

## **Executive Summary**

### **1. Introduction**

Lincoln Wastewater System (LWWS) proposes to evaluate and identify the need for various system improvements in the Oak Creek Basin to increase the level of service and provide capacity for the growth anticipated by the City of Lincoln/Lancaster County Comprehensive Plan and the Airport West Subarea Plan. This study includes the following sections:

- A summary of trunk sewer evaluations and alignment studies,
- Findings and evaluations of investigations in the project area,
- Improvement plan for 5,950 acres (Existing, Tier I, and 1,500 acres of Tier III area),
- Improvement plan for 4,450 acres (Existing and Tier I areas),
- Opinion of probable project costs for the 5,950 acres and 4,450 acres improvement plans,
- Investigations into staged improvements of Segment E-2.
- Conclusions and recommendations identifying the recommended implementation plan.

The goals for this project include the following:

- Determine the overall needs of the system for ultimate build-out and the required capacity for the trunk system.
- Leverage cost of construction for capacities of proposed and existing systems needed in the near-term versus the additional cost of improvements in the future.
- Develop a project implementation plan that will minimize the overall disruption of the area, create a cost-effective solution to meet near-term needs that is easily adaptable to long-term growth, and identify an overall plan that meets the needs of the system.

The Oak Creek Basin study area is indicated in Figure 1-1, and includes development areas identified as Existing, Tier IA, Tier IB, and Tier III. No Tier II development areas currently exist in the basin.

This project is the next step in further opening to development, areas of west Lincoln that will not only become commercial and industrial clusters, but residential opportunities as well. The potential economic impact to Lincoln with current and anticipated projects in this area is significant. The primary stakeholders that have participated in the study include the Lincoln Airport Authority (LAA), Lincoln Water System (LWS), Watershed Management, City of Lincoln Planning Department, Engineering Services, Park & Recreation, Public Works and Utilities, and other City Departments.

## **2. Findings and Evaluation of Investigations in the Project Area**

This section presents the findings and evaluation of alignment selection factors used to develop and evaluate alternative alignments. Multiple field visits were conducted by HDR personnel to determine topographic features and define alignment alternatives. A reconnaissance trip was also conducted with LWWS staff, other City department staff, and the Lincoln Airport Authority to review alignment issues. Geotechnical investigations were conducted by HWS and survey information was obtained by JEO. Figure 2-1 identifies critical locations, excavations, boring locations, and other investigation information for the following factors:

- Geotechnical Investigations
- Concrete Rubble Pit
- Survey Data of Existing Trunk Sewer
- Condition Assessment of Existing Facilities
- Existing Utilities
- Alltel
- Aquila
- Lincoln Electric System (LES)
- Lincoln Water System (LWS)
- Watershed Management
- Magellan Pipeline Company
- Sprint
- Lincoln Airport Authority Utilities
- Wetlands, Hazardous Substances, and Cultural Resources
- Pavement and Traffic Impacts
- Proposed Roadway/Railway Improvements
- Proposed Natural Resources District Improvements
- Public Relations
- Impacts and Disruptions to Existing Businesses
- Easements and Land Acquisition
- Permits and Approvals

## **3. Summary of Trunk Sewer Evaluation and Alignment Studies**

The purpose of the Trunk Sewer Evaluation and Alignment Studies is to determine the optimum alignment to provide for current and future growth in the basin. The procedure for identifying the optimal alignments is as follows:

- a. Evaluate and model the existing, Tier I, and future wastewater flow rates and capacities in the existing trunk sewer from Manhole AA6-68 to the Theresa Street WWTF.
- b. Identify improvements for the existing trunk sewer and compare these improvements to the Facility Plan Update (April 2003).
- c. Evaluate the existing, Tier I, and future wastewater flow rates and capacities in the existing collection system upstream from Manhole AA6-68.
- d. Based on the available capacity identified in the existing trunk sewer; determine where future development areas could be located within the basin. Identify the

necessary collection system improvements to serve existing, Tier I, and future development areas.

### **Trunk Sewer Evaluation**

The existing trunk sewer (Figure 3-1) was modeled and evaluated to determine the existing and Tier I flow rates and capacities. The Lincoln Wastewater Facilities Plan has indicated improvements that would be required to the trunk sewer to convey Tier I flows without submergence. Based on the results of the SWMM model for the Trunk Sewer, it was determined that no parallel improvements would be required to convey Tier I and 1,500 acres for Tier III.

