KING COUNTY CONVEYANCE SYSTEM IMPROVEMENT PROJECT

BELLEVUE PUMP STATION AND ASSOCIATED FACILITIES

FORMERLY (SWEYOLOCKEN II PUMP STATION SERVICE AREA)

FLOW MANAGEMENT ALTERNATIVES EVALUATION

TASK 250

REPORT

AUGUST 2000

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. This report embodies a continuation of the efforts 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. However, the primary focus of this report is transfers of the Bellevue Pump Station flows away from the Sweyolocken Pump Station. Hence, during the course of this planning effort, the task changed from the "Sweyolocken II Pump Station Service Area" effort to the "Bellevue Pump Station and Associated Facilities" planning effort.

The Bellevue Pump Station pumps flow through the Bellevue Trunk to the Sweyolocken Pump Station. 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 and the Bellevue Trunk.

Six flow transfer and three storage alternatives were evaluated in the Task 240 report, which preceded this Task 250 effort, to reduce future flows to these hydraulically limited conveyance components. During the course of this Task 250 planning effort additional alternatives were developed based on the most promising alternatives from Task 240 effort. These alternatives were discussed in meeting with consultant and King County staff. As a result of these discussions, it was recommended that the alternative known as Alternative 4 be carried forward to predesign.

Alternative 4, as described in the Task 240 report, consists of the following components:

- An upgrade of the Bellevue Pump Station to pump directly to the ESI;
- A 5,500 foot long, 24-inch diameter force main from the Bellevue Pump Station to the ESI; and
- A discharge structure at the ESI just upstream of the Wilburton Siphon inlet structure.

The estimated total project capital cost for this alternative is approximately $12 million (2000 dollars). This budgetary project costs include $2.0 million in improvements to the Bellevue Pump Station previously identified by King County Wastewater Treatment Division staff and is an increase over the original estimate due to the greater geotechnical risk associated with this project than initially anticipated.

CHAPTER 1 – INTRODUCTION

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. This report builds on the analysis of the recently completed Task 240 report. Since the KCWTD Bellevue Pump Station will be upgraded and potentially modified in all the flow management alternatives evaluated in this report, the name of the study has been changed from the Sweyolocken II Pump Station Service Area to the Bellevue Pump Station and Associated Facilities.

BACKGROUND

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 in 2000. 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 downstream of 112th Avenue SE.

FACILITIES REVIEW

The major KCWTD facilities in the Sweyolocken Pump Station Service Area include the three 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 resulted in 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 Pipes

The major KCWTD conveyance lines discussed further in this report are the Eastside Interceptor (ESI), the Bellevue Trunk, and the Bellevue Pump Station Force Main. These major conveyance pipes 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). A more detailed review of these conveyance facilities was included in the Task 240 report.

Table 1-1: Bellevue Pump Station Related KCWTD Conveyance Pipes

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
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.

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). The peak capacity (all pumps operating) of the existing pump station is approximately 21 mgd. An upgrade of the Sweyolocken Pump Station is currently under design to increase the firm capacity (largest pump out of service) 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 larger diameter suction piping, lowering the water surface elevation in the wetwell, and larger pumps.

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 with project completion by the end of 2001.

