CHAPTER 1

EXECUTIVE SUMMARY

Background

The City of Lincoln's last wastewater facilities plan update was completed in 1995. Since then, several regulations have been promulgated or are anticipated that will impact the City's wastewater treatment requirements. Lincoln's increasing population and the overall age of some wastewater system components are also driving the need for system improvements. The long-term capital projects required to address these issues will take several years to complete.

This updated Wastewater Facilities Plan was developed in conjunction with the 2002 Lincoln-Lancaster County Comprehensive Plan to proactively address wastewater issues and assure that the City is well prepared to meet wastewater service needs when they occur. Wastewater collection and treatment facilities required over the next 25 years have been identified to guide planning for both short and long-term improvements. The information contained in this report is to be used for general planning, identifying capital improvement projects, and determining funding requirements.

Planning Goals and Objectives

The overall goal of the 2003 Lincoln Wastewater Facilities Plan Update is to identify wastewater collection and treatment system modifications required to:

1. Provide efficient wastewater service,
2. Assure adequate protection of public health and the environment, and
3. Comply with all relevant local, state, and federal regulations.

Study Area Boundaries

The study area includes:

1. The entire City of Lincoln, Nebraska;
2. Portions of the Middle Creek and Haines Branch basins to the west;
3. Cardwell Branch, located in the southwest;
4. The Upper Salt Creek and Beals Slough areas to the south;
5. Little Salt Creek and Lynn Creek drainages to the north and northwest;
6. Northeast Salt Creek drainage to the north and northeast; and
7. Stevens Creek to the east.

Population Projections

Future wastewater utility needs for 25-year (Tier I) and 50-year (Tier II) planning horizons have been developed using population projections provided by the Lincoln-Lancaster County Planning Department. These projections are shown in Table 1-1.

Table 1-1. City / County Population Projections

Year	City of Lincoln	Annual % Increase	Lancaster County	Annual % Increase
2001	225,581	1.5	250,291	1.5
2005	243,015	1.5	269,634	1.5
2010	261,796	1.5	290,473	1.5
2015	282,029	1.5	312,922	1.5
2020	303,825	1.5	337,106	1.5
2025	327,306	1.5	363,159	1.5
2030	352,601	1.5	391,225	1.5
2035	379,852	1.5	421,460	1.5
2040	409,208	1.5	454,032	1.5
2045	440,833	1.5	489,122	1.5
2050	474,903	1.5	526,923	1.5

The population projections shown in Table 1-1 indicate that the historical growth trend is expected to continue. The result will be approximately 102,000 and 113,000 additional people in the City of Lincoln and Lancaster County respectively by the year 2025. This represents an annual growth rate of 1.5 percent.

Wastewater Collection

The existing Lincoln wastewater collection system service area covers 13 drainage basins encompassing over 50 square miles. These drainage basins include:

1. Salt Creek
2. West “O” Street
3. Beals Slough
4. Haines Branch
5. Middle Creek
6. Antelope Creek
7. East Campus
8. Oak Creek
9. Little Salt Creek
10. Lynn Creek

