KING COUNTY CONVEYANCE SYSTEM IMPROVEMENT PROJECT

SWEYOLOCKEN II

PUMP STATION SERVICE AREA FLOW TRANSFER ALTERNATIVES DEVELOPMENT

TASK 240

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KING COUNTY
Department of Natural Resources

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EXECUTIVE SUMMARY

The Conveyance System Improvement (CSI) Project involves planning efforts on an array of pump station and conveyance system improvements. The purpose of this report is to evaluate potential flow transfer and inflow and infiltration (I/I) reduction alternatives for the area served by the Sweyolocken Pump Station, which includes the central part of the City of Bellevue and northern Mercer Island

The Sweyolocken Pump Station and some related King County conveyance facilities are projected to experience capacity limitations as a result of increased base flows from the development of the Bellevue Central Business District (CBD) combined with projected increases in inflow and infiltration (I/I). These projected capacity limitations include:

- The Sweyolocken Pump Station
- The Upper Bellevue Trunk (upstream of the Bellefield Pump Station force main discharge), and
- The Lower Bellevue Trunk (downstream of the Bellefield Pump Station force main discharge).

Six flow transfer and three storage alternatives were evaluated to reduce future flows to these conveyance components. Specific inflow and infiltration (I/I) reduction goals were recommended where flow transfers alone were not sufficient to avoid exceeding the capacity of the Sweyolocken Pump Station and Bellevue Trunk.

Two alternatives appear to be the most feasible:

- Transfer 4.5 mgd from the Bellevue Pump Station to a new pump station adjacent to the existing City of Bellevue (COB) Bellefield Pump Station and upgrade the Bellefield Pump Station to pump directly to the East Side Interceptor (ESI). Convey the remainder of the flows from the Bellevue Pump Station to the Sweyolocken Pump Station through the Bellevue Trunk.
- Transfer all the flow from the Bellevue Pump Station directly to the ESI.

The estimated total budgetary project cost for these two alternatives is $10.4 million for the Bellefield Pump Station to ESI alternative and $9.5 million for the Bellevue Pump Station to ESI alternative. These budgetary project costs include $2.0 million in improvements to the Bellevue Pump Station previously identified by King County Wastewater Treatment Division staff.

CHAPTER 1 – BACKGROUND INFORMATION

The Conveyance System Improvement (CSI) Project involves planning efforts on an array of pump station and conveyance system improvements. The purpose of this report is to evaluate potential flow transfer and inflow and infiltration (I/I) reduction alternatives for the area served by the King County Wastewater Treatment Division (KCWTD) Sweyolocken Pump Station, which includes the central part of the City of Bellevue and northern Mercer Island.

PLANNING AREA ISSUES AND PROBLEMS

The Sweyolocken Pump Station and some related King County conveyance facilities are projected to experience capacity limitations as a result of increased base flows from the development of the Bellevue Central Business District (CBD) combined with projected increases in inflow and infiltration (I/I). Three projected capacity limitations of KCWTD facilities have been identified:

1. The Sweyolocken Pump Station;

2. The Upper Bellevue Trunk between the Bellevue Pump Station discharge and the City of Bellevue (COB) Bellefield Pump Station discharge at the intersection of Bellevue Way and 112th Avenue SE (RE Bellevue: R07-7 to R07-16A), and

3. The Lower Bellevue Trunk between COB Bellefield Pump Station discharge and the Sweyolocken Pump Station (RE Bellevue: R07-16A to R07-25A).

An upgrade of the Sweyolocken Pump Station is currently under design. The goal of the design is to maximize the capacity of the pump station within the existing structure. If no action is taken to reduce flows to the pump station, both the firm and peak capacities of the pump station will be exceeded by the 5-year and 20-year design storms for 1999. In addition, the capacity of the Bellevue Trunk upstream of 112th Avenue SE will be exceed by 2022. The 20-year storm design flow already exceeds the capacity of the Bellevue Trunk below this point.

PLANNING AREA DESCRIPTION

The KCWTD, COB, and City of Mercer Island own and maintain facilities within the Sweyolocken Pump Station Service Area. The Sweyolocken Pump Station Service Area includes three KCWTD designated basins: North Mercer Island, Bellevue Pump Station, and Sweyolocken Local. These service areas are located within the COB, except for the North Mercer Island Basin located on Mercer Island, small portions of the Bellevue Pump

Station Basin in Clyde Hill and Medina, and a portion of the Sweyolocken Pump Station Basin in Beaux Arts.

The Sweyolocken Pump Station receives flow from two other KCWTD pump stations, the North Mercer Pump Station and Bellevue Pump Station, as well as directly from the City of Bellevue and Mercer Island. The KCWTD facilities and basins served by the Sweyolocken Pump Station are summarized in Table 1-1 and are depicted in Figure 1-1.

Table 1-1: King County Pump Stations in the Sweyolocken Service Area

Basin	Pumps/Motor Horsepower	Firm Capacity[1] (mgd)	Peak Capacity[1] (mgd)	Basin Area (acres)
North Mercer	3/125	6.0	9.1	1,708
Bellevue Pump Station	3/100	9.2	13.8	1,172
Sweyolocken Local[2]	4/125	16.8	23.5	1,480

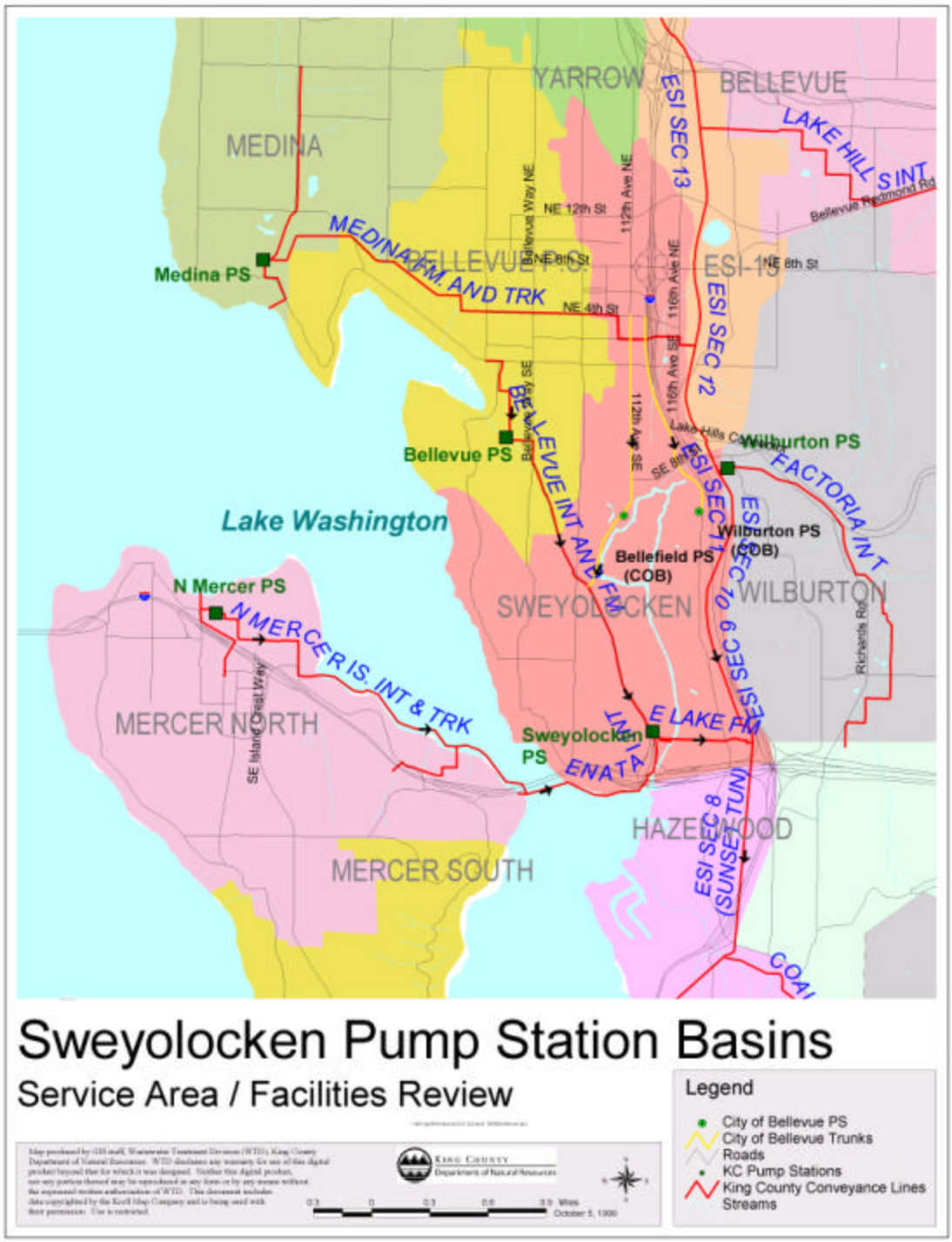
Note:
1) Firm and peak pump station capacities are as provided by King County on the spreadsheet entitled "Pump Station Facts".
2) Only Sweyolocken Local Basin. Total area served by the Sweyolocken Pump Station is 4,360 acres.

The KCWTD designated service areas are composed of several COB and City of Mercer Island basins. The service area is approximately 100 percent sewered and the residential areas are nearly fully developed. However, the Bellevue Central Business District (CBD) is less than 20 percent developed based upon increased densification and practical build-out population projections. As a result, base flows from it are projected to increase significantly over the next 50 years.

As a result of this projected growth, the 1994 City of Bellevue Comprehensive Sewer Plan includes the following recommendations:

- Replace 410 feet of existing pipe with 21-inch diameter pipe on 112th Avenue SE immediately north and south of Main Street;
- Replace the existing trunk along 112th Avenue SE between SE 6th Street and the Bellefield Pump Station with 675 feet of 18-inch pipe, and 1,099 feet of 30-inch pipe; and
- Review pump and force main design criteria, and provide additional capacity at the Bellefield Pump Station.

The most significant recommendation has resulted in the COB planned replacement of the Bellefield Pump Station.



Sweyolocken Pump Station Basins

Service Area / Facilities Review

Legend

- City of Bellevue PS
- City of Bellevue Trunks
- Roads
- KC Pump Stations
- King County Conveyance Lines
- Streams

Figure 1-1: Sweyolocken Pump Station Service Areas

FACILITIES REVIEW

The major KCWTD facilities in the Sweyolocken Pump Station Service Area include the three previously mentioned pump stations, as well as several KCWTD trunk lines. Currently, the Sweyolocken Pump Station upgrade is under final design and engineering work requests (EWRs) were issued for the Bellevue Pump Station. These EWRs precipitated a separate KCWTD review of the Bellevue Pump Station. The planning and design work on these conveyance system components is discussed in more detail below.

Major Conveyance Lines

The major KCWTD conveyance lines in the Sweyolocken Pump Station Basin include the Eastside Interceptor (ESI), the North Mercer Interceptor and Trunk, the East Channel Siphon, the Enatai Interceptor, the Bellevue Trunk, and the Sweyolocken Pump Station Force Mains. These major conveyance lines were evaluated as a part of the 1996 *Wastewater 2020 Plus Conveyance and Treatment Alternatives Screening and Refinement* Report. As a result of this analysis, several trunk and interceptors with capacity limitations were identified (Table 1-2). Some of these improvements are included as a part of this study, while others have been addressed as a part of other projects as noted in the table below.

Table 1-2: King County Trunks and Interceptors in the Sweyolocken Service Area

Facility	Length (feet)	Diameter[1] (inches)	Status
Bellevue Trunk (BELLINF:R07-06 to R07-01A)	1,556	12-24	See Note 2
Bellevue Trunk (R07-07 to R07-16A)	2,406	18-27	Evaluated as a part of this report
Bellevue Trunk (R07-16A to R07-25A)	3,988	27	Evaluated as a part of this report
Bellevue Trunk (R07-26 to R07-29)	501	27-30	Evaluated as a part of this report
East Channel Siphon – (Enatai Interceptor R08-01D to R08-01B)	1,386	16	See Note 3
Wilburton Siphon (ESI: Section 11)	1,900	16/30/48	Final design complete. Bid September, 2000. Start construction May, 2001.

Notes:
1. Diameter of existing pipe(s).
2. Bellevue Pump Station Influent Sewer. An initial review of the influent sewer was completed as part of work associated with EWRs 91 and 94.
3. The upgrade of this siphon will be addressed in a separate report.

As identified in the table above, the Bellevue Trunk is the only KCWTD gravity conveyance pipe evaluated in this report since the other gravity pipes have not been identified as under capacity or are addressed in separate reports. The Bellevue Trunk conveys wastewater from the Bellevue Pump Station to the Sweyolocken Pump Station, and collects wastewater from a portion of the Sweyolocken Local Basin. The alignment of the Bellevue Trunk follows Bellevue Way from the Bellevue Pump Station discharge near the intersection of Bellevue Way and SE 13th Street for approximately 6,400 feet to the Sweyolocken Pump Station.

The Upper Bellevue Trunk varies in slope, size and capacity. The two uppermost sections, 400 feet of 21-inch diameter reinforced concrete pipe and 332 feet of 18-inch pipe are the most hydraulically limited with capacities of 10.7 and 10.8 mgd respectively. The remaining 860 feet of the Upper Bellevue Trunk has a capacity of 11.2 to 16.4 mgd. The capacity of the Lower Bellevue Trunk is approximately 12.2 mgd. This trunk, a 27-inch diameter reinforced concrete pipe, is aligned under Bellevue Way for approximately 4,800 feet from the intersection of 108th Avenue SE and Bellevue Way to the Sweyolocken Pump Station. Portions of the Lower Bellevue Trunk are buried with approximately 20 to 25 feet of cover. The Bellevue Trunk has been inspected within the past two years and found to be in good condition.

Based on this depth of cover and high traffic volume on Bellevue Way, replacement of this section of gravity pipe would involve significant traffic impacts. In addition, the alignment is within both southbound lanes for a significant portion of the alignment, which would require shutting down both southbound lanes if open trench construction were to be used to replace the pipe. Therefore, alternatives were developed that did not require replacing or paralleling this section of the Bellevue Trunk.

Sweyolocken Pump Station

The Sweyolocken Pump Station was constructed in 1965 and is located just east of Bellevue Way near the intersection of Bellevue Way and 113th Avenue SE (Figure 1-1). This facility is located approximately 400 feet from Mercer Slough, a Class A waterway. The station is similar to a number of other KCWTD facilities with an adjacent dry well and wetwell, and vertical non-clog sewage pumps. A fourth pump was added in 1984 to increase the pump station to its present capacity. Odor control facilities were added in 1973 and modified in 1992. The peak capacity of the existing pump station is approximately 21 to 22 mgd. An upgrade of the Sweyolocken Pump Station is currently under design to increase the firm capacity of the pump station to 22.5 mgd and the peak capacity to 26 mgd.

The upgrade is limited to 26 mgd by site, structural, and hydraulic constraints. To increase the peak pump station capacity above 26 mgd would require large diameter suction piping, lowering the water surface elevation in the wetwell, and larger pumps. These modifications would require lowering the wetwell and pump room floor elevations. In the *Sweyolocken Pump Station Upgrade Project –Predesign Report*, it was determined that lowering the floor and wetwell would be very difficult due to the design of the structure and floor.

The current schedule for the Sweyolocken Pump Station Upgrade Project is to award the construction contract by the end of 2000. Due to a limited summer low flow window and the need to keep at least two pumps in operation throughout construction, it will probably not be possible to replace all the pumps during summer 2000. In which case, pump replacement would extend into summer 2001, and the project completed by the end of the year.