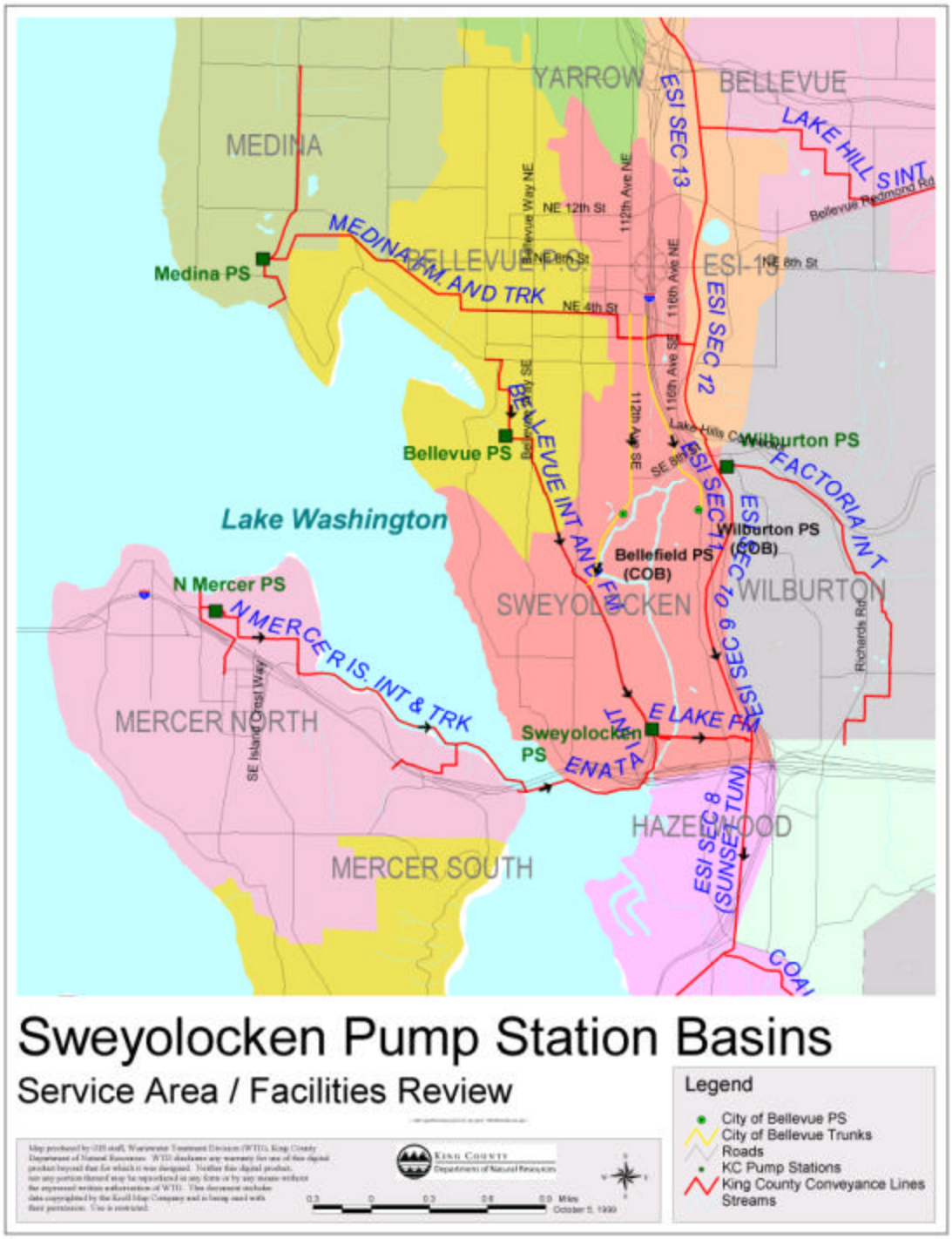


Figure 1-1: Sweyolocken Pump Station Basins

Bellevue Pump Station

Construction of the Bellevue Pump Station was completed in 1964. A photo of the facility is provided as Figure 1-2. Odor control facilities were provided at the station and the structural integrity of the facility was improved in 1972. The raw sewage pumps and 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. The firm capacity of the existing station is approximately 8.4 mgd with a peak capacity of 10.2 mgd.

Figure 1-2: Bellevue 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).

SWEYOLOCKEN II PUMP STATION SERVICE AREA CSI TASK 240 REPORT

The CSI Task 240 project report identified several capacity constraints within the area served by the Sweyolocken Pump Station based on the projected increase in flows resulting from development of the Bellevue CBD and increased I/I due to deterioration of the collection system. Several flow management alternatives were developed ranging from diversion and I/I reduction to in-line storage. 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. Three storage alternatives were developed after an initial review of the draft report by KCWTD staff.

All of the flow diversion alternatives developed in the Task 240 effort include a connection to the Wilburton Siphon. For this reason, the connection of a new force main to the ESI in the vicinity of the Wilburton Siphon was discussed at a meeting with KCWTD staff on November 3, 1999. During this meeting, it was determined that the best place to connect to the ESI was just upstream of the Wilburton Siphon for hydraulic reasons and to provide effective odor control.

Another meeting was held with KCWTD staff on January 4, 2000 to discuss the draft Sweyolocken II Task 240 report. As a result of the discussion held during this meeting, the draft report was modified to include three storage alternatives; (1) in-line storage upstream of the Bellevue Pump Station; (2) in-line storage upstream of the Sweyolocken Pump Station; and (3) off-line storage upstream of the Sweyolocken Pump Station. The final draft of the Task 240 Report was submitted to the KCWTD on February 3, 2000, comments were received in late February, and the final Task 240 Report was completed on March 3, 2000. Following completion of the Task 240 Report, additional meetings were held regarding the Task 250 effort. These meetings and the Task 250 effort are discussed in more detail in the following chapters.

CHAPTER 2 – ALTERNATIVE EVALUATION

INTRODUCTION

As mentioned in the previous chapter, several flow transfer, I/I reduction, and storage alternatives were developed in the Task 240 effort. Alternatives 3 and 4 were recommended in the Task 240 report, and are summarized as follows:

- Alternative 3 - Transfer up to 4.5 mgd from the Bellevue Pump Station through an existing force main to the COB 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, up to 11.8 mgd, the projected peak flow in 2050 without any I/I reduction, through a new 24-inch diameter, 5,500 foot long force main directly to the ESI.

With these recommendations in mind, more meetings were held as part of the Task 250 effort to review and more fully develop appropriate alternatives.