11. Deadmans Run
12. Havelock
13. Regent Heights (portion of West Stevens Creek drainage basin)

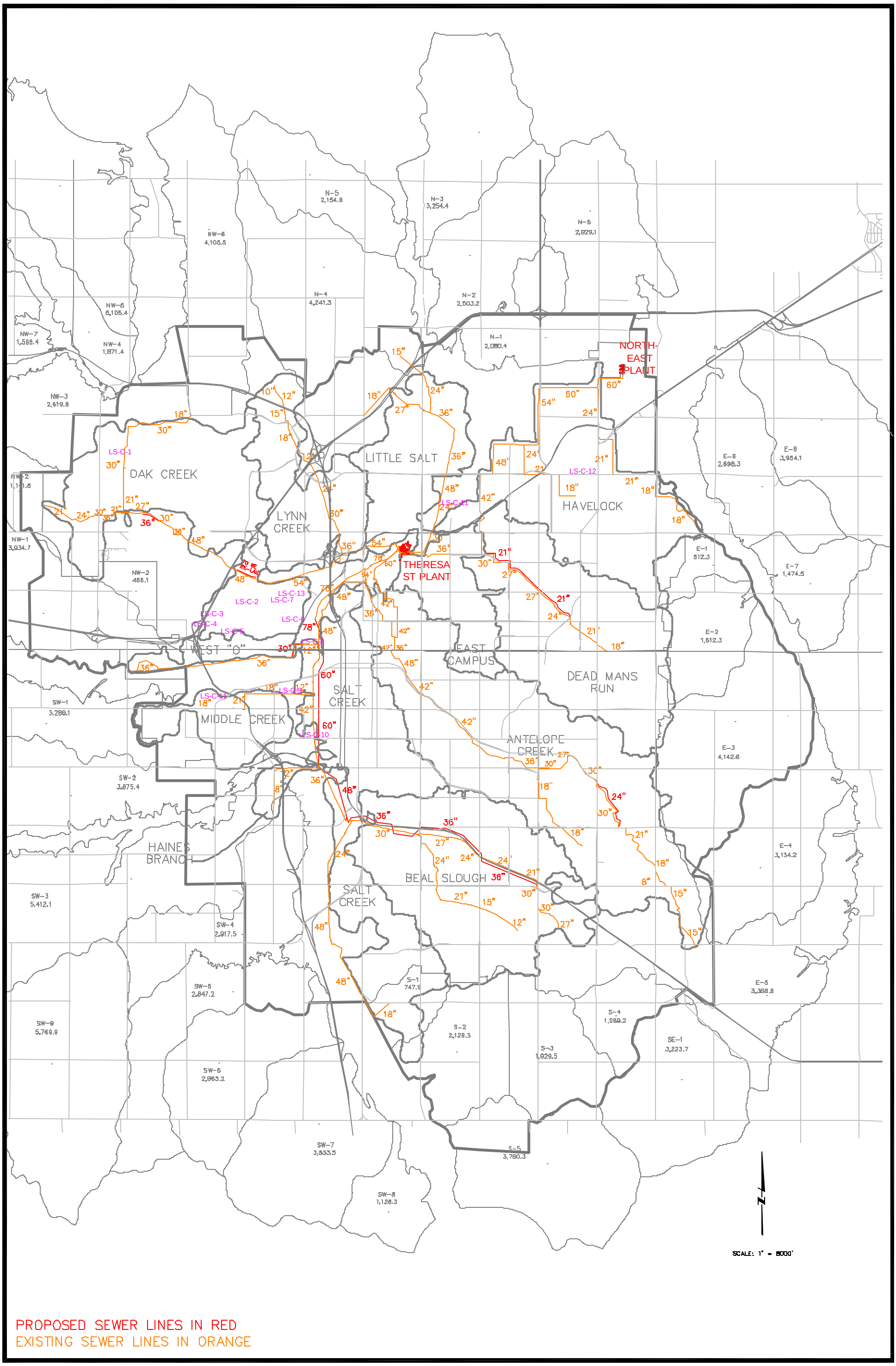
The Lincoln wastewater collection system includes over 800 miles of wastewater collection pipelines ranging in size from 8-inch to 90-inch in diameter. Flow through the system is predominantly by gravity, however some low elevation areas are served by wastewater lift (pumping) stations. There are a total of 14 lift stations located throughout the collection system. The existing wastewater collection system is shown in Figure 1-1.

Collection System Needs. Some portions of the collection system are hydraulically overloaded under current conditions. These include pipelines serving portions of the Salt Creek, Beals Slough, Deadmans Run, and West "O" drainage basins. In each of these cases, construction of new collection lines to parallel the existing overloaded lines is recommended. Improvements recommended to address these hydraulic problems are listed in Table 9-1 in this report. Some of these recommended improvements are already underway. In the case of the Deadmans Run pipeline, the existing line is quite deep and the overloaded condition does not appear to be creating any immediate functional problem. Before a parallel pipeline is constructed to alleviate the overloaded condition in Deadmans Run, additional monitoring and evaluation are recommended to determine the extent and impact of the existing loading conditions.

As population growth occurs within the service area, the system will have to be further upgraded and expanded to meet service needs. It is recommended that the gravity character of the Lincoln Wastewater Collection System be maintained to the extent possible as the system is expanded to accommodate future development.

The timing associated with future system improvements within each drainage basin will depend on the rate of development within the basin. For the purposes of this planning effort, development projections for "Tier I" and "Tier II" were taken from the 2002 Lincoln-Lancaster County Comprehensive Plan. Based on this information, wastewater collection system projects required to meet future service requirements have been identified in the Salt Creek, Antelope Creek, Beals Slough, Middle Creek, Little Salt Creek, Northeast Salt Creek, Oak Creek, and Stevens Creek basins. Specific wastewater collection system upgrade and expansion projects in these areas were identified based on the Tier I and Tier II development scenarios and are presented in Tables 9-1 and 9-2 of this report. The recommended Tier I improvements are shown in Figure 1-2. The recommended Tier I improvements have been categorized as Priority A or Priority B in a manner consistent with needs projected in the Comprehensive Plan. Tier II improvement recommendations are all considered together with no assigned priorities. As future development occurs, the wastewater collection service plan should be revised and updated to appropriately reflect changing conditions.

