CHAPTER 8

DEVELOPMENT AND EVALUATION OF ALTERNATIVES

Previous chapters have presented background information and key factors that influence wastewater management planning for the City of Lincoln and Lancaster County. Wastewater flow rates and characteristics have been discussed. Population growth, distribution, and land-use development projections have been presented. Existing wastewater collection and treatment systems have been described and their capabilities defined. Regulatory and water quality criteria affecting effluent quality requirements have also been summarized. Finally, the basis for capital improvement project development including the planning process, design considerations, cost estimating, and procedures used to evaluate the alternatives have been presented.

During development of the 1995 Lincoln Wastewater Facilities Plan, several system-wide alternatives were evaluated. These evaluations addressed key questions the City had regarding wastewater handling. These questions, along with the answers developed in 1995, were:

Question: Should the City give serious consideration to a third wastewater treatment facility?

Answer: A third wastewater treatment facility in southwest Lincoln was evaluated and its cost along with issues regarding the acceptable siting of such a facility were compared to the cost of constructing a "Salt Creek Interceptor Relief Sewer." The decision was made to construct the Relief Sewer and not build a third treatment plant, at least within the Tier I planning period. Construction of the Salt Creek Relief Sewer is approximately thirty percent complete.

Question: If a third wastewater treatment facility is not selected, how should the Salt Valley interceptor system be upgraded?

Answer: This design has been completed using a gravity sewer.

Question: Should the solids generated at the Northeast WWTF be treated at the Northeast site or the Theresa Street site?

Answer: These alternatives were evaluated and it was determined that the capital cost of treating solids from the Northeast WWTF at the Theresa Street WWTF was approximately equal to continuing to handle these solids separately. Since there was no clear economic advantage, the decision was made to maintain separate solids handling facilities. The cost of land application of the Northeast WWTF biosolids has historically been substantially less than the cost for disposal of Theresa Street WWTF biosolids.

This update of the Wastewater Facility Plan will not address the above questions, but will deal with several new issues that have arisen since completion of the 1995 facilities plan, including questions such as:

Question: What changes must be made to the current wastewater interceptor sewer system, and what expansion plans must be implemented to accommodate projected population growth?

Question: What practical alternatives are available to achieve the type of treatment needed to meet anticipated effluent ammonia limits at the Theresa Street and Northeast WWTFs?

Question: What alternatives are available to handle peak wet weather events at the Theresa Street and Northeast WWTFs?

Question: What are the existing process deficiencies at the Theresa Street and the Northeast WWTFs?

These questions have been addressed through a multi-step approach that evaluated and compared system-wide wastewater management plans. These steps included:

1. Formulation of wastewater transportation and treatment alternatives to serve existing growth areas as defined by the 2002 Lincoln-Lancaster County Comprehensive Plan.
2. Identification of collection system needs.
3. Identification and evaluation of treatment alternatives.
4. Selection of the most favorable system-wide plan.
5. Economic analysis.

The wastewater collection system needs and wastewater treatment alternatives considered in this facilities plan update are described in the following paragraphs.

Anticipated Collection System Needs

City of Lincoln future wastewater collection system needs within each of the drainage areas served by the City have been separated into two phases or "Tiers". The different basins and interceptors were evaluated for the Tier I Priority A and B conditions (12 and 25 years into the future respectively) and the Tier II condition (50 years into the future). These "Tier" designations are consistent with those presented in the 2002 Lincoln-Lancaster County Comprehensive Plan

Recommendations are made in accordance with the sanitary sewer capacity needs of the different basins depending on where the existing trunk sewer lines are located and whether or not these lines need to be paralleled, upgraded, or extended. All of the recommendations include lengths and sizes

of the main lines needed but do not include any laterals required to convey the flow to the main lines. The City has developed the costs for lateral lines required for each basin.
The acreages for the future basin areas were provided on the Directional Growth Map with the acreages for the presently developed areas taken from the City map entitled *Physical Data on Sewer System Drainage Basins – December 1999*. The acreages presented in the December 1999 document are assumed to be the acreages currently contributing flow to the City's collection system. These acreages are then translated into peak flows utilizing the City's design flow equation:

