SECTION 8
ALTERNATIVE ANALYSIS: SANITARY SEWER

8.01 GENERAL

A. Alternatives Analysis Overview

This section discusses alternatives analyzed to address existing surcharging and sanitary sewer capacity issues in the Forest Park area. Each alternative presented includes a description of the alternative and the planning-level Opinion of Probable Construction Cost (OPCC). OPCCs presented were estimated using historical bid costs, where available, and supplemented by other reference sources. All OPCCs include allowances for engineering and project contingencies. The goal of this report is to provide City personnel with the information required to initiate the budgeting and planning phase for facilities improvements. All costs are presented in 2nd quarter 2010 dollars. Future construction costs should be adjusted for inflation when final project schedules are determined. OPCC estimates should be updated during the design phase.

In general, three types of conveyance system improvements were considered. These included gravity conveyance alternatives (i.e., new sewers to convey the projected peak flows), wet weather pumping station alternatives, and wet weather storage alternatives. In most instances, the pumping station and storage alternatives also required new gravity sewers to achieve the intended system operational conditions following implementation of the improvement. The gravity conveyance improvements were modeled to eliminate surcharging in the Forest Park Basin, although some minor surcharging was considered acceptable. The pumping station and storage options were modeled to reduce surcharging to levels that were believed to be below basement drain elevations. The pumping station and storage options also required new minimum 15-inch gravity sewers in Pershing Boulevard, as will be discussed below.

B. Conveyance Improvements

The hydraulic model was used to evaluate conveyance improvements for the north and south basin wet weather response to different rainfall intensities (refer to Table 6.01-1).

The results of the north basin modeling are shown on Figures 8.01-1 through 8.01-8. The results of the south basin modeling are shown on Figures 8.01-9 through 8.01-16. Additional modeling information and details at all manholes and pipes modeled are located in Appendix F. Additional detail regarding the OPCC is located in Appendix G.

The gravity conveyance improvements were modeled to eliminate the majority of surcharging in the sewer system. For some recurrence intervals minor surcharging was considered acceptable. For example, for the 5-year recurrence interval in the north basin surcharging of 0.09 feet occurred in MH-354. Refer to Appendix F for additional details. Note that the model predicts that surcharging may occur in the 18-inch interceptor sewers in 60th Street.

Present worth costs along with the potential improvements for the gravity conveyance alternatives for 5-year through 100-year recurrence intervals are tabulated in Table 8.01-1 (it was assumed that no consideration would be given to improvements that did not convey at least the 5-year recurrence interval event). The 50-year recurrence interval approximates the June 19, 2009 storm event and requires replacing 660 LF of 10-inch sanitary sewer in Pershing Boulevard and 1,430 LF of 10-inch sanitary sewer in 61st Street with 15-inch sanitary sewer. Refer to Figure 8.01-7 for additional detail. The 100-year recurrence interval requires the most extensive improvements and has the highest net present worth cost.

Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19,2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300
Feet

PROPOSED NORTH BASIN - SANITARY SEWER CAPACITY EVALUATION
6-MONTH RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 8.01-1
1540.001

S:\MAD\1500--1599\1540\001\Data\GIS Data\Figures\Sewer Analysis\Sewer Analysis 031510\Figure 8.01-1 - 6Month Proposed North 11x17.mxd

Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300 Feet

PROPOSED NORTH BASIN - SANITARY SEWER CAPACITY EVALUATION
1-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

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FIGURE 8.01-2
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Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300
Feet

PROPOSED NORTH BASIN - SANITARY SEWER CAPACITY EVALUATION
2-YEAR RECURRENCE INTERVAL EVENT
FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 8.01-3
1540.001

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PROPOSED NORTH BASIN - SANITARY SEWER CAPACITY EVALUATION
5-YEAR RECURRENCE INTERVAL EVENT
FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300
Feet

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 8.01-4
1540.001

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Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300 Feet