TASK 250 ALTERNATIVE DEVELOPMENT

On March 23, 2000, KCWTD and HDR staff met to discuss the Task 240 Report and plan the Task 250 effort. As a result of this discussion, three alternatives were developed that combined various elements of the flow transfer and I/I reduction alternatives developed in the Task 240 Report. These alternatives, titled Alternative 1A, Alternative 3A, and Alternative 4A, are briefly described in this report.

- Alternative 1A – This alternative would entail upgrading the Bellevue Pump Station, constructing a new 5.3 mgd peak capacity Bellefield Pump Station, and constructing a 4,200 foot long, 16-inch diameter force main from the new Bellefield Pump Station to the ESI. In combination with these capital improvements, I/I reduction would need to be implemented. An I/I reduction of approximately 30 percent would be required by 2050 to maintain a 20-year level of service. Should I/I reduction of this magnitude not be feasible, a force main would need to be constructed from the Bellevue Pump Station to the ESI to divert additional flows. Modifications to the Bellevue Pump Station would be required along with construction of a 16-inch diameter, 5,500-foot long force main from the Bellevue Pump Station to the ESI.

- Alternative 3A – This alternative would be similar to Alternative 1A. Initially, a new 5.3 mgd peak capacity Bellefield Pump Station would be constructed along with a 4,200

foot long, 16-inch diameter force main from the new Bellefield Pump Station to the ESI. The Bellefield Pump Station would need to be constructed so that it could be expanded to 9.8 mgd in the future. In combination with these improvements, I/I reduction would need to be implemented. If I/I control could not achieve the required level of reduction, then the existing Bellefield Pump Station force main could be used to divert up to 4.5. mgd of wastewater from the Bellevue Trunk to the Bellefield Pump Station. With this diversion, a second 4,200 foot long, 14 or 16-inch diameter force main would need to be constructed from the Bellefield Pump Station to the ESI.

- Alternative 4A – This alternative would initially involve constructing a 16-inch diameter, 5,500 foot long force main from the Bellevue Pump Station to the ESI in combination with an upgrade of the Bellevue Pump Station. The majority of the wastewater from the Bellevue Pump Station would continue to be discharged through the existing Bellevue Pump Station force main to the Bellevue Trunk. To protect the Bellevue Trunk from experiencing surcharged conditions, or perhaps overflowing, it would be necessary to limit discharges from the COB Bellefield Pump Station to approximately 5.0 mgd. With these improvements and restrictions, a 10 percent reduction in I/I by 2050 would still be required. If this level of I/I reduction could not be implemented, it would be necessary to provide in-line storage upstream of the Bellevue Pump Station and/or upgrade the Bellevue Pump Station to divert more wastewater through the 16-inch force main to the ESI.

TASK 250 ALTERNATIVE REVIEW BY KCWTD AND CITY OF BELLEVUE

Both KCWTD and City of Bellevue staff were involved in the planning process and review of the alternatives developed in the Task 240 effort and the development of additional alternatives. Several meetings were held to review and evaluate the alternatives developed as a part of this project. These meetings are briefly summarized below:

- April 5, 2000 - At the request of KCWTD staff, additional alternatives were developed based on the two recommended alternatives from the Task 240 effort. These alternatives, Alternatives 1A, 3A, and 4A, were reviewed by KCWTD CSI staff at this meeting.

- May 15, 2000 - These three alternatives were then refined and presented again to KCWTD staff including staff from the CIP and I/I programs. A review of the Task 240 effort, flow modeling information, and a more detailed review of how to phase to a 20 year level of service for the KCWTD conveyance facilities in the area were included in the presentation as well. The Power Point slides prepared for this presentation are included in Appendix A.

- May 22, 2000 - A KCWTD Capital Systems team meeting was held during which all of the alternatives were reviewed.

- June 8, 2000 - This meeting of senior KCWTD management involved a review of all the alternatives. At this meeting, it was recommended that only Alternative 4 be developed

further in the Task 250 effort. The rational for this decision and recommendation was as follows:

- Alternative 3 and 3A cost approximately the same as Alternative 4 but include the additional complexity of making modifications to the City of Bellevue's local system. These modifications would include upgrading or replacing and possibly taking over the City's Bellefield Pump Station, which is located adjacent to the Mercer Slough. Alternative 4 will still be coordinated with the City but work will be entirely on existing or proposed King County regional facilities.

- Alternative 1A is less desirable since it may require two connections to the ESI, and for the coordination and environmental reasons outlined for Alternative 3.

- Alternative 4A is less feasible because it would require limiting the peak discharge from the Bellefield Pump Station to 5 mgd

Given this process of elimination, it was recommended that only Alternative 4 be evaluated further.

KCWTD staff discussed the planning process, alternatives evaluated, and the recommended alternative with City of Bellevue staff at a meeting held on June 22, 2000. A flow analysis memorandum prepared for this meeting is included in Appendix A along with other technical memoranda prepared during the Task 250 effort.

