

MIDDLE CREEK AND WEST 'O' STREET BASINS

16.1 MIDDLE CREEK AND WEST 'O' STREET TRUNK SEWER SYSTEMS

The existing Middle Creek and West 'O' St drainage basins are shown in Figure 16.1. Shown in Figure 16.1 are the existing gravity trunk sewers as well as two lift stations C-8 and C-9. The following projects are currently in the planning, design, or construction phases and have been included in the model of the existing system.

1. West 'O' Street Trunk Sewer Extension - Phase I
2. West 'O' Street Trunk Sewer Extension - Phase II
3. West 'O' Street Trunk Sewer Extension - Phase III

Shown in Table 16.1 are the existing and anticipated service areas that were used to determine the flows for the different modeling efforts.

Table 16.1 Service Areas and Flows - West O St & Middle Creek Basins Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska								
Basin	Existing		Existing and Tier I		Existing and Tiers I & II		Existing and Tiers I, II & III	
	Area (ac)	Flow (cfs)	Area (ac)	Flow (cfs)	Area (ac)	Flow (cfs)	Area (ac)	Flow (cfs)
Middle Creek	1,389	9.81	2,936	19.07	4,839	29.82	7,489	44.17
West O	1,042	7.61	2,785	18.19	4,833	29.79	7,059	41.88

1. Based on information provided by LWWS
2. As of July, 2006.

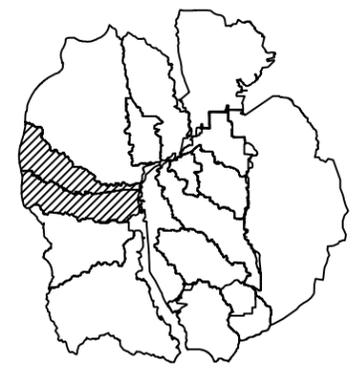
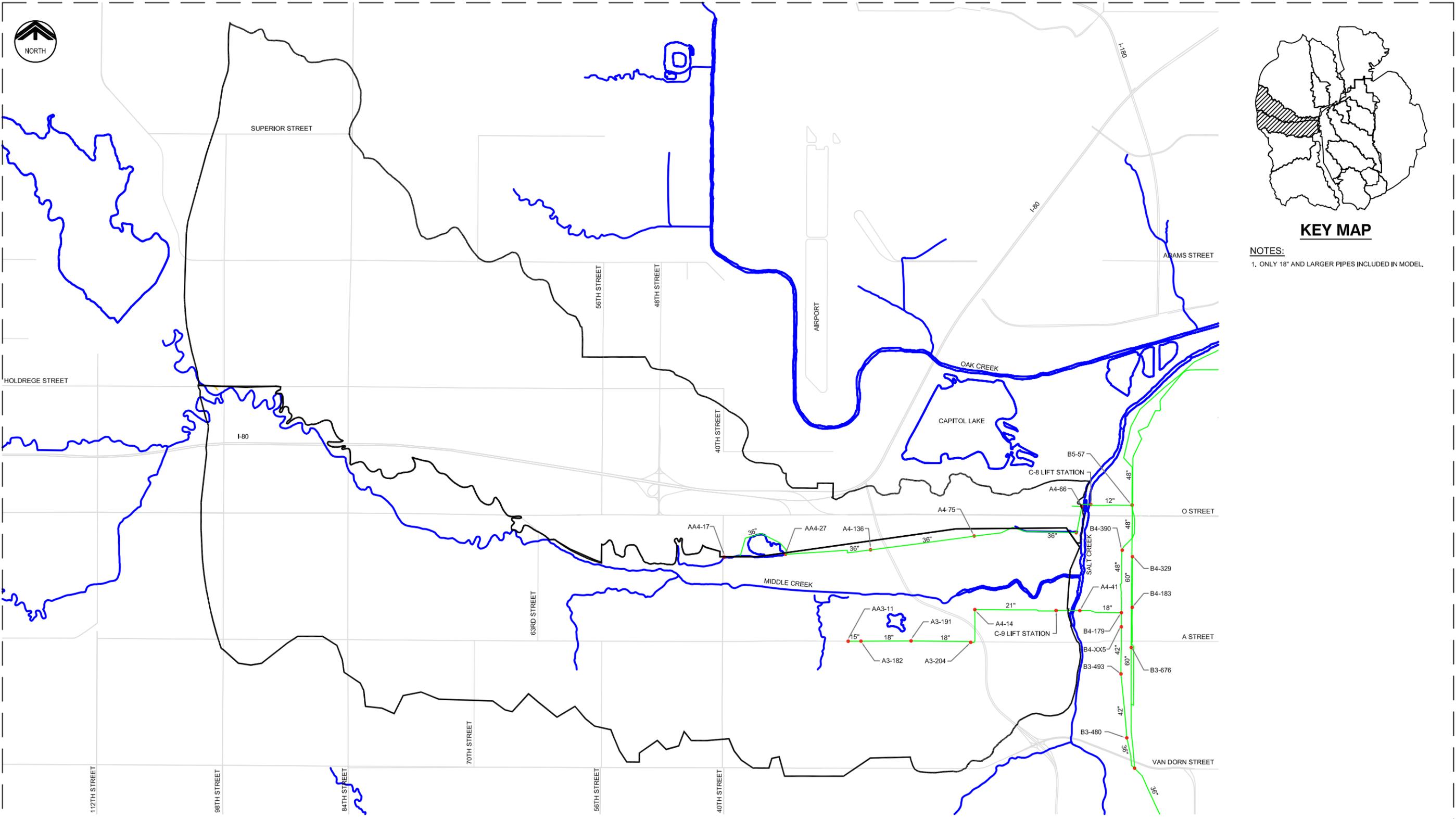
16.2 MODELING RESULTS

The Middle Creek and West 'O' Basin Trunk Sewers presented are preliminarily sized to convey the Tier III flows. The modeling results for the scenarios presented are located in Appendix D.

16.2.1 Existing Conditions

16.2.1.1 Middle Creek

The existing Middle Creek trunk sewer conveys wastewater flow from the Middle Creek drainage basin east into the C-9 Lift Station (West 'E' St and SW 6th St). From there, the wastewater is pumped under Salt Creek through a 12-inch diameter force main into an 18-inch gravity sewer.



KEY MAP

NOTES:
 1. ONLY 18" AND LARGER PIPES INCLUDED IN MODEL.

Figure No. 16.1
MIDDLE CREEK AND WEST "O" STREET TRUNK SEWER SYSTEMS
WASTEWATER FACILITIES MASTER PLAN UPDATE - 2007
CITY OF LINCOLN, NEBRASKA

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The 18-inch sewer is connected to the existing 48-inch sewer at 3rd and 'D' Streets at manhole B4-179. The C-9 Lift Station contains three pumps. Two pumps have a capacity of 900 gpm, and the third has a capacity of 800 gpm. With all three pumps operating, the pump station has an estimated capacity of 4.46 cfs. The pumps were modeled to react to the wet-well liquid level.

