CHAPTER 8

SYSTEM EVALUATION

INTRODUCTION

The information presented in this chapter outlines the District's strategy for providing future sewer service to the residents of the District. The hydraulic model developed in Chapter 6 is used to evaluate the existing system and determine which pipes will need to be upgraded in the future. Providing service to currently unsewered areas is also discussed. Additional improvements that will improve efficiency and reliability are also addressed. Finally, King County plans are discussed. The recommendations presented in this chapter are the basis of the capital improvement plan presented in Chapter 9.

COLLECTION SYSTEM EVALUATION

As part of the hydraulic analysis, MOUSE calculates peak flow, average flow, peak velocity, and depth of flow for each pipe in the system. Four separate analyses have been performed, i.e., 2005 (Existing), 2012 (Interim), 2026 (Interim), and Buildout scenarios. The hydraulic model of the existing system is used to identify the portions of the system that may be currently at or approaching capacity. The interim models are used to determine the timing of the improvements required for the 6- and 20-year planning intervals. Finally, the buildout model is used to identify the improvements required to serve the sewer area at buildout. The buildout model is also used to determine the required capacity of all recommended improvements, regardless of when construction will take place. This will ensure adequate capacity for as long as the system is maintained in a structurally sound condition. The results are included in Appendix L and used in Chapter 8 to develop a capital improvement plan (CIP).

EXISTING SYSTEM EVALUATION

Gravity Main Deficiencies

Gravity pipe that is deficient under existing system conditions is identified based on results from the hydraulic model. Undersized pipes can be upgraded by either replacing the existing pipe with a larger size or by adding a parallel pipe. The pipes identified as being undersized under existing system conditions are included in Table 8-1. In general, pipes in the model flowing with water levels greater than two pipe diameters in height under peak wet weather flow conditions are considered to be undersized. For example, an 8-inch diameter sewer main would have to surcharge 8 inches above the crown of the pipe before being considered for a project. Pipes are allowed to surcharge before being considered a project because the conditions modeled are extremely conservative.

The model was evaluated at peak conditions; the diurnal peak factor and the peak I/I rate have been applied simultaneously. Furthermore, it is assumed a storm event hit the entire District at the same time; whereas, some attenuation is likely to occur as a storm moves across the District. Figure 5-3 displays the relative I/I rates established by the 2001/2002 KCDNR Flow Monitoring.

INTERIM MODEL

The model has been used to estimate flows in the years 2012 and 2026, in order to plan for the construction of future facilities. The results of these model runs have been used to determine when undersized pipes reach capacity. First, the system has been evaluated using the I/I rates established by the 2001/2002 KCDNR Flow Monitoring Study. Second, the I/I rate has been decreased to 1,100 gpad. Despite the fact that most of the basins in King County have a peak I/I rate well over 1,100 gpad; a peak I/I rate of 1,100 gpad serves as a KCDNR recommended guideline. The pipes identified as being undersized for the years 2012 and 2026 are included in Table 8-1. The I/I rate has been decreased to determine whether the size limitations are due to growth or due to excessive I/I. Figure 8-1 highlights deficiencies listed in Table 8-1; Figure 8-2 highlights deficiencies due to growth, if I/I is decreased.

BUILDOUT MODEL

The build-out model has been used to estimate the capacity required at buildout. The buildout scenario was evaluated with the I/I rates established by the 2001/2002 KCDNR Flow Monitoring Study and with a decreased I/I rate of 1,100 gpad. The upgrades for the 6- and 20-year planning interval are based on the results of the buildout model. The pipes identified as being undersized for the builtout condition are included in Table 8-1.

Most deficiencies (Projects No. 1, 2, 5, 6, 7, 8, 10, 12, and 13) are directly related to high I/I values established by KCDNR for basins in this area. These areas are candidates for I/I investigation rather than replacing the mains with greater capacity.

Only Project Nos. 3, 4, 9, and 11 appear to be undersized due to growth. Project Nos. 3 and 4 are deficient under the current system and Project Nos. 9 and 11 are deficient at buildout.

SNOHOMISH COUNTY

KING COUNTY

LIFT STATION #4

KENMORE P.S.

LIFT STATION #17

LIFT STATION #18

LIFT STATION #19

LIFT STATION #2

LIFT STATION #3

LIFT STATION #1

LIFT STATION #14

LIFT STATION #15

LIFT STATION #20

LIFT STATION #10

JUANITA BAY P.S.