The Sevens Creek drainage area has substantial development potential, but the majority of the area is currently not served by the City's wastewater collection system. It is recommended that a detailed routing study be performed to identify the most logical pipeline routing configuration to serve this growth area with a gravity wastewater collection system.



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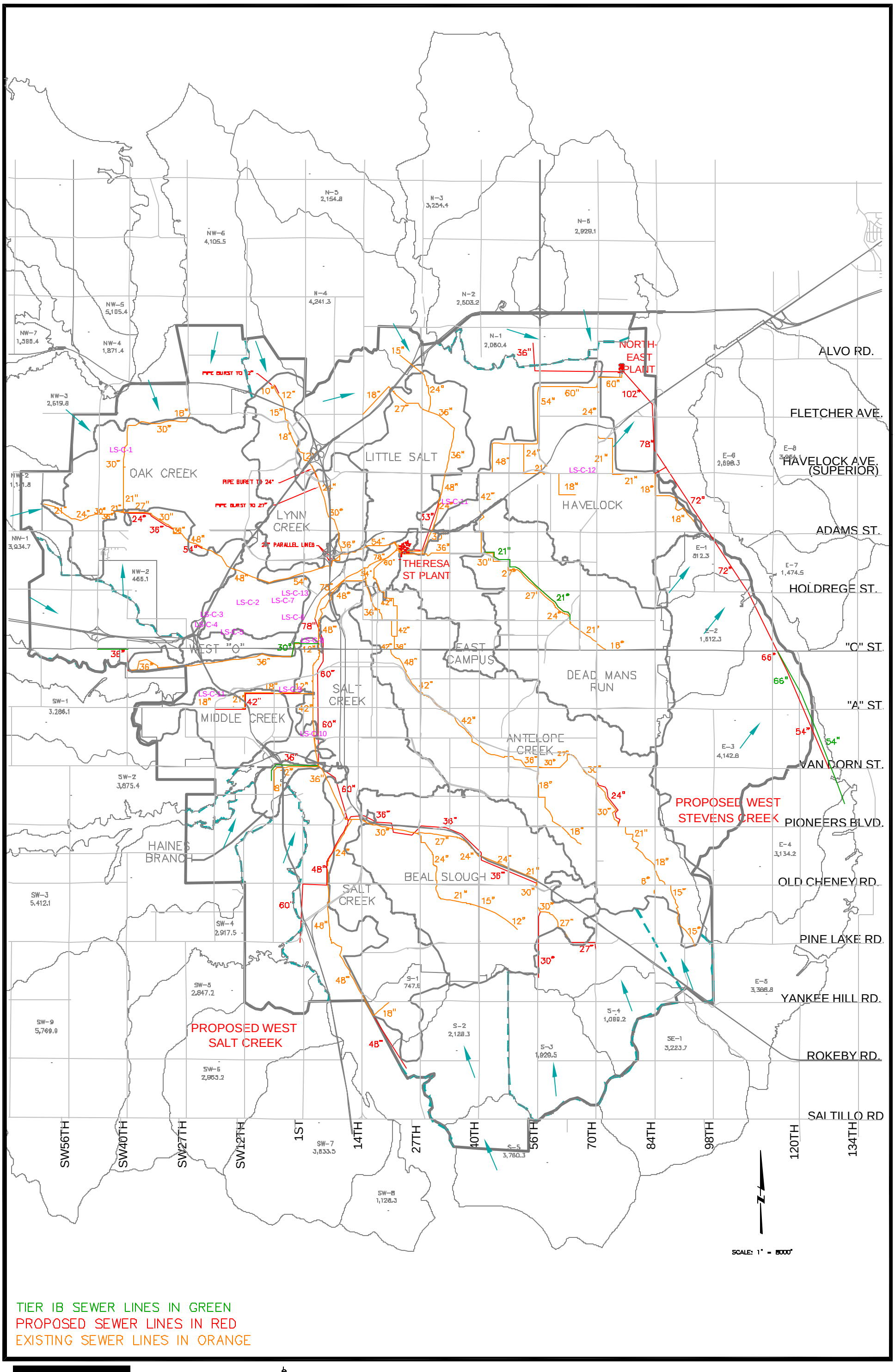
Lincoln Wastewater System Facilities Plan Update
CITY OF LINCOLN
SANITARY SEWER BASINS

Figure 1-1

EXISTING WASTEWATER COLLECTION SYSTEM



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Lincoln Wastewater System Facilities Plan Update
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SANITARY SEWER BASINS

Figure 1-2

RECOMMENDED TIER I WASTEWATER COLLECTION SYSTEM IMPROVEMENTS

Wastewater Treatment

Wastewater Flows. Table 1-2 presents projected wastewater flows based on the year 2000 per capita flow rates, the service area population projections, and historical dry weather peaking factors.