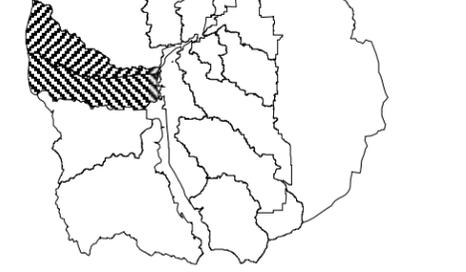
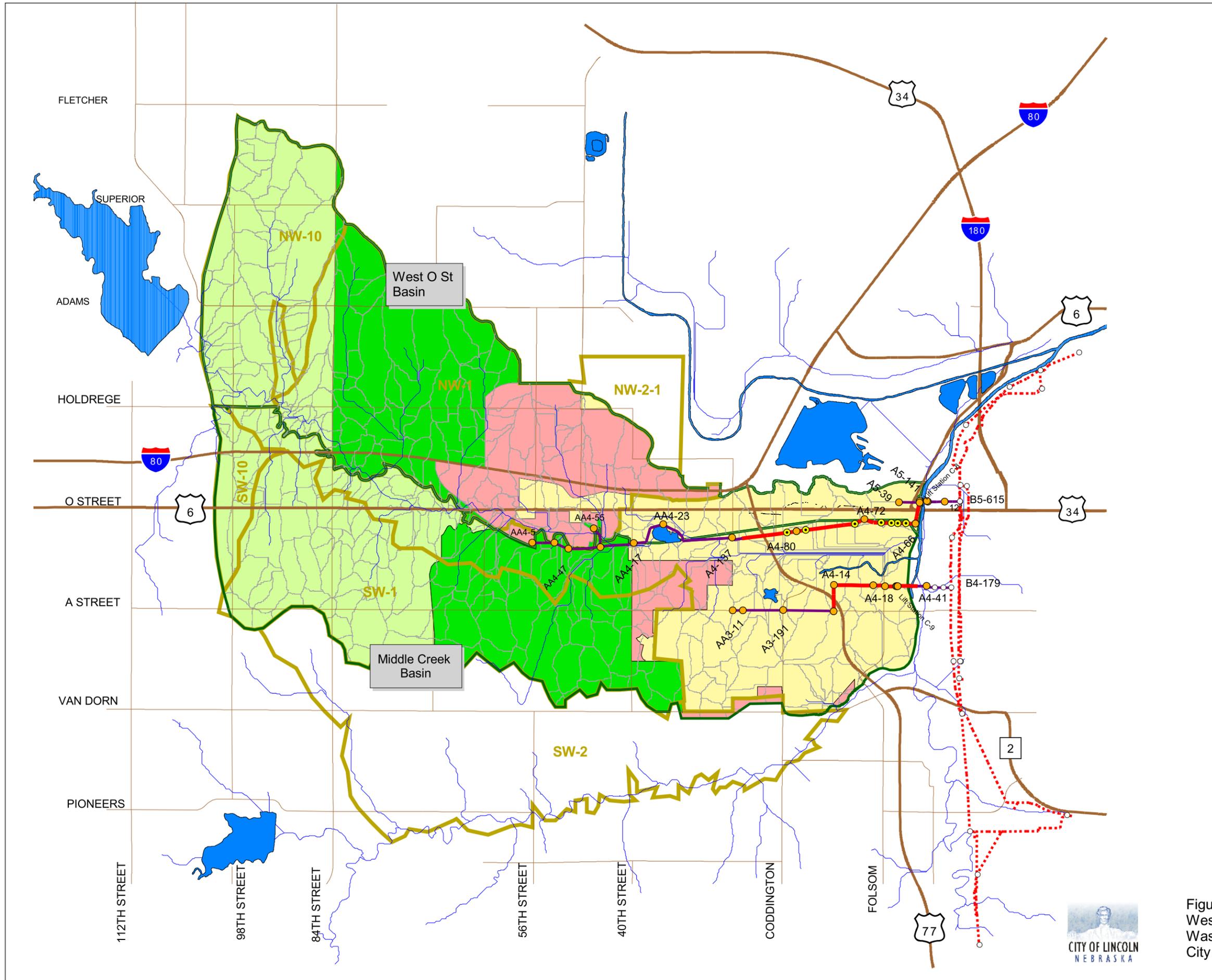
The existing Middle Creek system was modeled using a total service area of about 1,389 acres, which resulted in a peak flow of 9.81 cfs. Based on this flow, the simulation indicates severe surcharging in all pipes upstream of the C-9 Lift Station as shown in Figure 16.2. The d/D ratio of these surcharged pipes varied to values greater than 10.

In order to determine if the C-9 Lift Station was acting to limit the collection system capacity, a free outfall simulation was conducted. In this simulation, C-9 pumps were removed from the model and replaced with a free outfall allowing flows to escape the collection system without being inhibited by backwater. The free outfall analysis indicates that the undersized pumps at C-9 are causing system backup. Under free outfall conditions, the d/D of the pipes range between 0.71 and 0.84.

16.2.1.2 West 'O' Street

The existing West 'O' Street trunk sewer conveys wastewater flow from the drainage basin east into Lift Station C-8 (West 'P' St and Salt Creek). The wastewater enters the lift station through 12-inch and 15-inch gravity sewers. The lift station pumps the wastewater under Salt Creek through an 8-inch diameter force main into a 12-inch gravity sewer. The 12-inch sewer drains to the 78-inch diameter Salt Valley Trunk Sewer at Manhole B5-616 near the intersection of 4th St and West 'P' Street. The C-8 Lift Station contains two pumps. Each pump has a design capacity of 900 gpm. With both pumps operating, the pump station has an estimated capacity of 3.5 cfs. This lift station is anticipated to be at capacity between the years 2005 and 2009. The pumps were modeled to react to the wet-well liquid level.

The existing system was modeled using a total service area of about 1,042 acres, which resulted in a peak flow of 7.61 cfs. Based on this flow, the simulation indicates surcharging for much of the 36-inch sewer near the C-8 Lift Station. The entire length of sewer between manholes A4-80 and A5-141 exceeds a d/D ratio of 1.0, ranging from 1.12 and 15.90. The model also indicates that the 36-inch pipes are running well below the design full capacity. The simulated d/D values of the 36-inch pipes are therefore not caused by limited conveyance capacity, but by a downstream obstruction of flow. The limited conveyance capacity of the 12-inch sewers downstream of manhole A4-66 is a source of the modeled surcharging conditions prominent in this area under existing flow conditions. The locations of these pipes within the existing system are displayed in Figure 16.2.



Key Map

- LEGEND**
- Manholes with SSO's
 - Pipe Surcharge Conditions
 - ▾ d/D ≤ 1.0
 - ▾ d/D > 1.0
 - ⋯ Salt Valley - Existing Pipes
 - ▬ Streams
 - ▬ Streets
 - ▭ Basin Boundary
 - ▭ Utility Planning Zones
 - ▭ Existing Service Area
 - ▭ Tier I Area
 - ▭ Tier II Area
 - ▭ Tier III Area



Figure 16.2 Surcharged Pipes - Existing Conditions
 West O St and Middle Creek Basins Trunk Sewers
 Wastewater Facilities Master Plan Update - 2007
 City of Lincoln, Nebraska



16.2.2 Tier I Conditions

16.2.2.1 Middle Creek

The Tier I Middle Creek basin scenario was modeled using the existing service area plus the Tier I areas as outlined in Table 16.1. The total tributary area modeled is approximately 2,936 acres, which corresponds to a peak flow of approximately 19.07 cfs. The Tier I flows were routed through the existing sewer system with the preliminary improvements for Tier I pipes. The simulation results show that the existing modeled sewer system does not have sufficient capacity to convey the peak wet weather flows under Tier I conditions. The capacity shortages are manifested most noticeably in the large volume of modeled overflows (SSOs) at eight locations. Table 16.2 provides a summary of capacity related overflows under Tier I conditions. The modeled SSO locations are shown in Figure 16.2.