Twin 20-inch force mains convey wastewater from the Sweyolocken Pump Station to the ESI. A third force main was evaluated as a part of the Sweyolocken Pump Station Upgrade

predesign effort. Due to concerns over the Endangered Species Act (ESA) listing of salmonid species in the Lake Washington Basin, construction of a third force main would likely be difficult to permit. In addition, construction of a third force main would substantially extend the time required to upgrade the pump station.

Bellevue Pump Station

Construction of the Bellevue Pump Station was completed in 1964. Odor control facilities were provided at the station and the structural integrity of the facility was improved in 1972. The raw sewage pump sand motors were replaced in 1984. A new structure was constructed to house an emergency generator for the facility in 1989. In 1992, a Pepcon odor control unit was added to the facility and HVAC improvements were made to the wetwell, the most recent improvements to the pump station.

In November 1997, EWRs 91 and 94 were initiated to investigate the reliability of the electrical systems and magnetic drive clutches. As a result of this evaluation of the Bellevue Pump Station, KCWTD staff determined that the pumps, motors, electrical and HVAC systems, and instrumentation and controls needed to be replaced. The findings of this evaluation of the Bellevue Pump Station are summarized in an October 19, 1999 KCWTD draft memo. The estimated total project cost for these improvements, including allied costs, is $2.0 million (Seattle 1999 ENRCCI = 7000). The cost to upgrade this facility was included as a separate line item in the alternatives developed in this report.

CHARACTERIZATION OF EXISTING CONDITIONS

The natural features and sensitive areas of the study area were reviewed in an effort to identify potential constraints on the conveyance alternatives developed in Chapter 3.

Geology and Soils

The geology of the study area is a consequence of multiple Pleistocene glaciations that resulted in a series of north-trending elongated ridges, the Interlake Drift Upland, separated by the deep troughs of the Mercer Slough and Lake Washington. The surficial geology study area is generally composed of soils of the Alderwood and Seattle associations overlaying Vashon till. The Alderwood association soils are generally suitable for sewer construction but tend to have a seasonally high water table, which can result in increased infiltration. The soils in the area around Mercer Slough up to SE 6th Street between 112th Avenue SE and 114th Avenue SE, are classified as Seattle association. This soil is peat and provides no structural support requiring piling supported pipelines. Mercer Slough is the largest peat bog in King County encompassing more than 500 acres.

Erosion hazards exist throughout the study area. These include the steep slopes in the vicinity of the Eastside Interceptor and the upland drift between Bellevue Way and 112th

Avenue SE (Figure 1-2). There are no designated landslide or seismic hazard zones within the study area (King County Sensitive Areas Map Folio, 1990).

Hazardous Waste Sites

The study area primarily consists of a mixture of residential, central business district, and commercial land-use. Potential hazardous waste sites in the study area include gas stations, dry cleaners, car washes, and light industrial facilities. Based upon a review of the Washington State Department of Ecology 1999 Hazardous Waste Sites List, there are no active hazardous waste sites within the study area. However, there are a few leaking underground storage tanks (LUSTs) within the study area that are awaiting cleanup. In addition, the abandoned King County Bellefield Landfill at the intersection of 112th Avenue SE and SE 8th Street was investigated as a potential hazardous waste site. A preliminary assessment was performed in 1986, but no further action was taken. Since that time, the site has been developed. In general, there a limited number of potential hazardous waste sites, and there is a low probability that hazardous waste will impact wastewater conveyance alternatives.

Water Features

The study area includes portions of the Mercer Slough and East Lake Washington Drainage Basins (King County Sensitive Areas map Folio, 1990). The Mercer Slough, Kelsey Creek, and Sturtevant Creek south of SE 6th Street are classified as Type A riparian corridors (Bellevue Sensitive Areas Notebook, 1987). A Type A corridor is the most restrictive classification, and requires a 50-foot buffer between the top of the stream bank and most construction activities. Exemptions to construction activities within the buffer are allowed for a number of conditions including existing roadways and utilities.

Flood plains were identified for both Kelsey Creek and Mercer Slough. The boundary of the 100-year flood event for the Mercer Slough and the section of Kelsey Creek within the study area are close to congruous with the area of open water in the slough (Bellevue Sensitive Areas Notebook, 1987). No flood hazard was identified for Sturtevant Creek.

Meydenbauer Creek, which flows into Meydenbauer Bay in the vicinity of the Bellevue Pump Station, is listed as unclassified (King County Sensitive Areas Map Folio, 1990). However, it is listed as a Type A riparian corridor (Bellevue Sensitive Areas Notebook, 1987). There are limited areas around Meydenbauer Creek and the North Fork of Meydenbauer Creek that are also designated flood hazards.

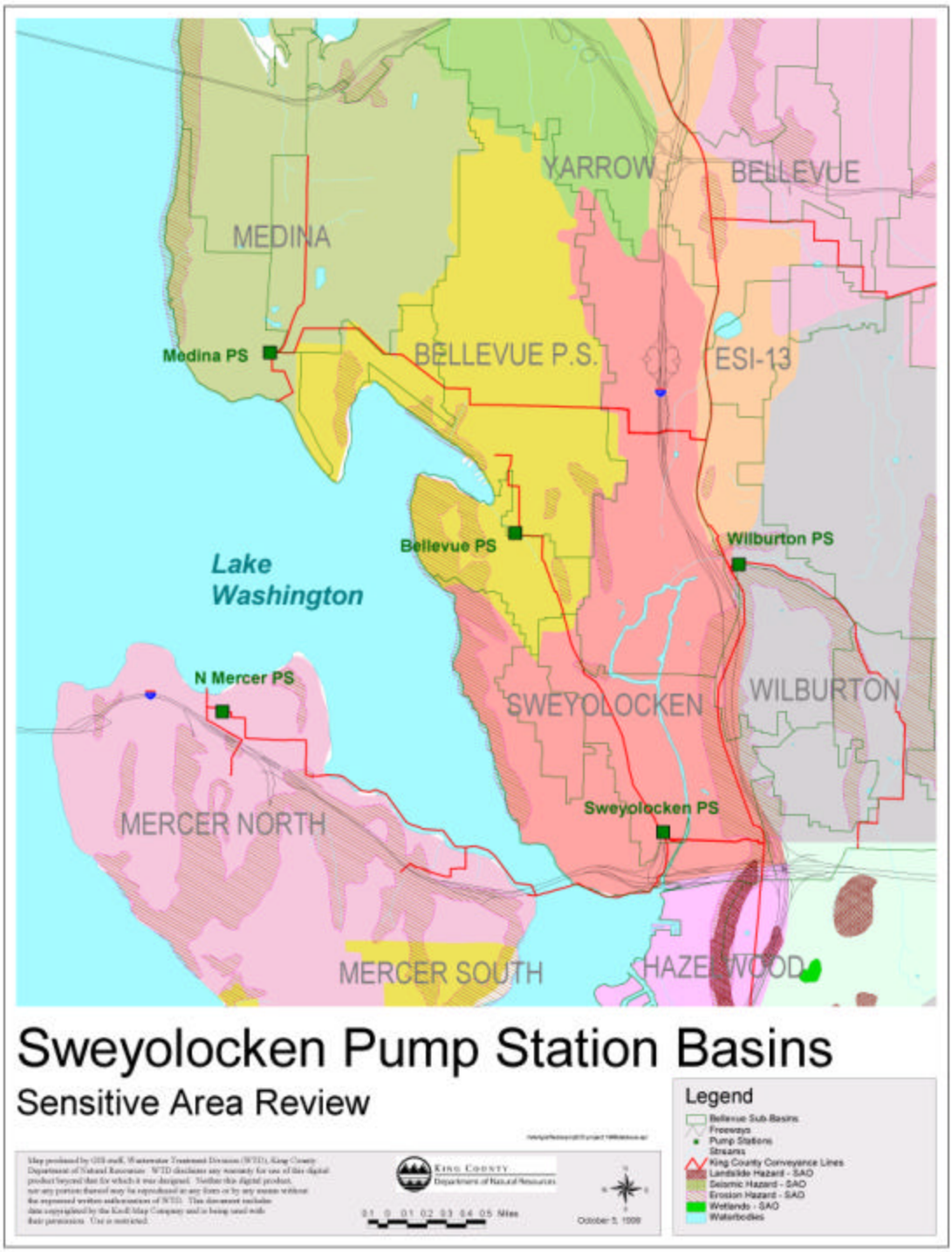


Figure 1-2: Sensitive Areas

Note: Wetlands designated in the Bellevue Sensitive Areas Notebook are not available in a digitized format and as a result not shown on the above figure.

Wetlands

Wetlands provide a number of functions from attenuation of peak storm flows to providing habitat for wildlife. In the study area, wetlands cover an expansive area east of 112th Avenue SE and Bellevue Way, west of 114th Avenue SE and 118th Avenue SE, south of SE 6th Street, and north of Interstate 90. For purposes of identification, the City of Bellevue divided this area of wetlands into the Wilburton Interchange Wetland north of SE 8th Street and the Mercer Slough Wetland south of SE 8th Street (Bellevue Sensitive Areas Notebook, 1987). The Bellefield Residential Park wetlands are located to the west of 112 Avenue SE across the road from the COB Bellefield Pump Station. All three are classified as Type A wetlands, the most protective classification, which prohibits development within 50 feet of designated wetlands (City of Bellevue Land Use Code, 20.25H.90).

Shorelines

The City of Bellevue Land Use Code and Washington State Regulations restrict development within sensitive and shoreline areas. Development within 200 feet of the Mercer Slough and Lower Kelsey Creek falls within the City of Bellevue Shoreline Overlay District (City of Bellevue Land Use Code 20.25E). As a result, a Substantial Development Permit is required in accordance with Chapter 173-14 of the Washington Administrative Code (WAC). Development within sensitive areas is regulated under Section 20.25H of the Bellevue Land Use Code. These land use restrictions will need to be considered given the proximity of the Mercer Slough, lower Kelsey Creek, and Sturtevant Creek to the COB Bellefield Pump Station and potential utility work north of the Bellefield Office Park.

LAND USE REGULATIONS AND ZONING

A few sites were investigated for a new pump station. These include the site of the existing Bellefield Pump Station, and sites near the intersection of 114th Avenue SE and SE 8th Street (Figures 1-3 and 1-4). The Bellefield Pump Station site is currently classified as Office (O). The parcels near the intersection of 114th Avenue SE and SE 8th Street are classified Office/Limited Business (OLB), a more restrictive land use classification. The setback requirements for these two land use classifications are summarized in Table 1-3. Special OLB design standards and minimum yard dimensions are described in Sections 20.25C.030 and 20.25C.040 of the City of Bellevue Land Use Code.

Table 1-3: Land Use Setback Requirements

Minimum Setback (feet)	Land Use Classification	
	Office	Office/Limited Business
Front Yard	30	50
Rear Yard	25	50
Side Yard	20	30

A pump station is defined as a utility facility (City of Bellevue Land Use Code 20.50.050). As such, a Conditional Use Permit will be required to construct a pump station regardless of the land use classification. Other City of Bellevue Permits that will probably be required include a Clearing and Grading Permit for site development, Right-of-Way Permit for new sewers and force mains, and Building Permit for a new pump station. In addition, a Puget Sound Air Pollution Control Agency (PSAPCA) Notice of Construction and a State Environmental Policy Act (SEPA) checklist will be required.

Figure 1-3: Vicinity of SE 8th Street and 114th Avenue SE Intersection

Figure 1-4: Bellefield Pump Station Site

CHAPTER 2 – FLOW PROJECTIONS

The most recent Sweyolocken Basin flow projections prepared by King County in June 1999 indicated that, as the basin is further developed, the 1990 pump station base flow of 2.59 mgd would more than double to 6.84 mgd by 2050 (Table 2-1). In addition, the infiltration and inflow (I/I) flows are projected to increase as a result of deterioration of the collection system. The 20-year peak flows include a 7 percent increase in I/I rates per decade to a maximum of nearly 29 percent more than 1990 I/I. As a result of these projected I/I and base flow increases, the peak 20-year design storm peak flow is projected to increase to 34.9 mgd by 2050, well above the nominal 26.0 mgd peak capacity of the upgraded Sweyolocken Pump Station.

Table 2-1: Flow Projections (All Basins)

Year	Base Flow (mgd)	5-yr I/I (gpad)	5-yr Peak (mgd)	20-yr I/I (gpad)	20-yr Peak (mgd)
1990	2.59	4,040	20.2	4,980	24.3
2000	3.47	4,330	22.4	5,350	26.8
2010	4.16	4,630	24.3	5,710	29.1
2020	4.82	4,920	26.3	6,080	31.3
2030	5.49	5,220	28.2	6,440	33.6
2040	6.16	5,220	28.9	6,440	34.2
2050	6.84	5,220	29.6	6,440	34.9

The Sweyolocken Pump Station Service Area includes three KCWTD designated basins, the North Mercer, Sweyolocken Local, and Bellevue Pump Station Basins. Flow projections for these basins are summarized in Table 2-2 through 2-5. The Bellevue Pump Station Basin is zoned approximately 75 percent residential, 23 percent central business district (CBD), and 2 percent commercial. Base flows in the basin are projected to almost triple as the CBD is more fully developed with multistory office buildings and residential towers. The Bellevue Pump Station Basin also has the highest apparent I/I rate of all the basins in the Sweyolocken Pump Station Service Area.

Table 2-2: 20-year Peak Flows by Basin

Year	20-year Peak Flows by Basin (mgd)		
	Bellevue Pump Station	Sweyolocken Local	North Mercer
1990	7.9	6.7	10.0
2000	8.5	7.8	10.8
2010	9.3	8.5	11.5
2020	10.2	9.2	12.2
2030	11.1	9.9	12.9
2040	11.4	10.2	12.9
2050	11.8	10.5	13.0

Table 2-3: Bellevue Pump Station Basin Flow Projections

Year	Base Flow (mgd)	5-yr I/I (gpad)	5-yr Peak (mgd)	20-yr I/I (gpad)	20-yr Peak (mgd)
1990	1.14	4,530	6.4	5,790	7.9
2000	1.17	4,860	6.9	6,220	8.5
2010	1.54	5,190	7.6	6,640	9.3
2020	2.15	5,450	8.4	7,070	10.2
2030	2.58	5,780	9.1	7,490	11.1
2040	2.65	5,850	9.5	7,490	11.4
2050	3.02	5,850	9.9	7,490	11.8

The North Mercer Basin is zoned with a mixture of commercial residential, and multifamily residential land use and 100 percent sewered. The basin is almost fully developed. Therefore, the base flow in the basin is projected to increase by only 0.25 mgd or 40 percent through 2050. The North Mercer Basin also has a high I/I rate, the second highest after the Bellevue Pump Station Basin of the three KCWTD basins in the Sweyolocken Pump Station Service Area.

Table 2-4: North Mercer Pump Station Basin Flow Projections

Year	Base Flow (mgd)	5-yr I/I (gpad)	5-yr Peak (mgd)	20-yr I/I (gpad)	20-yr Peak (mgd)
1990	0.61	4,560	7.8	5,490	10.0
2000	0.79	4,890	8.4	5,890	10.8
2010	0.81	5,230	8.9	6,290	11.5
2020	0.82	5,560	9.5	6,690	12.2
2030	0.83	5,890	10.1	7,090	12.9
2040	0.84	5,890	10.1	7,090	12.9
2050	0.86	5,890	10.1	7,090	13.0

The Sweyolocken Local Basin is 100 percent sewered and zoned approximately 10 percent CBD, 20 percent commercial and the remaining 70 percent residential. Base flows in the basin are projected to more than triple as the CBD is more fully developed with multistory office buildings and residential towers. The Sweyolocken Local Basin has the lowest apparent I/I rate of all the basins in the Sweyolocken Pump Station Service Area.