1 2 3 4 5 6 7 8 9 10 11 12 13

N

0 1,600 3,200 6,400 Feet

LEGEND:

- CORPORATE BOUNDARY
- SEWER SERVICE STUDY AREA BOUNDARY
- PRIVATE FORCE MAIN

SEWER MAINS:

MODEL RESULTS

- <2.00 PIPE DIAMETERS - SURCHARGED (NOT A DEFICIENCY)
- >2.00 PIPE DIAMETERS - SURCHARGED (DEFICIENCY)
- LIFT STATIONS
- KCDNR LIFT STATIONS

DEFICIENT SEWER MAINS (>2.00 PIPE DIAMETERS SURCHARGED):

- 2005
- 2012
- BUILDOUT
- COUNTY LINE

3 DEFICIENCY PROJECT NUMBER

SOURCE: NORTHSHORE UTILITY DISTRICT

NORTHSHORE UTILITY DISTRICT WATER SEWER

WASTEWATER SYSTEM PLAN

FIGURE 8-1
MODEL RESULTS

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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SNOHOMISH COUNTY

KING COUNTY

LIFT STATION #4

KENMORE P.S.

LIFT STATION #17

LIFT STATION #18

LIFT STATION #19

LIFT STATION #2

LIFT STATION #3

LIFT STATION #1

LIFT STATION #14

LIFT STATION #15

LIFT STATION #20

LIFT STATION #10

JUANITA BAY P.S.

N

0 1,600 3,200 6,400 Feet

LEGEND:

- CORPORATE BOUNDARY
- SEWER SERVICE STUDY AREA BOUNDARY
- PRIVATE FORCE MAIN

SEWER MAINS:

MODEL RESULTS

- <2.00 PIPE DIAMETERS
- >2.00 PIPE DIAMETERS
- LIFT STATIONS
- KCDNR LIFT STATIONS

DEFICIENT SEWER MAINS (>2.00 PIPE DIAMETERS SURCHARGED):

- 2005
- 2012
- BUILDOUT
- COUNTY LINE

(3) DEFICIENCY PROJECT NUMBER

SOURCE: NORTHSHORE UTILITY DISTRICT

NORTHSHORE UTILITY DISTRICT WATER SEWER

WASTEWATER SYSTEM PLAN

FIGURE 8-2
MODEL RESULTS WITH DECREASED I/I

Gray & Osborne, Inc.
CONSULTING ENGINEERS

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TABLE 8-1

Summary of Undersized Pipes

Project No.	From Model MH No.	To Model MH No.	Length (lf)	Pipe Diameter (Inches)	Model Year	Year Installed	Material[1]	Problem after I/I Decreased? [2]
1	6185	5182	3,500	8, 10, 12	2005	1967	AC	Yes
1	5181	5177	935	12, 15	2005	1967	CP	Yes
1	5093	5115	250	12	2005	1969	CP	Yes
1	5137	5115	85	8	2005	1979	PVC	Yes
1	6132	6174	690	8	2005	NA	NA	Yes
1	5164	5178	420	12	2005	1967	CP	Yes
2	5921	5918	710	8	2005	1969	CP	Yes
2	5064	5925	1,000	8	2005	1969	CP	Yes
3	5403, 5385	5387	990	8	2005	1968	AC	No
4	6594	6584	2,490	27	2005	1968	CP	No
5	6380	1648	766	10	2005	1968	CP	Yes
6	3	5	360	10	2005	1968	CP	Yes
6	506	4	210	8	2005	1968	CP	Yes
6	517	518	210	8	2005	1968	CP	Yes
7	4735	5598	1636	15, 18	2012	1975	CP (&DI)	No
8	6366	548	7,500 [3]	10, 12, 15	2012	1968 & 1970	CP	No
8	6535	6573	900	12	2012	1968	CP	No
9	4731	5606	6,035[4]	12, 15, 18	buildout	1975	CP	Yes [5]
10	1734	3220	1,905	8	buildout	1968	CP	No
10	3028	3035	607	8	buildout	1968	CP	No
11	3207	3836	2,870	8	buildout	1975	CP	Yes [5]
12	3240	3231	717	8, 15	buildout	1967	CP	No
13	5132	6583	10,526 [6]	18, 21, 24, 30	buildout	1967	CP	No [7]

(1) AC = Asbestos Concrete, CP = Concrete Pipe, DI = Ductile Iron, and NA = Unknown
(2) The I/I rate was decreased to 1,100 gpad to determine if the deficiencies were the result of growth or the result of excessive I/I.
(3) Includes pipeline from Project Nos. 5 and 6.
(4) Includes pipeline from Project No. 7.
(5) Only portions of the pipeline are deficient once the I/I rate is decreased.
(6) Includes pipeline from Project No. 4.
(7) No, except the pipeline from Project No. 4.