Table 16.2 Manholes with Modeled SSO's - Tier I Conditions - West 'O' St and Middle Creek Basins Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska			
Node ID	Invert Elevation (ft)	Modeled Water Surface Elevation (ft)	Modeled Depth of Water (ft) ⁽¹⁾
A4-73	1133.10	1145.52	0.02
A4-79	1138.10	1146.61	0.51
A4-78	1137.30	1146.43	0.63
A4-67	1128.68	1144.76	1.76
A4-70	1130.76	1145.02	2.02
A4-66	1127.88	1144.74	2.74
A4-80	1138.90	1146.79	2.79
A4-69	1129.91	1144.85	2.85
A4-68	1129.38	1144.78	3.78
Notes: 1 -The depth of water is calculated from the Manhole Inverts			

16.2.2.2 West 'O' Street

The Tier I West O St Basin scenario was modeled using the existing service area plus the Tier I areas as outlined in Table 16.1. The total tributary area modeled is approximately 2,785 acres, which corresponds to a peak flow of approximately 18.19 cfs. The Tier I flows were routed through the existing sewer with preliminary improvements for Tier I flows. The simulation results show that the existing sewer system with a larger lift station has sufficient capacity to convey the peak wet weather flows under Tier I conditions.

16.2.3 Tier II Conditions

16.2.3.1 Middle Creek

The Tier II Middle Creek Basin scenario was modeled using the existing service area plus the Tiers I and II areas as outlined in Table 16.1. The total tributary area modeled is approximately 4,839 acres, which corresponds to a peak flow of approximately 29.82 cfs. The Tier II flows were routed through the existing sewer and Tier I sewer system. Additional pipes were added to convey sanitary flow from the Tier II service areas to the existing system. The simulation results show that the existing and Tier I sewer system does have sufficient capacity to convey the peak wet weather flows under Tier II conditions.

16.2.3.2 West 'O' Street

The Tier II West O St Basin scenario was modeled using the existing service area plus the Tiers I and II areas as outlined in Table 16.1. The total tributary area modeled is approximately 4,833 acres, which corresponds to a peak flow of approximately 29.79 cfs. The Tier II flows were routed through the improved existing sewer system. Additional pipes were added to convey sanitary flow from the Tier II service areas to the existing system. The simulation results show that the existing sewer system does not have sufficient capacity to convey the peak wet weather flows under Tier II conditions.

16.2.4 Tier III Conditions

16.2.4.1 Middle Creek

The Tier III Middle Creek Basin scenario was modeled using existing service area plus the anticipated Tiers I, II, and III areas as outlined in Table 16.1 above. The total tributary area modeled is approximately 7,489 acres, which corresponds to a peak flow of approximately 44.17 cfs. The Tier III flows were routed through the existing and Tier II sewer system. Additional pipes were added to the model to convey sanitary flow from the Tier III service areas to the existing system. The simulation results show that the existing sewer system and the new Tiers II and III sewers have sufficient capacity to convey the peak wet weather flows under Tier III conditions.

16.2.4.2 West 'O' Street

The Tier III West 'O' Street Basin scenario was modeled using existing service area plus the Tiers I, II, and III areas as outlined in Table 16.1 above. The total tributary area modeled is approximately 7,059 acres, which corresponds to a peak flow of approximately 41.88 cfs. The Tier III flows were routed through the improved existing sewer and Tier II sewer system. Additional pipes were added to convey sanitary flow from the Tier III service areas to the existing system. The simulation results show that the existing sewer system does not have sufficient capacity to convey the peak wet weather flows under Tier III conditions.

16.3 IMPROVEMENTS

The improvements for the Middle Creek and West O St Basins are shown in Figure 16.3 and summarized in Tables 16.3, 16.4, 16.5, and 16.6.

16.3.1 Existing Conditions

Recommendations are made to the existing system in order to eliminate problems identified under existing flow conditions. These recommendations include storage, increased conveyance capacity, and increased pumping capacity.

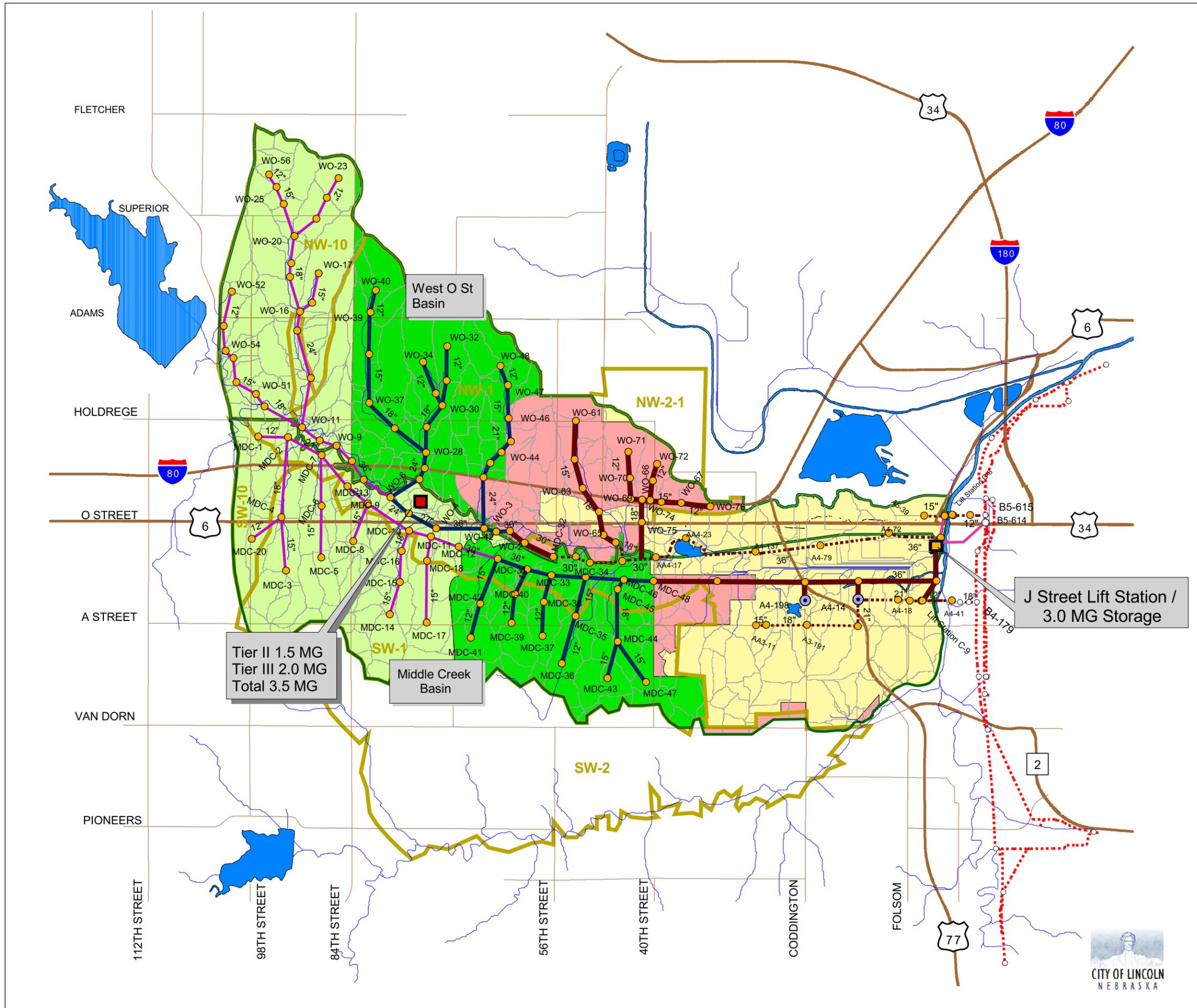
16.3.1.1 Middle Creek

16.3.1.1.1 New Pump Station

The capacity of the C-9 Lift Station was evaluated as a part of this study. The C-9 Lift Station was designed for a maximum capacity of 2.88 mgd (4.46 cfs) with all pumps running. With all pumps in service, the existing lift station should be adequate to serve the existing service area with no backups. However, if one pump is taken out of service, the modeling results indicate severe backups as previously discussed.