Table 2-5: Sweyolocken Local Basin Flow Projections

Year	Base Flow (mgd)	5-yr I/I (gpad)	5-yr Peak (mgd)	20-yr I/I (gpad)	20-yr Peak (mgd)
1990	0.84	3,280	5.7	4,010	6.7
2000	1.51	3,520	6.7	4,300	7.8
2010	1.81	3,750	7.4	4,590	8.5
2020	2.09	3,990	8.0	4,880	9.2
2030	2.38	4,230	8.6	5,180	9.9
2040	2.67	4,230	8.9	5,180	10.2
2050	2.97	4,230	9.2	5,180	10.5

The City of Bellevue Bellefield Pump Station serves a portion of the Sweyolocken Local Basin. Therefore, the Bellefield Pump Station Basin was modeled to quantify the flows that could be diverted by redirecting the Bellefield Pump Station Force Main discharge from the KCWTD Bellevue Trunk to the East Side Interceptor (ESI). From an analysis of storm data and pump run times, it was determined that the peak storm flow to the Bellefield Pump Station comprises 33 to 50 per cent of the total Sweyolocken Local Basin flow. These flow projections are summarized in Table 2-6.

Table 2-6: Bellefield Pump Station Basin Flow Projections

	Bellefield as 33 percent of Sweyolocken Local basin		Bellefield as 50 percent of Sweyolocken Local basin	
Year	5-yr Peak Flow (mgd)	20-yr Peak Flow (mgd)	5-yr Peak Flow (mgd)	20-yr Peak Flow (mgd)
1990	1.88	2.21	2.84	3.35
2000	2.21	2.57	3.35	3.89
2010	2.43	2.81	3.68	4.26
2020	2.64	3.04	4.00	4.61
2030	2.85	3.28	4.32	4.97
2040	2.95	3.38	4.47	5.12
2050	3.04	3.47	4.61	5.26

KCWTD I/I REDUCTION PROGRAM

As noted in the Regional Wastewater Services Plan (RWSP) adopted in December 1999, King County is committed to reducing inflow and infiltration within its regional conveyance system. The overall goal of this program is to reduce peak I/I in the service area by 30 percent for the peak 20-year storm event. The I/I reduction program consists of a multi-step approach to be implemented over the next six years (Table 2-7). Based on this schedule, it appears that I/I control measures will not be widely implemented until 2005. This schedule and the overall I/I reduction goal were considered in the alternatives developed in this report.

Table 2-7: RWSP I/I Performance Measures

Performance Measure	Completed By
Initial list of proposed pilot rehabilitation projects submitted for Council review and approval.	May 1, 2001
Design, inspection and enforcement standards for use by component agencies developed.	December 31, 2002
Report to Council defining I/I levels in local collection systems, options for controlling I/I, and the associated costs.	December 31, 2003
Target I/I levels for local collection systems and long-term measures to meet these targets recommended.	December 31, 2004
Consideration of an I/I surcharge on component agencies that do not meet the adopted target levels of I/I reduction.	June 30, 2005

The projected I/I rates from the three Sweyolocken Pump Station basins modeled by King County are summarized in Tables 2-1 through 2-5. The estimated I/I for the Sweyolocken Pump Station basins is relatively high, 4,980 gallons per acre-day (gpad) for the 20-year peak storm in 1990 in comparison to 2,280 gpad for the same year in the Juanita Bay Pump Station service area.

Both the City of Bellevue and the City of Mercer Island have investigated and documented I/I in their sewer collection system. In subbasins within the North Mercer Basin, the City of Mercer Island has identified I/I loading rates ranging from 1,250 gpad to 2,750 gpad. For planning purposes I/I rates ranging from 3,300 gpad to 6,640 gpad were used for individual subbasins. Unfortunately, the I/I observed and used for planning purposes by the City of Mercer Island were not correlated with a design-storm return frequency so it is difficult to compare their rates with the 5 or 20-year I/I rates established by the calibrated King County model.

The City of Bellevue has documented I/I rates in subbasins within their collection system up to 5,760 gpad. In the Bellevue Pump Station Basin and Sweyolocken Basins the City of Bellevue used planning allowances of 2,200 gpad for I/I. However, like Mercer Island, the I/I rates observed and used for planning are not correlated with a design storm return frequency and therefore difficult to compare with the rates used by King County.

Where applicable, the feasibility of I/I reduction to meet the identified conveyance capacity limitations in the Sweyolocken, Bellevue and North Mercer Basins will be discussed in association with the analysis of the alternatives to convey the projected flows.

I/I Reduction Feasibility

The feasibility of I/I reduction as a stand alone alternative to meet the projected flow increases within the capacity of the conveyance components in the study area was evaluated

in the context of the RWSP guidelines for the I/I reduction program. The three conveyance system components, evaluated were those identified in Chapter 1:

- The Sweyolocken Pump Station,
- The Upper Bellevue Trunk, and
- The Lower Bellevue Trunk.

The peak capacity of the upgraded Sweyolocken Pump Station will be approximately 26 mgd. In comparison, the projected peak 20-year storm flow in 2050 is 34.9 mgd. Therefore, a 2,040 gpad reduction in peak 20-year I/I rates would be required. This correlates to a 32 percent reduction in peak 20-year I/I rates. For the 5-year peak, the peak 5-year flow in 2050 would need to be reduced by 7.1 mgd to be within firm pump station capacity of 22.5 mgd. Therefore, an average basin-wide reduction of 1,630 gpad would be required. This correlates to a 32 percent reduction in the peak 5-year I/I rate. This reduction is slightly higher than the 30 percent goal stated in the RWSP. Furthermore, the timing of this reduction is not compatible with the I/I program as currently envisaged since both the 5-year and 20-year peak flows to the Sweyolocken Pump Station are currently greater than the firm and peak capacity of the pump station.

The capacity of the Lower Bellevue Trunk is approximately 12.2 mgd while the projected 20-year peak flow in 2050 is 19.9 mgd. Therefore, a 3,330 gpad reduction in the peak 20-year I/I rate would be required by 2050. This correlates to a 54 percent reduction in the peak 20-year I/I rates if applied equally to both the Sweyolocken Local and Bellevue Pump Station Basins. This 54 percent reduction is well beyond the 30 percent goal stated in the RWSP. Furthermore, the capacity of the Lower Bellevue Trunk is significantly less than the currently projected 20-year peak flow.

The capacity of the most hydraulically restricted section of the Upper Bellevue Trunk is approximately 10.7 mgd while the projected peak 20-year flow in 2050 is 11.8 mgd. Based on these parameters, a 1.1-mgd, 939 gpad, or 13 percent reduction in the peak 20-year I/I rate would be required by 2050, well within the I/I reduction goal of 30 percent. Also, since this capacity of the Upper Bellevue Trunk is not projected to be exceeded until 2025, there would be time to implement an I/I reduction program in this basin.

Both the timing and quantity of I/I reduction required to meet the projected 20-year peak flows preclude the use of I/I as a stand alone alternative. However, I/I reduction when combined with flow transfers or other conveyance improvements, may be beneficial in meeting the overall goal of ensuring that the system is capable of conveying the 20-year peak flow. Combining I/I reduction with flow transfers is evaluated in Chapter 3.

CHAPTER 3 – ALTERNATIVE EVALUATION

INTRODUCTION

Based on the capacity limitation identified in Chapter 1 and projected flows to the Sweyolocken Pump Station outlined in Chapter 2, seven alternatives were developed to reduce the projected flows to the Bellevue Trunk and Sweyolocken Pump Station. These alternatives were developed during discussions with KCWTD staff, COB staff, and other CSI project team members. KCWTD, COB, and CSI consultant staff reviewed the first six of these alternatives at a meeting held on October 25, 1999 at KCWTD offices. Alternative 7 was developed after an initial review of the draft report by KCWTD staff.

The flow transfer and reduction alternatives developed in this report are:

- Alternative 1 - Transfer flows directly from the City of Bellevue (COB) Bellefield Pump Station through a new force main to the ESI.
- Alternative 2 - Transfer up to 4.0 mgd from the Bellevue Pump Station through a new force main to the Medina Siphon. Convey the remainder of the flows from the Bellevue Pump Station to the Sweyolocken Pump Station through the Bellevue Trunk.
- Alternative 3 - Transfer up to 4.5 mgd from the Bellevue Pump Station through an existing force main to the Bellefield Pump Station and replace the Bellefield Pump Station to pump to the ESI through a new force main. Convey the remainder of the flows from the Bellevue Pump Station to the Sweyolocken Pump Station through the Bellevue Trunk.
- Alternative 4 - Transfer all the flow from the Bellevue Pump Station through a new force main directly to the ESI.
- Alternative 5 - Construct a new KCWTD pump station upstream of the COB Bellefield Pump Station to receive flows by gravity from the upper Sweyolocken Local Basin and the Bellefield Pump Station. From this new pump station, wastewater would be pumped through a new force main to the ESI. This alternative would divert the same quantity of wastewater from the Lower Bellevue Trunk and Sweyolocken Pump Station as Alternative 1.
- Alternative 6 - Transfer flows from the North Mercer Island Pump Station through a new force main to the South Mercer Island Pump Station, and increase the capacity of the South Mercer Island Pump Station to convey wastewater to the ESI.
- Alternative 7 – Store peak flows upstream of the Sweyolocken Pump Station and upstream of the Bellevue Pump Station.

As noted in the previous chapter, the I/I flows are relatively high for the area served by the Sweyolocken Pump Station. Some sub-basins within this service area have exceptionally high I/I flows, including City of Mercer Island sub-basins 40, 48, 54, and 55 and the area served by the Bellevue Pump Station in the City of Bellevue. Therefore, I/I reduction was considered where flow transfers alone were not sufficient to reduce peak flows to the capacity of conveyance system components.

EVALUATION OF ALTERNATIVES

Each alternative was evaluated to determine the extent to which it would reduce flows to the Sweyolocken Pump Station and Bellevue Trunk. In addition, planning level costs were developed for each practical alternative.

The COB is considering several alternatives to either significantly upgrade or entirely replace the Bellefield Pump Station. These alternatives range from constructing a new pump station adjacent to the existing facility that would incorporate the existing facility to construction of a new pump station at a nearby site. The cost to replace the COB Bellefield Pump Station and associated force main was not included in the evaluation of the alternatives.

Other criteria included in the analysis of each alternative included general environmental impacts, system reliability, special permitting requirements, and operations and maintenance requirements.

Alternative 1 – Bellefield Pump Station to ESI

The COB Bellefield Pump Station is located on 112th Avenue SE at SE 12th Street near the entrance to the Bellefield Office Park. This pump station receives wastewater from the eastern half of the Bellevue Central Business District and discharges wastewater through a 2,250 foot long 14-inch diameter force main to a manhole that connects to the Bellevue Trunk near the intersection of Bellevue Way and 109th Avenue SE. In the early spring 2000, the City of Bellevue plans to begin predesign to upgrade the firm capacity of the Bellefield Pump Station to 10.0 mgd. This will probably involve construction of a new pump station in the vicinity of the existing Bellefield Pump Station. The existing Bellefield Pump Station may be a part of this new facility or be abandoned.

KCWTD, COB and HDR staff conducted a field visit to the COB Bellefield Pump Station in September 1999 (Figures 3-1 and 3-2) as a precursor to discussions of jointly upgrading or King County acquisition of the facility. For King County to acquire a local agency wastewater conveyance facility, the facility must meet certain basic criteria by providing service to a minimum of 1,000 acres and be economically feasible. The COB Bellefield Pump Station currently serves 840 acres. KCWTD has also developed a draft Inspection Checklist for Acquisition of Facilities to more effectively implement work plans and budgets when facilities are acquired (Appendix A).

Figure 3-1: Bellefield Pump Station Pump Room

Figure 3-2: Bellefield Pump Station Discharge Header

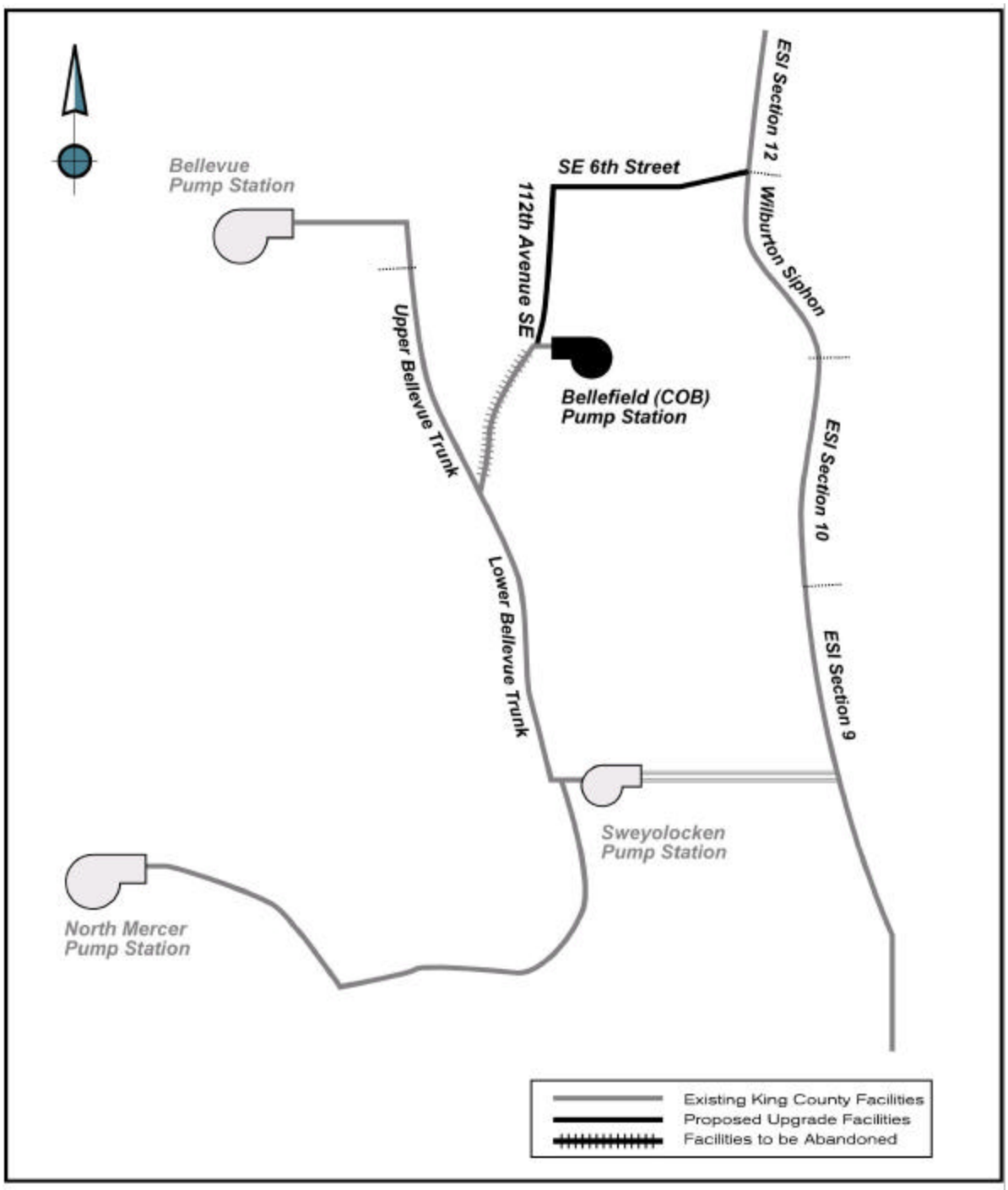
The Bellefield Pump Station currently includes three suction-lift pumps. The use of suction lift pumps is not a standard KCWTD design. Therefore, the KCWTD will consider the reliability of this type of pump system and compatibility with other KCWTD facilities, as well as the limited service area as part of evaluating the acquisition of the existing Bellefield Pump Station.

