area (mgd)	Total Flow from New Sewered Area (mgd)	Total Future I/I (mgd)	Total Future Sewage Flow (mgd)	Flow from Total Future Sewered Area (mgd)
Talus (Issaquah Sect. 2)	9	6	11	6	269	3360	0.00	0.02	120	2100	0.00	0.01	0.06	0.00	0.03
	15	67	68	1	269	3360	0.04	0.28	120	2100	0.00	0.00	0.58	0.04	0.28
	31		263	263					120	2100	0.22	0.80	0.55	0.22	0.80
	33		106	106					120	2100	0.02	0.25	0.22	0.02	0.25
	34		24	24					120	2100	0.00	0.05	0.05	0.00	0.05
	Subtotal	72	472	400	269	3360	0.04	0.30	120	2100	0.23	1.12	1.46	0.28	1.42
Newport Way (Issaquah Sect. 2)	3	50	87	37	45	2243	0.02	0.13	120	2100	0.02	0.10	0.36	0.03	0.23
	8		77	77					120	2100	0.04	0.21	0.16	0.04	0.21
	26	123	155	32	144	1043	0.05	0.20	144	1043	0.01	0.05	0.43	0.06	0.24
	27	23	35	12	0	1808	0.01	0.05	120	2100	0.01	0.03	0.13	0.02	0.09
	29		50	50					120	2100	0.03	0.14	0.11	0.03	0.14
	32		461	461					120	2100	0.01	1.04	0.97	0.01	1.04
	Subtotal	195	865	669	102	1437	0.08	0.38	121	2049	0.11	1.56	2.15	0.19	1.94
NW 18th St. (Iss Crk & Iss Sect. 2)	5	9	38	29	269	3360	0.00	0.03	120	2100	0.02	0.08	0.14	0.02	0.11
I-90 East (Issaquah Creek)	6	44	45	1	269	3360	0.01	0.17	120	2100	0.01	0.01	0.39	0.01	0.18
I-90 West (Issaquah Int.)	1		23	23					120	2100	0.00	0.05	0.05	0.00	0.05
	2	18	46	28	269	3360	0.02	0.08	120	2100	0.02	0.08	0.21	0.03	0.16
	Subtotal	18	69	51	269	3360	0.02	0.08	120	2100	0.02	0.13	0.26	0.04	0.21
I-90 South (Issaquah Sect. 2)	7	74	78	4	269	3360	0.02	0.29	120	2100	0.00	0.01	0.65	0.02	0.30
Totals	Subtotal	1748	4269	2521	284	3122	0.89	6.85	128	2190	1.13	6.98	20.45	2.03	13.83

8.4 SUBBASIN RANKINGS

Peak flow conditions for the Issaquah sewer system is dominated by extraneous flow from infiltration and inflow sources. This is true both for existing conditions, and for the conditions forecasted in 20 years. Data from **Table 8-4** has been reorganized in **Table 8-5** to focus on the highest magnitude of BI and RDII in terms of gallons per acre per day. The RDII component included is the estimated 5-year peak flow. Subbasin 18, for example, is shown in bold with a BI of 868 gpad.

Table 8-5: Highest Extraneous Flows (In gal/ac/day)

Area	Existing Flows	
	BI	RDII
Connections to King County		
East/West Downtown Trunk	566	4,635
NE Trunk	191	3,156
SE 56th Street	542	3,360
City Subbasins		
18 East Downtown	868	6,185
11 Central (Issaquah Highlands)	314	5,163
13 Newport Interceptor	261	4,300
16 Morgan's Ridge	314	3,360

Table 8-4 also summarizes the City BI and RDII flows entering the King county sewer system at a single connection, which usually comprises several City subbasins. These are shown in the subtotal lines. The resulting extraneous flows for each connection can be compared on an average gallons per day per acre basis.

Table 8-5 presents the King County connections and subbasins with the highest extraneous flows. Although control of I/I to meet King County standards may ultimately be enforced at connections to the King County system, targeted system rehabilitation should be directed at controlling extraneous flows at the subbasin level.

As indicated in Table 8-5, the current rehabilitation efforts underway in Subbasin 18 should be completed. The second priority should be able to control flows in Subbasins 11, 13 and 16. These subbasins appear to have high RDII flows, but less significant BI flows. In contrast, the King County connection at S.E. 56th Street (Subbasin 4, 10 and 12) displayed high BI flow as opposed to RDII flow.

