KING COUNTY CONVEYANCE SYSTEM IMPROVEMENT PROJECT

TASK 220

HIDDEN LAKE SERVICE AREA FACILITIES REVIEW

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INTRODUCTION

The existing wastewater facilities in the Hidden Lake Service Area are described in this memorandum. The King County Wastewater Treatment Division (WTD), Shoreline Wastewater Management District (WMD) and the Highlands Sewer District (SD) own and maintain conveyance facilities in the Hidden Lake Service Area. System inventories and capacities, as well as current rehabilitation requirements and planned conveyance system changes, are discussed for each of the contributing agencies.

The Hidden Lake Service Area conveyance system can be summarized as follows:

- Shoreline WMD and Highlands SD collect and transport sanitary sewage to the King County WTD facilities using a network of gravity sewers, lift stations and force mains.
- King County WTD transports sewage along the Boeing Creek Trunk to the Richmond Beach Pump Station. The Hidden Lake Pump Station, located along the Boeing Creek Trunk, assists with flow transfer to Richmond Beach.
- Downstream of the Richmond Beach Pump Station, wastewater flows to the Edmonds Treatment Plant, in accordance with King County's wastewater treatment sharing agreement with the city of Edmonds.

Hydraulic capacity issues have been identified at the Hidden Lake Pump Station and in the downstream conveyance system. Accordingly, the description of conveyance system facilities has been divided into 2 sections: (1) the Hidden Lake Pump Station and upstream facilities, and (2) facilities downstream of the Hidden Lake Pump Station (see Task 210 memo, Figure 2).

PART I. HIDDEN LAKE PUMP STATION AND UPSTREAM FACILITIES

The Hidden Lake Pump Station receives wastewater flows from three separate sources:

(1) Shoreline WMD Basin 14 located to the east of the pump station,

(2) Shoreline Pump Station No. 4 which serves Shoreline WMD Basin 7, and

(3) Shoreline Pump Station No. 5 which serves the Highlands SD and Shoreline WMD Basin 13.

Each of these areas is described in this section.

Shoreline WMD Basin 14

Shoreline WMD Basin 14 has a total drainage area of approximately 1,300 acres (2 sq. mi.). Shoreline WMD collects and conveys wastewater via gravity sewers to the Boeing Creek Trunk at N.W. 175th Street and 6th Avenue N.W. (MH B00-49). The Boeing Creek Trunk is aligned for approximately one half mile along N.W. 175th Street and 10th Avenue N.W. to the Hidden Lake Pump Station. Table 1 inventories Shoreline WMD pipe diameters for Basin 14.

Table 1. Shoreline WMD Basin 14 sewer system characteristics [a]

Sewer Diameter (in)	Sewer Length (ft)
8	140,450
10	8,745
12	4,960
15	13,035
18	1,715
24	850

a. Source: Infiltration/Inflow Analysis for Hidden Lake Pump Station Standby Generator (Metro, 1974).

At the connection point, three Shoreline WMD sewers (8, 12, 24-inch diameters) discharge to the upstream end of the Boeing Creek Trunk (at manhole B00-49). This was the site of a washout during the January 1, 1997 storm. While repairing the damage caused by this storm, approximately 185 feet of the Boeing Creek Trunk was replaced with 24-inch diameter concrete pipe in an attempt to reduce the potential for backups into MH B00-49. The remainder of the Boeing Creek Trunk above the Hidden Lake Pump Station is 15 or 16-inch diameter.

The only lift station in Basin 14 is a pneumatic ejector (Shoreline P.S. No. 6, see Table 2) located on the south side of 10th Avenue N.W. This lift station serves a small number of houses on the slope between 10th Avenue N.W. and Boeing Creek. Shoreline WMD maintenance practices include complete sewer system cleaning every two years.

Table 2. Shoreline WMD Pump Stations in the upstream conveyance system.

Pump Station	Address	Type	Capacity
P.S. No. 4	16777 16th Avenue N.W.	Wetwell/Drywell	180 gpm @ 93 ft TDH
P.S. No. 5	1057 N.W. 166th Street	Wetwell/Drywell	600 gpm @ 97 ft TDH
P.S. No. 6	17069 10th Avenue N.W.	Pneumatic Ejector	30 gpm @ 34 ft TDH

Shoreline WMD Pump Station No. 4 and Basin 7

Shoreline WMD Basin 7 is a small catchment with a drainage area of 39 acres located in a residential area to the north of the Highlands near Puget Sound. Sewage is collected at Shoreline Pump Station No. 4 (see Table 2) and pumped approximately one third of a mile to the Hidden Lake Pump Station.