The transfer of flow from the Bellefield Pump Station directly to the ESI would require constructing a 4,200-foot long 16-inch diameter force main depicted on Figure 3-3. The most direct force main route from the Bellefield Pump Station to the ESI is along SE 8th Street. However, this street is constructed on peat. Therefore, a pier-supported force main would be required at significant additional construction cost. In addition, the City of Bellevue is planning to reconstruct SE 8th Street. Once reconstructed, any cutting of the roadway would jeopardize the integrity of the roadway. For these reasons, the force main for this alternative was aligned along SE 6th Street, the east end of which abuts Interstate 405.

Between 112th Avenue SE and 114th Avenue SE, the force main could be installed using open-trench construction, a distance of approximately 600 feet. The force main could then be directionally drilled under Interstate 405 to connect to the Wilburton Siphon inlet structure. This section would be approximately 700 feet long and require permanent easements from Washington State Department of Transportation (WSDOT) and one to two other property owners. The total length of this proposed force main is approximately 5,500 feet.

The COB Bellefield Pump Station would need to be upgraded beyond the capacity increase planned by the COB to convey wastewater to the Wilburton Siphon. If the pump station were to discharge to the Wilburton Siphon instead of the Bellevue Trunk, the static head on the pumps at the Bellefield Pump Station would increase from approximately 25 feet to over 105 feet. This increase in static head, as well as the increase in total dynamic head (TDH), would require the following improvements to the COB Bellefield Pump Station:

- Increased pump motor size;
- Improved HVAC to dissipate the additional heat;
- Increased VFD size;
- Increased generator size; and
- Increased building square footage for the larger generator.



KING COUNTY
Conveyance System Improvements
Sweyolocken Basin Flow Transfer

Figure 3-3
Alternative 1

Flow Projections

Constructing a force main from the COB Bellefield Pump Station to discharge directly to the ESI rather than the Bellevue Trunk would reduce the flows to the Lower Bellevue Trunk and the Sweyolocken Pump Station. However, based on the most conservative version of the most recent flow projections, this alternative would not, by itself, sufficiently relieve the Sweyolocken Pump Station and Bellevue Trunk for them to convey the 20-year peak flow through 2050. Historical flow data for the COB Bellefield Pump Station was used to estimate future flows to the Bellefield Pump Station. From this analysis, the flow to the Bellefield Pump Station reflected between 30 and 50 percent of the total flow in the Sweyolocken Local Basin. Based on the former criterion even with this flow transfer, the peak capacity of the Sweyolocken Pump Station would be exceeded by 2009 (Figure 3-4) and the firm capacity exceeded by 2014 (Figure 3-5). Also, based on these flow projections, the capacity of the Lower Bellevue Trunk would be exceeded by 2002 (Figure 3-6), and the capacity of the Upper Bellevue Trunk would be exceeded by 2025 (Figure 3-7). These dates and additional flow reduction requirements by 2050 are summarized in Table 3-1.

Table 3-1: Alternative 1 (Bellefield Pump Station to ESI)
Summary of Conveyance Limitations

Conveyance Component	Year Exceeded	I/I Reduction Required by 2050		
		(mgd)	(gpad)	percent
Sweyolocken Pump Station				
5-year firm capacity	2014	4.1	940	18
20-year peak capacity	2009	5.4	1,240	19
Lower Bellevue Trunk	2002	4.2	1,820	29
Upper Bellevue Trunk	2025	1.1	940	13

I/I Reduction

Flow projections indicated that the capacity of certain KCWTD conveyance facilities would be exceeded even if this alternative were to be implemented. As indicated on Table 3-1, the capacity of the Lower Bellevue Trunk will be exceeded by 2002 and the peak capacity of the Sweyolocken Pump Station will be exceeded by 2009. Based upon the I/I Reduction program as outlined in the RWSP, target levels of I/I reduction for local collection systems are scheduled to be implemented by December 31, 2004. Therefore, it does not appear that I/I would be implemented in time to ensure the conveyance capacity is not exceeded.

By saturation, a significant amount of I/I reduction would be required. By 2050, the I/I reduction effort would need to reduce the peak flow to the Lower Bellevue Trunk by 4.2 mgd. This is equivalent to a 3,590 gpad (48 percent) reduction in the projected 2050 I/I rate in I/I if this reduction were to come entirely from the Bellevue Pump Station Basin. If the portion Sweyolocken Local Basin that flows into the Bellevue Trunk were included, a 1,820 gpad (29 percent) reduction in the 2050 I/I rate would be required. These levels of I/I reduction would probably be difficult to achieve. Therefore, it does not appear likely that this alternative combined with a typical I/I reduction program could meet the overall goal of ensuring the conveyance system could convey the peak 20-year flow though 2050.