In all the subbasins except Subbasin 11, the service area is nearly fully developed. As such, the only means to reduce I/I contribution that is computed on a "per acre" basis is to complete system rehabilitation. However, in Subbasin 11 approximately one-third of the service area is currently undeveloped. It is possible that new construction could contribute to a future reduction in the relative "per acre" I/I contribution from Subbasin 11.

With the limited amount of available flow data, it is recommended that additional investigation be conducted in the apparent problem areas. Additional flow monitoring should be completed flow of all these basins over a sufficient time frame so that wet and dry weather conditions are evaluated, including rain storms of representative magnitudes.

8.5 REHABILITATION OPTIONS

8.5.1 Rehabilitation of Sewer Systems

Extraneous flow can be removed from a specific sub-basin with excessive I/I flow by rehabilitating a part, or all of the system. Usually, the most effective results are achieved by rehabilitating the entire system, both the public portion in rights-of-way, and the private portion on private property (i.e. side sewers). Often, only the public portion is addressed because that is where the agency has authority to work and is fully responsible. However, the real problems are often associated with side sewers on the private properties. Unless such private sources can be ruled out through testing or inspection, rehabilitation of the public sewers alone is not likely to be effective.

There are several options for rehabilitating the collection system. The selected method selected should be based on cost, disruption caused by the rehabilitation work, and other factors specific to a particular rehabilitation project. The intent of an I/I rehabilitation project is to cost-effectively eliminate sources of I/I, yet still provide a collection system with the same functional features and capabilities of a new system.

8.5.2 Rehabilitation Methods

Dig and Replace

Pipe systems that are beyond repair via trenchless methods or for which dig and replace is found to be more economical than trenchless methods, must be replaced by trench excavation to control I/I.

Trenchless Technology

Various methods are available. Excavation of the entire existing sewer main is not required, though spot excavations may be needed to reconnect side sewer laterals:

- *Pipe Bursting* makes it possible to increase the size of the sewer pipe; however, site-specific constraints may limit the ability to increase the size. Using pipe bursting to replace a pipe may be restricted depending upon adjacent utilities, proximity to a road surface, the type of existing pipe being replaced, and soil conditions. There are a number of variations on pipe bursting such as pneumatic, hydraulic expansion, and static pull systems. All of these displace the old pipe into the adjacent ground and pull a new pipe in to replace the old pipe. There are also related processes such as pipe reaming, which is a variation of horizontal directional drilling, where pieces of the old pipe are removed rather than pushing them into the adjacent soil. Pipe bursting may be used for mainline, lateral, and side sewer repair. The most common pipe material used is HDPE but other types of pipe material such as cast iron, MDPE, and ABS can be used for the replacement pipe.

- *Cure in Place Pipe Liner* involves inverting a epoxy-resin-impregnated flexible tube into an existing line using hydrostatic head. The resin is then cured using heat to produce a pipe inside the existing pipe. The outside diameter of the replacement pipe must be smaller than the existing pipe to allow the system to be installed, so flow capacity will be reduced.

- *Slip Liner* involves pushing or pulling a replacement pipe into an existing pipe. The outside diameter of the replacement pipe is smaller than the inside diameter of the existing pipe to allow installation. Capacity in the pipeline will be reduced accordingly. A variety of pipe materials may be used including HDPE, ductile iron, PVC, concrete and fiberglass. The annular space should be grouted unless there are project specific reasons to do otherwise.

- *Spiral Wound Liner* involves pulling in a helically wound PVC strip into an existing pipe, then twisting it to expand outward to produce a pipe inside the existing pipe. Depending on pipe size, the lining is either installed automatically from an access manhole (for smaller pipe sizes) or by a crew in a larger pipe. The outside diameter of the replacement pipe is smaller than the existing pipe to allow the system to be installed and capacity in the pipeline will be reduced. The annular space shall be grouted unless there are project specific reasons to do otherwise.

- *Fold and Form* involves inserting a heated PVC or HDPE thermoplastic liner, folded or deformed into a U-shape, into an existing sewer and re-rounding the liner using heat and pressure to produce a pipe inside the existing pipe. The outside diameter of the replacement pipe is smaller than the existing pipe to allow the system to be installed. Capacity in the pipeline will be reduced because of the reduction in pipe size.