Basin 7 is also the site of a marine outfall for the Hidden Lake Pump Station overflows. King County WTD flow monitoring equipment is located at Shoreline WMD MH 139-A (upstream of P.S. No. 4) for estimating overflow volumes. This monitor may be moved to MH 139-C because of upstream diversions at MH 139-A. The details of the overflow line and the Shoreline Pump Station No. 4 discharge are discussed in a subsequent section on the Hidden Lake Pump Station.

Shoreline Pump Station No. 5, The Highlands SD and Shoreline WMD Basin 13

The Highlands is a private community located in the city of Shoreline. The Highlands SD provides sewerage for 103 homes in the community with a total drainage area of approximately 400 acres. The district owns, operates and maintains approximately five miles of separated gravity sewers and force mains ranging in size from 8 to 15 inches in diameter. There are also three small lift stations that assist in transferring flow to the Shoreline WMD Pump Station No. 5 (see Table 2). Firm pump capacities were not readily available, but according to Highlands SD staff, the largest of their pump stations, Lift Station No. 3, has a 3,000 gallon wetwell and after starting up, the pump runs for three to four minutes, before lowering the water level in the wetwell sufficiently to shut off.

The original Highlands sewer system predates the 1958 Metropolitan Seattle Sewerage and Drainage Survey. It was a combined system that discharged directly to Puget Sound. The current separated system was built in the early 1970's, at which time the original sewer system was converted to stormwater conveyance. By ordinance, the Highlands SD has required the removal of roof drain downspouts from the sanitary sewer lines upon any construction, remodeling or landscaping activities. Approximately 40 houses have had downspouts removed in the past six years, leaving only three homes with directly connected downspouts.

Standard Highlands SD maintenance practices involve routine cleaning. Lateral sewers may be cleaned up to four times per year at residents' request. The trunk sewers were CCTV inspected two years ago by Shoreline WMD staff. According to Highlands SD staff, the trunk sewers are in very good condition and contain no cracks.

The Shoreline WMD assesses a usage charge for the wastewater transferred to Pump Station No. 5 from the Highlands SD sewers. Usage charges have been based on pump operating times rather than direct flow measurements. Shoreline WMD also limits the total flow entering Pump Station No. 5 from the Highlands with a weir located upstream of the wetwell inlet. Unfortunately, nobody was able to provide details about the weir or what happens to the wastewater overtopping the weir.

The Highlands SD has been identified as a significant potential source of infiltration and inflow (I/I), primarily due to the long driveways and older lateral sewers within the District. As such, the Shoreline WMD is installing a flow monitor upstream of Pump Station No. 5 to measure wastewater flows from the Highlands SD.

Shoreline WMD Basin 13 is a residential neighborhood of approximately 50 acres located to the southwest of Shoreline Community College and Shorewood Park. Sanitary sewage flows in gravity sewers to Shoreline Pump Station No. 5. These flows are a small portion of total flows at the inlet to Pump Station No. 5.

Hidden Lake Pump Station

The Hidden Lake Pump Station has three raw sewage pumps with a reported combined capacity of 4.2 mgd . Table 3 presents an overview of the pump station equipment characteristics. There are 2 separate influent lines: a 15-inch diameter gravity-fed portion of the Boeing Creek Trunk and a combination 24/10-inch diameter line that carries wastewater from Shoreline WMD Pump Stations No. 4 and No. 5 (Figure 1). When overflows occur, the direction of flow reverses in the 24/10-inch diameter pipe and wastewater travels to Shoreline WMD Manhole 221. In this manhole, there is a weir that admits overflows to an 18-inch diameter line that leads to Shoreline Pump Station No. 4. If overflow conditions do not persist, the overflows may be pumped back to the Hidden Lake Pump Station by Shoreline Pump Station No. 4. Approximately 20 percent of the overflows are controlled in this manner . The remainder is discharged directly to Puget Sound through a 365-foot long section of pipe to a marine outfall. According to Shoreline WMD staff, the capacity of Shoreline Pump Station No. 4 is sufficient for the number of residences in its drainage. Discharges to Puget Sound only occur when the Hidden Lake Pump Station sends overflows to Shoreline Pump Station No. 4.