### **1,500 Acres of Tier III Development**

The City of Lincoln Planning Department indicated that the 1,500 acres of additional area could be developed on either side of Oak Creek; therefore, sizing of the proposed collection system improvements assumed either:

- 1,500 acres of development on the east side of Oak Creek north of Highway 34, or
- 200 acres of development north of West Adams Street and west of the identified Tier IB areas in Figure 1-1, and the additional 1,300 acres north and west of Oak Creek.

Based on the Planning Department's recommendation, the proposed collection system for the 5,950 acre development plan was designed to allow for 1,500 acres of growth to potentially occur on either side of Oak Creek.

### **Collection System Evaluation**

Portions of the existing collection system lack capacity to convey existing and Tier I flows. The following sewers have been identified for removal/replacement as indicated in Fig. 4-1.

- Oak Creek Siphon (remove and replace)
- E-2 (undersized/parallel)
- E-3 (parallel/replace)
- E-4 (parallel/replace)
- E-5 (future construction of intermodal project)
- E-6d (undersized)

Each segment of the existing collection system was modeled to determine the available capacity and at what point in time the segment will be required to be paralleled or replaced.

Order of Magnitude Opinions of Probable Project Costs were created for the various alignments as part of the preliminary alignment study. As a result, the alignment alternatives were refined and examined in the subsequent study.

**4. Improvement Plan for 5,950 Acres (1,500 Tier III Acres)**

This section presents the improvement plan for the basin area at 5,950 acres upstream of MH AA6-68. This improvement plant includes 1,500 (Tier III) acres beyond a Tier I and Tier II flow condition. The existing, Tier IA, Tier IB, and Future (Tier III) development areas are indicated in Figure 1-1 and in Table ES-1.

<b>Table ES-1: Oak Creek Basin Areas</b>			
	West of Oak Creek (acres)	East of Oak Creek (acres)	Basin Total (acres)
Existing Areas	1,550	1,305	2,855
Tier IA	195	322	517
Tier IB	725	353	1,078
Future (Tier III)	1,500	1,500	1,500
<b>Total</b>	<b>3,970</b>	<b>3,480</b>	<b>5,950</b>

The proposed sewer alignments identified in Figure 4-3 were modeled with SWMM to verify the anticipated flows as a result of developing the Existing, Tier I, and Future (1,500 acres) areas could be handled by the sewers. Based on the modeled data, Table ES-2 was created to identify a phased improvement plan for the collection system improvements including the capacity and designated date for improvement. The phased improvement plan indicates both “Existing Areas” and “Developed Areas”. “Existing areas” indicates areas already incorporated into the City of Lincoln/Lancaster County Comprehensive Plan. “Developed Areas” indicates portions of the existing areas where development has already occurred.

<b>Table ES-2: Phased Construction of the Proposed Collection System Improvements (5,950 ac)</b>					
Phase	Existing Segment	Proposed Replacement	Capacity (cfs)	“Existing Areas” Replacement Date	“Developed Areas” Replacement Date
1	E-3	E-3	2.45 cfs	2005	2006
2	E-2	Red-1, Red-2, Pink-1 and Siphon	2.54 cfs	2005	2006*
3	E-6D	E-6D	3.30 cfs	As development requires.	
4	E-4	Yellow-2 and Orange-1	8.3 cfs	2006	2017
4	E-5	Yellow-2 and Orange-1	8.5 cfs	2009	2018
5	E-9	Pink-2	3.0 cfs	As development requires	
6	E-10	Pink-3 and Pink-4	0.7 cfs	As development requires	
7	-	Orange-2	-	As development requires	

\*The existing sewer capacity of the siphon is insufficient for the Developed Area. Replacement of E-2 is contingent on construction of the new replacement sewer Red-1, Red-2, and Pink-1.

**5.0 Improvement Plan for 4,450 Acres (Existing and Tier I Areas)**

This section presents the improvement plan for the basin area at 4,450 acres upstream of MH AA6-68. This improvement plan relates to areas identified in the Lincoln/Lancaster County 2025 Comprehensive Plan as Existing and Tier I. The existing, Tier IA, and Tier IB development areas are indicated in Figure 1-1 and in Table ES-3.