Pipeline Spot Repairs

Pipeline spot repairs are repairs to specific deficiencies in a pipeline, such as a specific leaking pipe joint. These repairs can be a cost effect way to eliminate I/I in sections (generally manhole to manhole) of a pipeline that are sound except for a few point locations. Only those specific deficiencies in the pipeline are repaired. In pipeline sections with numerous spot problems or with other mitigating factors such as age, the entire pipeline segment is a candidate for manhole-to-manhole rehabilitation or replacement.

Manhole Rehabilitation

Various manhole rehabilitation can be used to eliminate sources of both infiltration and inflow directly into the manhole structure:

- *Manhole Grouting* from inside the manhole, cementitious spray-on lining, epoxy linings, manhole inserts, and cure-in-place liners can be installed. Many of these methods provide benefits other than just I/I reduction, such as protection from internal corrosion due to hydrogen sulfide.

- *Manhole Leveling Rings* for the frame and cover can be cracked and be a source of infiltration. Repair can be by grouting or replacement.

- *Manhole Lid Inserts* may be used. Older style manhole covers may contain lift holes or several vent holes that allow inflow into the collection system during storm events. Old and new manhole covers both are susceptible to inflow through or around the cover if water ponds over the cover. Replacing the cover with a new cover may be required, or the rim elevation can be raised.

8.5.3 Rehabilitation of Private Sewer Systems

Side sewers contain various sources of infiltration and inflow ranging from illicit connections to system defects. These sources may have been part of the original construction, or may have developed over time as a result of system deterioration. Sewer connections usually involve two piping elements:

- The lateral connects the sewer main to the private property. Typically, this pipe ends at the property line and is the responsibility of the City.

- The side sewer is the piping located on private property and is the responsibility of the property owner. Often a single side sewer connects to a single lateral, though many laterals have double side sewers connections, or even occasional three or four side sewers.

Several options are available for rehabilitating private sewers systems, ranging from repair of specific defects to complete replacement. The rehabilitation methods are similar to those employed for public sewers, varying conventional trenching methods to one of many trenchless techniques. The intent of a private I/I rehabilitation project is to eliminate sources of I/I on private property, yet still provide a side sewer with the same functional features and capabilities of a new service line.

A private rehabilitation project needs to be coordinated closely with the property owners and an adjacent public rehabilitation project. It may be implemented in a variety of ways:

- Solely through regulation with enforcement action by the City
- Various forms of cost-sharing incentives/disincentives can be offered
- Rehabilitation can be funded solely by the City based on the principal that flow reduction offers general benefits to the City as a whole.

To be accepted and successful, a private I/I rehabilitation project needs to be based on documented evidence that excessive I/I exists, and that a strong likelihood that exists that it originates from the side sewer. The rehabilitation techniques used should based upon the results of the Sanitary Sewer Evaluation Survey that establishes the least cost and disruption to be caused by the rehabilitation work.

8.6 RECOMMENDED PROGRAM

Based on the information available to date, the Rehabilitation Program should be focused as outlined in **Table 8-6**.

Table 8-6: Recommended I/I Rehabilitation Program

Program Element	Composition	Estimated Project Cost
Flow Monitoring	4 basins for 6 months	$ 85,000
Subbasin 18		1,713,000
Subbasin 11	5,100 lf	431,000
Subbasin 16	7,200 lf	608,000
Subbasin 13	17,800 lf	1,504,000
Subbasin 4	5,200 lf	439,000
Subbasin 10	14,600 lf	1,234,000
Subbasin 12	500 lf	42,000
Estimated Total		**$6,056,000**

CHAPTER 9
Capital Improvements Program

9.1 FORMULATION OF CAPACITY IMPROVEMENTS TO TRUNK SEWERS

Figure 7-1 illustrates the capacity limitations identified by the hydraulic model for the existing trunk system with the forecasted future land use development and a 5-year storm event. Resulting surcharge depths are also shown. Table 9-1 identifies those specific pipe segments with future diameter limitations, as well as existing limitations under a 5-year storm noted under Comments.