ALTERNATIVE 4 OVERVIEW

Alternative 4, as described in the Task 240 report, consists of the following components:

- An upgrade of the Bellevue Pump Station to pump directly to the ESI;

- A 5,500 foot long, 24-inch diameter force main from the Bellevue Pump Station to the ESI; and

- A discharge structure at the ESI just upstream of the Wilburton Siphon inlet structure.

Each one of these components is described in more detail and evaluated in this report.

BELLEVUE PUMP STATION

As described in engineering work requests (EWRs) 91 and 94, there are a number of improvement required for the Bellevue Pump Station to reliably convey the projected flows. In November 1997, these EWRS were initiated to investigate the reliability of the electrical systems and magnetic drive clutches at the Bellevue Pump Station. A team was assembled consisting of staff from the Capital Improvement Program (CIP) Construction Management,

Engineering and Facility Inspection, and East Division Offsite Operation and Maintenance. Also included in the team were the East Division Offsite Supervisor and the Equipment Services Supervisor. Some basic existing and proposed pump station information is summarized in Table 2-1.

Table 2-1: Bellevue Pump Station Equipment and Capacity

Parameter	Existing	Proposed
Pump Station Firm Capacity	8.4 mgd	9.9 mgd
Pump Station Peak Capacity	10.2 mgd	11.8 mgd
Influent Sewer Full Pipe Capacity	8.5 mgd	14.5 mgd
Raw Sewage Pumps	3 – 100 HP	3 – 150 HP
Static Head	63 feet	98 feet
Speed Control	Magnetic Drive Clutches	Variable Frequency Drives

The team determined that due to the relationship between the motors, pumps, clutches, electrical, HVAC, instrumentation, and control systems, it would be impossible to simply replace the clutches and upgrade the electrical system without modifying the essential elements of the pump station. In addition, the team determined that the age and reliability of these essential systems combined with maintaining the firm pumping capacity of the pump station through the duration of the project would result in a complex and potentially expensive project.

As a result of these findings, the team determined that the project would involve more than simply replacing the electrical systems and magnetic drive clutches at the pump station. To ensure a reliable and efficient pump station in the future, the team determined that the motors, pumps, electrical, instrumentation and control, and HVAC systems would have to be replaced. In addition, the team determined that the equipment may not fit into the existing pump station structure.

The team also determined that the 24-inch diameter influent line into the wetwell had a full pipe capacity of approximately 8.5 mgd. The projected 20-year peak flow to the pump station will be 8.5 mgd in 2000, and may be higher considering that there may be upstream hydraulic restrictions resulting in slightly lower peak flows that would be experienced otherwise. Surcharging of this influent line is not recommended since the elevation of the overflow weir to Meydenbauer Creek (119.11 feet Metro datum) is only 2 feet above the crown of the pipe. The overflow to Meydenbauer Creek is shown in Figure 2-1.

Figure 2-1: Bellevue Pump Station Overflow

Previously Recommended Bellevue Pump Station Improvements

A number of improvements for the Bellevue Pump Station were recommended as a part of an earlier analysis performed by KCWTD staff. These recommended improvements are defined in two memos included in Appendix B and summarized briefly here.

- Replace 50 feet of 24-inch diameter influent sewer from MH R07-01A to wetwell with a 30-inch diameter pipe. Although the 30-inch pipe would be sufficient to convey the projected peak flows through 2050, a larger pipe should be considered during predesign, to provide additional time before an overflow occurs to start a second pump in the event one pump drops off-line or fails to start when required. According to a recent analysis by KCWTD staff, there is approximately 30 seconds between the time a pump fails and an overflow would occur, and significantly less time during peak flow events.

- Replace the three existing 100 HP motors and pumps with 150 HP units;

- Replace the existing electrical clutches with variable frequency drives (VFDs);

- Replace the existing electrical system;

- Replace the existing instrumentation and control system; and

- Replace the existing HVAC system.

- Provide flow and other monitoring equipment in the overflow manhole (MH R07-2A) to allow monitoring and quantification of overflows.

Alternative 4 - Bellevue Pump Station Improvements

The Bellevue Pump Station will need to be modified to pump the same projected flows at slightly higher head conditions. The three potential pump station discharge scenarios are summarized in Table 2-2. If I/I control is implemented, the size of the force main and pumps could be also be reduced. Further optimization of the pipe diameter and the relationship between I/I control, pipe diameter and electrical equipment requirements at the pump station should be performed during predesign. These and other issues that should be further developed during predesign are discussed later in this chapter.