LIFT STATION RESULTS

Table 8-2 illustrates the capacity of each lift station and the maximum flow into each lift station under each of the modeled scenarios. Based on the results of the hydraulic model, none of the lift stations modeled exceeded capacity, but Lift Station No. 14 will be over 95 percent of its rated capacity by the year 2012. The District is currently upgrading this station.

TABLE 8-2

Lift Station Results

Lift Station	Capacity (gpm)	2005 Peak Flow (gpm)	2012 Peak Flow (gpm)	2026 Peak Flow (gpm)	Buildout Peak Flow (gpm)
No. 1	180	27	27	27	27
No. 2	270	107	107	107	107
No. 3	100	10	10	10	10
No. 4	150	30	30	30	30
No. 10	800	491	403	404	777
No. 14	400	295	381	385	241
No. 15	500	82	64	64	467
No. 16	40	NA(1)	NA(1)	NA(1)	NA(1)
No. 17	40	3	3	3	3
No. 18	80	34	34	34	1

(1) N/A – Not modeled.

2006 SEWER REHABILITATION PROGRAM

The District television inspects segments of the District's sewer as part of the ongoing maintenance program. The District has identified 1,465 lineal feet of 8-inch concrete sewer and 240 lineal feet of 8-inch asbestos concrete sewer that is scheduled for CIPP (cured in place pipeline) sewer rehabilitation in 2006. Draft quarter section maps of the pipe segments scheduled for rehabilitation are included in Appendix M.

MANHOLE REHABILITATION PROGRAM

The District continuously investigates manholes, which includes vacuum testing, as part of the continuous effort to reduce I/I. A manhole investigation has been completed, surveying manholes in basins with high peak I/I rates. In 2003/2004 the District identified approximately 39 manholes that are in need of repair. In 2006, the District identified an additional 70 manholes in need of repair due to leakage. The manholes are scheduled for repair in the CIP. The District has also changed the standard specifications to require fiberglass base liners and that all manholes be certified by the manufacturer.

Plans and partial specifications for the Sewer Manhole Rehabilitation Project (Small Works Roster Project) developed in 2003/2004 are included in Appendix N.

TABLE 8-3

Summary of ULID-5 Repairs Identified in the Television Inspection

Pipe ID No.	Map Grid	Pipe Diameter (Inches)	Upstream MH	Downstream MH	Problem	Details
5124	H-9	15	5017	5019	Lateral Problem	Break in Connection
5144	H-9	24	5041	5042	Manhole Problem	Roots
6101	J-9	24	5907	5908	Joint Problem	Infiltration
6049	J-8	27	5893	5894	Manhole Problem	Infiltration
6054	J-8	27	5872	5896	Joint Problem	Infiltration
6055	J-8	27	5896	5897	Joint Problem	Infiltration
40	K-8	27	6594	6593	Pipe Problem	Infiltration
39	K-8	27	6593	6592	Lateral Problem	Infiltration
38	K-8	27	6592	6591	Lateral Problem	Infiltration
34	K-8	27	6588	6586	Lateral Problem	Infiltration
33	K-8	27	6586	6585	Manhole Problem	Infiltration
28	K-8	27	6581	6580	Joint Problem	Infiltration
64	K-8	27	6579	7037	Joint Problem	Infiltration
65	K-8	27	6579	7037	Joint Problem	Infiltration

SERVICE TO UNSEWERED AREAS

The District has completed a Sewer System Buildout Catalog summarizing developed areas within the District that currently do not have sewer service; the District has identified approximately 600 lots (568) within the District without sewer service. Sewer facilities required to serve developed areas are shown on the map at the back of this Plan. The future pipes indicated are located in existing rights-of-way and easements; pipes required within future development or subdivisions are not included as part of this Plan. Table 8-3 presents a prioritized list of the proposed sewer extensions within the District. Each Project No. is referenced on the map.