Table 9-1: Capacity Improvements to Trunk Sewers

Pipe Segment	Length (feet)	Existing > Required Diameter (inches)	Pipe Depth (feet)	Surcharge (feet)	Comments
	East Downtown Trunk				
81 to 83	996	10 > 12	8.5 to 9.9	1.3 to 3.8	Limited Now Fig. 6.4
	West Downtown Trunk				
29 to 28	748	8 > 12	8.3 to 12.4	0.1 to 2.8	
48 to 55	2181	10 > 12	9.2 to 10.5	0.1 to 5.6	
	Issaquah Creek Trunk (King County)				
118 to 127	5144	21 > 24	15.1 to 21.0	6.9 to 16.5	
134	288	21 > 27	19.0	5.8	Limited per Fig. 6.4
133 to 129	1835	21 > 24	14.5 to 18.7	1.5 to 4.8	May be adequate
128	98	21 > 33	14.7	0.8	Limited per Fig. 6.4
	Newport Way Trunk				
8 to 12	1532	12 > 15	7.0 to 15.5	1.7 to 5.6	
16	40	15 > 18	11.8	2.5	
18	277	12 > 15	9.6	2.3	
19	295	15 > 18	11.3	0.9	May be adequate
24	46	16 > 21	12.3	0.7	May be adequate
26	262	16 > 18	12.7	0.5	May be adequate
	Northeast Trunk				
103	421	18 > 21	14.8	4.5	
104	451	18 > 24	18.2	3.9	Limited per Fig. 6.4
105	452	18 > 21	16.4	2.5	May be adequate
106	452	18 > 24	17.9	1.4	Limited per Fig. 6.4
	Issaquah Trunk (King County)				
107 to 113	2335	21 > 24	16.9 to 21.7	12.2 to 16.6	109 above grade
142 to 136	2566	21 > 24	16.2 to 22.6	1.4 to 11.4	May be adequate

Pipe segments listed in Table 9-1 that are also show as of limited capacity in **Figure 6.4** for existing land use development under a 5 year storm should be included in the immediate capital improvement program. Part of the Issaquah Trunk will flood on to the ground surface under the modeled future storm conditions and likewise should be a priority for increased capacity.

Several pipe segments are noted as "may be adequate". The model shows these segments to experience some surcharging under future conditions; however, the surcharge amount is not great in comparison with the pipe depths. The hydraulic gradeline would be 10 feet or more below ground, which should not threaten to flood any basements. These segments should be re-evaluated when the Plan is next updated and further improvements are considered.

The required diameter in almost all cases is only one pipe size larger then exists. These segments may be suitable for pipe bursting to achieve the larger diameter, which should be cost effective.

9.2 IDENTIFIED IMPROVEMENTS

Recommended system improvements described in the preceding sections and are categorized as follows:

- Immediate capacity improvements
- Sewer extensions
- Sewer main rehabilitation
- Miscellaneous projects

These identified improvements are summarized in **Table 9-2**. The improvements listed in Table 9-2 are not all of the improvements that may be needed according to the modeling results displayed in Table 9-1, or are known to the City. And not all of these need to be implemented within the coming six years.

This plan identifies improvements to the existing systems that are needed to accommodate additional flows from anticipated development within the existing City limits and the Talus East Cougar Mountain and Issaquah 69 developments, which are within the City's Potential Annexation Area boundary. However, the Plan does not identify improvements to King County facilities which may result from development within the City's planning area, although it does identify the limitations on system capacity imposed by the King County system. Also, the Plan does not attempt to identify any details regarding sewer main extensions into undeveloped areas.

9.3 COST ESTIMATES

Construction costs provided in the CIP are "order-of-magnitude" estimates based on 2002 dollars. Order-of-magnitude is defined as an estimate based on typical industry experience for similar work, but made without detailed design level data. Projected costs for system improvements are based on historical costs for similar projects as well as:

- 15 percent for construction contingencies and change orders.
- 8.8 percent sales tax.
- 15 percent allowance for design engineering, basic permits, and SEPA.
- 10 percent construction administration, inspection, and startup.

The order-of-magnitude level cost estimates prepared as part of the CIP are provided for guidance in project evaluation, funding, and implementation from the information available at the time of the estimates. Final project costs will depend on actual labor and materials costs, actual site conditions, productivity, competitive market conditions, the final project scope and schedule, engineering design, and other variable factors. As a result, final project cost will vary from the estimates presented herein.

Because of these factors, funding needs must be carefully reviewed prior to making specific decisions or establishing final budgets.