Table 2-2: Force Main Hydraulics and Related Electrical Loads

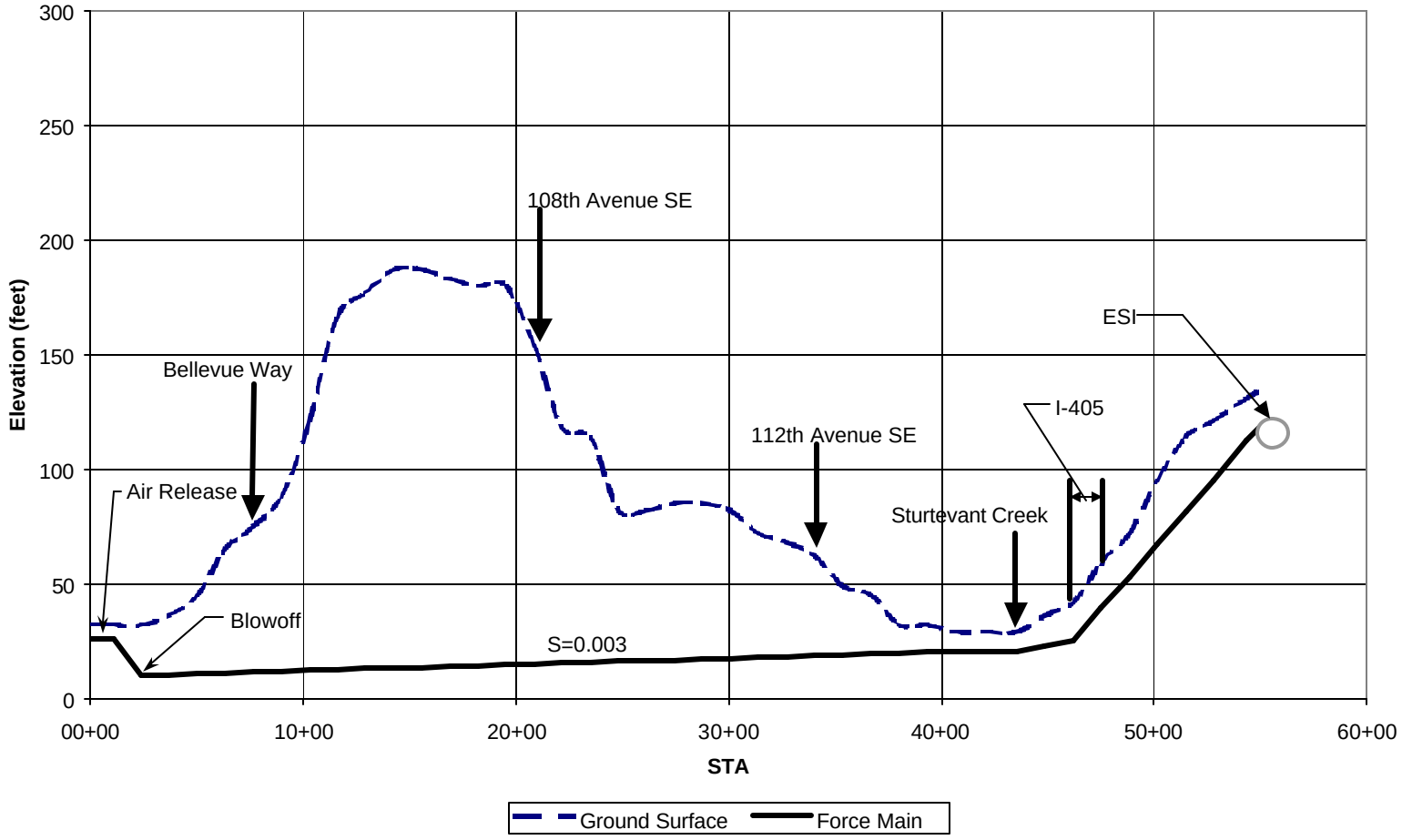
Force Main Alternative	Dia (in)	V_{max}[1] (fps)	Q_{min}[2] (mgd)	Static head (ft)	Length (ft)	Max TDH[3] (ft)	Pump Motor[4] (HP)
Existing Force Main	20	8.6	2.8	63	2800	120	150
Proposed 22-inch Force Main	22	7.1	3.4	98	5500	144	175
Proposed 24-inch Force Main	24	6.0	4.1	98	5500	133	150-175

Notes:
1. Maximum velocity at 11.8 mgd, the peak 20-year flow in 2050 without I/I reduction.
2. Minimum flow to ensure a minimum velocity of 2 fps.
3. Maximum TDH at 11.8 mgd. For the existing force main, a Hazen-Williams Coefficient of 100 was used, while for the proposed force main, a Hazen-Williams coefficient of 120 was assumed since it is anticipated that this force main will be HDPE instead of cement mortar lined steel or ductile iron.
4. The pump motor horsepower was based on conveying 11.8 mgd with three pumps, a pump motor efficiency of 90 percent, and a pump mechanical efficiency of 70 percent. These are relatively conservative values.