TABLE 8-4

Unsewered Areas

Project No.	Project Name	Year	Length	#/Lots	Environmental Issues				
					Erosion	Landslide	Stream	Wetland	Seismic
E-06	118/72 Sewer	2007	2,475	22		Y			
E-07	68/HPD Sewer	2007	845	5					
E-31	186/80 Sewer	2007	185	2					
E-47	Tolt/91 Sewer	2007	570	3					
E-01	134/108 Sewer	2008	2,510	35					
E-48	165/77 Sewer	2008	315	3	Y		Y		
E-51	147/Simonds Sewer	2008	210	6		Y	Y		
E-52	144/123 Sewer	2008	940	6					
E-11	120/89 Sewer	2009	2,375	21	Y				
E-29	175/89 Sewer	2009	245	3					
E-30	178/86 Sewer	2009	615	3					
E-44	204/80 Sewer	2009	685	7					
E-02	117/82 Sewer	2010	1,420	18					
E-05	159/82 Sewer	2010	595	4					
E-22	133/88 Sewer	2010	1,245	15					
E-50	156/74 Sewer	2010	410	4					
E-14	132/68 Sewer	2011	310	5					
E-15	110/85 Sewer	2011	1,355	14	Y	Y			
E-21	163/74 Sewer	2011	2,640	24	Y	Y			
E-60	124/68 Sewer	2012	1,904	18	Y	Y	Y		
E-61	152/105 Sewer	2012	2,455	19		Y			
E-04	121/72 Sewer	2013	245	4	Y	Y			

TABLE 8-4 – (continued)

Unsewered Areas

Project No.	Project Name	Year	Length	#/Lots	Environmental Issues				
					Erosion	Landslide	Stream	Wetland	Seismic
E-09	126/72 Sewer	2013	1,515	20	Y	Y			
E-62	155/79 Sewer	2014	815	16	Y				
E-63	156/78 Sewer	2014	1,100	17	Y	Y			
E-08	125/HPD Sewer	2015	1,510	11		Y			
E-16	138/62 Sewer	2015	735	8	Y	Y			
E-26	163/90 Sewer	2015	1,030	11	Y	Y	Y		
E-32	200/73 Sewer	2015	1,095	5					
E-10	120/91 Sewer	2016	1,325	15	Y	Y			
E-35	203/80 Sewer	2016	1,500	12			Y		
E-37	112/77 Sewer	2016	1,035	8					
E-41	189/68 Sewer	2016	450	5	Y				
E-33	190/40 Sewer	2017	4,415	44		Y	Y		
E-25	163/76 Sewer	2018	1,740	4	Y	Y	Y		
E-28	176/86 Sewer	2018	245	1					
E-34	192/39 Sewer	2018	815	7					
E-42	182/68 Sewer	2018	220	1					
E-54	157/124 Sewer	2018	150	1					
E-59	145/88 Sewer	2018	200	1	Y	Y			
E-36	160/Tolt Sewer	2018	1,650	6					
E-20	167/72 Sewer	2019	340	3			Y		
E-38	116/89 Sewer	2019	3,620	19	Y				

TABLE 8-4 – (continued)

Unsewered Areas

Project No.	Project Name	Year	Length	#/Lots	Environmental Issues				
					Erosion	Landslide	Stream	Wetland	Seismic
E-46	Tolt/82 Sewer	2019	390	2	Y				
E-53	160/124 Sewer	2019	530	4					
E-57	131/94 Sewer	2019	270	2	Y	Y	Y		
E-03	124/84 Sewer	2020	450	3					
E-17	135/HPD Sewer	2020	2,430	12	Y	Y			
E-19	170/75 Sewer	2020	600	6			Y		Y
E-43	190/74 Sewer	2020	210	1			Y		
E-56	131/96 Sewer	2020	375	2	Y	Y	Y		
E-12	131/HPD Sewer	2021	1,375	9	Y	Y			
E-18	169/84 Sewer	2021	240	7		Y			
E-24	144/77 Sewer	2021	490	4				Y	
E-27	173/91 Sewer	2021	605	3	Y				
E-40	200/61 Sewer	2021	150	1					
E-45	195/80 Sewer	2021	2,350	8	Y		Y		
E-13	130/68 Sewer	2022	570	8		Y			
E-23	150/81 Sewer	2022	600	2					
E-39	129/70 Sewer	2022	1,200	11	Y	Y			
E-49	160/76 Sewer	2022	660	3	Y	Y			
E-55	137/90 Sewer	2022	205	2			Y		
E-58	122/93 Sewer	2022	1,520	22	Y	Y			
Total			**65,274**	**568**					

LIFT STATION REHABILITATION

LIFT STATION NO. 14

Lift Station No. 14 is in the process of undergoing an upgrade and is currently in the design phase. Construction is scheduled for 2007.

LIFT STATION NO. 19

The District is in the process of rehabilitating Lift Station No. 19 to improve the performance of the lift station due to pump clogging. The District plans to replace the existing pumps with two new chopper pumps. The chopper pumps are anticipated to require less maintenance than the existing pumps. The telemetry and control system will also be upgraded. The significant changes to the control logic planned are: to prevent the pumps from pumping until they cavitate in the event that both pumps are called upon, and to ensure that the lift station pumps will be controlled by PLC at the District office with redundant backup relays at the lift station. An on-site generator is also being planned for the lift station. Although the lift station is currently undergoing rehabilitation, a gravity alignment has been identified that may allow for the future elimination of this lift station.