Table 1-2. Wastewater Flow Projections (mgd)

		2000*	2010	2025	2050
Theresa Street WWTF					
	Daily Average (ADF)	16.8	19.5	24	36
	Maximum Month (MMF)	18.6	21.6	27	40
	Peak Day (PDF)	25.5	29.6	37	54
	Peak Hour (PHF)	32.4	37.7	47	69
Northeast WWTF					
	Annual Average (ADF)	6.8	7.9	10	15
	Maximum Month (MMF)	7.8	9.1	11	17
	Peak Day (PDF)	10.5	12.2	15	23
	Peak Hour (PHF)	13.3	15.4	19	28
Total Annual Average (ADF)		23.6	27.4	34	51
Total Maximum Month (MMF)		26.4	30.7	38	57
Total Peak Day (PDF)		36.0	41.8	52	77
Total Peak Hour (PHF)		45.7	53.1	66	97

*Actual Flow

It is recommended that the Lincoln Wastewater Treatment Facilities (WWTFs) be designed to treat projected peak hourly flows presented in Table 1-2. Wet weather flows in excess of these values should be handled using special wet weather flow facilities.

Existing Treatment Facilities. The Lincoln wastewater service area is currently served by two wastewater treatment facilities. The Theresa Street WWTF is the larger of the two facilities and is located at 2400 Theresa Street in Lincoln. The Theresa Street WWTF currently consists of preliminary treatment followed by three distinct treatment trains:

1. The Trickling Filter Train,
2. The West Side Activated Sludge Train, and
3. The East Side Activated Sludge Train.

Flows from all three treatment trains are combined prior to disinfection. The original design capacity of the Theresa Street WWTF, including all three treatment trains was 30 million gallons per day (mgd). This was based on treatment to meet only standard secondary treatment requirements.

The second facility, the Northeast WWTF, is located at 7000 North 70th Street in Lincoln. The Northeast WWTF consists of a single treatment train including preliminary treatment, primary treatment, secondary treatment using an activated biotower process, and disinfection. The original design capacity of the Northeast WWTF was 8 mgd based on treatment to meet standard secondary treatment requirements only.

Treatment Requirements. New effluent discharge limits proposed by the Nebraska Department of Environmental Quality (NDEQ) will require both the Theresa Street and Northeast WWTFs to meet effluent discharge limits for ammonia in addition to the standard secondary treatment requirements that have been required in the past. The City has worked with the NDEQ, the U.S. Environmental Protection Agency (US EPA), and other agencies over the last decade to establish effluent ammonia limits that will meet state surface water quality standards for protecting aquatic wildlife in Salt Creek, the creek to which effluent from both facilities is discharged. Though the final effluent ammonia limits have not yet been formally adopted, the anticipated limits are presented in Table 1-3.

Table 1-3. Anticipated Effluent Ammonia Limits*
(Calculated with 30-day Averaging Period for
Waste Load Allocation Long-Term Average Multiplier)

Treatment Facility	Spring		Summer		Winter	
	Monthly Avg	Daily Max	Monthly Avg	Daily Max	Monthly Avg	Daily Max
	mg/L – N	mg/L – N	mg/L – N	mg/L – N	mg/L – N	mg/L -N
Theresa Street						
2008	8.29	21.71	2.88	7.55	8.34	21.84
2013	8.20	21.46	2.75	7.21	8.27	21.64
2025	8.05	21.07	2.55	6.68	8.15	21.31
2050	6.93	18.14	2.23	5.84	7.96	20.85
Northeast						
2008	13.99	36.62	5.68	14.86	14.87	38.93
2013	13.50	35.53	4.98	13.03	14.35	37.56
2025	12.45	32.58	4.18	10.94	13.81	36.16
2050	7.45	19.51	2.48	6.49	8.21	21.50

* The effluent ammonia limits shown are not final and are based on the best information available at the time this report was prepared (March 2003).

In addition to meeting the effluent ammonia limits indicated in Table 1-3, it is expected that both treatment facilities will be required to treat peak wet weather flows sufficiently to meet secondary standards in accordance with the anticipated Sanitary Sewer Overflow (SSO) regulations.