	West of Oak Creek (acres)	East of Oak Creek (acres)	Basin Total (acres)
Existing Areas	1,550	1,305	2,855
Tier IA	195	322	517
Tier IB	725	353	1,078
<b>Total</b>	<b>2,470</b>	<b>1,980</b>	<b>4,450</b>

The proposed sewer alignments identified in Figure 4-3 were modeled with SWMM to verify the anticipated flows as a result of developing the Existing and Tier I areas could be handled by the sewers. Based on the modeled data, Table ES-4 was created to identify a phased improvement plan for the collection system improvements including the capacity and designated date for improvement. The 4,450 acre development plan does not require sewer segment Orange-2 to serve the areas north of Highway 34.

Phase	Existing Segment	Proposed Replacement	Capacity (cfs)	“Existing Areas” Replacement Date	“Developed Areas” Replacement Date
1	E-3	E-3	2.45 cfs	2005	2006
2	E-2	Red-1, Red-2, Pink-1 and Siphon	2.54 cfs	2005	2006*
3	E-6D	E-6D	3.30 cfs	As development requires.	
4	E-4	Yellow-2 and Orange-1	8.3 cfs	2006	2017
4	E-5	Yellow-2 and Orange-1	8.5 cfs	2009	2018
5	E-9	Pink-2	3.0 cfs	As development requires	
6	E-10	Pink-3 and Pink-4	0.7 cfs	As development requires	

\*The existing sewer capacity of the siphon is insufficient for the Developed Area. Replacement of E-2 is contingent on construction of the new replacement sewer Red-1, Red-2, and Pink-1.

**6. Project Costs for Selected Improvements**

Capital costs developed for the alternative sewer alignments were based on opinions of cost for previous HDR projects and records from previous LWWS projects. All horizontal lengths for pipelines, tunnels, and siphons were obtained from the 2005 aerial photographs, utilizing the Lancaster County Coordinate System; vertical information was derived from the 2004 LIDAR data, all obtained from the Lincoln/Lancaster County GIS ftp site. All project costs are provided in August 2005 dollars. Additional amounts for contingencies; easement acquisition; and engineering, legal, and administrative costs were added to obtain a total opinion of probable project cost for each alignment.

The opinion of probable project cost for each sewer segment for the 5,950 acres (Existing, Tier I, and 1,500 acres of Tier III) development plan is listed in Table ES-5. The opinion of probable project cost for each segment for the 4,450 acres (Existing and Tier I) development plan is listed in Table ES-6. The complete breakdown of the capital costs for each alignment is located in Appendix B.

<b>Segment</b>	<b>Construction Cost</b>	<b>Easement Costs</b>	<b>Eng, Legal, Admin. Costs</b>	<b>Total Project Cost</b>
E-3	\$1,088,000	-	\$218,000	\$1,306,000
Additional Siphon Barrel	\$255,000	-	\$51,000	\$306,000
E-6d	\$428,000	\$86,000	\$103,000	\$617,000
Red-1 and Red-2	\$2,301,000	-	\$460,000	\$2,761,000
Pink-1 and New Siphon	\$1,067,000	-	\$213,000	\$1,280,000
Orange-2	\$1,189,000	\$99,000	\$258,000	\$1,546,000
Pink-2, 3, and 4	\$1,699,000	-	\$222,000	\$2,039,000
Yellow-2 and Orange-1	\$1,724,000	-	\$345,000	\$2,069,000
<b>Total Cost</b>	<b>\$9,751,000</b>	<b>\$185,000</b>	<b>\$1,870,000</b>	<b>\$11,924,000</b>

