

## **2.1 BACKGROUND**

### **2.1.1 History**

The City of Lincoln has been operating a wastewater collection system since 1888. The original collection system collected and conveyed the wastewater to Salt Creek. The first wastewater treatment facility in Lincoln began operation in 1923 and was operated by Sanitary Improvement District No. 1. In 1957, the Sanitary District deeded the original wastewater treatment facility to the City. This treatment facility was located at 24th and Theresa Streets, where the Theresa Street treatment facility still exists to this day. A more complete history of wastewater treatment in the City of Lincoln is located in Appendix A.

### **2.1.2 Reason for Updating the Wastewater Facilities Master Plan**

The City of Lincoln last updated their Wastewater Facilities Master Plan in 2003. Since that time the City's population has continued to grow at a steady rate. This growth is the main driving factor for this Wastewater Facilities Master Plan Update and the system improvements that will be identified. Since the last facilities plan update there have been several improvements made to the wastewater systems that have changed and modified the system capacities. These changes need to be incorporated into the overall system wide evaluation that will determine how these changes and modifications affect the overall system capacity and operating characteristics. The ever changing impacts that new and proposed regulations have on the facilities will also be factored into the evaluation to determine future needs.

In addition to identifying new facilities, this Master Plan Update will also identify existing facilities that need to be upgraded or rehabilitated to efficiently serve the existing as well as future service needs.

Generally, the information contained in this Update will be used for general planning, identifying capital improvement projects, asset management, and as an aid in determining funding requirements.

### **2.1.3 2030 Comprehensive Plan**

This updated Wastewater Facilities Master Plan has been developed in conjunction with the 2030 update of the Lincoln City-Lancaster County Comprehensive Plan. The Comprehensive Plan has identified three tiers of growth for the City of Lincoln.

Tier I reflects the future service area where wastewater services are anticipated by 2030. Tier I areas currently encompass an area of 52 square miles which could generally expect

service within the next 25 years. Tier I areas are those that are generally contingent with the existing City boundaries and development.

Tier II areas encompass approximately 70 square miles and are generally located further from the existing City service area. Tier II represents a potential longer term growth area which may not need service for 25 years or longer.

Tier III areas are currently identified as approximately 85 square miles. Services in these areas are only considered in this update as future long term growth. Therefore, the improvements and recommendations identified for Tier I areas will be in greater depth than those in Tier II areas. Likewise, the improvements identified for Tier III areas will be considered conceptual, and be of less detail than those identified for Tier II.

## **2.2 FACTORS THAT AFFECT FACILITIES PLANNING**

Since the completion of the 2003 Wastewater Facilities Plan Update, a number of factors that affect the planning and design of improvements to the wastewater systems have been identified.

### **2.2.1 Population Increases**

The City of Lincoln population has historically increased over time. This growth is expected to continue at a steady rate for the foreseeable future. It is envisioned that this growth will tax existing wastewater collection and treatment systems at some time in the future. The intent of this update is to identify the improvements needed to accommodate the anticipated growth for the planning periods.

### **2.2.2 Regulatory Changes**

Regulations that affect the operation and maintenance of wastewater collection and treatment systems are continually being updated and modified to meet changing conditions. These changes in regulations have a direct impact on the level of future treatment required and the quality of the discharged effluent and other byproducts generated by the treatment process. Regulations that impact the collection and treatment of wastewater are addressed in detail in Section 6.

### **2.2.3 Condition and Age of Facilities**

The City's wastewater collection system dates back to 1888 when the first sanitary sewer lines were installed in the Lincoln area. The older sections are considered to be outdated with respect to materials of construction and current construction techniques. Replacement and/or rehabilitation of less than 1.0-percent of the existing older lines and other lines in need of replacement and repair of the collection system currently occurs on an annual basis. Increasing the amount of funding for additional replacement and rehabilitation of

older and critical lines may be necessary to provide reliable service and to minimize the quantity of extraneous Infiltration and Inflow (I/I) that enters the system.

The original wastewater treatment facilities were constructed at the current Theresa Street site in 1923. The system was upgraded and expanded in the 1940's to include the trickling filter process. Subsequent expansions in 1966 and 1973 added the west side and east side activated sludge treatment trains. Currently the WWTF is undergoing another expansion that when completed will bring the total average daily treatment capacity to 27 mgd.

The Northeast WWTF was placed into service in 1981. In 2004, the facility was expanded to bring the total average daily capacity of the WWTF to 10 mgd.