Existing Treatment Capacities. As part of the facilities plan update, the capacities of the Theresa Street WWTF and the Northeast WWTF were evaluated in terms of their capability to meet the proposed effluent ammonia limits. These capacities are summarized in Table 1-4.

Table 1-4. Capacity Summary - Lincoln Wastewater Treatment Facilities

Facility	Hydraulic Capacity*	Nitrification Capacity**
Theresa Street WWTF	36 mgd	14.4 mgd
Northeast WWTF	37 mgd***	4.4 mgd

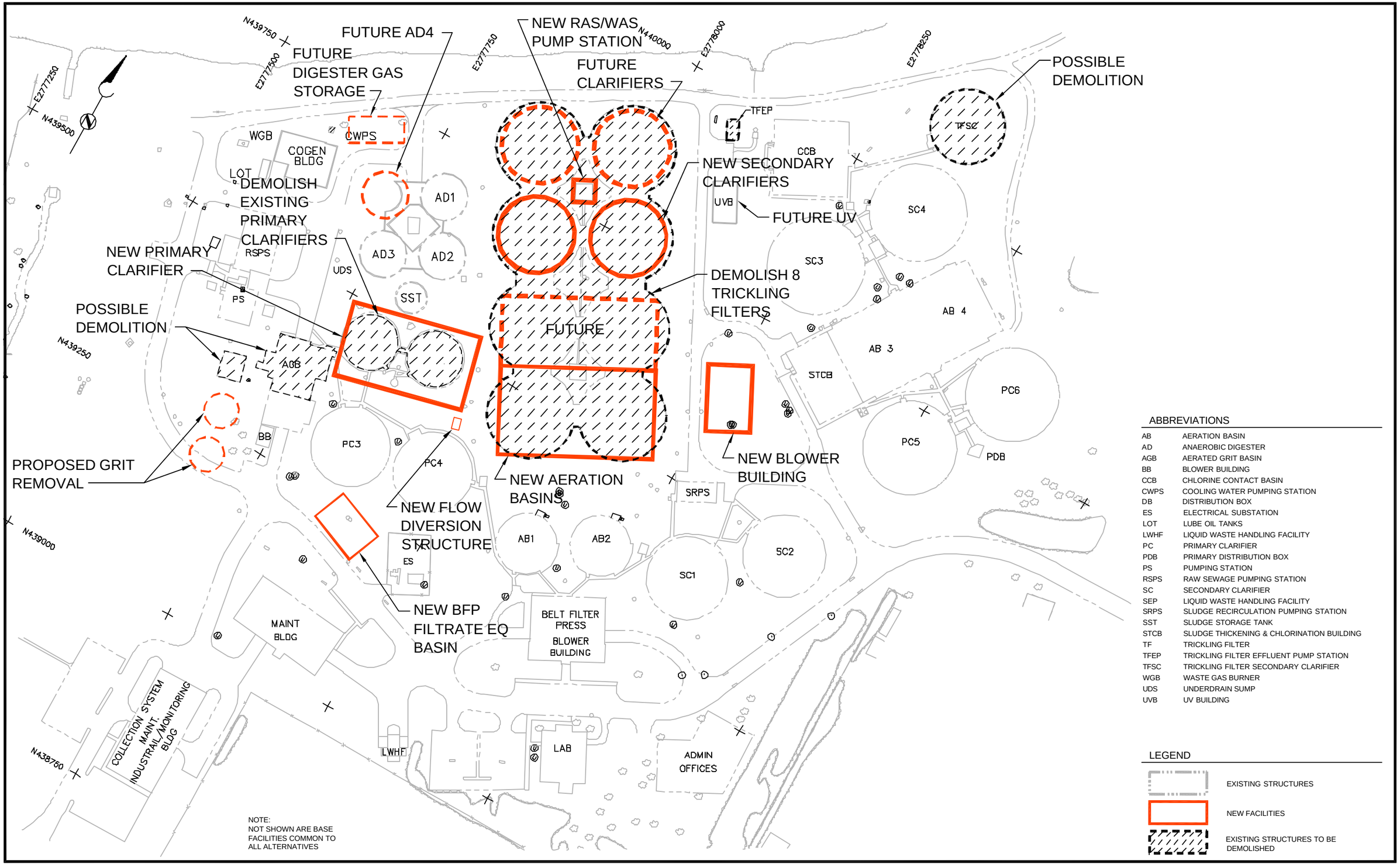
* The hydraulic capacity indicated represents the most hydraulically limiting segment of the treatment facility. For the Theresa Street facility the most limiting segments are the disinfection and outfall segments. For the Northeast facility the most limiting segments are the aeration basins and the chlorine contact basin.
** The nitrification capacity of both facilities is limited by the combination of aeration basin size and secondary clarifier sizes and is based on maximum monthly flow rates.
*** High flows experienced in 1993 indicate that Northeast WWTF hydraulic capacity is significantly less than 37 mgd. Further research should be conducted to identify the hydraulic limitations experienced in 1993.