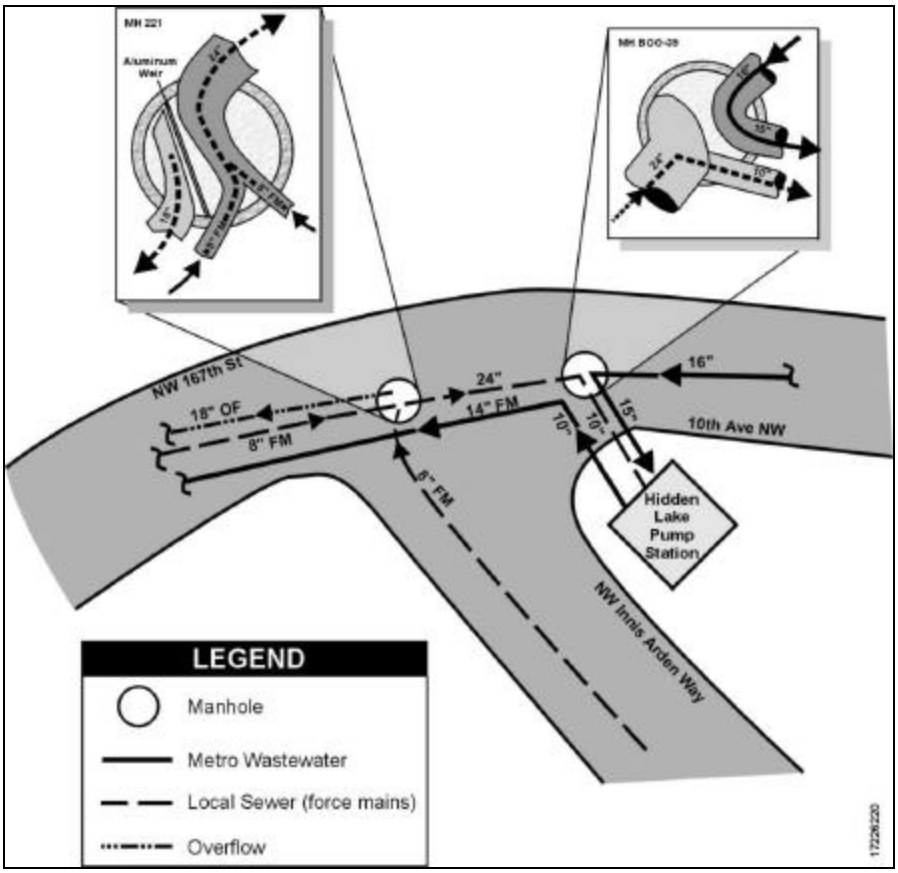

Figure 1. Hidden Lake Pump Station influent and overflow systems

Table 3. Hidden Lake Pump Station characteristics

Date Completed	July 1962
Number of Pumps	3
Pump No. 1 (motor adjustable clutch driven):	Worthington 8FLV16, capacity: 2,100 gpm at 90 ft TDH and 1,145 rpm. Motor: Electricity Machinery C445UP, rating: 75 hp at 1,180 rpm, 3-phase, 440 V, 88.5 A
Pump No. 2 (motor adjustable clutch driven):	same as Pump No. 1
Pump No. 3 (variable frequency drive):	Gorman Rupp T8A3.B Motor: U.S. Motor 354U type H, rating: 40 hp at 1,800 rpm, 3-phase, 440 V, 50 A
Standby Generator	Cummins NT-855-GS, turbocharged, four-cycle, six-cylinder diesel; rating: 355 hp continuous at 1,800 rpm
Wetwell detention time	5 to 10 minutes (ADWF)

PART II. DOWNSTREAM CONVEYANCE SYSTEM

Sources of wastewater in the downstream conveyance system include (1) discharge from the Hidden Lake Pump Station, (2) Shoreline WMD sewers and (3) flows transferred by outside the Shoreline WMD. The drainage area of the downstream conveyance system is approximately 1100 acres (1.7 sq. mi.). The area is approximately 100 percent sewered with a population of approximately 12,000 (customer equivalents).

Hidden Lake Pump Station Discharge and the Boeing Creek Trunk

The Hidden Lake Pump Station discharges to the Boeing Creek Trunk, which then connects to the Richmond Beach Pump Station. Table 4 summarizes flow information for the Richmond Beach Pump Station. The downstream piping is a primarily a combination of force main and gravity sewers, ranging in diameter from 14 to 24 inches. There is also a double-barreled siphon with diameters of 8 and 16-inches with its forebay located at MH B00-29. A King County WTD "no pu" structure is located in the siphon forebay, because of odor problems at this site. Figure 2 shows the locations of the Boeing Creek Trunk and manhole numbers. Table 5 shows pipe lengths and diameters. Downstream of MH B00-38, there are numerous connection points from Shoreline WMD sewers that allow additional wastewater to enter the Boeing Creek Trunk.