Figure 3-4
Sweyolocken Pump Station 20-Year Flow Projections

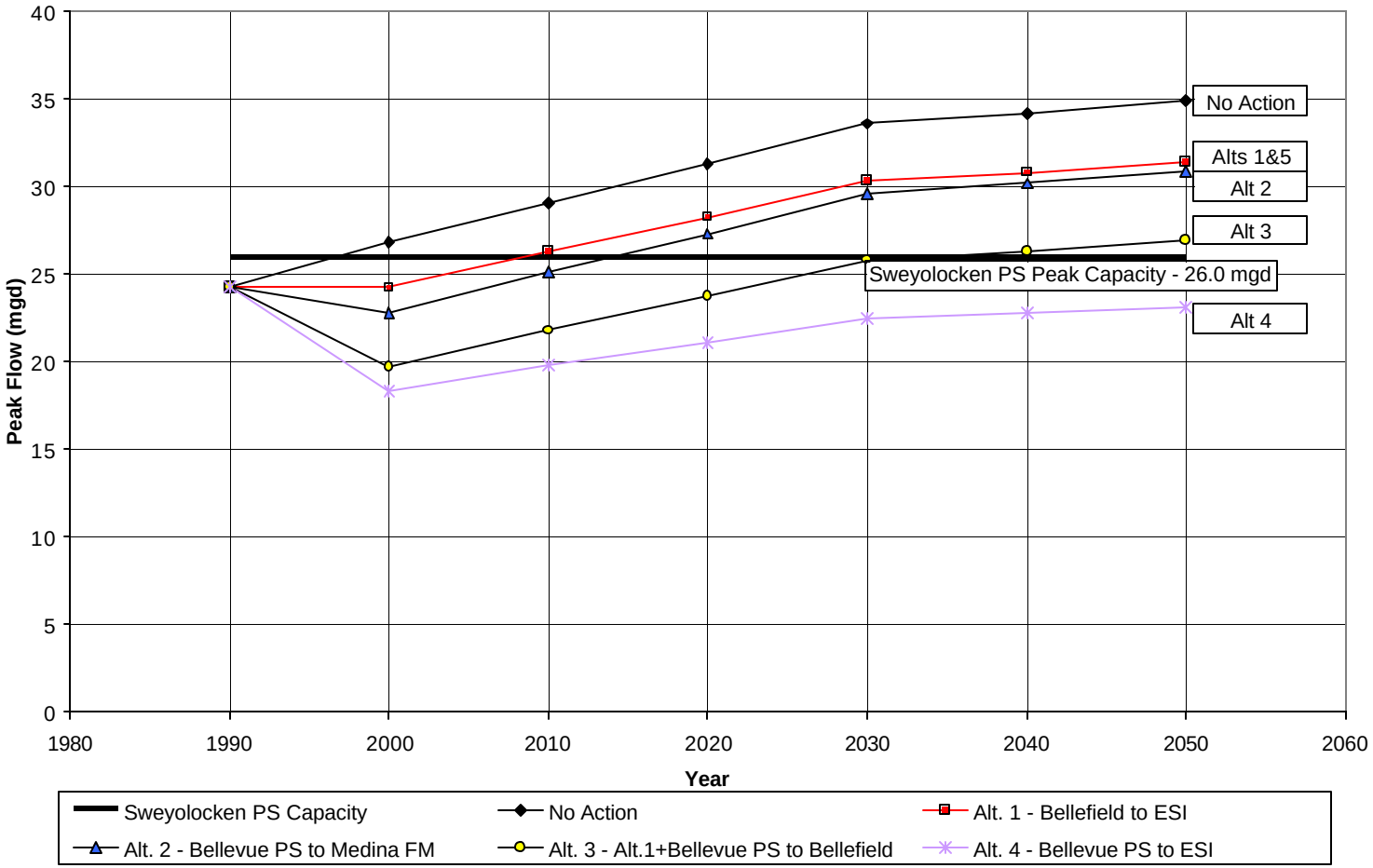


Figure 3-5
Sweyolocken Pump Station 5-Year Flow Projections

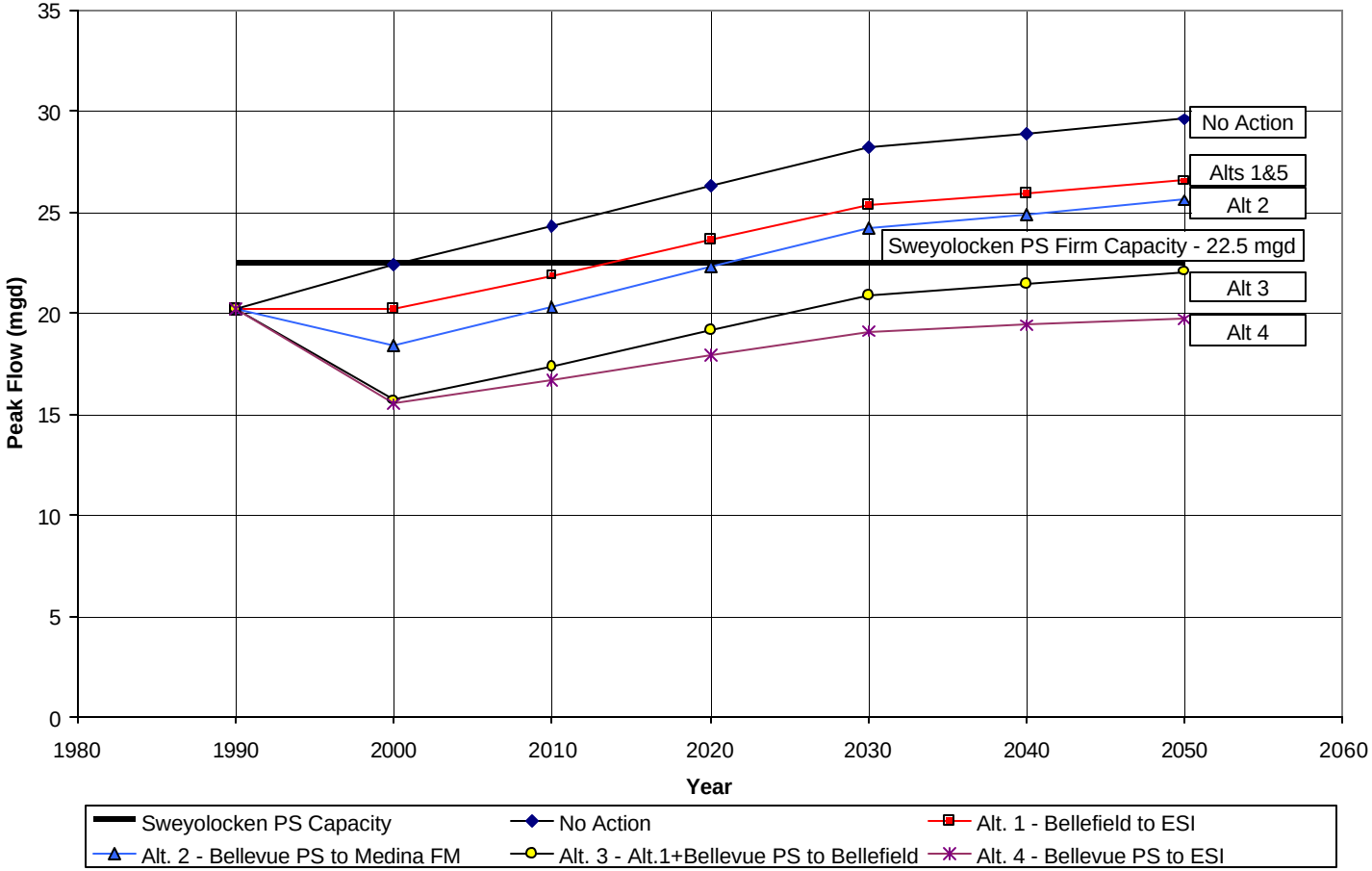


Figure 3-6
Lower Bellevue Trunk Flow Projections

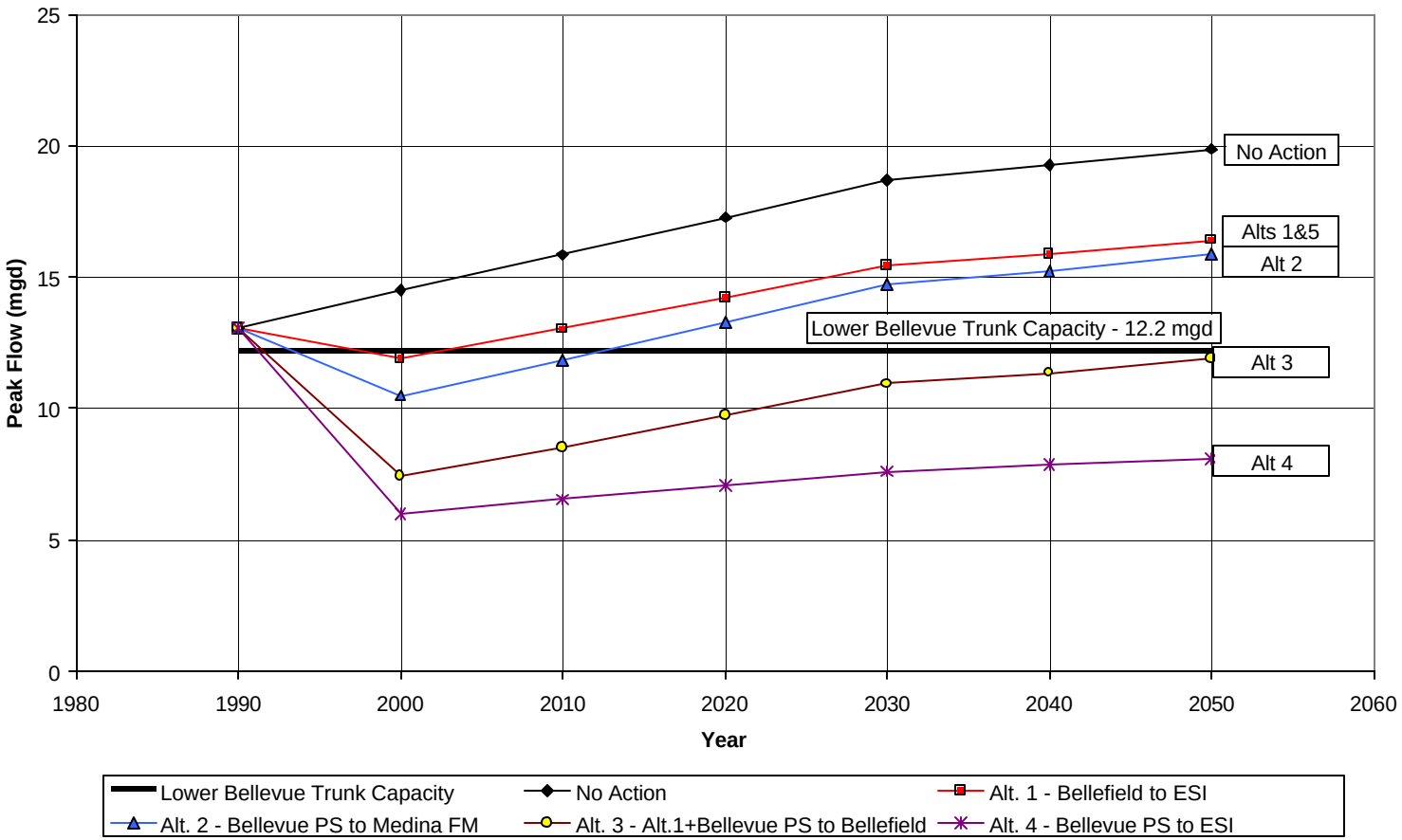
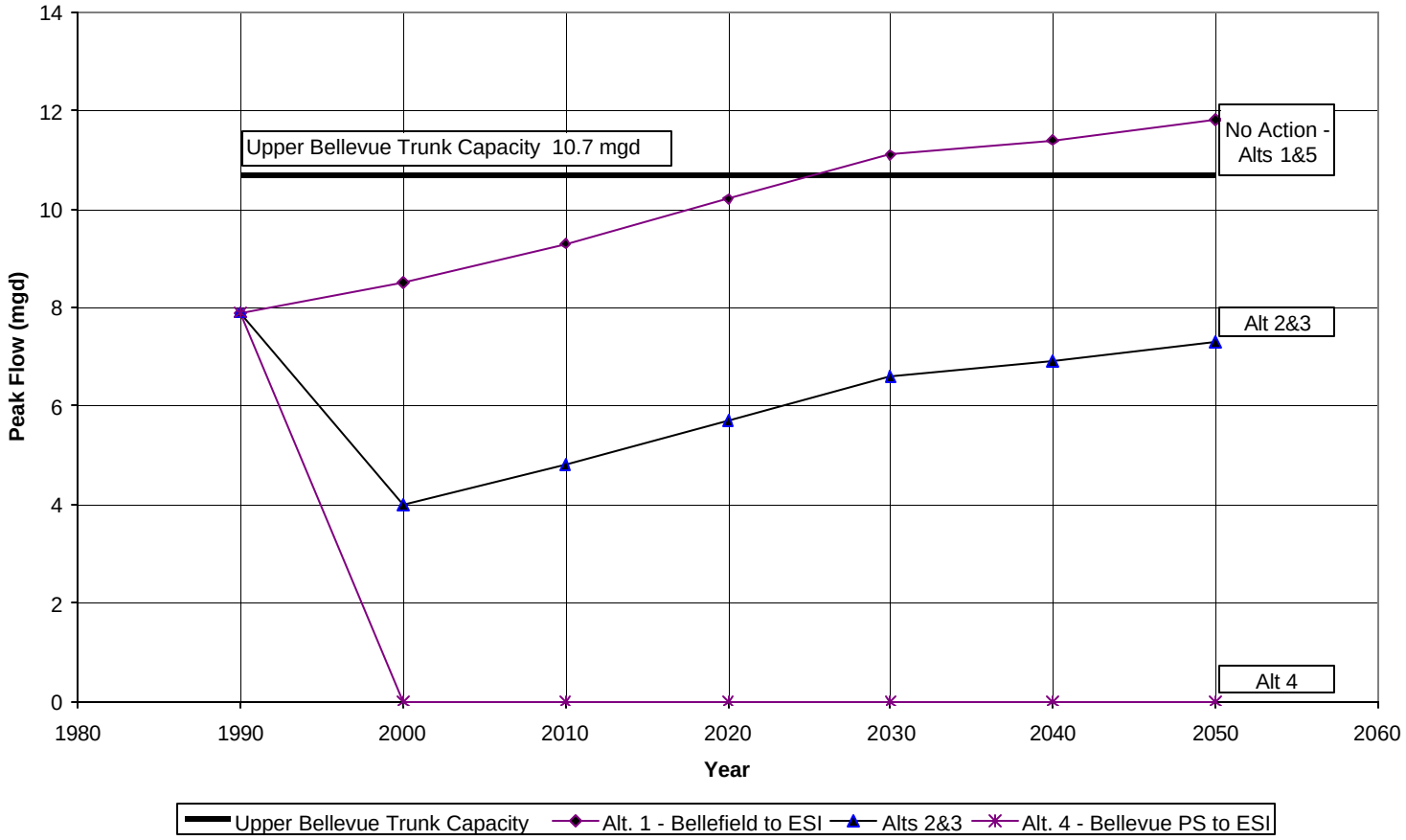


Figure 3-7
Upper Bellevue Trunk Flow Projections



Alternative 2 – Bellevue Pump Station to Medina Force Main/ Siphon Inlet Structure

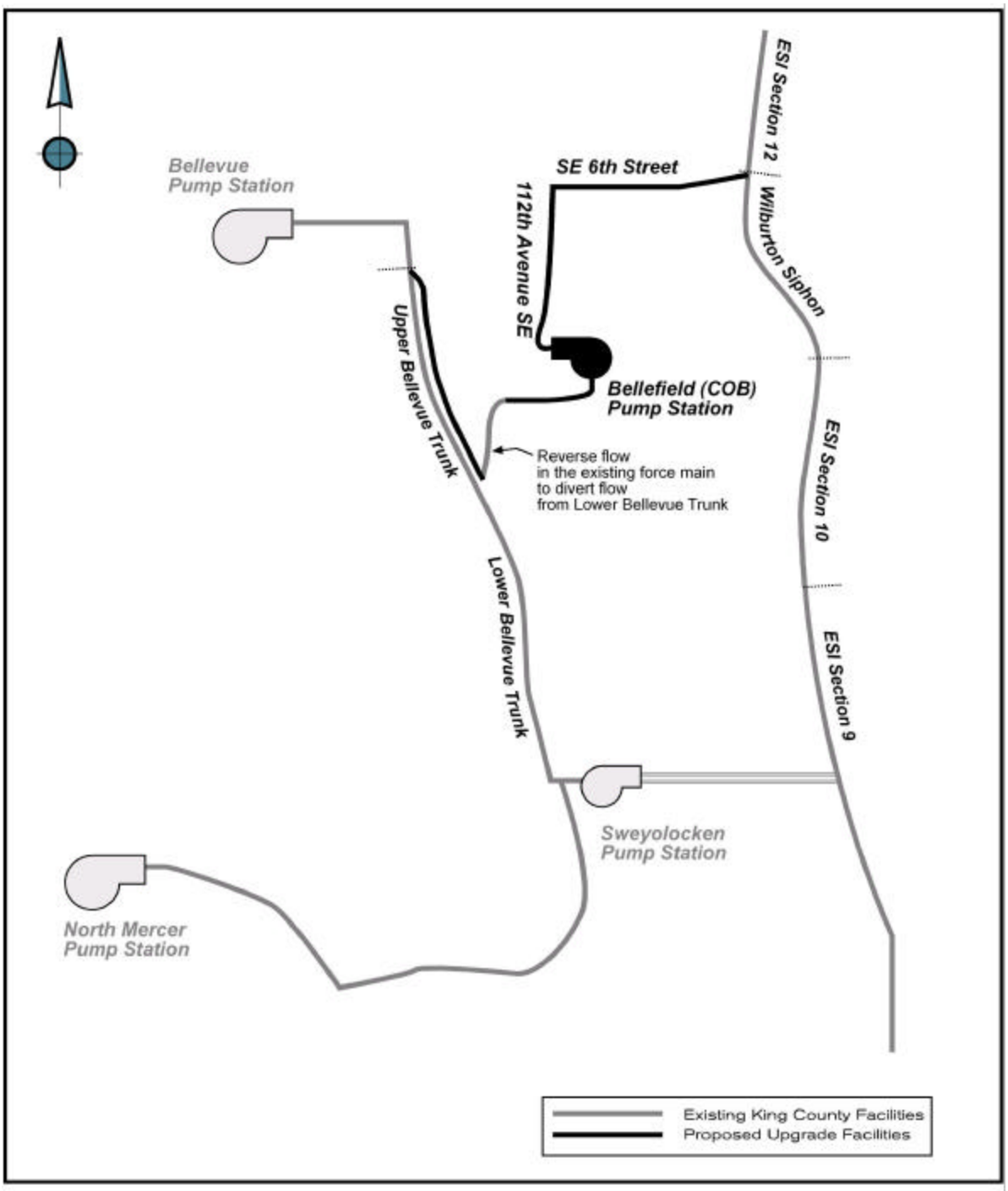
Based on the flow projections for the Medina Basin of 4.3 mgd at build-out contained in the *Wastewater 2020 Existing Conditions* report and a force main velocity of 8 feet per second (fps), the available capacity in the existing 18-inch diameter Medina Force Main approximately 4.8 mgd. For planning purposes, it was assumed up to 4 mgd of wastewater could be conveyed from the Bellevue Pump Station to the Median Force Main/Siphon and the remainder would be pumped from the Bellevue Pump Station to the Bellevue Trunk.

This alternative has a number of disadvantages. First, it would require the Bellevue Pump Station to discharge into two different basins, an unusual situation and not reflective of most KCWTD designs. In addition, based on current flow projections, this alternative would only relieve the Sweyolocken Pump Station through 2015 and the Bellevue Trunk through 2012 with no I/I reduction. Finally, the pump hydraulics would be significantly different than current conditions. The pump dedicated to discharge through a new force main to the Medina Force Main would pump against approximately 155 feet of static head versus 66 feet of static head for the existing Bellevue Pump Station Force Main. Such significantly different pump hydraulics combined with the control problems presented by this alternative eliminated it from further consideration.

Alternative 3 – Bellevue Pump Station to Bellefield Pump Station to ESI

Alternative 3 would off-load the Lower Bellevue Trunk and the Sweyolocken Pump Station by the construction of a parallel to the Upper Bellevue Trunk and diversion of a portion of the flows from the Bellevue Trunk to the COB Bellefield Pump Station (Figure 3-8). The main conveyance components of this alternative are:

- A new 2,400-foot long 15-inch diameter parallel of the Upper Bellevue Trunk from the force main discharge to the intersection of Bellevue Way and 112th Avenue SE.
- Utilize the existing 14-inch COB Bellefield Pump Station Force Main to convey wastewater by gravity to the COB Bellefield Pump Station.
- A new 18-inch force main from the Bellefield Pump Station to the ESI; and
- An upgrade of the Bellefield Pump Station beyond the replacement required in Alternative 1 to convey the additional 4.5 mgd from the Bellevue Pump Station combined with the local flow from the COB Bellefield Pump Station Service Area against a total dynamic head (TDH) of 155 feet.



KING COUNTY
Conveyance System Improvements
Sweyolocken Basin Flow Transfer

Figure 3-8
Alternative 3

Similar to Alternative 1, the discharge from this Bellefield Pump Station would be rerouted directly to the Eastside Interceptor (ESI) as shown on Figure 3-8. Based on these flow diversions, the force main from the Bellefield Pump Station to the ESI would need to be sized to convey 8.0 to 9.8 mgd (5,200 to 6,800 gpm), the range of projected 20-year peak flow in 2050 depending upon the percentage of the Sweyolocken Local Basin flows diverted by transferring the flows from the Bellefield Pump Station directly to the ESI. At this peak flow, the velocity in a 20-inch force main would be 5.7 to 6.9 fps. This force main alignment is the same as that described in Alternative 1 from the Bellefield Pump Station to the ESI.

It may be feasible to use part of the existing 14-inch Bellefield Pump Station force main to divert flows from the Bellevue Trunk to the pump station. To convert this pipeline to a gravity sewer would require minor modifications at the pump station and the interceptor. The average slope of the force main would be about 0.017 ft/ft, if the lower 400 feet were relayed to enter the wetwell at the same elevation as the 114th Avenue SE Trunk. At this slope, the line should provide approximately 4.5 mgd of capacity.

Flow Projections

Based on the most recent flow projections, only 8.9 mgd would need to be diverted in order to keep the future peak flows in 2050 at the Sweyolocken Pump Station at less than 26 mgd. If the Bellefield Pump Station flows are only 33 percent of the peak Sweyolocken Local basin flows, then the peak capacity of the Sweyolocken Pump Station is the only conveyance component that would be exceeded by 2050, and then only by 0.9 mgd (Table 3-2). If the Bellefield Pump Station flows are 50 percent of the peak Sweyolocken Local basin flows, then no I/I reduction would be required. The flow projections for this alternative based on the 33 percent estimate are depicted graphically in Figures 3-4 through 3-6.

Table 3-2: Alternative 3 (Bellevue Pump Station to Bellefield Pump Station to ESI) Summary of Conveyance Limitations

Conveyance Component	Year Exceeded	I/I Reduction Required by 2050		
		(mgd)	(gpad)	percent
Sweyolocken Pump Station				
5-year firm capacity	Not Exceeded	None	None	0
20-year peak capacity	2032	0.9	210	3
Lower Bellevue Trunk	Not Exceeded	None	None	0
Upper Bellevue Trunk	Not Exceeded	None	None	0

I/I Reduction

Flow projections indicated that only the capacity of the Sweyolocken Pump Station will be exceeded if this alternative is implemented. With the flow transfers implemented by this alternative, the peak capacity of the Sweyolocken Pump Station will not be exceeded until 2032, which should provide sufficient time to reduce I/I.

By 2050, only a 0.9-mgd reduction in I/I would be required. Since the Sweyolocken Pump Station is the conveyance facility under capacity, the required I/I reduction could be a result of implementation of an I/I reduction program in any or all of the basins served by the pump station. If the I/I reduction were to come from all the basins, this would equate to a reduction of 206 gpad (0.3 percent) over the projected I/I rate of 6,440 gpad for the entire Sweyolocken Pump Station service area.

Alternative 4 – Bellevue Pump Station to ESI

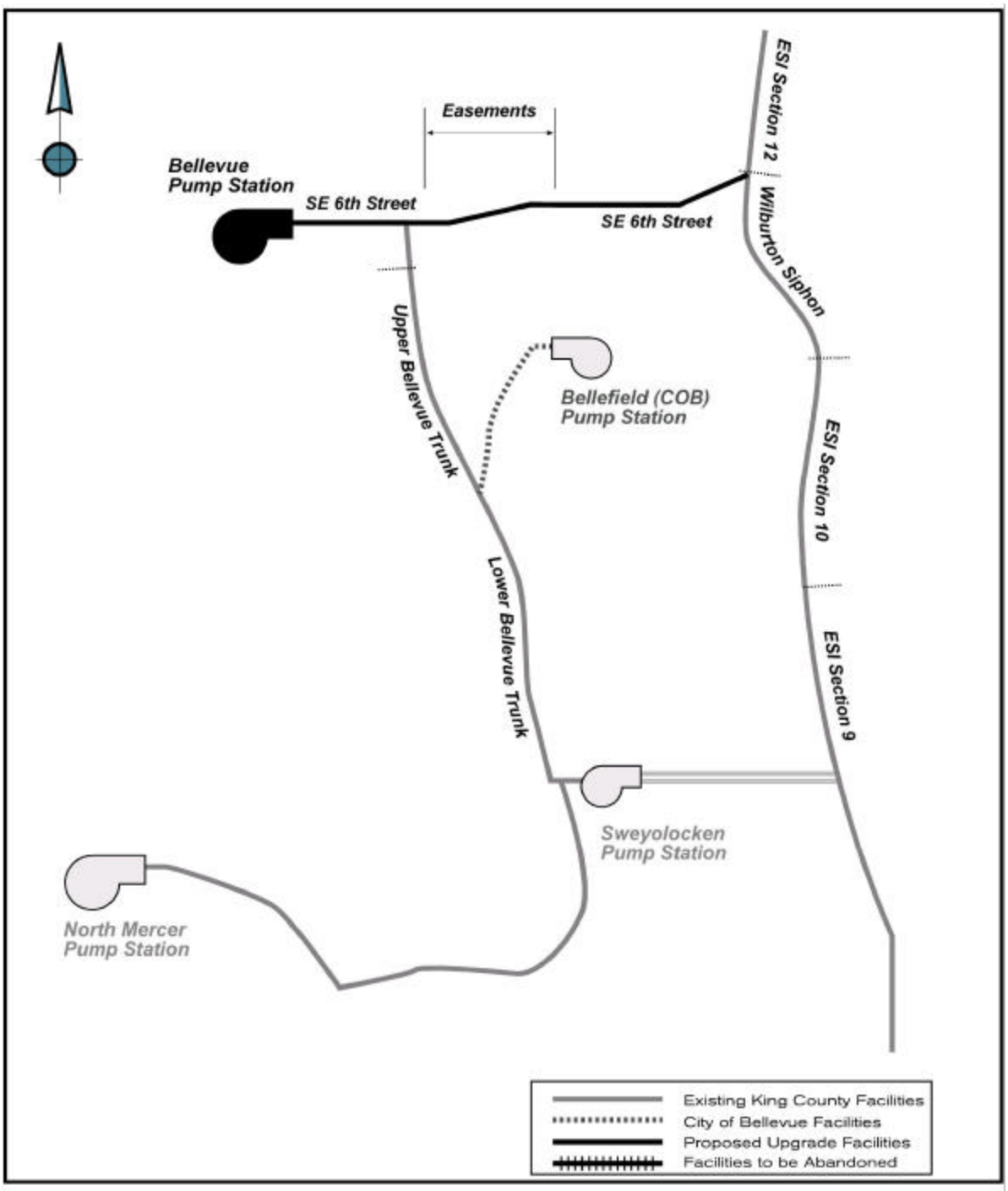
Alternative 4 would include:

- A new 5,500-foot long 24-inch diameter force main; and
- An increase in the raw sewage pump motor horsepower and associated improvements at the Bellevue Pump Station.