## **2.3 PLANNING GOALS AND OBJECTIVES**

The overall goal of this Wastewater Facilities Master Plan Update is to determine and verify the capacity of the existing facilities, and to identify collection and treatment system modifications that are required to:

1. Provide efficient wastewater collection and treatment service for existing as well as future users in the City of Lincoln.
2. Provide for continued protection of public health and the environment.
3. Comply with relevant local, State, and Federal operating permits, regulations, and other requirements.
4. Continue growth and development policies of providing gravity sanitary sewer service in drainage basins.

## **2.4 IDENTIFIED IMPROVEMENTS**

Because future growth details such as the location of roads and other features are not known at this time, the facilities plan update addresses future wastewater collection and treatment needs in a general way. For example, identified extensions to the trunk sewer system are generally shown following the natural drainage such as creeks and streams. As development proceeds into specific areas, the actual physical characteristics and final locations of the wastewater collection system will need to be determined and finalized through additional detailed engineering and siting studies.

## **2.5 RELATED STUDIES, REPORTS, AND DOCUMENTS**

During the course of preparing this update, several related studies, reports, memorandums, improvement plans, and other documents were prepared for the City of Lincoln, were used, referenced and incorporated into this work. The following list includes, but is not limited to the documents that were incorporated into the preparation of this update

1. Lincoln Wastewater Facilities Plan, Salt Valley Study Area, 1981, Black & Veatch Consulting Engineers.
2. Lincoln Wastewater Facilities Plan, January 1995, Brown and Caldwell.

3. Lincoln Wastewater Facilities Plan Update, April 2003, Brown and Caldwell and Montgomery Watson.
4. Upper Southeast Salt Creek Trunk Sewer Preliminary Routing Corridor Study and Design, Draft August 2004, EA Engineering, Science and Technology, Inc.
5. Salt Valley Trunk Relief Sewer Improvements, Phases I through V, September 1998, Montgomery Watson.
6. Theresa Street Wastewater Treatment Facilities, Egg-Shaped Digester System Inspection, August 2005, Brown and Caldwell.
7. Theresa Street Wastewater Treatment Facility Improvements Pre-Design Report, September 2003, HDR Engineering, Inc.
8. Nitrification Improvements Theresa Street Wastewater Treatment Facility Operations Manual, Draft March 2006, HDR Engineering, Inc.
9. Grit Handling Improvements Theresa Street Wastewater Treatment Facility, October, 2002, Black & Veatch and Olsson Associates.
10. Stevens Creek Basin Trunk Sewer Preliminary Design Report, January 2005, Carollo Engineers.
11. Upper Southeast Sub-basin Sewers Final Design Memorandum, August 2005, HDR Engineering, Inc.
12. Oak Creek Basin Trunk Sewer and Sub-basin Sewers Preliminary Design Report, May 2006, HDR Engineering, Inc.
13. Final Design Memorandum, Middle Creek Drainage Basin and West 'D' Street Lift Station Trunk Sewers, Kirkham Michael & Associates.
14. Memorandum, Final Beal Slough Evaluation, June 2001, Montgomery Watson.
15. West Salt Creek Trunk Sewer Alignment Study Report, August 2007, Black & Veatch and Olsson Associates.
16. Memorandum, Beal Slough Relief Trunk Sewer - Redesign, November 2005, Black & Veatch.
17. Northeast Salt Creek Basin Collection System Study, January 2004, Kirkham Michael & Associates.
18. Solids Handling and Processing Improvements at Northeast WWTF Technical Memorandum's 1, 2, and 3, HDR Engineering, Inc.
19. Study and Evaluation of Solids Treatment and Handling at the Theresa Street and Northeast Wastewater Treatment Facilities, January 2007, HDR.
20. Design Memorandum, NE WWTF Nitrification Improvements, October 2003, Black & Veatch.
21. Design Memorandum, Northeast Wastewater Treatment Facility Grit Handling Improvements, August 2004, Black & Veatch and Olsson Associates.
22. Memorandum, Theresa Street WWTF Flood Storage Evaluation (Draft), July 28, 2007, CDM.

23. Theresa Street WWTF Odor Abatement Study.
24. Draft Siting Study Southwest Wastewater Facility, March 2007, Black & Veatch.
25. Other, numerous Collection System and Wastewater Treatment Facility Improvement Project Plans and Reports.