Due to extensive corrosion, sections of the Boeing Creek Trunk were sliplined during 1991. The installation of sliplining reduced the hydraulic capacity resulting in an increase in the frequency of storm related impacts. The locations of rehabilitated pipes are also shown in Figure 2. In response to continuing corrosion in previously untreated pipes, rehabilitation is currently planned for additional downstream sections of the Boeing Creek Trunk. In order to minimize the effects of this next rehabilitation on pipe hydraulics, King County WTD may use an in situ impregnated resin technology in lieu of sliplining.

Table 4. Richmond Beach Pump Station flows (mgd)

Flows	1992	2030
Average Annual:	2.1	2.7
Winter Month Average:	3.0	3.8
Winter Month Peak Hour:	7.1	9.2
Summer Month Peak Hour:	2.6	3.4
Summer Minimum Hour:	0.1	0.2

Table 5. Boeing Creek Trunk pipe lengths and diameters

Upstream MH	Length (ft)	Diameter (in)	Upstream MH	Length (ft)	Diameter (in)
B00-49	305	24/15	B00-25	344	18
B00-48	341	15	B00-24	319	15
B00-47	258	15	B00-23	15	18
B00-46	300	15	B00-22A	382	18
B00-45	147	15	B00-22	334	18
B00-44A	145	15	B00-21	407	18
B00-44	246	15	B00-20	132	18
B00-43	286	15	B00-19	59	18
B00-42	123	15	B00-18A	175	18
B00-41	235	15	B00-18	312	24
B00-40	357	16	B00-17A	44	24
B00-39	40 (est.)	16	B00-17	297	18
HL PS	2375	14	B00-16	282	15
B00-38	271	15	B00-15	337	18
B00-37	125	15	B00-14	348	18
B00-36A	48	18	B00-13	333	15
B00-36	334	18	B00-12	252	15
B00-35	439	18	B00-11	427	18
B00-34	126	18	B00-10	288	15
B00-33	141	18	B00-9	206	21
B00-32A	112	18	B00-8	60	15
B00-32	274	18	B00-7	160	15
B00-31	327	18	B00-6	280	15
B00-30	279	15	B00-5	399	15
B00-29	1820	8,16	B00-4	337	21
B00-28	233	18	B00-3	316	24
B00-27	265	18	B00-2	214	24
B00-26	333	15	B00-1		