In 1986, Metro reviewed rerouting the Bellevue Pump Station force main to pump directly to the ESI rather than to the Bellevue Trunk and Sweyolocken Pump Station in memo entitled "Bellevue Pump Station to Eastside Interceptor". The two alignments reviewed in this memo included inverted siphons with lengths of 2,700 and 4,350 feet respectively. Such long siphons were determined to be unacceptable and these alternatives were not considered further.

For this alternative, a force main alignment from the Bellevue Pump Station to the ESI was investigated that would eliminate the need for an inverted siphon. This alignment is depicted on Figure 3-9 and a profile is shown on Figure 3-10. This alternative would involve a combination of open trench construction, and horizontal directional drilling. To convey the projected 20-year peak flow of 11.8 mgd in 2050, a 24-inch diameter force main would be required with a resulting peak velocity approximately 5.9 fps. Other force main combinations could be developed during predesign if it is determined that this alternative should be further evaluated.

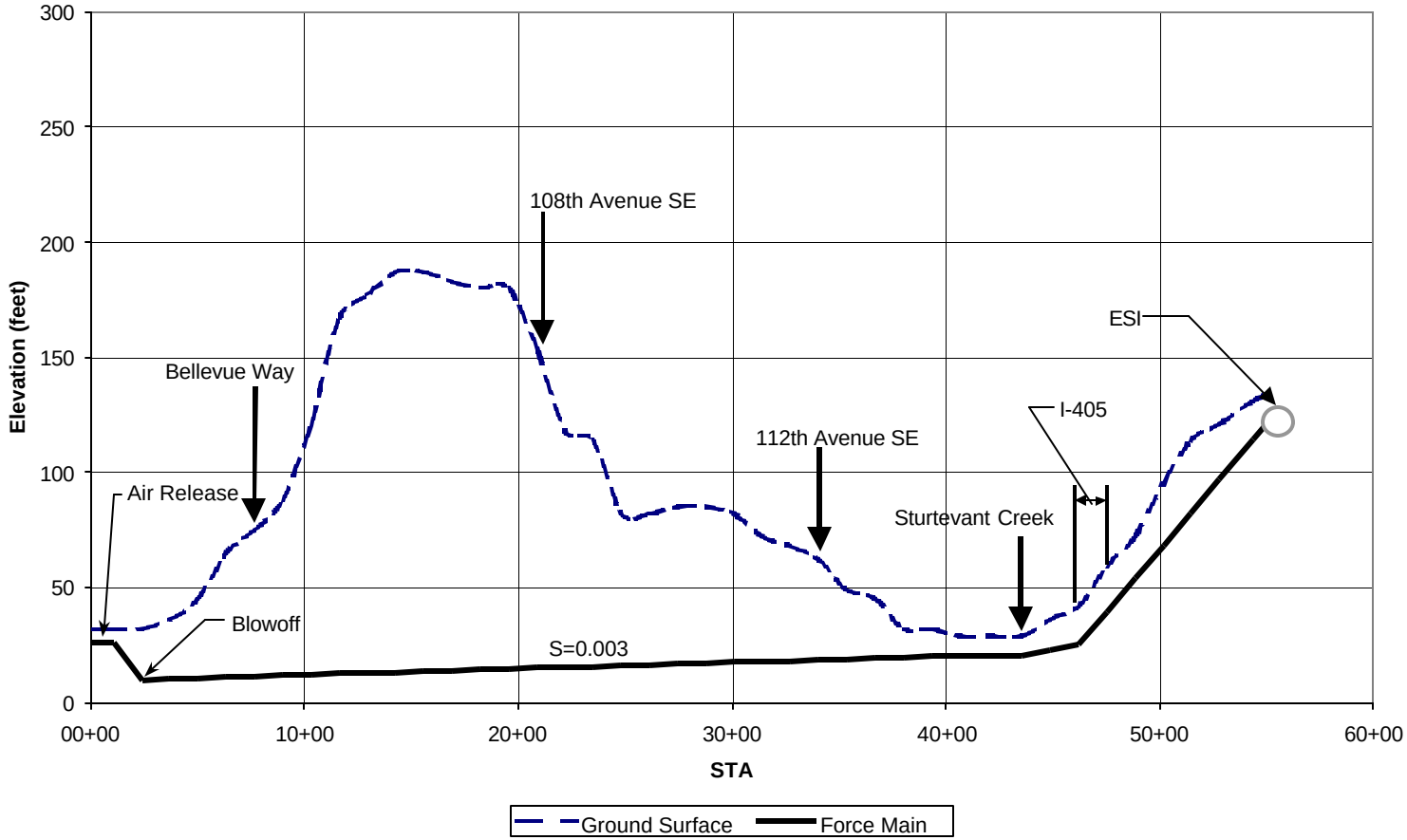
The proposed force main alignment would be almost due east from the Bellevue Pump Station. A 3,300-foot long directional drill would be required from west of Bellevue Way to east of 112th Avenue SE. Directional drills are commonly used for large force mains and water mains. In 1999 in Washington State, large diameter bores of 3,800 feet and 4,000 feet were completed, the former through soils that included glacial till. Also in 1999, a large water main was installed beneath a river by directional drilling over 6,000 feet through rock. Based on this comparison with other directional drill projects and brief discussions with directional drilling contractors, it appears that this project is feasible. However, a more detailed geotechnical review of this alternative would be performed during predesign.



KING COUNTY
Conveyance System Improvements
Sweyolocken Basin Flow Transfer

Figure 3-9
Alternative 4

Figure 3-10
Alternative 4 - Forcemain Profile



Since SE 6th Street stops at Bellevue Way and resumes on the eastside of 112th Avenue SE, approximately nine easements would be required including one from the City of Bellevue and another from the owner of the Surrey Downs School site.

Between 112th Avenue SE and 114th Avenue SE, the force main could be installed using open-trench construction, a distance of approximately 600 feet. The force main could then be directionally drilled underneath Interstate 405 to connect to the Wilburton Siphon inlet structure. This section would be approximately 700 feet long and require permanent easements from Washington State Department of Transportation (WSDOT) and one to two other property owners. The total length of this proposed force main is approximately 5,500 feet.

As a result of this flow diversion, the pump motor horsepower in the Bellevue Pump Station would need to be increased. Currently, the 20-inch diameter Bellevue Pump Station Force Main extends approximately 2,750 feet from the Bellevue Pump Station to the Bellevue Trunk. There is approximately 66 feet of static head on the raw sewage pumps in comparison to approximately 96 feet of static head if Bellevue Pump Station force main were to discharge to the Wilburton Siphon inlet structure. Utilizing the existing force main, the TDH would be approximately 120 feet at a flow of 11.8 mgd, the 20-year peak flow in 2050. In comparison, the TDH for the proposed force main at this flow is approximately 150 feet. The increase in pump motor horsepower from approximately 150 Hp to 175 Hp should be addressed in the Bellevue Pump Station upgrade required in this alternative.

Flow Projections

This alternative would divert enough flow to ensure the Sweyolocken Pump Station and Bellevue Trunk could convey the peak 20-year flow through 2050. The affect of this flow diversion on the Sweyolocken Pump Station and Bellevue Trunk are shown on Figures 3-4 through 3-7 discussed previously. Since the projected 20-year peak flow is well below the conveyance capacity of the Sweyolocken Pump Station, no additional I/I reduction would be required.

Alternative 5 – Bellefield Pump Station to New KCWTD Pump Station to ESI

This alternative would divert flows upstream of the COB Bellefield Pump Station and redirect them to a new KCWTD pump station. Three alternative sites were reviewed including two in the vicinity of the SE 8th Street WSDOT Park and Ride Lot at the intersection of 114th Avenue SE and SE 8th Street and another near the Bellevue Athletic Club north of SE 6th Street. These locations are shown on Figure 3-11. This new pump station would pump flows to the inlet to the Wilburton Siphon. Based on a new KCWTD pump station at the WSDOT Park and Ride Lot and a parallel of the COB 114th Avenue Trunk, this alternative would have the following facilities as shown on Figure 3-12:

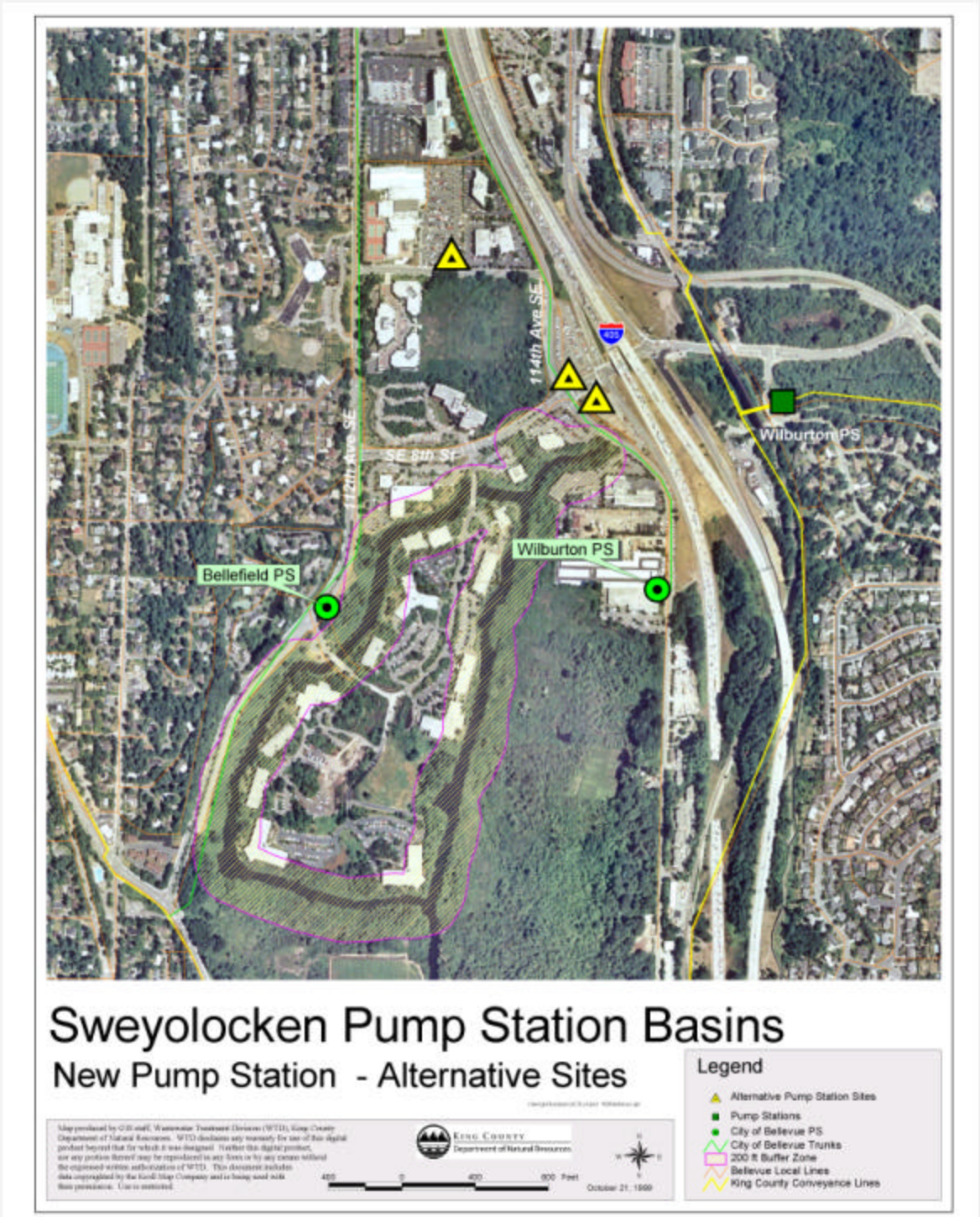
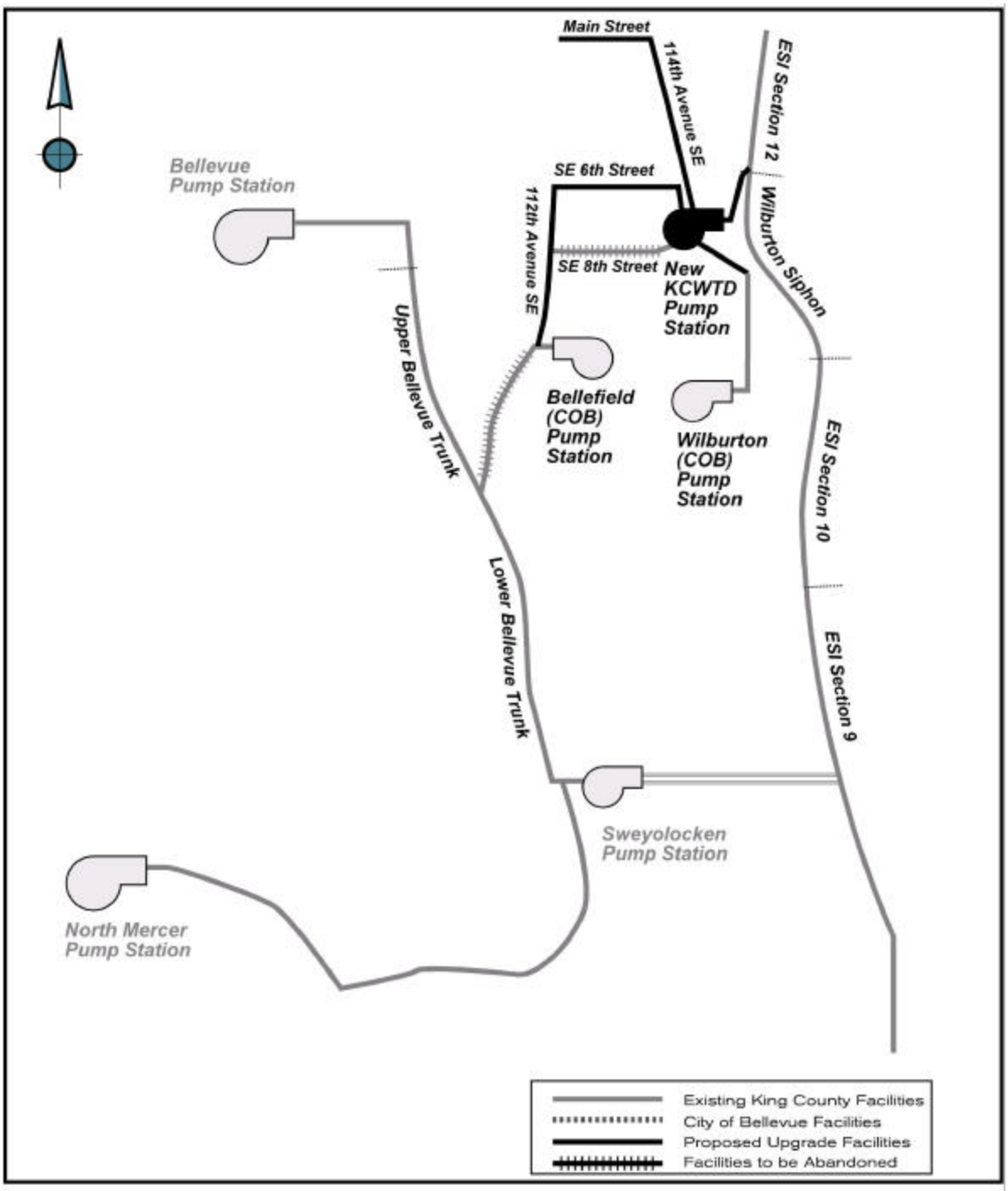


Figure 3-11: New Pump Station Alternative Sites



KING COUNTY
Conveyance System Improvements
Sweyolocken Basin Flow Transfer

Figure 3-12
Alternative 5

- Approximately 3,200 feet of 18-inch gravity sewer from the intersection of Main Street and 112th Avenue SE to 114th Avenue SE, and then following 114th Avenue SE to a new KCWTD pump station.