Force Main Alignment

A preliminary review of the feasibility of using horizontal directional drilling (HDD) to install the proposed force main was performed as part of the Task 240 report. Given the alignment topography, HDD was the preferred method of construction. As shown on Figure 2-2 on the next page, there is a significant hill between the Bellevue Pump Station and the ESI. A force main alignment over this hill would have resulted in a unacceptably long siphon and microtunneling through this hill would be significantly more expensive than HDD as well as requiring access and jacking shafts over 180 feet deep. Other routes for the force main were evaluated in a 1986 Metro Report and the Task 240 Report. None of these force main alternatives were deemed acceptable by KCWTD staff primarily because they would require construction of unacceptably long siphons

Figure 2-2
Alternative 4 - Force Main Profile



A preliminary geotechnical review of the proposed force main alignment was performed as by HWA Geosciences for this report, and is included in Appendix C. In general, this geotechnical review indicated that directional drilling the force main is feasible but will have greater risk and be more expensive than initially anticipated due to the possibility of encountering ice-rafted boulders and other obstructions. In addition, it appears that there is some peat beneath the section of SE 6th Street between 112th Avenue SE and 114th Avenue SE, the section of the alignment that would be open cut, and warrants further analysis (Figure 2-3). A more detailed geotechnical review should be included as a part of predesign.

Figure 2-3: SE 6th Street Between 112th Avenue SE and 114th Avenue SE

The force main alignment would primarily be within public right-of-way. However, approximately nine tunnel easements would be required from property owners. In addition, the proposed force main alignment would cross beneath Interstate 405, and would therefore require a Washington State Department of Transportation (WSDOT) Utility Accommodation Franchise Permit. The proposed force main crossing would be classified as a Category 2 (questionable impact) project as long as the force main is installed in a casing pipe underneath the freeway. If a casing pipe is not used, the crossing would be classified as a Category 1 project and be subject to a much more cumbersome permitting process commensurate with the increased risk to WSDOT for such a utility undercrossing. Information on the WSDOT Utility Accommodation and Franchise Permit Process is included in Appendix D. After crossing beneath Interstate 405, the force main alignment would primarily be within public right-of-way to the point of connection to the ESI upstream of the Wilburton Siphon Inlet.

Connection to the ESI

The force main connection to the ESI will probably be just upstream of the Wilburton Siphon Inlet Structure. On November 3, 1999, a meeting was held between CSI staff, the CIP Project Manager for the Wilburton Siphon Upgrade, and consultant staff at which the force main connection to the ESI was discussed. Based on this discussion it was determined that force main connection would not be included in the Wilburton Siphon Upgrade design contract. Currently, the Wilburton Siphon Upgrade is scheduled to be bid in October 2000 with construction starting May 2001. The Wilburton Siphon Inlet site is depicted in Figure 2-4. It is anticipated that the proposed odor control facility at the siphon inlet will not be included as part of the bid package since the location of the facility has not been determined as of June 2000. The Wilburton Siphon Upgrade also involved over one year of permit negotiations with the Burlington Northern and Santa Fe Railway (BNSF) over construction within the BNSF right-of-way.

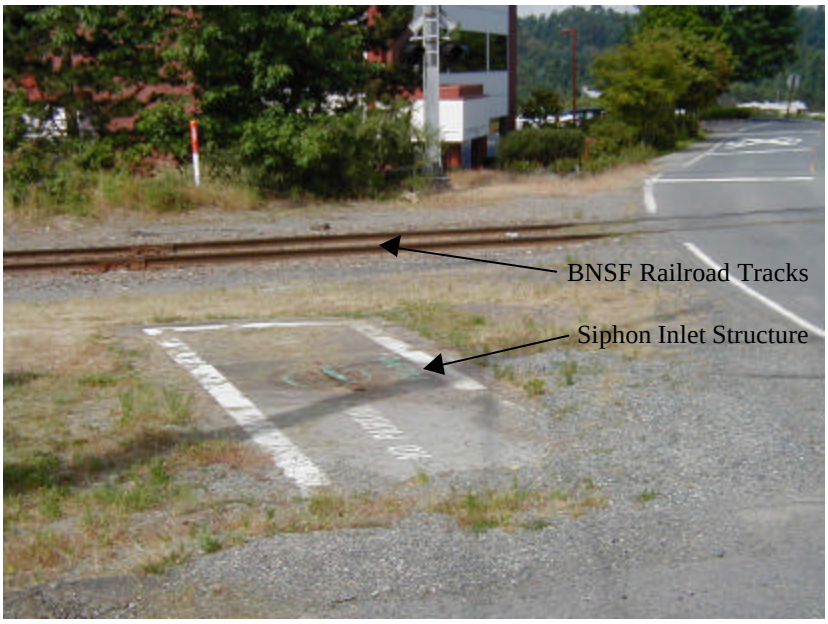


Figure 2-4: Existing Wilburton Siphon Inlet Structure

The force main connection to the ESI will probably involve a new structure adjacent to the ESI and upstream of the existing Wilburton Siphon Inlet Structure. In addition, the force main project may include the odor control facility that was originally part of the Wilburton Siphon Upgrade. The additional air displaced from the force main discharge should be considered in the design of the odor control facility. For example, if the force main discharges 6.0 mgd, twice the base flow in 2050, this would displace approximately 600 cfm. Whether or not the odor control facility should be included along with the other work outlined in this report should be determined during predesign.