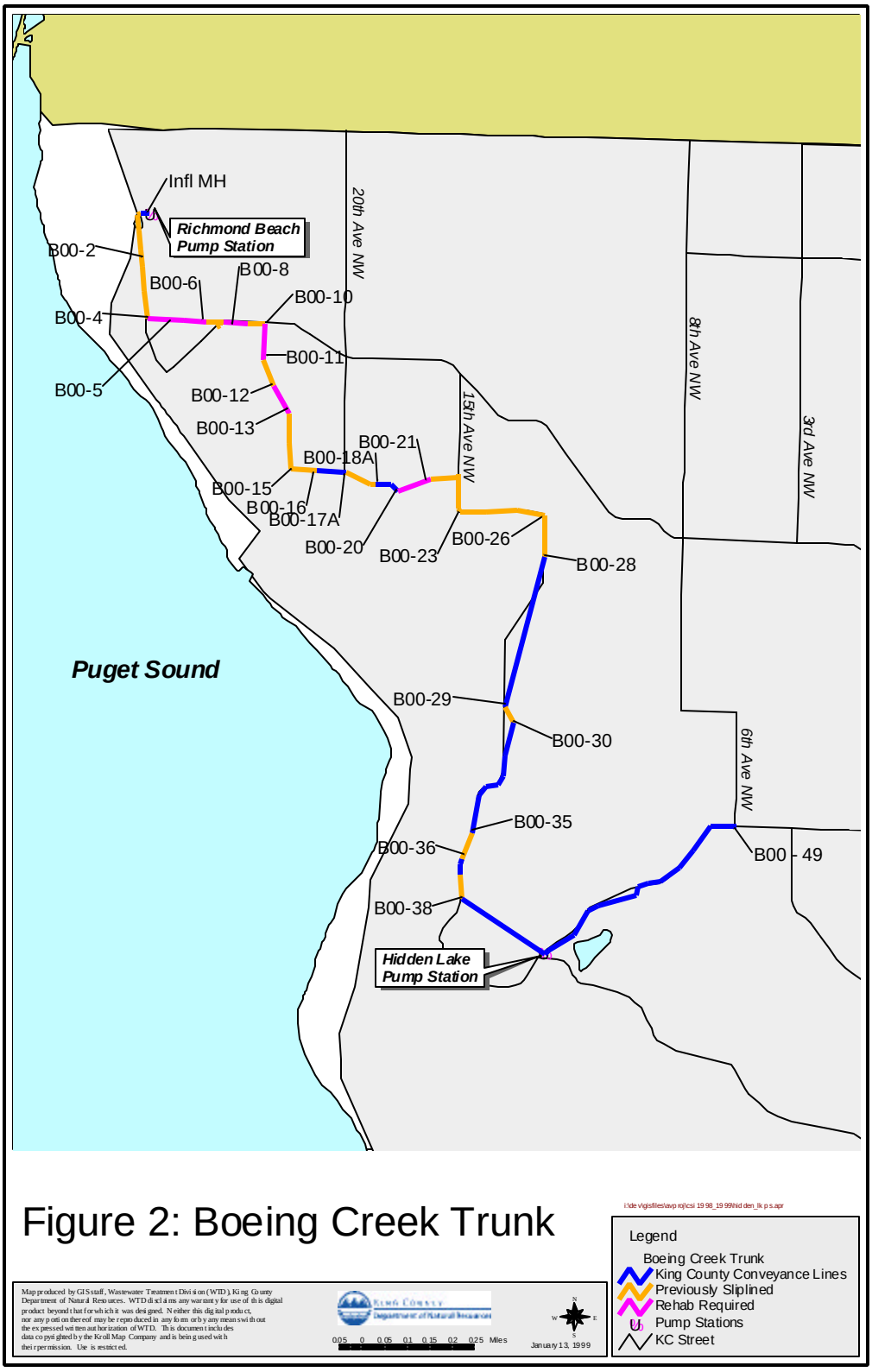

Figure 2: Boeing Creek Trunk

Downstream Conveyance System Shoreline WMD Facilities

There are several Shoreline WMD sewer basins downstream of the Hidden Lake Pump Station that connect to the Boeing Creek Trunk. Shoreline WMD owns, operates and maintains a system of pump stations to assist in transferring flow to the Boeing Creek Trunk (Table 6). The section of the Boeing Creek Trunk is frequently storm impacted. As a result, there have been backups into the Shoreline WMD system. A flap gate was installed at Shoreline WMD MH C5-1A near 15 Avenue N.W. and N.W. 188th Street to prevent backups into a Shoreline WMD customer's home. The flap gate was provided and installed by King County WTD and is maintained by the Shoreline WMD. An I/I analysis was performed for Shoreline WMD Basins 1 and 2, located near the Richmond Beach Pump Station with flow data collected during the 1995 wet season.

Table 6. Shoreline WMD Pump Stations in the downstream conveyance system

Pump Station	Address	Type	Capacity
P.S. No. 1	18316 17th Place N.W.	Wetwell/Drywell	200 gpm @ 120 ft TDH
P.S. No. 2	1628 N.W. 185th Street	Wetwell/Drywell	250 gpm @ 50 ft TDH
P.S. No. 3	17211 15th Avenue N.W.	Pneumatic Ejector	40 gpm @ 35 ft TDH
P.S. No. 11	19101 17th Avenue N.W.	Pneumatic Ejector	50 gpm @ 62 ft TDH
P.S. No. 12	19501 Richmond Beach Drive N.W.	Wetwell/Drywell	400 gpm @ 37 ft TDH
P.S. No. 13	20454 Richmond Beach Drive N.W.	Wetwell/Drywell	450 gpm @ 50 ft TDH

Wastewater from Outside the Shoreline WMD

There are two wastewater sources from outside of the Shoreline WMD that discharge to the Boeing Creek Trunk and Richmond Beach Pump Station: the Chevron Plant at Point Wells and the town of Woodway.

Shoreline Pump Station No. 13 currently only collects wastewater from the Chevron Plant, transfers the flow along Richmond Beach Drive, and discharges to MH B00-4, just upstream of the Richmond Beach Pump Station. Shoreline WMD Pump Station No. 13 is only a few years old, and is presently oversized because of uncertainty in the development plans for its drainage area.

Approximately 156 homes located in south Woodway are serviced by the Shoreline WMD. This neighborhood is topographically separated from the rest of Woodway and would require a pump station if wastewater were not accepted by the Shoreline WMD.

CONTACT LIST:

Information for this section was obtained from the following persons:

Shoreline WMD

General Manager:	Phil Montgomery	(206) 546-2494
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Highlands SD

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Maintenance Manager:	Steve Hammond	(206) 362-2100

King County WTD

Facilities Inspection Coordinator	Ed Cox	(206) 684-1292