PROPOSED NORTH BASIN - SANITARY SEWER CAPACITY EVALUATION
10-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

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FIGURE 8.01-5
1540.001

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Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300
Feet

PROPOSED NORTH BASIN - SANITARY SEWER CAPACITY EVALUATION
25-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

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FIGURE 8.01-6
1540.001

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Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300
Feet

PROPOSED NORTH BASIN - SANITARY SEWER CAPACITY EVALUATION
50-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

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FIGURE 8.01-7
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PROPOSED NORTH BASIN - SANITARY SEWER CAPACITY EVALUATION
100-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300
Feet

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FIGURE 8.01-8
1540.001

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Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300 Feet

PROPOSED SOUTH BASIN - SANITARY SEWER CAPACITY EVALUATION
6-MONTH RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 8.01-9
1540.001

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Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300 Feet

PROPOSED SOUTH BASIN - SANITARY SEWER CAPACITY EVALUATION
1-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 8.01-10
1540.001

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Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300 Feet

PROPOSED SOUTH BASIN - SANITARY SEWER CAPACITY EVALUATION
2-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 8.01-11
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Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300 Feet

PROPOSED SOUTH BASIN - SANITARY SEWER CAPACITY EVALUATION
5-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 8.01-12
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PROPOSED SOUTH BASIN - SANITARY SEWER CAPACITY EVALUATION
10-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300
Feet

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 8.01-13
1540.001

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Legend

- Proposed Pipe Replacemnet
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300 Feet

PROPOSED SOUTH BASIN - SANITARY SEWER CAPACITY EVALUATION
25-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 8.01-14
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Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300 Feet

PROPOSED SOUTH BASIN - SANITARY SEWER CAPACITY EVALUATION
50-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 8.01-15
1540.001

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Legend

- Proposed Pipe Replacement
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

0 75 150 300 Feet

PROPOSED SOUTH BASIN - SANITARY SEWER CAPACITY EVALUATION
100-YEAR RECURRENCE INTERVAL EVENT

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

STRAND ASSOCIATES, INC.® ENGINEERS

FIGURE 8.01-16
1540.001

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Recurrence Interval	Study Area	Location	Length (ft)	Sanitary Improvement	NPW Cost	Total NPW Cost
5-Year	North	61st St. (Between 48th/49th Ave. to Pershing Blvd.)	1430	Increase from 10" to 12"	$680,000	$870,000
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 12"		
	South	65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 12"	$190,000	
10-Year and 25-Year	North	61st St. (46th Ave. to Between 48th/49th Ave.)	1100	Increase from 10" to 12"	$770,000	$960,000
		61st St. (46th Ave. to Pershing Blvd.)	330	Increase from 10" to 15"		
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 15"		
	South	65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 12"	$190,000	
50-Year	North	61st St. (Between 48th/49th Ave. to Pershing Blvd.)	1430	Increase from 10" to 15"	$820,000	$1,040,000
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 15"		
	South	65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 15"	$220,000	
100-Year	North	61st St. (Between 48th/49th Ave. to 50th Ave.)	160	Increase from 10" to 12"	$880,000	$1,200,000
		61st St. (Between 48th/49th Ave. to Pershing Blvd.)	1430	Increase from 10" to 15"		
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 15"		
		Pershing Blvd./60th St. Intersection	20	Increase from 15" to 18"		
	South	65th St. (50th Ave. to 51st Ave.)	310	Increase from 10" to 12"	$320,000	
		65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 15"		

Table 8.01-1 Summary of Gravity Conveyance Improvements and Net Present Worth Costs

C. Pumping Station Improvements–Pumping Alternatives

The hydraulic model was used to evaluate pumping station improvements for the north basin wet weather response to the design storm events. Following a review of the existing utilities and open space, it was determined that pumping alternatives would not be evaluated for the south basin because of the lack of available land.

For the 5- and 10-year recurrence interval events, modeled surcharging does not indicate a need for wet weather pumping facilities for these recurrence interval events. The gravity conveyance improvements presented in Table 8.01-1 adequately reduce surcharging in the study area.