Bellevue Pump Station Operation

The primary reason for conveying flows from the Bellevue Pump Station directly to the ESI is to prevent overloading the Bellevue Trunk and Sweyolocken Pump Station during storm related peak flow events. However, during dry weather, it may be preferable to discharge wastewater to the Bellevue Trunk rather than the ESI for a number of reasons.

First, the design team for the Sweyolocken Pump Station Upgrade has expressed some concern that diverting wastewater from the Bellevue Pump Station directly to the ESI will reduce the flows to the Sweyolocken Pump Station during dry weather. This flow diversion may cause the pumps at the Sweyolocken Pump Station to cycle in constant speed start-stop operations much of the time during dry weather. Such operation should be avoided if practical.

Second, the discharge of wastewater through the proposed Bellevue Pump Station force main to the ESI could lead to significant sulfide generation with resultant odor and corrosion problems if not adequately controlled. The sulfide generation potential of this proposed force main is approximately 5.5 mg/L under summer low flow conditions. The sulfide generation model assumptions and data are included in Appendix E. In contrast, field sampling in 1997 indicated there is little sulfide generation in the existing force main and only minor corrosion in the Bellevue Trunk at the force main discharge was observed in the last documented inspection of the Bellevue Trunk in 1990.

Finally, maintaining the existing Bellevue Pump Station Force Main will provide a level of redundancy should there be a catastrophic failure of one of the force mains. This operational flexibility may also be useful for maintenance or operational reasons. Although a catastrophic failure of a force main is unlikely, such a failure would present a significant challenge to be able to convey wastewater out of the Bellevue Pump Station Basin.

The flexibility and operational benefits of continuing to convey wastewater during the summer through the existing 20-inch force main should be compared to the additional electrical costs to pump this wastewater. Wastewater from the Bellevue Pump Station service area is currently pumped twice, once from the Bellevue Pump Station to the Bellevue Trunk and then again from the Sweyolocken Pump Station to the ESI. In contrast, the proposed alternative would pump the wastewater once, from the Bellevue Pump Station to the ESI. The proposed alternative would reduce the total dynamic head by approximately 30 feet than under the current system of pumping it twice. For a period of 180 days at a flow of 1.5 mgd, the base flow in 2010, this would result in an estimated savings of approximately $2,500 per year assuming an energy cost of $0.06 per KWH. This is a relatively modest cost savings and may be more than offset by the operational benefits of conveying wastewater through the existing Bellevue Pump Station Forcemain during the summer.

There are at least two operational issues that would have to be addressed if the flexibility to use both force mains is provided: (1) pump selection and (2) sulfide generation. As a part of predesign, pump selection should be performed to determine the operational range of the pumps to discharge to the two force mains and the proportion of time the pump station would cycle in constant speed start-stop operation. In addition, the sulfide generation in the

force mains would be significant if they were allowed to remain full of raw wastewater. To minimize the sulfide generation in a force main it may be possible to shock dose the line with caustic and/or hypochlorite prior to taking the forcemain off-line, or drain the forcemain and fill it with non-potable water from the pump stations existing C2HP system. These and other issues outlined below should be further evaluated during predesign.

Predesign Issues

There are a number of issues identified in this report that should be evaluated during predesign to more fully develop the alternative regarding each one of these specific design issues.

- Influent Sewer Size - Although a 30-inch diameter pipe is sufficient to convey the projected peak flows, a 42-inch diameter or larger pipe would provide some additional time prior to the time an overflow would occur. The feasibility, costs, and benefits of installing a larger diameter pipe from the wetwell to MH R07-02A should be evaluated during predesign. Costs for such a replacement are not included in the cost estimates in Appendix F.

- Wetwell Expansion - Expanding the wetwell would also provide additional time to start a second pump in case of a mechanical failure and start the emergency generator, when needed. The feasibility of expanding the wetwell five feet north was mentioned in an internal KCWTD memo provided in Appendix B and merits further evaluation during predesign. Costs for this wetwell expansion were not included in the estimated project costs.

- Emergency Generator – The existing 300 KVA emergency generator was installed in 1989. When the pump station is upgraded, it is likely that the emergency generator will be able to run only two of the three pumps, the firm capacity of the pump station. It is currently KCWTD standard practice to ensure that the generator can meet the firm pump station capacity. Although, in some cases, the emergency generator has been sized to meet the peak pump station demand. The feasibility of replacing the emergency generator, and possibly the entire emergency generator building, should be evaluated along with the practicality of operating only two pumps, the firm pump station capacity, on stand-by power. Replacement of the emergency generator is not included in the estimated project costs.

- Force Main Operation – It may be practical to maintain use of the existing Bellevue Pump Station Force Main for the reasons outlined in this report. However, there are also issues with using a force main on a periodic basis. These issues and benefits should be reviewed early in predesign so pump other design issues can be resolved.