<b>Segment</b>	<b>Construction Cost</b>	<b>Easement Costs</b>	<b>Eng, Legal, Admin. Costs</b>	<b>Total Project Cost</b>
E-3	\$1,088,000	-	\$218,000	\$1,306,000
Additional Siphon Barrel	\$255,000	-	\$51,000	\$306,000
E-6d	\$428,000	\$86,000	\$103,000	\$617,000
Red-1 and Red-2	\$2,248,000	-	\$450,000	\$2,698,000
Pink-1 and New Siphon	\$981,000	-	\$196,000	\$1,177,000
Pink-2, 3, and 4	\$1,439,000	-	\$288,000	\$1,727,000
Yellow-2 and Orange-1	\$1,232,000	-	\$246,000	\$1,478,000
<b>Total Cost</b>	<b>\$7,671,000</b>	<b>\$86,000</b>	<b>\$1,552,000</b>	<b>\$9,309,000</b>

## **7. Additional Study of Sewer Alternative along W. Mathis St. (Segment E-3)**

The preliminary design report presented a recommendation for construction of sewer segments Red-1 and Red-2 along the east and north side of Oak Creek from Manhole AA7-21 (NW 41<sup>st</sup> Street and West Mathis Street) to Manhole AA6-68 (located just west of the main Lincoln Airport runway). Based on the costs presented for Red-1 and Red-2, Lincoln Wastewater requested further analysis for rehabilitation of the existing 27 inch trunk sewer along West Mathis Street with a revised design flow condition of Tier I versus the previously identified Tier I plus 1,500 future acres condition.

The results of the analysis indicated that it would cost more to make the improvements to Segment E-2 from Manhole AA7-21 (NW 41<sup>st</sup> Street and West Mathis Street) to Manhole AA6-68 (located just west of the main Lincoln Airport runway) when compared to constructing Red-1 and Red-2. In addition, these improvements would not be sufficient to convey Tier I flows. Therefore, this alternative plan was not considered for implementation.

## **8. Conclusions and Recommendations**

The goal for the Oak Creek Basin Trunk Sewer and Sub-Basin Sewers project was to maximize long-term value. The City of Lincoln/Lancaster County Comprehensive Plan, Airpark West Subarea plan, and LWWS Facility Master Plan were each factored into the proposed alignments and phased development plan. By considering “Developed Areas” in the “Existing Areas” identified in the Comprehensive Plan, a more realistic phased approach to the project was achieved. The trunk sewer evaluation in Section 3 identified an additional 1,500 acres of capacity that can be served in the subbasin without costly parallel/replacement projects to achieve the capacity.

Major improvements for Segments E-2, E-4, and E-5 are to be delayed because of the lack of an identified development plan in the project area. Quantifiable flow capacities for each segment were identified to allow LWWS the greatest flexibility in planning future projects in the basin. These flow capacities were thoroughly analyzed with SWMM to ensure accurate modeling results. The proposed alignments minimize the overall disruption of the area, create a cost-effective solution for near-term needs that are easily adaptable to long-term growth.

### **Project Costs**

The project costs for the 5,950 acres phased development plan (Existing, Tier I, and 1,500 acres of Tier III) are listed in Table ES-7: Opinion of Probable Project Costs (5,950 acres of Development in Basin). The project costs for the 4,450 acres phased development plan (Existing and Tier I) are listed in Table ES-8: Opinion of Probable Project Costs (4,450 acres of Development in Basin). These costs include 15% contingencies in the Construction Cost. The construction cost for all of the segments results in a cost of approximately \$8.71/dia-

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in/LF for the 5,950 acre development plan and \$7.97/dia-in/LF for the 4,450 acre development plan.

<b>Table ES-7: Opinion of Probable Project Costs (5,950 acres of Development in Basin)</b>				
<b>Segment</b>	<b>Construction Cost</b>	<b>Easement Costs</b>	<b>Eng, Legal, Admin. Costs</b>	<b>Total Project Cost</b>
E-3	\$1,088,000	-	\$218,000	\$1,306,000
Additional Siphon Barrel	\$255,000	-	\$51,000	\$306,000
E-6d	\$428,000	\$86,000	\$103,000	\$617,000
Red-1 and Red-2	\$2,301,000	-	\$460,000	\$2,761,000
Pink-1 and New Siphon	\$1,067,000	-	\$213,000	\$1,280,000
Orange-2	\$1,189,000	\$99,000	\$258,000	\$1,546,000
Pink-2, 3, and 4	\$1,699,000	-	\$222,000	\$2,039,000
Yellow-2 and Orange-1	\$1,724,000	-	\$345,000	\$2,069,000
<b>Total Cost</b>	<b>\$9,751,000</b>	<b>\$185,000</b>	<b>\$1,870,000</b>	<b>\$11,924,000</b>