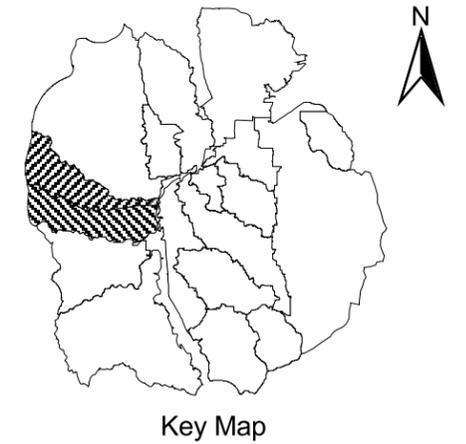
Previous studies have concluded that the lift station is in poor condition and should be replaced. Alternatives for replacing the lift station were reviewed including an alternative to combine the C-9 and C-8 Lift Stations. As suggested by previous studies, the construction of a combined lift station to serve the Middle Creek and West "O" drainage basins is recommended. This will enable the City to replace the C-8 Lift Station to keep pace with growth in the West "O" basin and also replace the C-9 Lift Station which is in need of structural and mechanical improvements. The initial phase will include a lift station designed to be easily expandable to accommodate growth. The first phase should provide sufficient pumping capacity for Tier I conditions. Peak flow storage and equalization should be considered at the combined lift station. This storage would be utilized to minimize the pumping requirements while holding peak flows from entering the Salt Valley Trunk Sewer while it is operating under peak flow conditions. This flow dampening will not only allow the Salt Valley Trunk Sewer to operate more efficiently, but will aid in lowering the peak flows that enter the Theresa Street WWTF.

The preliminary site for the proposed combined lift station is south of 'O' Street and north of the rail yard near 'J' Street as shown in Figure 16.2. It is recommended that the force main from the pump station cross Salt Creek. Once across Salt Creek the force main could discharge into either the 48-inch Salt Valley Trunk Sewer near manhole B4-326, in the newer 60-inch Salt Valley Trunk Sewer near manhole B4-741, or in the 78-inch sewer at manhole B5-614. From a hydraulics point of view it is preferred that the force main discharge into the larger 78-inch trunk sewer.



Tier II 1.5 MG
Tier III 2.0 MG
Total 3.5 MG

J Street Lift Station /
3.0 MG Storage



- LEGEND**
- Potential Diversion Manholes
 - Tier I Pipes
 - Tier II Pipes
 - Tier III Pipes
 - Proposed Lift Station Diversion & Force Main
 - West O Street and Middle Creek Pipes
 - Salt Valley - Existing Pipes
 - Streams
 - Streets
 - Basin Boundary
 - Utility Planning Zones
 - J Street Lift Station (Proposed)
 - Storage Basin - Tier II & III
 - Existing Service Area
 - Tier I Area
 - Tier II Area
 - Tier III Area



Figure 16.3 Proposed Sewer Improvements
West 'O' St and Middle Creek Basins Trunk Sewers
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska

16.3.1.1.2 Pipelines

In addition to the lift station, new pipelines would be required to connect the existing system to the new lift station. This would include the construction of 3,350 feet of 36-inch trunk sewer and a siphon under Middle Creek. Sanitary flow from the combined lift station will be conveyed through approximately 2,000 feet of 18-inch force main to the 78-inch sewer at manhole B5-614.

Various improvements were evaluated to alleviate the surcharging conditions in the Middle Creek Basin identified under existing conditions. As recommended in the "MIDDLE CREEK DRAINAGE BASIN AND 'D' STREET LIFT STATION TRUNK SEWERS" report, a parallel 15-inch sewer from C-9 Lift Station to West "A" Street at SW 12th Street and a parallel 12-inch sewer from West "A" Street to SW 27th Street will relieve the surcharged conditions.

16.3.1.2 West 'O' St

16.3.1.2.1 New Pump Station

This study confirms the conclusions detailed in the previous West 'D' Street Report, which indicates the existing C-8 Lift Station, force main, and 12-inch trunk sewer conveying sanitary flow to the C-8 Street Lift Station are now or will soon be over-loaded. As discussed in Section 16.3.3.1 above, a combined lift station with storage is recommended.

16.3.1.2.2 Pipelines

To convey the wastewater to the new lift station approximately 1,200 lf of 15-inch sewer would be required from manhole A5-141 south to near manhole A4-66. At this location approximately 1,500 feet of 36-inch sewer would be required to convey the sanitary flow from the West "O" system at manhole A4-66 to the combined lift station.

16.3.2 Tier I Improvements

16.3.2.1 Middle Creek

Additional pipes were designed and added to the model to convey sanitary flow from the Tier I service areas to the existing system. The characteristics and preliminary alignment of the additional pipes are presented in Figure 16.3. The simulation results indicate the new pipes have enough capacity to convey the Tier I flows to the combined lift station.

16.3.2.2 West 'O' St

The simulation results show that with larger pumps the existing West 'O' Street sewer system can convey the Tier I flows. However, additional pipes are needed to convey the sanitary flow from 'O' Street to the existing 36-inch sewer at manhole AA4-5.

16.3.3 Tier II Improvements

16.3.3.1 Middle Creek

Additional pipes were designed and added to the model to convey sanitary flow from the Tier II service areas to the existing system. The characteristics and preliminary alignment of the additional pipes are presented in Figure 16.3. The additional pipes include a new trunk sewer varying in size from 24 inches to 36 inches. The design of the new trunk sewer does not account for any potential flow diversion from the old or existing system to the new trunk sewer. Flow from the existing system can be potentially diverted from manholes A4-198 and A4-14. These manhole locations are shown in Figure 16.3.

The simulation of the new system indicates that the new pipes have enough capacity to convey the Tier II flows to the combined lift station. The simulation also indicates that if flow is diverted from the existing system to new trunk sewer, then the new trunk sewer should be upsized to 48 inches from manhole MDC-51 to the combined lift station.

16.3.3.2 West 'O' St

16.3.3.2.1 Storage

The simulation results indicates that the existing and Tier I system does not have adequate capacity to convey the Tier II flows. To alleviate the surcharged conditions from Tier II flows, a 1.5 MG off-line storage facility is recommended at approximately 84th St and West "O" St. The location of the storage facility is shown in Figure 16.3.

Sometime in the Tier II growth period, storage should be incorporated into the J-Street lift station. The model simulation has indicated that 3 MG of storage should be provided. The timing and volume requirements should be determined as development dictates.

16.3.3.2.2 Pipelines

Additional pipes were designed and added to the model to convey the sanitary flow from the Tier II areas to the Tier I and existing system. The characteristics and preliminary alignment of these additional pipes are presented in Figure 16.3. The simulation of the proposed system indicates that the new pipes and other improvements have adequate capacity to handle the tier II peak flows.