- Hydraulic Transients – The hydraulic transients in the proposed force main are not expected to be severe based on a cursory review of the proposed force main profile which indicated that there are no “knees” in the proposed alignment where column separation could occur. Nonetheless, a simple hydraulic transient analysis is warranted to determine what, if any, transient control equipment should be installed.

- Odor and Sulfide Control – The proposed force main will have the potential to generate sulfides and lead to odor and corrosion problems at the force main discharge to the ESI. Therefore, the feasibility of chemical addition at the Bellevue Pump Station should be evaluated along with protection of the discharge structure from sulfide based corrosion by using corrosion resistant materials in the structure and minimizing turbulence at the discharge point. The cost for a 150 gallon-per-day chemical feed system was included in the estimated project costs. A new odor control facility at the Wilburton Siphon Inlet is also planned as part of the Wilburton Siphon Upgrade project which should be included in overall odor control strategies during predesign.

- Analyze Ancillary Systems – The seal water pumps as well as other systems should be evaluated to determine their suitability for operating at the higher head conditions that would result from using the proposed force main. A $30,000 allowance for miscellaneous mechanical piping and valves is included in the estimated project costs.

- Expansion of the Pump Station Superstructure – The feasibility of expanding the pump station superstructure to accommodate new electrical equipment and VFDs should be evaluated. The expansion may be similar to the one at the KCWTD Wilburton Pump Station to provide VFDs for the facility. Since the wetwell is on the north side of the pump station, it appears to be most practical to expand the superstructure either to the west or to the south. For planning purposes, it was assumed a 400 square foot addition to the pump station would be required and is accounted for in the estimated project costs.

- Interstate 405 Crossing – The primary issue with crossing beneath I-405 will be developing an alignment that minimizes risk of settlement while avoiding any highpoints in the force main alignment that would lead to maintenance and operation problems.

- I/I Reduction – As the I/I project progresses, the practical level of I/I reduction in the Bellevue Pump Station basin will probably become more clear. As such, the CIP PM should continue to work closely to identify the level of practical I/I reduction and make appropriate adjustments to the design.

- Pump Selection – Although the approximate motor horsepower of the pumps is known, there are a number of factors that could affect the final pump selection. These factors include the level of practical I/I reduction, the final size of the force main, and the decision whether or not to use the existing Bellevue Pump Station force main during the summer when flows will be lower.

This planning effort was intended to provide a general framework for the capital improvements necessary to convey the projected peak flows from the Bellevue Pump Station Basin and identify the issues that will need to be resolved during predesign and final design. The process for implementing these improvements is outlined below.

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	August 2000
Predesign Complete	May 2001
Final Design and Permitting Complete	June 2002
Start Construction	September 2002
Finish Construction	September 2004.

Costs

Planning level capital 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 F.

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. This planning level opinion of probable costs to upgrade the Bellevue Pump Station and influent sewer was developed by KCWTD staff. The estimated total project capital cost for this project is approximately $12 million (Seattle ENRCCI = 7200), of which $2 million are for improvements to the Bellevue Pump Station identified by KCWTD staff.

The estimated operations and maintenance (O&M) costs for this alternative were also developed. These O&M costs are expected to increase slightly for the Bellevue Pump Station over existing O&M costs due to the larger pumps that will be required and the higher discharge head. Annual O&M costs are expected to be approximately $115,000 in year 2000 dollars. The O&M cost estimates are included in Appendix F.

CHAPTER 3 – CONCLUSIONS AND RECOMMENDATIONS

During the process of writing this report several alternatives were developed. As a result of discussions with KCWTD staff, it was determined that Alternative 4 was the preferred alternative. This alternative includes the following components:

- An upgrade of the capacity, electrical, and control systems for the Bellevue Pump Station;
- A 5,500 foot long, 20 to 24-inch diameter force main from the Bellevue Pump Station to the ESI; and
- A discharge structure at the ESI just upstream of the Wilburton Siphon inlet structure.

In addition, numerous issues are discussed in this report that merit further evaluation during predesign.

APPENDIX A

TASK 250 PRESENTATIONS AND MEMORANDA

Sweyolocken II Basin Planning Meeting

April 5, 2000 Slides

Sweyolocken II Basin Planning Meeting

May 15, 2000 Slides

Sweyolocken Basin Conveyance Level of Protection

May 18, 2000 Memorandum

Bellefield Pump Station Flow Analysis

June 21, 2000 Memorandum

APPENDIX B

KCWTD BELLEVUE PUMP STATION MEMORANDA

APPENDIX C

PRELIMINARY GEOTECHNICAL REVIEW

APPENDIX D

WSDOT UTILITY FRANCHISE AGREEMENT

APPENDIX E

PROPOSED BELLEVUE PUMP STATION

FORCE MAIN SULFIDE MODELING

APPENDIX F

COST ESTIMATES