The pumping station alternative includes construction of a new pumping station with a portable generator connection located in Forest Park between 47th and 48th Avenue. Approximately 600 LF of gravity sewer would be installed to convey flow from a diversion structure at the location of MH-879 (located at the intersection of 61st Street and 49th Avenue) to the pumping station. Approximately 900 LF of force main would be installed to convey pumped flow from the pumping station to the 18-inch interceptor in 60th Street. The pumping station improvements are shown in Figure 8.01-17. The weir elevation in the diversion structure establishes surcharge levels upstream of MH-879, sewage flows

PROPOSED NORTH BASIN - PUMPING STATION IMPROVEMENTS

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

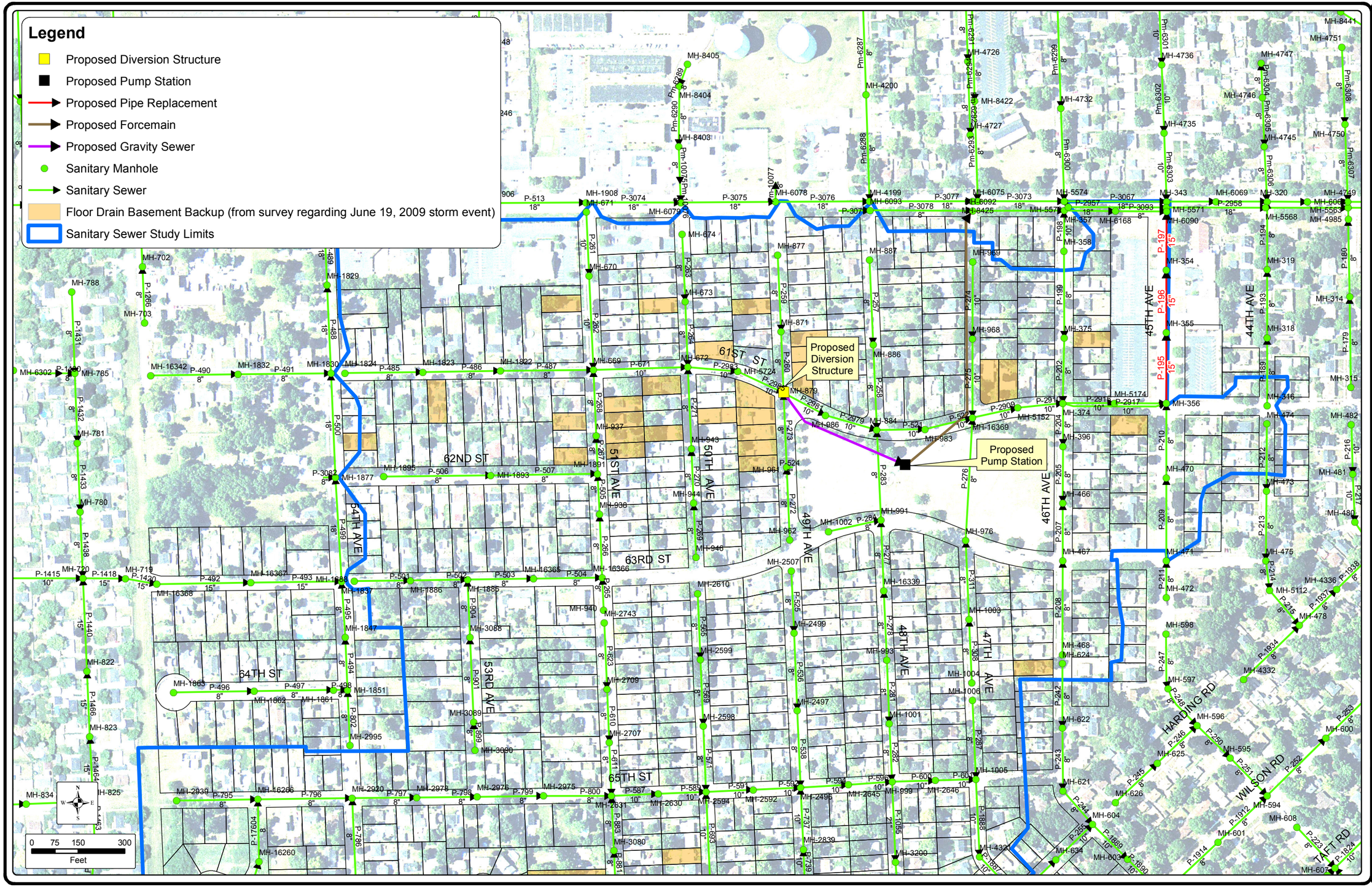

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FIGURE 8.01-17
1540.001

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downstream of MH-879, and sewage flows to the pumping station. The weir elevation was set at 2 feet above the lowest pipe invert in MH-879. The pumping station model does not eliminate surcharge from the system, but it reduces the surcharge to levels that are believed to be below basement drains. In addition to the pumping station improvements, it is recommended the existing deteriorated 10-inch pipe in Pershing Boulevard (aka 45th Avenue) be replaced with a minimum 15-inch pipe to reduce surcharging downstream of MH-879. An alternative to replacing the 10-inch pipe in Pershing Boulevard is to install additional gravity sewer from MH-374 (located at the intersection of 61st Street and 46th Avenue) back to the pumping station to convey additional flow. This alternative was not evaluated any further because of the condition of the existing 10-inch pipe in Pershing Boulevard.

Table 8.01-2 lists the potential improvements and associated present worth value. Note that the OPCC for the 5- and 10-year recurrence interval events reflect the fact that a pumping station is not required for these scenarios. Therefore, the OPCC values presented reflect gravity sewer improvements as presented in Table 8.01-1, which would be required. Additional modeling information at all manholes and pipes modeled are located in Appendix F. Additional detail regarding the OPCC is located in Appendix G.