## **2.6 GENERAL TERMINOLOGY**

The following terms and abbreviations are of special interest and are used throughout this report. It should be noted that there are other abbreviations that are used in this document as well as to identify City facilities. A more complete listing of abbreviations is located in Appendix B.

### **2.6.1 Facilities**

Northeast Wastewater Treatment Facility (Northeast WWTF).

Theresa Street Wastewater Treatment Facility (Theresa Street WWTF).

Wastewater Treatment Facility (WWTF).

### **2.6.2 Wastewater Flow**

Annual Average Daily Flow (AAD) - The average daily flow that passes through a facility on an annual basis is expressed as the annual average daily flow (AAD).

Gallons per Capita per Day (gpcd) - The average wastewater yield per person per day.

Maximum Month Average Day (MMAD) - The maximum month average day flow is the average daily flow rate for the month of maximum wastewater flow.

Million Gallons per Day (mgd) - The amount of flow expressed in millions of gallons per day.

Peak Daily Flow (PDF) - The peak daily flow represents the maximum flowrate entering the WWTF during a single day.

Peak Hourly Flow (PHF) - The maximum flow entering the WWTF during any one hour period.

Infiltration and Inflow (I/I) - Infiltration is groundwater that enters the collection system through leaking pipes or manholes. Inflow is the extraneous surface water that enters into the system though leaking manhole covers, roof drains, and similar sources.

Rainfall Dependent Infiltration and Inflow (RDII) - RDII is the inflow and infiltration that is attributed to precipitation events.

Peak Wet Weather Flows (PWWF) - Peak wet weather flows are extremely high flows that occur in conjunction with an unusually large precipitation event.

Sanitary Sewer Overflow (SSO) - Situation where conveyed wastewater in sanitary sewer collection systems overflows. This generally occurs at manholes and junction structures, but can occur at other locations.

### **2.6.3 Wastewater Constituents**

Five Day Biological Oxygen Demand (BOD<sub>5</sub>) - One factor defining wastewater strength is its five day biochemical oxygen demand (BOD<sub>5</sub>). BOD<sub>5</sub> is described as the amount of oxygen required over a five-day period at 20°C by bacteria while stabilizing decomposable organic matter under aerobic conditions.

Carbonaceous Biological Oxygen Demand (CBOD) - A measure of the carbon-containing substances remaining in wastewater that may exert a demand for oxygen when released into a stream.

Chemical Oxygen Demand (COD) - The COD is used to measure the strength of the wastewater. To determine the amount of oxygen required to stabilize the waste the organic matter is converted to carbon dioxide and water under acidic conditions.

Total Suspended Solids (TSS) - TSS is defined as the amount of suspended material in the wastewater.

Total Kjeldahl Nitrogen (TKN) – TKN represents the combination of organic nitrogen and ammonia that is present in the influent wastewater.

Ammonia (NH<sub>3</sub>) – NH<sub>3</sub> is an wastewater parameter that is measured both on the influent and effluent.

Nitrate (NO<sub>3</sub>) – When NH<sub>3</sub> is aerated (oxidized) under aerobic conditions in the wastewater treatment facility it is converted to NO<sub>3</sub>. NO<sub>3</sub> may further be reduced to nitrogen gas (N) in anoxic conditions.

Phosphorus (P) – P is another important parameter used to characterize the wastewater. Orthophosphates and polyphosphates are the primary compounds of interest in water quality and wastewater treatment facility design and operation.

## **2.7 WASTEWATER AND SOLID WASTE ORGANIZATION**

The City of Lincoln wastewater and solid waste programs are administered under the direction of the Utilities Coordinator. The wastewater and solids waste programs are divided into the following four departments:

1. Wastewater Collection - includes maintenance, inspection, and construction of wastewater collection system piping.
2. Water Pollution Control - includes maintenance and operation of treatment facilities and lift station.
3. Solids Waste - includes maintenance and operation of solids waste handling, disposal, and recycling.
4. Engineering - includes engineering support, monitoring, and laboratory analysis for each of the wastewater and solid waste programs.

Figure 2.1 shows the organization chart for the wastewater and solid waste programs.