- Approximately 300 feet of 18-inch gravity sewer from the existing COB 114th Avenue SE trunk to a new KCWTD pump station.

- Approximately 4,400 feet of 8-inch force main from the Bellefield Pump Station to a new KCWTD pump station.

- Connect the force main from the COB Wilburton Pump Station to a new KCWTD pump station.

- Approximately 1,100 feet of 16-inch force main from the new pump station to the Wilburton Siphon inlet structure.

- Abandon approximately 1,500 feet of 18-inch gravity sewer in SE 8th Street between 114th Avenue SE and 112th Avenue SE.

- Abandon approximately 2,200 feet of force main from the Bellefield Pump Station to the KCWTD Bellevue Trunk.

This alternative would significantly reduce the flows to the COB Bellefield Pump Station since flows would be redirected from the 112th Avenue SE Trunk to a new KCWTD pump station. As a result, several capital improvements identified in the 1994 Bellevue Comprehensive Sewer Plan would no longer be required. These capital improvement projects that could be eliminated include:

- Replacement of 410 feet of 18-inch diameter pipe in the 112th Avenue SE Trunk immediately south of Main Street.

- Replacement of 1,110 feet of 20-inch diameter pipe in the 112th Avenue SE Trunk from SE 8th Street to the Bellefield Pump Station.

- The upgrade of the Bellefield Pump Station could be eliminated if a new KCWTD pump station can be completed by the time the upgrade is required. However, this is unlikely considering the COB is currently in predesign for a new Bellefield Pump Station.

- Replacement of the Bellefield Pump Station force main at the time the Bellefield Pump Station is replaced.

The benefit of eliminating these improvements was not included in the opinion of probable cost for this alternative.

The primary disadvantage of this alternative is that it would require construction of a new pump station. In addition this pump station would serve only 840 acres, which is a small service area for a regional KCWTD facility.

Flow Projections

The flow projections for this alternative are identical to those for Alternative 1 since the flows diverted would be those from the Bellefield Pump Station service area. The peak capacity of the conveyance components would be exceeded as summarized in Table 3-3 requiring an aggressive I/I reduction plan.

Based upon the I/I Reduction program as outlined in the RWSP, target levels of I/I reduction for local collection systems are scheduled to be implemented by December 31, 2004. It does not appear that I/I would be implemented in time to ensure the conveyance capacity is not exceeded. Furthermore, the level of I/I reduction required would be difficult to achieve. The reduction required is approximately equal to the 30 percent I/I reduction goal stated in the RWSP. Therefore, it does not appear likely that this alternative combined with a typical I/I reduction program could meet the overall goal of ensuring the conveyance system could convey the peak 20-year flow though 2050.

Table 3-3: Alternative 5 (New KCWTD Pump Station to ESI)
Summary of Conveyance Limitations

Conveyance Component	Year Exceeded	I/I Reduction Required by 2050		
Sweyolocken Pump Station		(mgd)	(gpad)	percent
5-year firm capacity	2014	4.1	940	18
20-year peak capacity	2009	5.4	1,240	19
Lower Bellevue Trunk	2002	4.2	1,820	29
Upper Bellevue Trunk	2025	1.1	940	13

Alternative 6 – North Mercer Pump Station to South Mercer Basin

In March, 1994, the *South Mercer Force Main Alternatives Report* reviewed several alternatives to provide redundancy for the 16-inch diameter South Mercer Force Main that conveys wastewater from the South Mercer Pump Station to the ESI. One alternative reviewed was to reroute flows from the South Mercer Pump Station to the North Mercer Trunk. This alternative was eliminated since it would require a four mile long force main over Mercer Island and the replacement of all the pumps and drives in the South Mercer Pump Station.

Transferring flows from the North Mercer Pump Station to the South Mercer Basin was eliminated from further consideration for many of the same reasons as the reverse situation outlined in the 1994 *South Mercer Force Main Alternatives Report*. This flow transfer would require construction of four to five miles of new force main and interceptor to convey the wastewater from the North Mercer Pump Station to the South Mercer Pump Station, a new North Mercer Pump Station, a new South Mercer Pump Station, and a new force main beneath Lake Washington from the South Mercer Pump Station to the ESI. These capital improvements would be expensive, difficult to permit, and difficult to construct. Therefore, this alternative was eliminated from further consideration.

Alternative 7 – Storage Alternatives

The feasibility of storage both upstream of the Sweyolocken Pump Station and upstream of the Bellevue Pump Station was evaluated. Three different storage alternatives were developed:

- Alternative 7A - In-line storage upstream of the Bellevue Pump Station
- Alternative 7B - Off-line storage upstream of the Sweyolocken Pump Station
- Alternative 7C - In-line storage in the Bellevue Trunk upstream of the Sweyolocken Pump Station.

Storage Requirements

Storage requirements were developed based on limiting flow to 26 mgd for the Sweyolocken Pump Station, the future peak capacity of the pump station, and to 10.7 mgd for Bellevue Pump Station, the capacity of the Upper Bellevue Trunk. Given these constraints, a program was written that takes the basin flows, crops the hydrographs, and sums the volume of the portion above the cropping limit and prints out the volume, peak inflow and starting and ending times for each storage event. One important assumption was that storage would be emptied by continuing to pump at a maximum flow rate until the storage was completely drained. After that time the storage event was determined to be over and a new event could begin. Hence, events do not have a fixed separation. Another assumption was that 2050 conditions could be reached by increasing the base flow by one factor (2050 base flow/1996 base flow, based on June 1999 TAZ data) and increasing I/I flow (that flow exceeding the base flow) by another factor (1.238, based on the 7 percent per decade non-compounded I/I degradation rate). This is consistent with prior calculations and allows use of other spreadsheets to check these results.

The results of the analysis are as follows:

- Bellevue Pump Station would require storage of around 0.1 million gallons (MG) for a 20 year storm event using 2050 conditions.

  This volume projection was developed using Bellevue Pump Station flow and Seatac rainfall data. There appear to be flow restrictions or overflows upstream of the pump station as evidenced by flattening of the hydrograph during large storm events. Some upstream flow monitoring is highly recommended if storage is further considered upstream of the Bellevue Pump Station. The currently projected storage volume may rise substantially when more information is gathered.

- Sweyolocken Pump Station would require storage of around 0.9 MG for a 20 year storm event using 2050 conditions.

  Several ways of extrapolating the projected storage requirements were examined, none of which fitted a particular curve type very well. Hence, the storage

volume requirements were rounded to the nearest tenth of a million gallons due to the uncertainty of the curve fit.

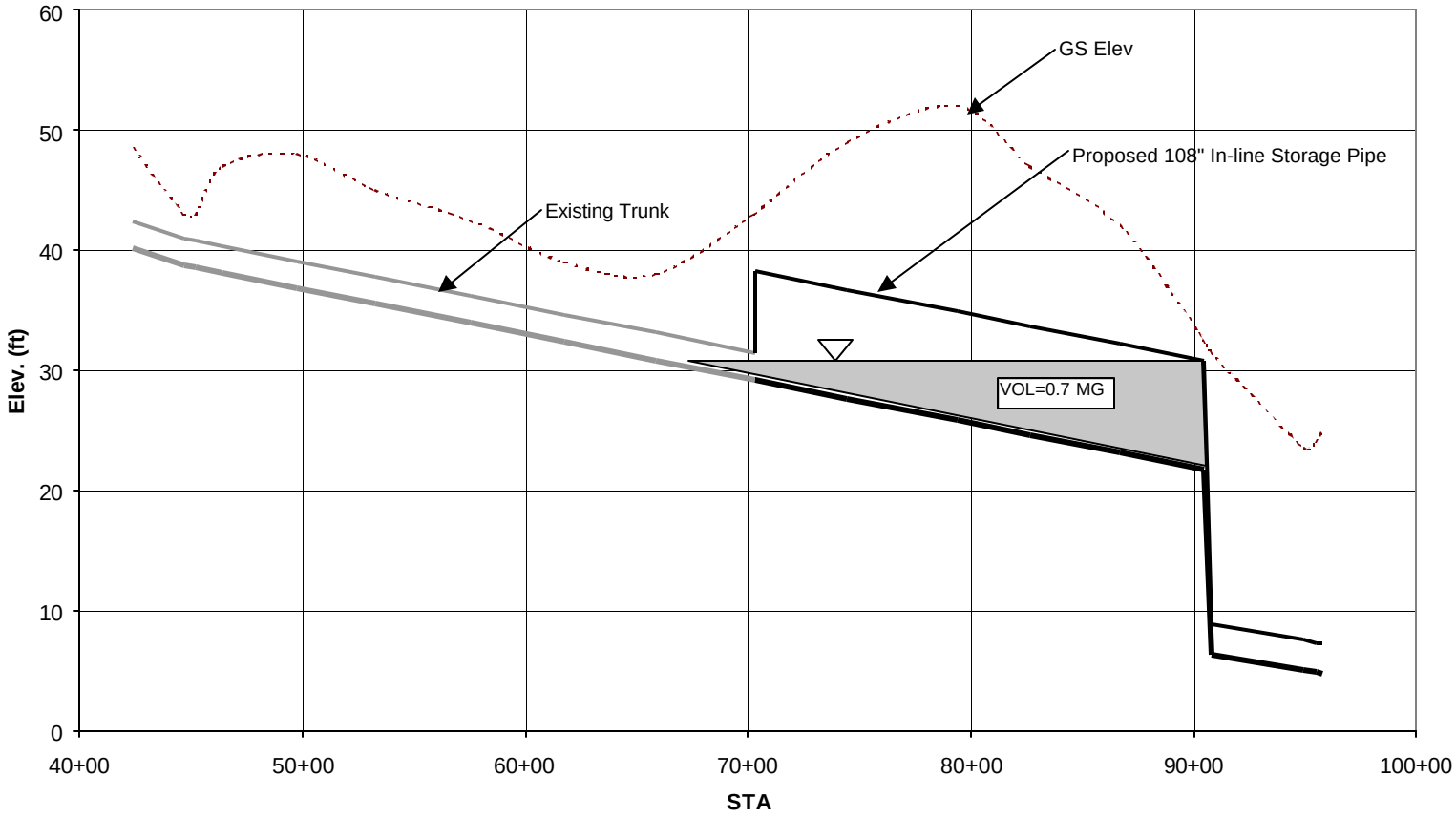
In-line Storage Upstream of the Sweyolocken Pump Station

The feasibility of using the Bellevue Trunk for in-line storage was investigated. This project would involve replacing approximately 2,050 lineal feet of the Lower Bellevue Trunk with 108-inch diameter pipe to increase the storage capacity of the trunk (Figure 3-13). The steep section of trunk between MH R07-25A and MH R07-26 limited storage to sections of trunk upstream of MH R07-25A. Therefore, a flow regulator would be required to limit flow to the Sweyolocken Pump Station downstream at this manhole. For this planning study, it was assumed that only one flow regulator would be installed. The storage volume was limited to approximately 0.7 MG by the topography of the alignment and the slope of the trunk. If a cunette were installed to increase the water velocities at low flows, the storage volume would be further limited. In comparison, approximately 0.9 MG of storage would be required to limit the 20-year peak flow in 2050, 34.9 mgd, to the peak capacity of the pump station, 26 mgd. Therefore, based on the assumptions outlined above, it does not appear feasible to use the Bellevue Trunk for in-line storage, by itself, to meet the goal of ensuring conveyance of the 20-year peak flow to the Sweyolocken Pump Station through 2050.

Since the in-line storage would be located at the downstream end of the Bellevue Trunk, the section of the Bellevue Trunk from MH 07-16 to MH 07-23 would still need to be paralleled or replaced because the peak 20-year flow currently exceeds the capacity of the Lower Bellevue Trunk. A 36-inch diameter, 2,960 foot long parallel pipe would be required to convey 22.7 mgd, the 2050 peak flow of 34.9 mgd minus 12.2 mgd, the full-pipe capacity of the existing 27-inch Lower Bellevue Trunk. Alternatively, additional storage could be provided by constructing a second regulator structure at MH 07-23 and increasing the size of the Bellevue Trunk above MH 07-23 to provide the requisite additional 0.2 MG of storage or changing the slope on the storage structure. These alternatives could be developed during predesign if it is determined that storage merit further evaluation.

The traffic impacts of constructing this off-line storage facility and associated structures would be significant. This alternative would involve closing at least two lanes of Bellevue Way SE, a heavily used arterial, the lower end of which becomes an entrance ramp to Interstate 90. Other issues, such as operations and maintenance concerns would need to be addressed in predesign if it is decided that this alternative merits further development. In addition, I/I reduction would still be required to provide the 20-year peak flow conveyance capacity through 2050.

Figure 3-13
Lower Bellevue Trunk Storage Capacity
MH R07-12 to MH R07-29



I/I Reduction

I/I reduction would still be required if this alternative were to be implemented since the volume of in-line storage available is limited to 0.7 MG and 0.9 MG is required. In addition, this alternative would not provide relief for the Upper Bellevue Trunk. A 1.1 mgd reduction in the 20-year peak flow event would be required by 2050 to ensure sufficient capacity in the Upper Bellevue Trunk. For the Bellevue Pump Station basin, this equates to an I/I reduction of 940 gpad or a 12.5 percent reduction in the 2050 I/I rate. Additional I/I reduction may also be required to ensure that there is sufficient in-line storage. This additional I/I reduction could be achieved by controlling I/I from any of the basins that serve the Sweyolocken Pump Station since the purpose of the in-line storage is to limit the peak flow to the Sweyolocken Pump Station to 26 mgd.