16.3.4 Tier III Improvements

16.3.4.1 Middle Creek

Additional pipes were designed and added to the model to convey sanitary flow from the Tier III service areas to the existing system. The characteristics and preliminary alignment of the additional pipes are presented in Figure 16.3. The additional pipes include a new 24-inch trunk sewer from 98th Street to 70th Street. The simulation of the new system

indicates that the new pipes have enough capacity to convey the Tier II flows to the combined lift station.

16.3.4.2 West 'O' St

16.3.4.2.1 Storage

The 1.5 MG storage facility proposed shown in Figure 16.3 near 84th Street and West 'O' Street would be expanded to 3.5 MG to temporarily hold wet weather flows that exceed the capacity of the sewer system. After flow subsides, the stored wastewater can be conveyed back the system. The modeling results indicate that this alternative will eliminate all surcharging identified under Tier III flow conditions.

16.3.4.2.2 Pipelines

In addition to additional storage, new pipelines were designed and added to the model to convey the flows from the Tier III areas. The characteristics and preliminary layout of these pipelines is shown schematically in Figure 16.3. The model simulation of this system indicated that the new pipelines have adequate capacity to convey the Tier III flows.

**Table 16.3 Design Characteristics of Proposed Sewers - Middle Creek Basin
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska**

Pipe ID	US Manhole	DS Manhole	Diameter (ft)	Length (ft)	Slope (%)	Design Cap. (cfs)	Tier
MD-P82	MDC-48	MDC-80	36	3,365	0.23	31.99	I
MD-P81	MDC-51	MDC-52	36	2,785	0.23	32.02	
MD-P83	MDC-52	MDC-53	36	4,016	0.23	31.99	
MD-P84	MDC-53	MDC-54	42	1,386	0.23	48.25	
MD-P85	MDC-54	MDC-91	42	724	0.23	47.69	
MD-P80	MDC-80	MDC-51	36	4,567	0.24	32.61	
MD-41	MDC-31	MDC-32	36	1,611	0.24	32.67	II
MD-42	MDC-32	MDC-33	36	1,281	0.24	32.68	
MD-43	MDC-33	MDC-34	36	1,766	0.24	32.68	
MD-44	MDC-34	MDC-46	36	1,930	0.24	32.68	
MD-45	MDC-46	MDC-48	36	1,529	0.24	32.67	
MD-46	MDC-41	MDC-42	12	1,829	0.26	1.82	
MD-47	MDC-42	MDC-31	15	2,519	0.26	3.29	
MD-48	MDC-39	MDC-40	12	1,540	0.26	1.79	
MD-49	MDC-40	MDC-32	15	1,416	0.26	3.34	
MD-50	MDC-37	MDC-38	12	1,765	0.26	1.82	
MD-51	MDC-38	MDC-33	12	1,409	0.26	1.82	
MD-52	MDC-36	MDC-35	12	2,521	0.26	1.82	
MD-53	MDC-35	MDC-34	15	2,072	0.26	3.29	
MD-54	MDC-43	MDC-44	15	1,969	0.26	3.29	
MD-55	MDC-44	MDC-45	18	2,680	0.26	5.36	
MD-56	MDC-45	MDC-46	18	639	0.26	5.36	
MD-57	MDC-47	MDC-44	15	2,606	0.26	3.29	
MD-P1	MDC-1	MDC-2	12	1,564	0.27	1.85	III
MD-P2	MDC-3	MDC-4	15	2,842	0.27	3.36	
MD-P3	MDC-4	MDC-2	18	4,034	0.27	5.46	
MD-P4	MDC-2	MDC-7	21	1,945	0.25	7.92	
MD-P5	MDC-5	MDC-6	15	2,704	0.27	3.36	
MD-P6	MDC-6	MDC-7	15	2,584	0.26	3.39	
MD-P7	MDC-7	MDC-13	24	2,107	0.25	11.31	
MD-P8	MDC-13	MDC-9	24	1,364	0.25	11.31	
MD-P9	MDC-8	MDC-9	15	2,122	0.26	3.29	
MD-P10	MDC-9	MDC-10	24	2,550	0.25	11.31	
MD-P11	MDC-14	MDC-15	15	1,789	0.26	3.29	
MD-P12	MDC-15	MDC-16	15	1,589	0.26	3.29	
MD-P13	MDC-16	MDC-10	18	1,033	0.26	5.36	
MD-P14	MDC-10	MDC-11	27	1,218	0.25	15.49	
MD-P15	MDC-17	MDC-18	15	3,250	0.26	3.29	
MD-P16	MDC-18	MDC-11	15	1,260	0.26	3.29	
MD-P17	MDC-20	MDC-4	12	1,972	0.25	1.78	
MD-22	MDC-11	MDC-12	30	1,586	0.25	20.51	
MD-40	MDC-12	MDC-31	30	2,111	0.25	20.51	

**Table 16.4 Design Characteristics of Proposed Sewers - West O St Basin
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska**

Pipe ID	US Manhole	DS Manhole	Diameter (ft)	Length (ft)	Slope (%)	Design Cap. (cfs)	Tier
WOP1	WO-1	AA4-5	30	1,642	0.26	19.24	I
WOP2	WO-2	WO-1	30	1,066	0.26	19.24	
WOP60	WO-68	WO-67	12	1,034	0.20	1.59	
WOP61	WO-69	WO-66	15	594	0.20	2.89	
WOP62	WO-71	WO-70	12	1,350	0.20	1.59	
WOP63	WO-70	WO-69	12	1,092	0.20	1.59	
WOP64	WO-62	WO-63	15	1,561	0.27	2.89	
WOP65	WO-63	WO-64	18	1,492	0.20	4.70	
WOP66	WO-64	WO-65	18	1,225	0.20	4.70	
WOP67	WO-65	AA4-55	18	721	0.20	4.70	
WOP68	WO-61	WO-62	15	2,003	0.27	2.89	
WOP69	WO-75	AA4-63	18	1,909	0.20	7.09	
WOP70	WO-66	WO-75	18	1,173	0.20	7.09	
WOP71	WO-72	WO-73	12	890	0.20	1.59	
WOP72	WO-73	WO-74	12	1,030	0.20	1.59	
WOP73	WO-67	WO-74	15	587	0.20	2.89	
WOP74	WO-74	WO-66	15	430	0.20	2.89	
WOP75	WO-76	WO-68	12	1,511	0.20	1.59	
WOP3	WO-3	WO-2	30	719	0.26	19.24	II
WOP4	WO-5	WO-4	36	1,635	0.27	10.61	
WOP5	WO-6	WO-5	36	1,241	0.27	10.61	
WOP24	WO-27	WO-6	24	1,777	0.27	11.31	
WOP25	WO-29	WO-28	18	1,335	0.26	5.15	
WOP26	WO-30	WO-29	18	1,378	0.26	5.15	
WOP27	WO-31	WO-30	12	1,307	0.27	1.75	
WOP28	WO-32	WO-31	12	1,794	0.27	1.75	
WOP29	WO-33	WO-30	12	713	0.27	1.72	
WOP30	WO-34	WO-33	12	1,754	0.27	1.72	
WOP32	WO-37	WO-36	18	1,872	0.28	5.25	
WOP33	WO-38	WO-37	15	2,530	0.27	3.23	
WOP34	WO-39	WO-38	15	2,165	0.27	3.23	
WOP35	WO-40	WO-39	12	1,172	0.28	1.78	
WOP37	WO-43	WO-42	24	2,647	0.00	10.61	
WOP38	WO-45	WO-44	21	745	0.27	7.43	
WOP39	WO-46	WO-45	21	1,207	0.27	7.43	
WOP40	WO-47	WO-46	15	1,706	0.27	3.03	
WOP41	WO-42	WO-3	36	675	0.26	19.24	
WOP42	WO-4	WO-42	36	2,483	0.27	10.61	
WOP43	WO-49	WO-43	24	834	0.27	10.61	
WOP44	WO-44	WO-49	24	809	0.27	10.61	
WOP45	WO-48	WO-47	12	1,079	0.27	1.67	
WOP46	WO-50	WO-27	24	619	0.27	11.31	
WOP48	WO-28	WO-50	24	818	0.27	11.31	
WOP47	WO-36	WO-28	18	2,056	0.28	5.25	