These capacities are both significantly below the current wastewater flows received at the WWTFs, indicating that the treatment capacity of both facilities must be expanded to comply with treatment requirements for existing flows as well as projected future flows.

Preferred Treatment Alternatives. Alternative methods of providing the required treatment capacity at both the Theresa Street and Northeast WWTFs were identified and evaluated. The preferred method of providing the additional treatment capacity required at the Theresa Street WWTF involves replacing the existing trickling filter process train with a new activated sludge treatment train. The new activated sludge train should be designed to provide an additional nitrifying capacity of 13 mgd, bringing the total nitrifying treatment capacity at the Theresa Street WWTF to approximately 27 mgd. This is sufficient capacity to adequately treat the maximum 30-day wastewater flow expected at the Theresa Street facility through 2025. A site layout for the proposed Theresa Street WWTF is shown in Figure 1-3. Several system improvements not directly related to providing increased nitrification capacity at the Theresa Street WWTF are also recommended between 2002 and 2025.

The additional nitrifying capacity required at the Northeast WWTF should be provided by expanding the treatment capacity of the existing activated biotower system. An additional 6 mgd of nitrifying capacity should be provided through the expansion. It is recommended that this capacity expansion be accomplished in two separate phases. The first phase would involve rehabilitation of the biotowers and the subsequent phase would include expansion of the aeration basins and secondary clarifiers. This will bring the nitrifying capacity of the Northeast WWTF to approximately 11 mgd. This capacity will be sufficient to treat the maximum 30-day flows anticipated at the facility through 2025. A site layout for the proposed Northeast WWTF is shown in Figure 1-4. A number of improvements not related to providing increased nitrification capacity are also recommended at the Northeast WWTF.

Increased biosolids handling and land application capabilities will be required for both the Theresa Street and Northeast facilities. This will include primarily additional digester capacity at Theresa Street and application acreage at the Northeast facility.



ABBREVIATIONS

AB	AERATION BASIN
AD	ANAEROBIC DIGESTER
AGB	AERATED GRIT BASIN
BB	BLOWER BUILDING
CCB	CHLORINE CONTACT BASIN
CWPS	COOLING WATER PUMPING STATION
DB	DISTRIBUTION BOX
ES	ELECTRICAL SUBSTATION
LOT	LUBE OIL TANKS
LWHF	LIQUID WASTE HANDLING FACILITY
PC	PRIMARY CLARIFIER
PDB	PRIMARY DISTRIBUTION BOX
PS	PUMPING STATION
RSPS	RAW SEWAGE PUMPING STATION
SC	SECONDARY CLARIFIER
SEP	LIQUID WASTE HANDLING FACILITY
SRPS	SLUDGE RECIRCULATION PUMPING STATION
SST	SLUDGE STORAGE TANK
STCB	SLUDGE THICKENING & CHLORINATION BUILDING
TF	TRICKLING FILTER
TFEP	TRICKLING FILTER EFFLUENT PUMP STATION
TFSC	TRICKLING FILTER SECONDARY CLARIFIER
WGB	WASTE GAS BURNER
UDS	UNDERDRAIN SUMP
UVB	UV BUILDING