Recurrence Interval	Study Area	Location	Length (ft)	Sanitary Improvement	NPW Cost	Total NPW Cost
5-Year	North	61st St. (Between 48th/49th Ave. to Pershing Blvd.)	1430	Increase from 10" to 12"	$680,000	$870,000
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 12"		
	South	65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 12"	$190,000	
10-Year	North	61st St. (Between 48th/49th Ave. to 46th Ave.)	1100	Increase from 10" to 12"	$770,000	$960,000
		61st St. (46th Ave. to Pershing Blvd.)	330	Increase from 10" to 15"		
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 15"		
	South	65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 12"	$190,000	
25-Year	North	Forest Park (Between 47th Ave. and 48th Ave.)	-	750 GPM Pump Station	$1,395,000	$1,585,000
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 12"		
	South	65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 12"	$190,000	
50-Year	North	Forest Park (Between 47th Ave. and 48th Ave.)	-	1200 GPM Pump Station	$1,583,000	$1,803,000
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 12"		
	South	65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 15"	$220,000	
100-Year	North	Forest Park (Between 47th Ave. and 48th Ave.)	-	1500 GPM Pump Station	$1,697,000	$2,017,000
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 12"		
	South	65th St. (50th Ave. to 51st Ave.)	310	Increase from 10" to 12"	$320,000	
		65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 15"		

Table 8.01-2 Summary of Pumping Station Improvements and Net Present Worth Costs

D. Underground Storage Improvements

The hydraulic model was used to evaluate underground storage improvements for the north basin wet weather response to the design storm events. Following a review of the existing utilities and open space, it was determined that underground storage alternatives would not be evaluated for the south basin because of the lack of available land.

For the 5- and 10-year recurrence interval events, modeled surcharging does not indicate a need for wet weather pumping facilities for these recurrence interval events. The gravity conveyance improvements presented in Table 8.01-1 adequately reduce surcharging in the study area.