Table 9-2: Identified Desired Improvements Through Year 2008 Estimated Project Cost in 2002 Dollars

Project	Description		Estimated Cost
Category I - Immediate Capacity Improvements		**Pipe Segments**	
Issaquah Creek Trunk	Burst 5144 lf to 24-in & 288 lf to 27-in	118 to 127 & 134	$ 830,000
Issaquah Trunk	Burst 2335 lf to 24-in	107 to 113	$ 350,000
King County Estimated Total Project Cost			$ 1,180,000
East Downtown Trunk	Burst 996 lf to 12-in	81 to 83	$ 80,000
Newport Way Trunk	Burst 1532 lf to 15-in & 317 lf to 18-in	8 to 18	$ 180,000
Northeast Trunk	Burst 1776 lf to 21-in	103 to 106	$ 230,000
City Total Project Cost			$ 490,000
Estimated Total Project Cost			$ 1,670,000
Category II - Sewer Extensions			
Upper Sycamore Extension	5860 lf x 8-in & 400 lf x 2-in FM		$ 1,200,000
Goode Place ULID #22	1000 lf x 8-inch		$ 170,000
NE Cherry Extension	700 lf x 8-in		$ 240,000
Forest Drive Extension	200 lf x 8-in		$ 290,000
Lewis Neighborhood Extension	2100 lf x 8-in		$ 200,000
NE Sewer Extension	3500 lf x 8-in & pump station		$ 1,200,000
Estimated Total Project Cost			$ 3,300,000
Category III - Sewer Main Rehabilitation			
Subbasin 18	Line most sewer mains & rebuild laterals		$ 1,710,000
Subbasin 11	Line 5100 lf of sewer & rebuild laterals		$ 430,000
7 Avenue Replacement	925 lf x 18-in		$ 150,000
Manhole Rehabilitation	Brick manholes from 1930/40 WPA		$ 320,000
Estimated Total Project Cost			$ 2,610,000
Category IV - Miscellaneous Projects			
Sanitary Sewer TV Inspection	On-going inspection of pipes		$ 210,000
Sewer System Surveying	Update mapping accuracy		$ 120,000
Sewer General Plan Update	Regular update in accord with State law		$ 150,000
Utility Rate Update	Reflect changes in operating costs		$ 100,000
Sewer Flow Monitoring	Refine Subbasin 18 rehabilitation		$ 150,000
Estimated Total Project Cost			$ 730,000
Estimated Total Project Cost for City Identified Improvements			**$ 7,130,000**

9.4 CAPITAL IMPROVEMENT PROGRAM

Identified improvement projects that are needed within the next few years to maintain the capacity and integrity of the City sewer system are formulated into a Capital Improvement Program. These projects are summarized in **Table 9-3** are to be implemented during the years 2003 through 2008.

Table 9-3: 2003-2008 Sewer Capital Improvements Program Cost and Schedule

System Improvements	2003	2004	2005	2006	2007	2008	Total
Category I - Immediate Capacity Improvements							
East Downtown Trunk	$ 80,000						$ 80,000
Newport Way Trunk					$ 180,000		$ 180,000
Northeast Trunk			$ 230,000				$ 230,000
Category II - Sewer Extensions							
Upper Sycamore Extension		$ 600,000	$ 600,000				$ 1,200,000
Lewis Neighborhood Extension	$ 200,000						$ 200,000
Category III - Sewer Main Rehabilitations							
Subbasin 18		$ 710,000	$ 1,000,000				$ 1,710,000
Subbasin 11					$ 430,000		$ 430,000
7^{th} Avenue Replacement						$ 150,000	$ 150,000
Manhole Rehabilitation				$ 320,000			$ 320,000
Category IV - Miscellaneous Projects							
Sanitary Sewer TV Inspect	$ 35,000	$ 35,000	$ 35,000	$ 35,000	$ 35,000	$ 35,000	$ 210,000
Sanitary Sewer Surveyors	$ 50,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 30,000	$ 200,000
General Sewer Plan Update				$ 75,000	$ 75,000		$ 150,000
Utility Rate Update					$ 50,000	$ 50,000	$ 100,000
Flow Monitoring	$ 100,000		$ 50,000				$ 150,000
TOTAL	**$465,000**	**$1,375,000**	**$1,945,000**	**$460,000**	**$800,000**	**$265,000**	**$5,510,000**

9.5 FUNDING ALTERNATIVES

Funding alternatives for capital improvements fall into two general categories:

- External funds include sources such as potential federal or state grants and developer financing; and

- Internal funding sources, which include federal or state loans, system revenue, revenue bonds, and the formation of utility local improvement districts (ULIDs).