**Table 16.4 Design Characteristics of Proposed Sewers - West O St Basin
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska**

Pipe ID	US Manhole	DS Manhole	Diameter (ft)	Length (ft)	Slope (%)	Design Cap. (cfs)	Tier
WOP6	WO-7	WO-6	36	1,673	0.27	31.99	III
WOP7	WO-8	WO-7	36	1,140	0.27	31.99	
WOP8	WO-9	WO-8	36	1,129	0.27	31.99	
WOP9	WO-10	WO-9	36	930	0.27	31.99	
WOP10	WO-12	WO-11	18	2,226	0.27	5.15	
WOP11	WO-51	WO-12	18	774	0.27	5.15	
WOP12	WO-14	WO-11	24	2,591	0.27	11.08	
WOP13	WO-15	WO-14	24	2,567	0.27	11.08	
WOP14	WO-16	WO-15	24	996	0.27	11.08	
WOP15	WO-17	WO-57	15	1,577	0.27	3.17	
WOP16	WO-18	WO-16	18	1,865	0.27	5.15	
WOP17	WO-20	WO-19	18	1,411	0.29	5.15	
WOP18	WO-24	WO-20	15	1,750	0.30	3.23	
WOP19	WO-25	WO-24	15	970	0.30	3.23	
WOP21	WO-21	WO-20	12	1,459	0.30	1.78	
WOP22	WO-22	WO-21	12	1,209	0.30	1.78	
WOP23	WO-23	WO-22	12	1,199	0.30	1.78	
WOP90	WO-11	WO-10	36	1,147	0.27	31.99	
WOP49	WO-13	WO-51	15	1,196	0.27	3.17	
WOP50	WO-52	WO-53	12	1,835	0.28	1.75	
WOP51	WO-53	WO-54	12	1,293	0.28	1.75	
WOP52	WO-54	WO-55	15	561	0.28	3.17	
WOP80	WO-55	WO-13	15	1,267	0.28	3.16	
WOP53	WO-57	WO-16	15	767	0.27	3.17	
WOP55	WO-56	WO-25	12	747	0.30	1.78	
WOP56	WO-19	WO-18	18	725	0.29	5.15	

**Table 16.5 Modeling Results of Proposed Sewers - Middle Creek Basin
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska**

Pipe ID	US Manhole	DS Manhole	Cap. cfs	Tier I Conditions		Tier I & II Conditions		Tier I, II, III Conditions		Tier
				Q, cfs	d/D	Q, cfs	d/D	Q, cfs	d/D	
MD-P82	MDC-48	MDC-80	31.99	13.05	0.48	13.05	0.48	30.29	0.82	I
MD-P81	MDC-51	MDC-52	32.02	15.44	0.49	15.44	0.49	32.48	0.85	
MD-P83	MDC-52	MDC-53	31.99	15.44	0.53	15.44	0.53	32.47	0.85	
MD-P84	MDC-53	MDC-54	48.25	20.42	0.47	20.42	0.47	37.42	0.67	
MD-P85	MDC-54	MDC-91	47.69	20.42	0.47	20.42	0.47	37.42	0.67	
MD-P80	MDC-80	MDC-51	32.61	15.44	0.49	15.44	0.49	32.49	0.84	
MD-41	MDC-31	MDC-32	32.67	NA	NA	2.91	0.25	20.22	0.60	II
MD-42	MDC-32	MDC-33	32.68			4.64	0.28	21.94	0.62	
MD-43	MDC-33	MDC-34	32.68			5.70	0.33	23.00	0.66	
MD-44	MDC-34	MDC-46	32.68			7.87	0.43	25.17	0.75	
MD-45	MDC-46	MDC-48	32.67			12.48	0.45	29.77	0.78	
MD-46	MDC-41	MDC-42	1.82			1.74	0.82	1.74	0.86	
MD-47	MDC-42	MDC-31	3.29			1.74	0.56	1.74	0.97	
MD-48	MDC-39	MDC-40	1.79			1.16	0.69	1.16	0.64	
MD-49	MDC-40	MDC-32	3.34			1.72	0.55	1.72	0.80	
MD-50	MDC-37	MDC-38	1.82			1.07	0.60	1.07	0.55	
MD-51	MDC-38	MDC-33	1.82			1.07	0.60	1.07	0.86	
MD-52	MDC-36	MDC-35	1.82			1.38	0.81	1.38	0.74	
MD-53	MDC-35	MDC-34	3.29			2.17	0.65	2.17	0.79	
MD-54	MDC-43	MDC-44	3.29			1.39	0.72	1.39	0.72	
MD-55	MDC-44	MDC-45	5.36			3.60	0.75	3.60	0.73	
MD-56	MDC-45	MDC-46	5.36			4.61	0.75	4.61	0.84	
MD-57	MDC-47	MDC-44	3.29			1.85	0.72	1.85	0.72	
MD-P1	MDC-1	MDC-2	1.85	NA	NA	NA	NA	1.43	0.70	III
MD-P2	MDC-3	MDC-4	3.36					1.93	0.74	
MD-P3	MDC-4	MDC-2	5.46					3.80	0.80	
MD-P4	MDC-2	MDC-7	7.92					6.42	0.76	
MD-P5	MDC-5	MDC-6	3.36					1.53	0.61	
MD-P6	MDC-6	MDC-7	3.39					2.36	0.98	
MD-P7	MDC-7	MDC-13	11.31					8.78	0.70	
MD-P8	MDC-13	MDC-9	11.31					9.36	0.77	
MD-P9	MDC-8	MDC-9	3.29					1.27	0.83	
MD-P10	MDC-9	MDC-10	11.31					10.63	0.85	
MD-P11	MDC-14	MDC-15	3.29					1.92	0.71	
MD-P12	MDC-15	MDC-16	3.29					2.76	0.71	
MD-P13	MDC-16	MDC-10	5.36					3.21	0.79	
MD-P14	MDC-10	MDC-11	15.49					14.12	0.75	
MD-P15	MDC-17	MDC-18	3.29					1.54	0.59	
MD-P16	MDC-18	MDC-11	3.29					2.13	0.95	
MD-P17	MDC-20	MDC-4	1.78					1.44	0.92	
MD-22	MDC-11	MDC-12	20.51	16.25	0.72					
MD-40	MDC-12	MDC-31	20.51	17.40	0.72					