The underground storage alternative includes construction of an underground storage tank and adjacent pumping station with portable generator connection located in Forest Park between 47th and 48th Avenue. The pumping station would be used to pump the sewage back to the sanitary sewer after the event. Approximately 600 LF of gravity sewer would be installed to convey flow from a diversion structure at the location of MH-879 to the pumping station. Approximately 200 LF of force main would be installed to convey pumped flow from the pumping station to MH-983 (located at the intersection of 46th Avenue and 61st Street) after the event. The underground storage improvements are shown in Figure 8.01-18. The weir elevation in the diversion structure dictates surcharge levels upstream of MH-879, sewage flows downstream of MH-879, and sewage flows to the storage tank. The weir elevation was set at 2 feet above the lowest pipe invert in MH-879. The storage tank model does not completely eliminate surcharge from the system, but it reduces the surcharge to levels that are believed to be below basement drains. In addition to the storage tank improvements, it is recommended that the existing deteriorated 10-inch pipe in Pershing Boulevard (aka 45th Avenue) be replaced with a 15-inch pipe to reduce surcharging downstream of MH-879.

Table 8.01-3 lists the potential improvements and associated net present worth costs. Note that the OPCC for the 5- and 10-year recurrence interval events reflect the fact that underground storage is not required for these scenarios. Therefore, the OPCC values presented reflect gravity sewer improvements as presented in Table 8.01-1, which would be required in Pershing Boulevard (45th Avenue). Additional modeling information at all manholes and pipes modeled are located in Appendix F. Additional detail regarding the OPCC is located in Appendix G.

PROPOSED NORTH BASIN - UNDERGROUND STORAGE IMPROVEMENTS

FOREST PARK AREA STORM AND SANITARY MANAGEMENT PLAN
CITY OF KENOSHA
KENOSHA COUNTY, WISCONSIN

Legend

- Proposed Underground Storage
- Proposed Diversion Structure
- Proposed Pipe Replacement
- Proposed Forcemain
- Proposed Gravity Sewer
- Sanitary Manhole
- Sanitary Sewer
- Floor Drain Basement Backup (from survey regarding June 19, 2009 storm event)
- Sanitary Sewer Study Limits

Proposed Diversion Structure

Proposed Underground Storage

61ST ST
62ND ST
63RD ST
64TH ST
65TH ST
44TH AVE
45TH AVE
46TH AVE
47TH AVE
48TH AVE
49TH AVE
50TH AVE
51ST AVE
53RD AVE
54TH AVE
HARDING RD
WILSON RD
TAFT RD

0 75 150 300
Feet

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FIGURE 8.01-18
1540.001

S:\MAD\1500--1599\1540\001\Data\GIS Data\Figures\Sewer Analysis\Sewer Analysis 031510\Figure 8.01-18 - Underground Storage Improvements 11x17.mxd

Recurrence Interval	Study Area	Location	Length (ft)	Sanitary Improvement	NPW Cost	Total NPW Cost
5-Year	North	61st St. (Between 48th/49th Ave. to Pershing Blvd.)	1430	Increase from 10" to 12"	$680,000	$870,000
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 12"		
	South	65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 12"	$190,000	
10-Year	North	61st St. (Between 48th/49th Ave. to 46th Ave.)	1100	Increase from 10" to 12"	$770,000	$960,000
		61st St. (46th Ave. to Pershing Blvd.)	330	Increase from 10" to 15"		
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 15"		
	South	65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 12"	$190,000	
25-Year	North	Forest Park (Between 47th Ave. and 48th Ave.)	-	70,000 Gallons Underground Storage	$1,430,000	$1,620,000
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 12"		
	South	65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 12"	$190,000	
50-Year	North	Forest Park (Between 47th Ave. and 48th Ave.)	-	130,000 Gallons Underground Storage	$1,640,000	$1,860,000
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 12"		
	South	65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 15"	$220,000	
100-Year	North	Forest Park (Between 47th Ave. and 48th Ave.)	-	215,000 Gallons Underground Storage	$1,920,000	$2,240,000
		Pershing Blvd. (60th St. to 61st St.)	660	Increase from 10" to 12"		
	South	65th St. (50th Ave. to 51st Ave.)	310	Increase from 10" to 12"	$320,000	
		65th St. (48th Ave. to 50th Ave.)	600	Increase from 10" to 15"		