<b>Table ES-8: Opinion of Probable Project Costs (4,450 acres of Development in Basin)</b>				
<b>Segment</b>	<b>Construction Cost</b>	<b>Easement Costs</b>	<b>Eng, Legal, Admin. Costs</b>	<b>Total Project Cost</b>
E-3	\$1,088,000	-	\$218,000	\$1,306,000
Additional Siphon Barrel	\$255,000	-	\$51,000	\$306,000
E-6d	\$428,000	\$86,000	\$103,000	\$617,000
Red-1 and Red-2	\$2,248,000	-	\$450,000	\$2,698,000
Pink-1 and New Siphon	\$981,000	-	\$196,000	\$1,177,000
Pink-2, 3, and 4	\$1,439,000	-	\$288,000	\$1,727,000
Yellow-2 and Orange-1	\$1,232,000	-	\$246,000	\$1,478,000
<b>Total Cost</b>	<b>\$7,671,000</b>	<b>\$86,000</b>	<b>\$1,552,000</b>	<b>\$9,309,000</b>

### **Recommended Phased Development Plan**

The recommended phased development plan for the project is indicated in Table ES-9. The “Existing Areas” represents the design flow condition for areas identified as existing in the Comprehensive Plan. The actual areas where development has occurred to-date is reflected in the “Developed Areas”. The development is significantly less than identified, thus the replacement date for portions of the collection system can be delayed. LWWS will have to monitor the development in the Oak Creek Basin to maximize their investment in the existing collection system.

<b>Table ES-9: Phased Construction of the Proposed Collection System Improvements</b>					
<b>Phase</b>	<b>Existing Segment</b>	<b>Proposed Replacement</b>	<b>Capacity (cfs)</b>	<b>“Existing Areas” Replacement Date</b>	<b>“Developed Areas” Replacement Date</b>
1	E-3	E-3	2.45 cfs	2005	2006
1	Existing Siphon	New 24” Barrel	2± cfs	2005	2006
2	E-6D	E-6D	3.30 cfs	As development requires.	
3	E-2	Red-1, Red-2,	5.2 cfs	2005	2015*
4	Improved Siphon	Pink-1 and New Siphon	14 cfs	2009	2020
5	E-4	Yellow-2 and Orange-1	8.3 cfs	2006	2017
5	E-5	Yellow-2 and Orange-1	8.5 cfs	2009	2018
6	E-9	Pink-2	3.0 cfs	As development requires	
6	E-10	Pink-3 and Pink-4	0.7 cfs	As development requires	
7	-	Orange-2	-	As development requires	

\*The existing sewer capacity of the siphon is insufficient for the Developed Area. Replacement of E-2 is contingent on construction of the new replacement sewer Red-1 and Red-2.

**Phase 1 Project**

The first phase of the Oak Creek Basin Sewer project will involve replacement of Segment E-3 with a new 42 inch sewer from West Mathis Street to West Airpark Road (MH AA7-21 to MH AA7-300). This sewer will be constructed to minimum grade requirements and will be able to convey Existing and Tier I flows, plus an additional 1,500 acres, if necessary.

The additional 24 inch barrel constructed at the existing Oak Creek siphon will increase the capacity of the siphon from 2 cfs to approximately 14 cfs. The improved siphon will not be able to convey a Tier I design flow, but will extend the life of the siphon through approximately Year 2020.

**1,500 Acres of Tier III Development**

This study identified two recommended development plans: 5,950 acres and 4,450 acres. As indicated in Section 3, there exists capacity in the existing trunk sewer from MH AA6-68 to the Theresa Street WWTF to convey this additional 1,500 acres beyond a Tier I flow condition. During the study, there was no indication from the Planning Department as to the specific location for the 1,500 Tier III acres to be included. In

addition, it was undetermined if the 1,500 acres would even be allowed to develop in the basin because of the additional cost to serve the potential Tier III areas. Phase 1 of the project can be designed and installed without a determination of the status of the 1,500 acres of Tier III area. Future sewer phases will require a decision on the location to minimize the capital costs of the project.