Potential future capital projects identified in Table 9-3 will be funded through the Sewer Utility and ULIDs. Sewer Utility revenue bonds typically fund system expansion and capacity improvements, and Sewer Utility operation funds (cash flow) cover annual sewer main replacements, inspections and studies. It is likely that King County will fund some rehabilitation work in the future, though a specific program has not yet been defined.

Historically the City has relied on developer-built facilities in new development (i.e., Issaquah Highlands, Foothills) and on Sewer Utility revenue bonds to up-front the funding of sewer extension to existing single-family areas (i.e., South Front Street). Hookup fees associated with those specific projects and City-wide sewer service charges help repay debt service on the revenue bonds. In an effort to address failing on-site systems and associated health issues, the City in 1998 adopted IMC 13.70.060 to require payment of construction assessments by new customers connecting to existing sewer lines. This latecomer fee provides additional funds to help cover the cost of future sewer extensions.

The sewers on Squak Mountain were funded by either developers or through a ULID process. Historically neighborhoods at the southern part of the City have rejected ULID's in opposition to any sewer extension. More recently, though, a neighborhood in the northwest section of town requested and supported a ULID for sewer. ULIDs offer several advantages such as low-interest financing and repayment of hookup fees over many years by all properties included in the ULID.

For future sewer extensions, there are three options available to the City for financing construction:

City-funded extensions can be scheduled and financed as it sees fit (and is able based on utility revenues). Improvements are funded through revenue bonds and reimbursed through a "latecomer fee" hookup charge as people hook up. This system requires the City to "front load" the cost and may never recover the total cost and is not allowed to recover interest it would have made if this money was invested in another way. Some properties within the new sewers influence area may never hook up and those fees, as well as the lost value of the dollar over time are never recovered and are therefore passed on to the general rate payers. The property seeking hookup may not pay over time as in a ULID but must pay when they hookup and the fee may be quite large.

Utility Local Improvement Districts (ULID) are governed by State (RCW) law. ULIDs can be formed by two methods. The first, which is rarely done, is called a Petition method. To use this method a group of properties draws up a legal ULID boundary and legal petition circulates it and if more than 50% (by assessed property value) sign the petition, the City certifies it as valid, and then the City approves or rejects the formation. The second ULID formation tool is called the Resolution method, in which the City draws up the boundary, sends out notices that it is attempting to form an ULID and the property owners have a defined period of time to reject the formation. If less than 50% (by assessed property value) protest the formation, the City may then form the ULID. In either case once the ULID is legally formed the property owners are obligated for paying all costs of the improvement up the increase in property value the improvement causes. The ULID is paid back over a period of anywhere from 1 to 20 years using tax exempt revenue bonds, and all properties in the ULID district must pay the assessment each year with the property tax assessment. This system had the advantage that the City may sewer a large portion of town as one project, reducing the unit cost of the project. The finance charges to the affected properties are tax exempt.

Developer extensions are where a developer or individual property owner chooses to construct a portion of sewer main within the City Right of Way or in a City Utility Easement and affronting unsewered properties. The cost of extending sewer along non-participating properties may be recovered at a later date through a "late comers fee". That fee must be reasonable, is approved by the City Council, and is valid for only 15 years. This means that if the non-participation properties "wait it out" they do not have to pay this portion of the hookup charge. The late comers fee must be paid at hookup and may be quiet high.

9.6 EFFECTS ON SEWER RATES

Specific funding for the CIP projects has not yet been authorized. Such capital needs and resulting rate implications are typically evaluated during the periodic City utility rate studies. However, an indication of the appropriate affect the anticipated funding could have on City sewer rates can be approximated by the funding required for a municipal bond, though additional cost factors from the City and King County will also affect sewer rates.

The six-year CIP total shown in Table 9-3 is an estimated $5,310,000 for the years 2002 through 2007. Municipal bond rates are currently under 6 percent annually and are unlikely to rise significantly in the near future. A 6 percent interest rate over 20 years translates into an annual payment of about $463,000. Any required coverage would increase that amount. However, the annual payment distributed simplistically among the approximately 5,200 existing ERU is about $7.40 monthly.