Alternative 7B -Off-line Storage Upstream of the Sweyolocken Pump Station

The construction of an off-line storage facility upstream of the Sweyolocken Pump Station was investigated. Based upon discussions with KCWTD staff and a review of land use in the area, there are a limited number of feasible sites for an off-line storage facility since the area is entirely developed with the exception of Mercer Slough, a large Class A wetlands adjacent to Bellevue Way. The only feasible site not in the wetlands is the South Bellevue Park and Ride just east of the intersection of Bellevue Way SE and 112th Avenue SE. Approximately half of the park and ride would have to be temporarily closed to permit construction of the off-line storage facility. Constructing a parking garage on the other half of the park-and-ride lot would help mitigate the effects of closure of the other half of the lot. This park-and-ride is consistently over capacity, so any construction would make it more difficult for commuters to use this park-and-ride lot. Wastewater could flow into the storage facility by gravity from the Bellevue Trunk and would be pumped out when flows receded. The off-line storage facility would require construction of the following facilities:

- A diversion structure adjacent to the Bellevue Trunk near MH R07-23;
- Approximately 300 lineal feet of 36-inch gravity sewer between the diversion structure and the off-line storage facility;
- A 1.0 MG storage facility including submersible pumps to pump out the facility following a peak flow event; and
- Approximately 1,000 lineal feet of force main from the off-line storage facility to the Sweyolocken Pump Station.

Since the in-line storage would be located at the downstream end of the Bellevue trunk, the section of the Bellevue Trunk from MH 07-16 to MH 07-23 would still need to be paralleled or replaced. A 36-inch diameter, 2,960 foot long parallel pipe would be required to convey 22.7 mgd, the 2050 peak flow of 34.9 mgd minus 12.2 mgd, the full-pipe capacity of the existing 27-inch Lower Bellevue Trunk.

The traffic impacts of constructing this off-line storage facility and associated structures would be significant. Other issues, such as the high groundwater in the area, specific

wetlands permitting issues, and operations and maintenance concerns would need to be addressed in predesign if it is decided that this alternative merits further development.

Alternative 7C - In-line Storage Upstream of the Bellevue Pump Station

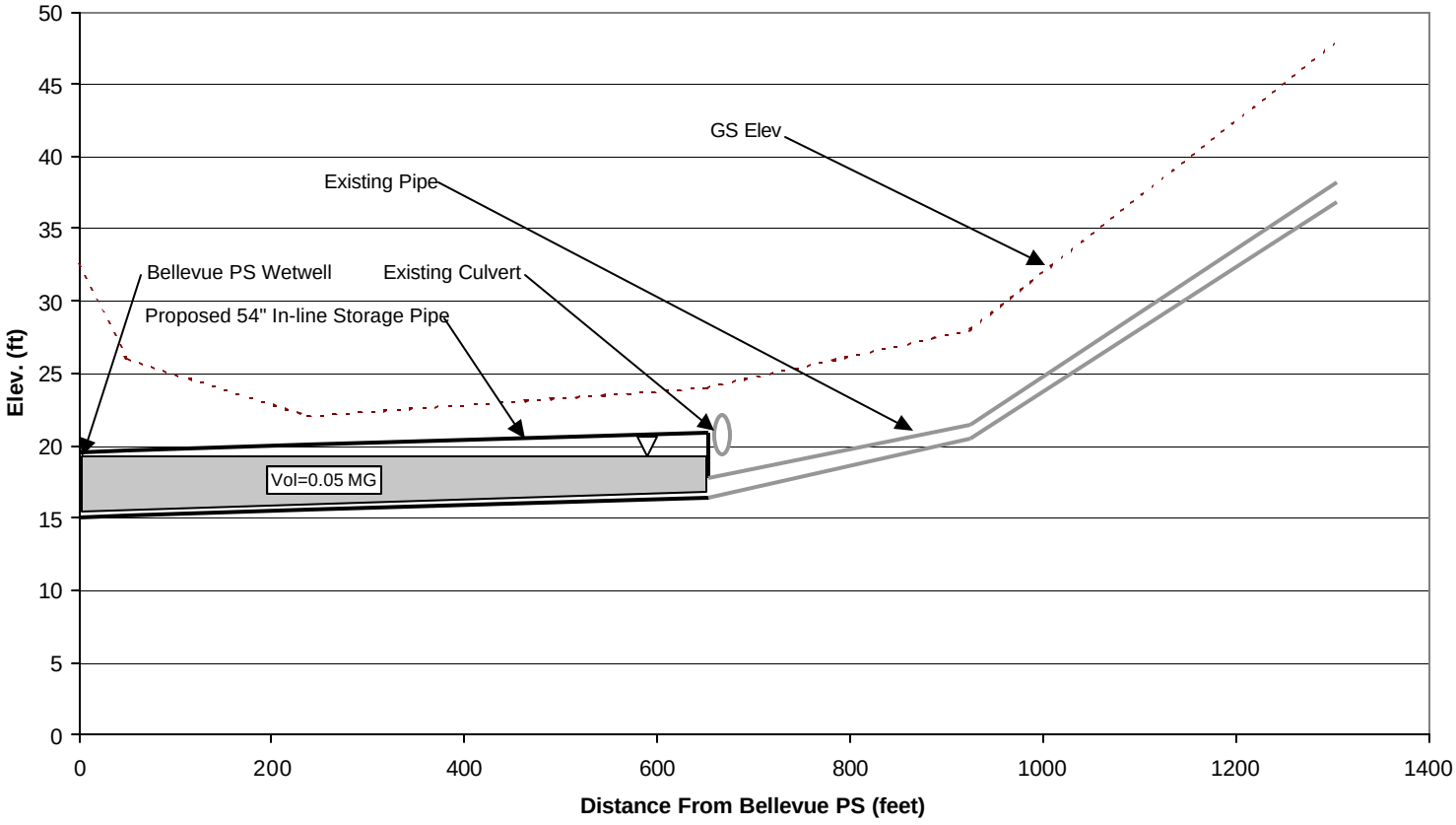
Increasing the size of the Bellevue Pump Station Influent Trunk would only offer a limited quantity of in-line storage. This project would involve replacing approximately 650 lineal feet of the Bellevue Pump Station Influent Trunk with 54-inch diameter pipe to increase the storage capacity of the trunk (Figure 3-14). The 36-inch diameter culvert adjacent to MH R07-3 and site topography limits the maximum pipe size. In addition, the top of the grating in the wetwell at elevation 18.75 feet (Metro Datum) limits the maximum water surface elevation in the upstream storage pipe. Based on these constraints, the storage volume would be limited to approximately 0.05 MG. In comparison, approximately 0.1 MG of storage would be required to limit the 20-year peak flow in 2050, 11.8 mgd, to the peak capacity Upper Bellevue Trunk, downstream of the Bellevue Pump Station, which has a full pipe capacity of 10.7 mgd. Therefore, it does not appear feasible to use the Bellevue Pump Station Influent Trunk for in-line storage to meet the goal of limiting the 20-year peak flow to the Upper Bellevue Trunk to 10.7 mgd through 2050.

COMPARISON OF ALTERNATIVES

The six flow transfer and three storage alternatives developed in this report were evaluated based upon the following criteria identified in Table 3-4:

- Ability to meet the project objective of providing conveyance relief through 2050.
- Operation and maintenance requirements,
- Environmental and permitting concerns,
- Right-of-way and easement acquisitions,
- Geotechnical issues,
- Local impacts and construction constraints; and
- Total capital cost including allied costs. The basis for these costs are discussed below.

Figure 3-14
Bellevue Pump Station Influent Sewer
MH R07-5 to Bellevue Pump Station



Capital Costs

Planning level costs were developed based on construction costs for recently built KCWTD conveyance facilities and standard cost criteria. These cost criteria include:

- A construction cost contingency of 30 percent,
- Sales tax of 8.6 percent of the estimated construction cost, and
- Allied costs of 35 percent of the total estimated capital cost.

The allied cost factor is considered to cover KCWTD facility management, consulting services, and insurance. Detailed planning level cost estimates are included in Appendix B.

These costs do not include the upgrade/replacement of the Bellefield Pump Station by the City of Bellevue. Only the additional cost to upgrade this proposed pump station to discharge at a higher head was included where required. The cost to upgrade the Bellevue Pump Station is included in the cost estimates as a line item in the cost estimates developed in this planning report. The planning level opinion of probable cost to upgrade the Bellevue Pump Station and influent sewer were developed by KCWTD staff.

Discussion

From the review of the alternatives summarized in Table 3-4, it appears that only Alternatives 3 and 4 merit further evaluation.

Even if constructed, Alternative 1 (Bellefield Pump Station to ESI) and Alternative 5 (Bellefield Pump Station to a new KCWTD Pump Station to the ESI) would provide conveyance relief only through 2002. These alternatives would require an acceleration of the regional I/I reduction program and a high level of I/I reduction that may not be feasible.

Alternative 2 (Bellevue Pump Station to Medina Force Main) and Alternative 6 (North Mercer Island to South Mercer Island) were eliminated from further consideration for the reasons outlined earlier in this report and summarized in Table 3-4. Specifically, these alternatives would not provide sufficient conveyance relief, and, in the case of Alternative 5, would be significantly more expensive than the other alternatives and would be difficult to permit and construct.

Both Alternative 3 (Flow transfer from the Upper Bellevue Trunk to the Bellefield Pump Station and Bellefield Pump Station to the ESI) and Alternative 4 (Bellevue Pump Station to the ESI) do not have any “fatal” flaws, although each would have their own challenges. Alternative 3 would require some I/I reduction, coordination with the COB on the Bellefield Pump Station upgrade, and permitting concerns associated with the construction of a pump station within 200 feet of the Mercer Slough. Alternative 4 would soil borings to minimize the geotechnical risk and would require easements from several property owners. Despite

these concerns, Alternative 3 and 4 appear to be the two most feasible alternatives for further evaluation.

Three storage alternatives were evaluated, two upstream of the Sweyolocken Pump Station (Alternatives 7A and 7B) and one upstream of the Bellevue Pump Station (Alternative 7C). These storage alternatives would involve temporary closure of surface streets and were, in some cases, significantly more expensive than the flow transfer alternatives investigated. Alternatives 7A and 7B would measurably impact traffic on SE Bellevue Way. The in-line storage alternative (Alternative 7A) would require the closure of at least two and possibly three lanes of SE Bellevue Way, a heavily used arterial, the south end of which becomes an on-ramp onto Interstate 90. The off-line storage alternative (Alternative 7B) would require closing half of the South Bellevue Way Park and Ride Lot, a heavily lot used that is consistently over-capacity on weekdays. In addition, the estimated capital cost for Alternative 7B is significantly greater than the estimated capital cost for any of the other alternatives. For these reasons, these two storage alternatives merit further evaluation only if the construction impacts are acceptable to local agencies and an I/I program is implemented for the basin. Alternative 7C was not feasible given the topographical constraints of the area upstream of the pump station. In addition, the goal of this storage alternative, to attenuate the projected peak flow to within the capacity of the Upper Bellevue Trunk, would not alleviate the need to parallel or upsize the Lower Bellevue Trunk or significantly decrease peak flows to the Sweyolocken Pump. For these reasons, storage upstream of the Bellevue Pump Station does not merit further evaluation.

Schedule

This planning effort is the first step in ensuring that wastewater can be conveyed from the area served by the Sweyolocken Pump Station to the East Side Interceptor through 2050. The preliminary schedule to implement the improvements outlined in this report is as follows:

Item	Date
Complete Basin Planning Effort	May, 2000
Predesign Complete	January, 2001
Final Design and Permitting Complete	October, 2001
Start Construction	January, 2002
Finish Construction	December, 2003.

The final schedule will depend upon the alternative selected. Those alternatives that include construction of a new pump station would take approximately one year longer to complete.

Table 3-4. Comparison of Alternatives

Alternative (Project Objectives)	Operations and Maintenance	Environmental/ Permitting	Right of Way/ Easements	Geotechnical Issues	Local Impacts and Construction Constraints	Total Capital Cost (Millions) (Seattle 1999 ENRCCI=7000)
1 – Bellefield PS to ESI *(Provides conveyance relief only through 2002)*	No additional pump stations to maintain.	Pump station would be within 200 feet of Mercer Slough triggering a shoreline Substantial Development Permit	Additional permanent easement required to construct larger pump station.	Most construction would be open cut excavation with limited risk. Site suitable for new pump station as evidenced by the existing pump station.	Most of the construction would be in the R/W. Impact on traffic in 112th Avenue SE.	$6.2 (But does not meet project objectives)
2 –Bellevue PS to Medina FM	Eliminated from further evaluation due to operational difficulties. (Does not provide sufficient conveyance relief and would result in the potential for operational difficulties at the Bellevue Pump Station)					
3 - Bellefield PS to ESI + Bellevue PS to Bellefield PS *(Requires minor I/I reduction)*	No additional pump stations to maintain.	Pump station would be within 200 feet of Mercer Slough triggering a shoreline Substantial Development Permit	Additional permanent easement required to construct larger pump station.	Most constitution would be open cut excavation with limited risk. Site suitable for new pump station as evidenced by the existing pump station.	Same as Alternative 1 plus additional traffic impacts on Bellevue Way and 112th Avenue SE.	$10.4
4 – Bellevue PS to ESI *(Provides conveyance relief. No I/I reduction required)*	No additional pump stations to maintain.	No new pump stations. Relatively easy to permit.	Easements required from seven property owners and the COB school district.	Borings required to determine if practical. Risk associated with length of the directional drill.	Use of trenchless technology would reduce traffic impacts. Access from non-arterial streets.	$9.5
5 – Bellefield PS to New KC WTD PS to ESI *(Provides conveyance relief only through 2002)*	New pump station to maintain.	No special permits required except those required for new pump station.	Easement required from WSDOT for new pump station.	Most construction would be open-cut excavation with limited risk.	Same as Alternative 1	$14.0 (But does not meet project objectives)
6 –North Mercer to South Mercer	Eliminated from further evaluation (Too expensive, difficult to permit and construct. Does not relieve Bellevue Trunk.)					
7A – Storage (In-Line) *(Requires minor I/I reduction)*	New regulator structure to maintain.	May be difficult to permit construction in Bellevue Way SE.	All within existing right-of-way.	Most construction would be deep open-cut excavation.	Would require closure of 2-3 lanes of Bellevue Way SE	$10.4
7B – Storage (Off-Line)	New off-line storage facility to maintain.	Storage facility would be within 50 feet of Mercer Slough wetlands.	Easement required from WSDOT for off-line storage facility.	High groundwater would require significant dewatering for the excavation.	Negotiate with WSDOT for partial closure of the South Bellevue Park and Ride.	$21.9
7C – Storage (Bellevue PS)	Eliminated from further evaluation. (Only a partial solution. Does not meet project objectives.)					

CHAPTER 4 – CONCLUSIONS AND RECOMMENDATIONS

Six flow transfer and three storage alternatives were evaluated to limit the flows to the Sweyolocken Pump Station and Bellevue Trunk to ensure these KCWTD facilities remain within their respective capacities through estimated build-out conditions in 2050. The cost to replace the COB Bellefield Pump Station and associated force main was not included in the evaluation of the alternatives. Of these six alternatives, the two that appear the most feasible are:

- Alternative 3 - Transfer up to 4.5 mgd from the Bellevue Pump Station to the COB Bellefield Pump Station and upgrade the Bellefield Pump Station to pump these flows to the ESI. Convey the remainder of the flows from the Bellevue Pump Station to the Sweyolocken Pump Station through the Bellevue Trunk.

- Alternative 4 - Transfer all the flow from the Bellevue Pump Station directly to the ESI.

Neither one of these alternatives would involve construction of a new KCWTD regional pump station, only construction of new force mains and upgrading existing or proposed pump stations to pump at a higher TDH. It is recommended that these two alternatives be further evaluated and refined in a Task 250 planning study. Specific goals of the Task 250 effort may include better defining the required pump station upgrades, sensitivity of the construction costs to I/I reduction, and a review of operations and maintenance costs for the alternatives.

APPENDIX A

ACQUISITION CHECKLISTS

APPENDIX B

COST ESTIMATES