Table 8.01-3 Underground Storage Improvements and Net Present Worth Costs

E. I/I Removal

Tables 6.02-1 and 6.02-2 presented earlier include a summary of model results for the June 19, 2009 rainfall event, which served as the base event for the sanitary sewer analysis. Table 6.02-1 presents information pertaining to the north basin while Table 6.02-2 presents information pertaining to the south basin.

Pipes P-197 and P-198 are existing sewers that represent the segments of sewer that convey flow out of the north study area (refer to Figures 6.01-1 through 6.01-3). The peak dry weather flow predicted for these locations is 0.259 cfs (116 gpm). The June 19 model results predict a peak flow in P-197 of 4.275 cfs (1,919 gpm). Therefore, the estimated I/I at this location, as predicted by the model for the June 19 event is, 4.016 cfs (1,803) gpm.

Pipe P-1056 is an existing 21-inch sewer that represents the last segment of sewer on the downstream end of the south study area (refer to Figures 6.01-1 through 6.01-3). The peak dry weather flow predicted for this location is 0.118 cfs (53 gpm). The June 19 model results predict

peak wet weather flow in P-1056 of 4.616 cfs (2,073 gpm). Therefore, the estimated I/I at this location, as predicted by the model for the June 19 event, is 4.498 cfs (2,020 gpm).

The total estimated I/I from both basins is approximately 8.514 cfs (3,823 gpm). This represents a significant amount of flow in these two basins.

Sources of clear water in the sanitary sewer system, as described in Section 3, included open pick holes in manhole covers and other manhole defects. A 1976 Neenah Foundry Company report titled *A Report on Inflow of Surface Water Through Manhole Covers* offers the following I/I estimates for various sources (assumes 1 inch of ponded water over manhole surface):

1. One 1.5-inch open pick hole ≈ 26 gpm
2. Two 1-inch open pick holes ≈ 25 gpm
3. Bearing Surface Only–Concealed Pick holes ≈ 17 gpm

Open pick holes can represent a significant source of I/I in a sanitary sewer system. Other defects typically found in manholes, such as leaking cracks, and defective pipe connections typically contribute less than 5 gpm of I/I.

To provide the City with an estimate of the I/I flow that may be coming from manholes, the storm sewer model output was reviewed to determine which manholes would be submerged during various rainfall events (2-, 5-, 10-, 25-, 50- and 100-year recurrence interval events). City data was also used to determine which manholes had open pick holes during the June 19, 2009 (approximately a 50-year RI event). Using the Neenah Foundry study previously referenced, an estimate of potential I/I flows through manhole covers was made. For the June 19, 2009 event, it was determined that an I/I rate of approximately 125 gpm was possible from various manhole sources within the north basin, and another 125 gpm was possible in the south basin.

Section 3 also documents properties that are discharging clear water directly to the sanitary sewer. These discharges included 29 homes where the foundation is drained to the sanitary sewer, and 3 homes where the sump pump discharges directly to the sanitary sewer via the floor drain. This represents approximately 22 percent of the homes that responded. If the assumption is made that the nonrespondent homes are connected to the sanitary sewer in a similar percentage, then the total number of connected homes would be 122 homes (63 north basin and 59 south basin).

Foundation drain discharge rates can vary widely depending on the size of the footing drains, groundwater height, and lateral diameter. Similarly, sump pump discharge rates can vary depending on the size of the pump, as well as the run times associated with pumping. Typical sump pump discharge rates are in the 25 to 30 gpm range and are usually intermittent discharges. On rare occasions sump pump discharge rates may be as high as 50 gpm and run continuously.