LEGEND

- EXISTING STRUCTURES
- NEW FACILITIES
- EXISTING STRUCTURES TO BE DEMOLISHED

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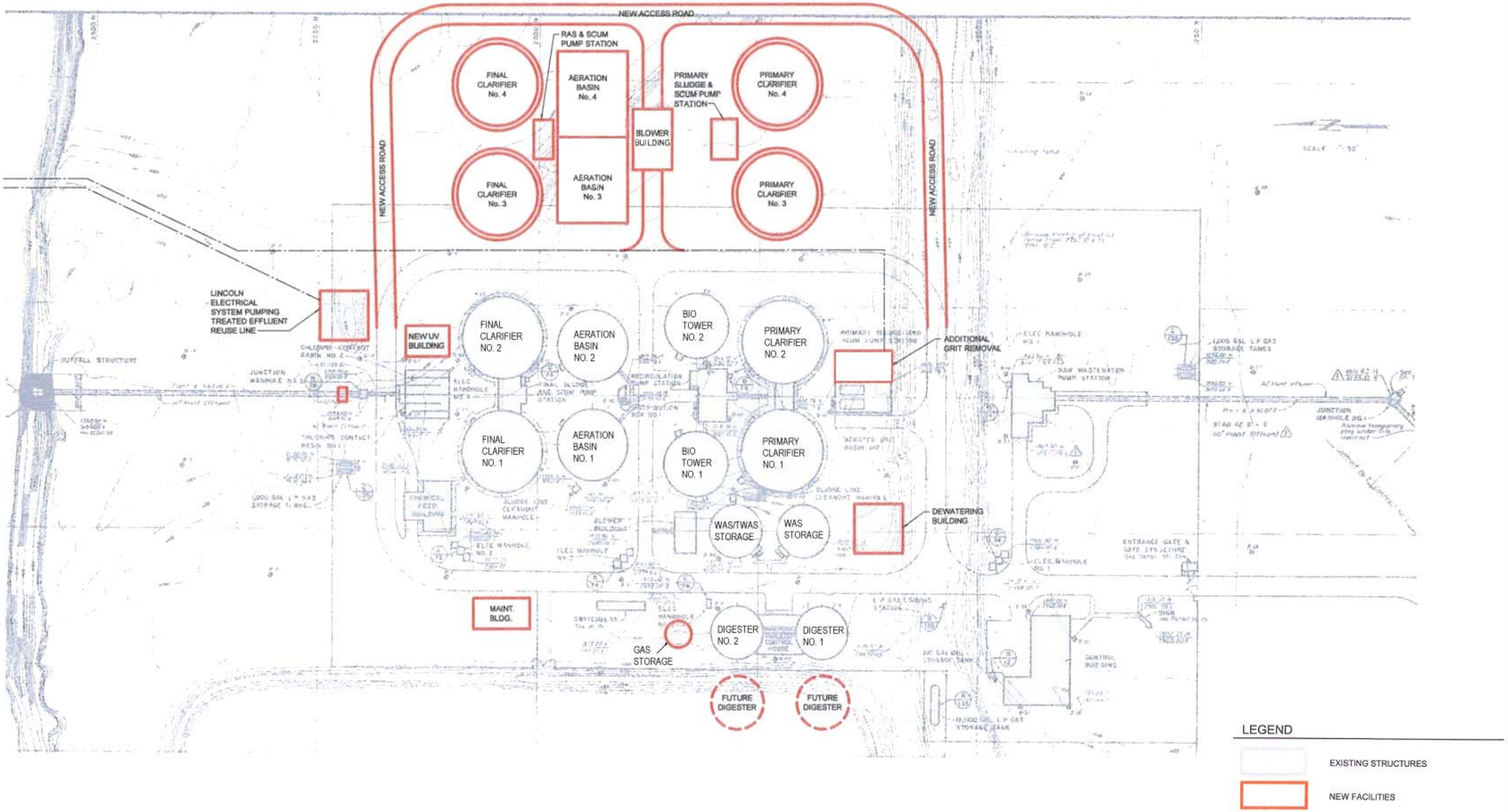
THERESA STREET WASTEWATER TREATMENT PLANT

Figure 1-3
Proposed Site Layout for Theresa Street WWTF



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Lincoln Wastewater System Facilities Plan Update

CITY OF LINCOLN

NORTHEAST WASTEWATER TREATMENT PLANT

Figure 1 - 4

Proposed Site Layout for Northeast WWTF

Facilities to provide temporary storage of peak wet weather flows should be constructed at both the Theresa Street and Northeast WWTFs. The stored wastewater can then be treated through the standard treatment systems at both facilities after the peak flows have subsided. This will allow peak wet weather flows to receive adequate treatment without adversely affecting system performance during the peak flow periods.

New facilities at the Theresa Street and Northeast WWTFs should be designed to allow space to accommodate future capacity expansions and treatment upgrades that may be necessary.

Improvement Costs

The estimated costs associated with upgrading and expanding the Lincoln Wastewater Collection System to serve the projected Tier I needs is approximately $114,000,000. This includes the main Trunk Sewer improvements of $82,000,000 and miscellaneous smaller collection system improvements of $32,000,000.

Expansion of the Theresa Street WWTF to provide 27 mgd of nitrifying capacity is expected to cost approximately $23,000,000. Additional hydraulic capacity and other improvements to the Theresa Street facility not directly related to the additional nitrification capacity are expected to cost approximately $67,000,000.

Costs associated with providing an additional 6 mgd of nitrifying treatment capacity at the Northeast WWTF are expected to be approximately $12,000,000. Additional recommended improvements to the Northeast WWTF are expected to cost approximately $43,000,000.

The total cost of all identified capital improvements for the Lincoln wastewater collection and treatment facilities for the Tier I period is shown in Table 1-5. All dollars are 2002 dollars.