EMERGENCY PREPAREDNESS

It is the responsibility of the District to prepare for emergency as well as day-to-day operations. Although power outages are the most likely emergency situation, other natural occurrences such as mud slides, earthquakes, fire, and flooding may affect district operations and are included in the Comprehensive Emergency Response Plan. The Comprehensive Emergency Response Plan is summarized in Appendix O.

EMERGENCY GENERATORS

Two of the District's lift stations have permanent auxiliary generators (Lift Station Nos. 10 and 20), which means that nine of the District's eleven lift stations rely on portable, truck-mounted generators for emergency power during power outages. Some of these have less than an hour of storage before overflows occur. In addition, there are a few lift stations that receive power from a nearby lift station. For these reasons, the District plans to install permanent auxiliary generators on the larger stations with limited storage and stations that supply power to multiple stations, such as Lift Station Nos. 14 and 19.

BYPASS PUMPING

There are several areas within the District that are susceptible to slides and seismic activity. The high flows and environmentally sensitive nature of these areas are such that

the District intends to maintain the ability to pump flows around a line break, should one occur. This will require the purchase of a large trailer-mounted portable pump.

FUTURE KING COUNTY FACILITIES

Future King County facilities may either directly or indirectly affect District operations and should be considered in planning efforts. Two projects currently being proposed are discussed below.

ULID-5 TRUNK MODIFICATIONS

The ULID-5 sewer trunk, consists of approximately 15,400 linear feet of concrete sewer pipe ranging in diameter from 12 to 27 inches. The trunk serves a portion of the Juanita Creek drainage basin, running south from near the intersection of 100th Avenue NE and Simonds Road NE to the Lake live interceptor of KCDNR Manhole No. R15-4, near Juanita Bay.

The trunk including approximately 79 manholes was video inspected and cleaned in 2005. The majority of the pipe and manholes were found to be in good condition and the pipe was found to be "relatively" clean due to the volume and velocity of fluid flow in the pipe. The severe defects detected in the television inspection are summarized in Table 8-5.

KCDNR has agreed in principal to purchase a portion of the ULID-5 trunk from the District. The details of the purchase are currently being discussed. The District has informally agreed to design, bid, administer, and construct the necessary improvements to the trunk line in accordance with KCDNR standards prior to KCDNR acquisition. KCDNR has informally agreed to reimburse the District for the work that the District does to complete repairs on the trunk line at the time that the purchase is finalized.

Approximately 15,400 linear feet of ULID-5 sewer trunk, installed in 1968, ranging from 12 to 27 inches in diameter, and approximately 79 manholes were inspected. The majority of the pipe is in good condition and is relatively "clean" due to the volume and velocity of fluid flow in the pipe. The severe defects detected in the television inspection are summarized in Table 8-5.

TABLE 8-5

Summary of ULID-5 Repairs Identified in the Television Inspection

Pipe ID No.	Map Grid	Pipe Diameter (Inches)	Upstream MH	Downstream MH	Problem	Details
5124	H-9	15	5017	5019	Lateral Problem	Break in Connection
5144	H-9	24	5041	5042	Manhole Problem	Roots
6101	J-9	24	5907	5908	Joint Problem	Infiltration
6049	J-8	27	5893	5894	Manhole Problem	Infiltration
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6055	J-8	27	5896	5897	Joint Problem	Infiltration
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34	K-8	27	6588	6586	Lateral Problem	Infiltration
33	K-8	27	6586	6585	Manhole Problem	Infiltration
28	K-8	27	6581	6580	Joint Problem	Infiltration
64	K-8	27	6579	7037	Joint Problem	Infiltration
65	K-8	27	6579	7037	Joint Problem	Infiltration

The District identified one severe defect in need of immediate repair in the 12- to 21-inch-diameter mains. Eleven severe defects in the 24- and 27-inch-diameter mains were detected and are in need of immediate repair; all defects involve infiltration problems. All manholes exhibit some evidence of infiltration. The ULID-5 inspection summary is included in Appendix H.

CONSTRUCTION OF THE BRIGHTWATER WASTEWATER TREATMENT PLANT

KCDNR is in the process of constructing a new treatment plant located in south Snohomish County, Brightwater WWTP. The new facility will not treat wastewater flows from the District at this time; however, after 2040 flows served by the Kenmore Pump Station will be rerouted to be treated at the Brightwater WWTP. The influent and effluent tunnel will be located within the District boundary. The tunnel route is displayed on Figure 5-1. It is not anticipated that significant modifications to District wastewater facilities would be required.