Again, to provide the City with an estimate of the potential I/I coming from foundation drain/sump pump sources, the following assumptions were made:

- Sump Pump Discharge Rate ≈ Foundation Drain Discharge Rate ≈ 25 gpm
  (A review of available sump pump information (University of Illinois Extension) indicates this is a reasonable assumption.)
- 63 homes connected in the north basin.
- 63 homes times 25 gpm per home = 1,575 gpm estimated I/I rate in North Basin.
- 59 homes connected in the south basin.
- 59 homes times 25 gpm per home = 1,475 gpm estimated I/I rate in South Basin.

As previously stated, the estimated I/I within the North Basin for the June 19th event was 1,803 gpm. Manhole sources may have contributed approximately 125 gpm to this total. Foundation drain/sump pumps may have contributed another 1,575 gpm, for a total of 1,700 gpm.

As previously stated, the estimated I/I within the South Basin for the June 19th event was 2,020 gpm. Manhole sources may have contributed approximately 125 gpm to this total. Foundation drain/sump pumps may have contributed another 1,475 gpm, for a total of 1,600 gpm.

In both basins, it can be seen that foundation drains and/or sump pump connections to the sanitary sewer likely represent a significant portion of the I/I in the sanitary sewer.

Historically, hundreds of communities across the United States have attempted to identify and remove sources of I/I, with limited success. Identification and removal of I/I sources is an ongoing process. However, successful programs continue to maintain and improve collection systems as part of the routine Operation and Maintenance (O&M) program. In some instances, significant reductions in peak flow have been achieved. However, this is not necessarily the “norm,” and to rely solely on I/I removal and identification as a means to forego the necessary capacity upgrades is often unsuccessful.

For purposes of this evaluation, it has been assumed that City staff will continue to locate and remove sources of I/I in the collection system. The net result of this may possibly be the maintenance of existing peak flow rates in the collection system but not necessarily a significant decrease in peak flow rates. This type of an assumption is supported by years of actual experience by communities across the country. It is very unlikely that enough I/I can be located and removed to eliminate the need for capacity upgrades.

8.02 SUMMARY

Table 8.02-1 presents a summary of net present worth costs associated with the gravity conveyance, wet weather pumping station, and underground storage alternatives evaluated.

Recurrence Interval	Gravity Conveyance	Wet Weather Pumping Station	Underground Storage
5-Year	$870,000	$870,000	$870,000
10-Year	$960,000	$960,000	$960,000
25-Year	$960,000	$1,585,000	$1,620,000
50-Year	$1,040,000	$1,803,000	$1,860,000
100-Year	$1,200,000	$2,017,000	$2,240,000

Table 8.02-1 Summary of Net Present Worth Costs

In addition to the overall net present worth comparison, each of the alternatives evaluated has certain nonmonetary advantages and disadvantages associated with it. Table 8.02-2 presents an overview of these advantages and disadvantages.

Conveyance Option	Advantages	Disadvantages
Gravity	▪ Minimized parkland impacts. ▪ Requires no electrical or emergency power. ▪ No new structures required–only replacement of existing structures.	▪ Maximum disruption of existing roadways.
Pumping Station	▪ Requires less roadway disruption as compared to gravity option. ▪ Overall smaller footprint than gravity option. ▪ Redirects peak flows out of study area (vs. routing through study area).	▪ Impacts existing parkland ▪ Requires routine O&M associated with pumping station facilities. ▪ Requires construction of new bypass facilities to direct wet weather flows to new pumping station. ▪ Requires electrical and emergency power source (portable generator for standby power).
Underground Storage	▪ Requires less roadway disruption as compared to gravity option. ▪ Redirects peak flows out of study area (vs. routing through study area).	▪ Impacts existing parkland. ▪ Requires routine O&M (cleaning, etc.) following wet weather event–may require confined space entry to maintain. ▪ Requires construction of new bypass facilities to direct wet weather flows to new storage facilities. ▪ Requires electrical and emergency power source (portable generator for standby power).

Table 8.02-2 Nonmonetary Comparison of Conveyance Alternatives