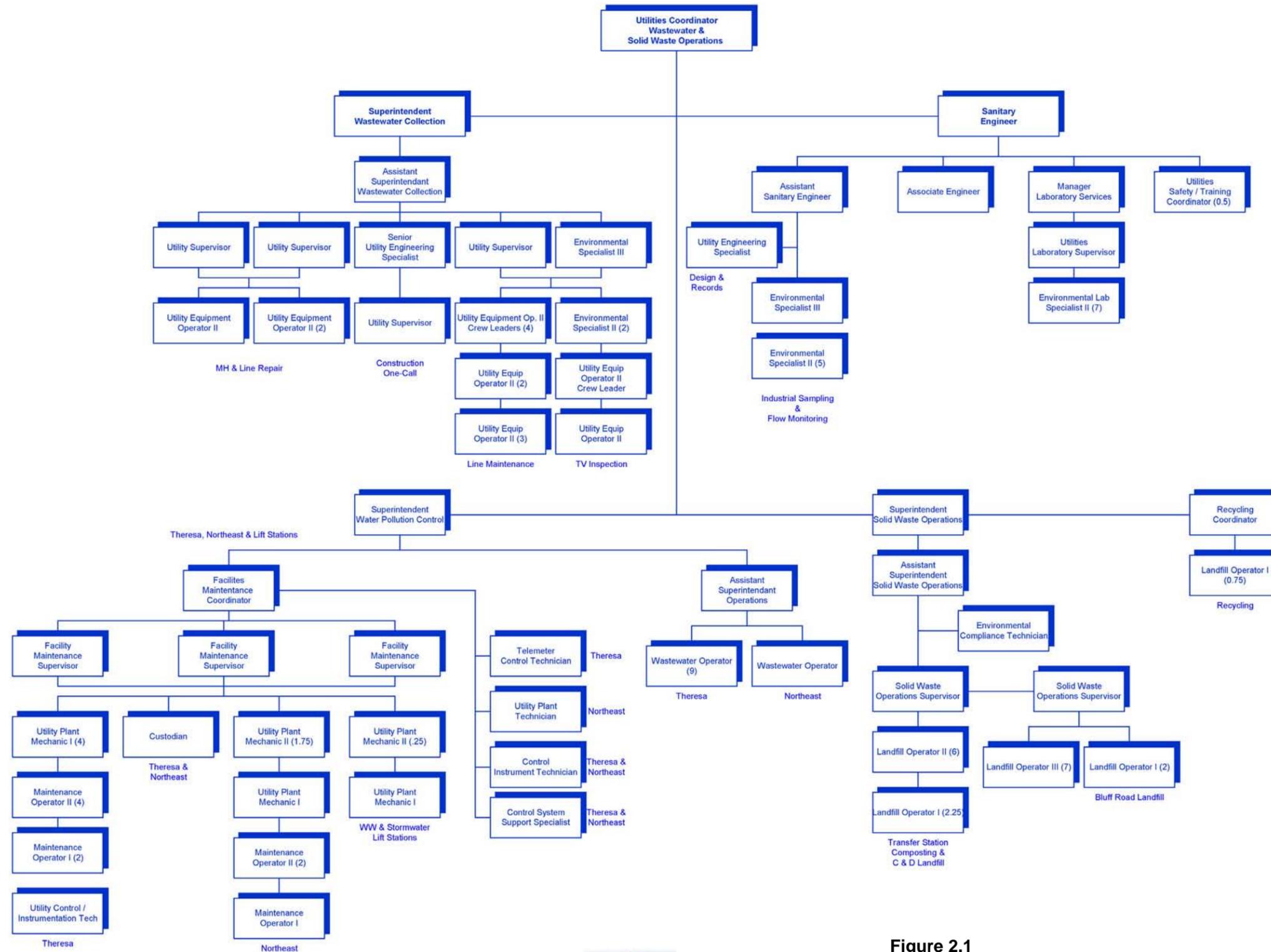
## **2.8 ACKNOWLEDGMENTS**

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3. Mr. Brian Kramer, Superintendent of Collection.
4. Mr. Randy Wilson, Superintendent of Water Pollution Control facilities.
5. Mr. Steve Crisler, Facilities Maintenance Coordinator.
6. Mr. Dave Beyersdorf, Associate Engineer.
7. Roger Krull, Assistant Supervisor of Collection.
8. Ms. Deborah Byrne, Sanitary Engineer.

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# Lincoln Wastewater System & Solid Waste Operations Proposed FY 2007 - 2008



**Figure 2.1**  
City of Lincoln Wastewater & Solid Waste System Organization Chart  
Wastewater Facilities Master Plan Update - 2007  
City of Lincoln, Nebraska