Table 16.6 Modeling Results of Proposed Sewers - West O St Basin Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska										
Pipe ID	US Manhole	DS Manhole	Cap. cfs	Tier I Conditions		Tier I & II Conditions		Tier I, II, & III Conditions		Tier
				Q, cfs	d/D	Q, cfs	d/D	Q, cfs	d/D	
WOP1	WO-1	AA4-5	19.24	7.96	0.48	7.96	0.48	5.28	0.38	I
WOP2	WO-2	WO-1	19.24	7.96	0.45	7.96	0.45	5.28	0.36	
WOP60	WO-68	WO-67	1.59	0.69	0.52	0.69	0.52	0.69	0.52	
WOP61	WO-69	WO-66	2.89	1.64	0.87	1.64	0.87	1.64	0.87	
WOP62	WO-71	WO-70	1.59	1.01	0.58	1.01	0.58	1.01	0.58	
WOP63	WO-70	WO-69	1.59	1.01	0.71	1.01	0.71	1.01	0.71	
WOP64	WO-62	WO-63	2.89	1.66	0.60	1.66	0.60	1.66	0.60	
WOP65	WO-63	WO-64	4.70	2.31	0.50	2.31	0.50	2.31	0.50	
WOP66	WO-64	WO-65	4.70	2.31	0.50	2.31	0.50	2.31	0.50	
WOP67	WO-65	AA4-55	4.70	2.31	0.51	2.31	0.51	2.31	0.51	
WOP68	WO-61	WO-62	2.89	1.29	0.54	1.29	0.54	1.29	0.54	
WOP69	WO-75	AA4-63	7.09	4.96	0.99	4.96	0.99	4.96	1.10	
WOP70	WO-66	WO-75	7.09	4.96	0.63	4.96	0.63	4.96	0.64	
WOP71	WO-72	WO-73	1.59	0.80	0.50	0.80	0.50	0.80	0.50	
WOP72	WO-73	WO-74	1.59	0.80	0.78	0.80	0.78	0.81	0.78	
WOP73	WO-67	WO-74	2.89	1.02	0.63	1.02	0.63	1.02	0.63	
WOP74	WO-74	WO-66	2.89	1.82	0.87	1.82	0.87	1.82	0.87	
WOP75	WO-76	WO-68	1.59	0.69	0.46	0.69	0.46	0.69	0.46	
WOP3	WO-3	WO-2	19.24	NA	NA	7.96	0.45	5.28	0.36	II
WOP4	WO-5	WO-4	10.61			0.78	0.18	2.19	0.31	
WOP5	WO-6	WO-5	10.61			0.78	0.18	2.19	0.31	
WOP24	WO-27	WO-6	11.31			8.82	0.82	8.82	0.80	
WOP25	WO-29	WO-28	5.15			3.87	0.89	3.87	0.89	
WOP26	WO-30	WO-29	5.15			3.39	0.65	3.39	0.65	
WOP27	WO-31	WO-30	1.75			1.31	0.89	1.31	0.89	
WOP28	WO-32	WO-31	1.75			1.31	0.65	1.31	0.65	
WOP29	WO-33	WO-30	1.72			1.53	0.89	1.53	0.89	
WOP30	WO-34	WO-33	1.72			1.53	0.75	1.53	0.75	
WOP32	WO-37	WO-36	5.25			4.62	0.78	4.62	0.78	
WOP33	WO-38	WO-37	3.23			3.05	0.87	3.05	0.87	
WOP34	WO-39	WO-38	3.23			1.48	0.78	1.48	0.78	
WOP35	WO-40	WO-39	1.78			1.48	0.74	1.48	0.74	
WOP37	WO-43	WO-42	10.61			3.09	0.56	3.09	0.45	
WOP38	WO-45	WO-44	7.43			3.09	0.46	3.09	0.46	
WOP39	WO-46	WO-45	7.43			2.47	0.46	2.47	0.46	
WOP40	WO-47	WO-46	3.03			2.47	0.74	2.47	0.74	
WOP41	WO-42	WO-3	19.24			7.96	0.45	5.28	0.36	
WOP42	WO-4	WO-42	10.61			0.78	0.56	2.19	0.45	
WOP43	WO-49	WO-43	10.61	3.09	0.37	3.09	0.37			
WOP44	WO-44	WO-49	10.61	3.09	0.37	3.09	0.37			
WOP45	WO-48	WO-47	1.67	1.31	0.93	1.31	0.93			
WOP46	WO-50	WO-27	11.31	8.82	0.82	8.82	0.80			
WOP48	WO-28	WO-50	11.31	8.82	0.69	8.82	0.69			

Table 16.6 Modeling Results of Proposed Sewers - West O St Basin Wastewater Facilities Master Plan Update - 2007 City of Lincoln, Nebraska										
Pipe ID	US Manhole	DS Manhole	Cap. cfs	Tier I Conditions		Tier I & II Conditions		Tier I, II, & III Conditions		Tier
				Q, cfs	d/D	Q, cfs	d/D	Q, cfs	d/D	
WOP47	WO-36	WO-28	5.25			4.95	0.89	4.95	0.89	
WOP6	WO-7	WO-6	31.99	NA	NA	NA	NA	14.94	0.55	III
WOP7	WO-8	WO-7	31.99					14.94	0.55	
WOP8	WO-9	WO-8	31.99					14.94	0.48	
WOP9	WO-10	WO-9	31.99					14.94	0.48	
WOP10	WO-12	WO-11	5.15					4.04	0.91	
WOP11	WO-51	WO-12	5.15					3.52	0.66	
WOP12	WO-14	WO-11	11.08					9.58	0.73	
WOP13	WO-15	WO-14	11.08					8.40	0.73	
WOP14	WO-16	WO-15	11.08					7.63	0.65	
WOP15	WO-17	WO-57	3.17					1.97	0.59	
WOP16	WO-18	WO-16	5.15					5.67	1.17	
WOP17	WO-20	WO-19	5.15					4.92	0.98	
WOP18	WO-24	WO-20	3.23					3.14	0.97	
WOP19	WO-25	WO-24	3.23					2.19	0.80	
WOP21	WO-21	WO-20	1.78					1.79	1.22	
WOP22	WO-22	WO-21	1.78					1.04	0.93	
WOP23	WO-23	WO-22	1.78					1.04	0.55	
WOP90	WO-11	WO-10	31.99					13.62	0.48	
WOP49	WO-13	WO-51	3.17					2.89	0.76	
WOP50	WO-52	WO-53	1.75					1.00	0.54	
WOP51	WO-53	WO-54	1.75					1.00	0.75	
WOP52	WO-54	WO-55	3.17					2.14	0.60	
WOP80	WO-55	WO-13	3.16					2.14	0.76	
WOP53	WO-57	WO-16	3.17	1.97	0.98					
WOP55	WO-56	WO-25	1.78	1.36	0.76					
WOP56	WO-19	WO-18	5.15	4.93	1.17					

16.4 SUMMARY OF RECOMMENDED IMPROVEMENTS

Recommendations for maintenance and improvements of the West 'O' Street and Middle Creek Basin Sewer Systems include:

- Existing Flows:
 - Replace C-8 and C-9 lift stations with combined lift station with storage and force main to Salt Valley trunk sewer.
 - Construct new sewer lines within the existing service area to reduce surcharging.

- Tier I Flows:
 - Construct new sewer lines to service the Tier I area.
- Tier II Flows:
 - Construct new sewer lines to service the Tier II area.
 - Add 3.0 MG of storage at J-Street (combined) lift station.
 - Construct a 1.5 MG storage facility southeast of 84th St and Interstate 80.
- Tier III Flows
 - Construct new sewer lines to service the Tier III area.
 - Expand 1.5 MG storage facility by 2.0 MG (total 3.5 MG) to handle additional Tier III flow.