Table 1-5. Tier I Improvement Costs[1]

	Tier I (25-Year) Costs
Collection System Trunks Sewers	$82,000,000
Theresa Street WWTF Improvements	$90,000,000
Northeast WWTF Improvements	$55,000,000
General System Improvements	$32,000,000
Totals Costs	**$259,000,000**

[1] All costs are in 2002 dollars.

Expected distribution of the capital improvement costs associated with recommended collection system and treatment facility improvements through the Tier I planning period is shown graphically in Figure 1-5.
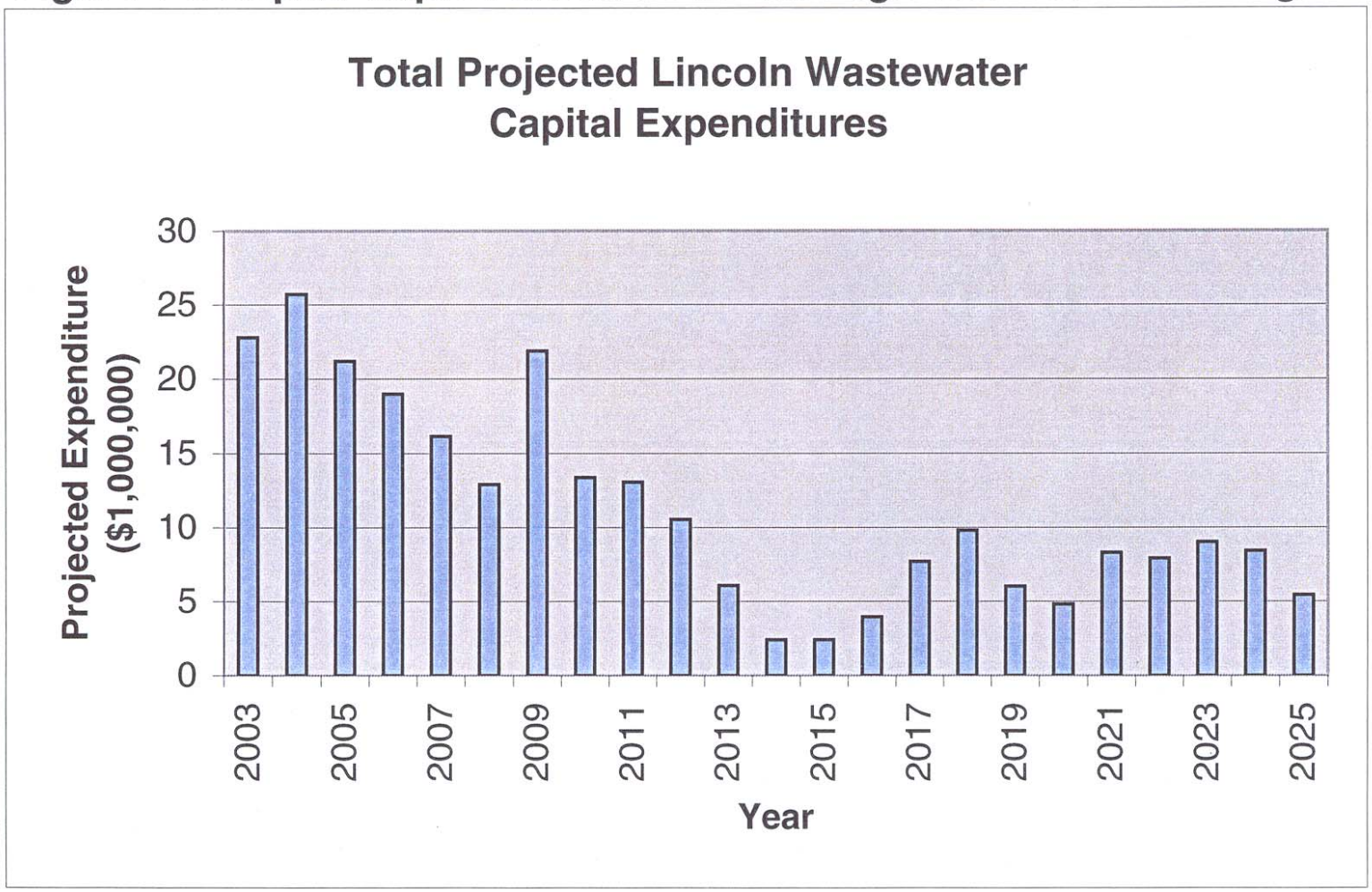
Figure 1-5 Capital Improvement Costs Through The Tier 1 Planning Period