The proposed alignments of the sanitary sewers are preliminary and developed for planning purposes. It is recommended that a detailed study be performed prior to designing the improvements to make certain conformance with existing and proposed development and to determine project phasing. In most cases, the alignments shown closely follow natural drainage ways. Until full development of the system, some pipes will be oversized with regard to interim flows. These sewers should be periodically inspected to determine if deposition is occurring.

To maximize the use of the recommended storage facilities it is recommended that they also be designed, constructed and operated to dampen the diurnal peaks throughout the trunk sewer system. Dampening the diurnal peaks will result in maximizing the trunk infrastructure and deliver a more constant flow to the WWTF's.

A summary of the improvement projects identified with planning costs is outlined in Table 16.7.

**Table 16.7 Recommended Improvements - West 'O' Street and Middle Creek Basins
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska**

Tier (Timing)	ID	Description	Location ⁽¹⁾	Parameters	Unit Price, \$/lf	Planning Cost ⁽²⁾
I	WO-1	36-inch	A4-66 to proposed J-Street lift station	1,500 lf	\$360.00	\$540,000
I	WO-2	15-inch	A5-141 to A4-66	1,200 lf	\$150.00	\$180,000
I	WO-3	Trunk Sewer (CIP 8.a)	Extend South of SW 60th & O St to near NW 63rd & O St			\$1,970,000 ⁽³⁾
I	WO-4	Sub-basin (CIP 8.b)	NW 43rd & NW 52nd north of I-80			\$700,000 ⁽³⁾
I	WO-5	Lift Station (CIP 8.c)	Replace LS at W. P St & Sunvalley Blvd, C-8			\$4,800,000 ⁽³⁾
I	MC-1	36-inch	C-9 lift station to proposed J-Street lift station	3,350 lf	\$360.00	\$1,206,000
I	MC-2	18-inch Force Main	Proposed J-Street lift station to Salt Valley Trunk sewer	2,000 lf	\$144.00	\$288,000
I	MC-3	Trunk Sewer (CIP 11.a)	Trunk improvements near SW 6th & E to SW 40th & A St			\$2,110,000 ⁽³⁾
I	MC-4	Siphon	Under Middle Creek	1	\$1,000,000	\$1,000,000
I	WO-6	30-inch	WO-2 to existing tie-in	2,560 lf	\$300.00	\$768,000
I	WO-7	18-inch	WO-66 to existing tie-in, WO-63 to existing tie-in	6,435 lf	\$180.00	\$1,158,000
I	WO-8	15-inch	WO-61 to WO-63, WO-69 to WO-66, WO-67 to WO-66	5,076 lf	\$150.00	\$761,000
I	WO-9	12-inch	WO-76 to WO-67, WO-71 to WO-69, WO-72 to WO-74	6,938 lf	\$120.00	\$833,000
I	MC-5	36-inch	MDC-48 to MDC-53	14,721 lf	\$360.00	\$5,300,000

**Table 16.7 Recommended Improvements - West 'O' Street and Middle Creek Basins
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska**

Tier (Timing)	ID	Description	Location ⁽¹⁾	Parameters	Unit Price, \$/lf	Planning Cost ⁽²⁾
II	WO-10	36-inch	WO-6 to WO-3	6,055 lf	\$360.00	\$2,180,000
II	WO-11	30-inch	WO-3 to WO-2	724 lf	\$300.00	\$217,000
II	WO-12	24-inch	WO-28 to WO-6, WO-44 to WO-42	7,526 lf	\$240.00	\$1,806,000
II	WO-13	21-inch	WO-46 to WO-44	1,909 lf	\$210.00	\$401,000
II	WO-14	18-inch	WO-37 to WO-28, WO-30 to WO-28	6,645 lf	\$180.00	\$1,196,000
II	WO-15	15-inch	WO-39 to WO-37, WO-47 to WO-46	6,370 lf	\$150.00	\$955,000
II	WO-16	12-inch	WO-40 to WO-39, WO-34 to WO-30, WO-32 to WO-30, WO-48 to 47	7,720 lf	\$120.00	\$926,000
II	WO-17	Storage Basin	Near proposed J-Street lift station	3,000,000 gal	\$4.00	\$12,000,000
II	WO-18	Storage Basin	Near 84th St & West O St	1,500,000 gal	\$4.00	\$6,000,000
II	MC-6	36-inch	MDC-31 to MDC-48	8,117 lf	\$360.00	\$2,922,000
II	MC-7	18-inch	MDC-44 to MDC-46	3,319 lf	\$180.00	\$597,000
II	MC-8	15-inch	MDC-42 to MDC-31, MDC-40 to MDC-32, MDC-35 to MDC-34, MDC-43 to MDC-44, MDC-47 to MDC- 44	10,582 lf	\$150.00	\$1,587,000
II	MC-9	12-inch	MDC-41 to MDC-42, MDC-39 to MDC-40, MDC-37 to MDC-33, MDC-36 to MDC-35	9,063 lf	\$120.00	\$1,088,000

**Table 16.7 Recommended Improvements - West 'O' Street and Middle Creek Basins
Wastewater Facilities Master Plan Update - 2007
City of Lincoln, Nebraska**

Tier (Timing)	ID	Description	Location ⁽¹⁾	Parameters	Unit Price, \$/lf	Planning Cost ⁽²⁾
III	WO-19	36-inch	WO-11 to WO-6	6,038 lf	\$360.00	\$2,174,000
III	WO-20	24-inch	WO-16 to WO-11	6,145 lf	\$240.00	\$1,475,000
III	WO-21	18-inch	WO-51 to WO-11, WO-20 to WO-16	7,008 lf	\$180.00	\$1,261,000
III	WO-22	15-inch	WO-25 to WO-20, WO-54 to WO-51, WO-17 to WO-16	8,124 lf	\$150.00	\$1,219,000
III	WO-23	12-inch	WO-23 to WO-20, WO-56 to WO-25, WO-52 to WO-54	7,632 lf	\$120.00	\$916,000
III	WO-24	Storage Basin	Additional storage near 84th St & West O St	2,000,000 gal	\$4.00	\$8,000,000
III	MC-10	30-inch	MDC-11 to MDC-31	3,697 lf	\$300.00	\$1,109,000
III	MC-11	27-inch	MDC-10 to MDC-11	1,218 lf	\$270.00	\$329,000
III	MC-12	24-inch	MDC-7 to MDC-10	6,022 lf	\$240.00	\$1,445,000
III	MC-13	21-inch	MDC-2 to MDC-7	1,945 lf	\$210.00	\$408,000
III	MC-14	18-inch	MDC-4 to MDC-2, MDC-16 to MDC-10	5,067 lf	\$180.00	\$912,000
III	MC-15	15-inch	MDC-3 to MDC-4, MDC-5 to MDC-7, MDC-8 to MDC-9, MDC-14 to MDC-16, MDC-17 to MDC-11	18,141 lf	\$150.00	\$2,721,000
III	MC-16	12-inch	MDC-1 to MDC-2, MDC-20 to MDC-4	3,535 lf	\$120.00	\$424,000

Notes:

1. Upstream and downstream nodes for each pipe section.
2. ENR CCI for Kansas City = 8512 (July 2006).
3. Costs from current City CIP.