$$Q\ (cfs) = 0.01726*(A)^{0.8} + 0.003(A)$$

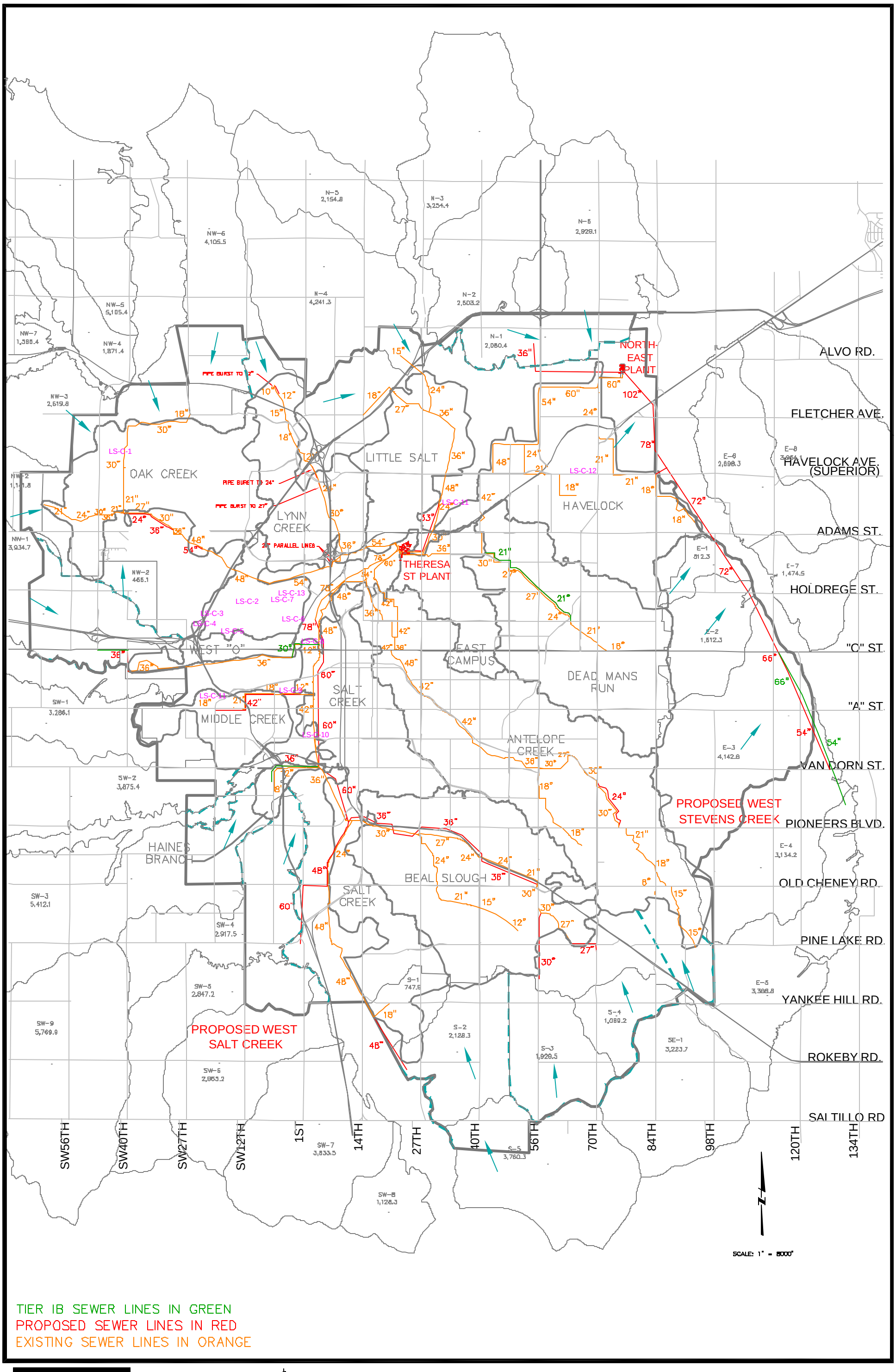
Figure 8-1, Tier I Improvements, and Figure 8-2, Tier II Improvements show the different sanitary sewer drainage basins, the wastewater lift stations, the locations of the City's two wastewater plants (the Northeast and the Theresa Street WWTFs), the existing trunk sewers in orange with pipe sizes, and the recommended main improvements in red (either paralleled, upgraded or extended) with recommended pipe sizes. Tier I improvements represent those anticipated to be needed between now and 2025. Tier II improvements are those that are expected to become necessary between 2025 and 2050.

The slope for all proposed line extensions used to determine needed pipeline sizes for both the 25-year and 50-year condition is assumed to be 0.0015 (or 0.15 percent) unless the pipe is being paralleled, in which case the slope would be the same as the paralleled pipe. Hydraulic calculations were performed using Mannings "n" values of 0.013.

In cases where pipelines are only one or two standard pipe sizes smaller than what is required to serve an area, it may be possible to upgrade the existing pipeline using a technology known as pipe bursting. The opportunity to upgrade pipelines through pipe bursting will depend on the soils around the pipe, the material of the pipe being burst, and the utilities found surrounding the pipe.

Salt Creek. In accordance with the City's flow equation, approximately 2.4 cfs of wastewater will be generated from the west and is conveyed through a 12-inch PVC pipe from the Haines Branch Basin. Since assuming that the slope is 0.15 percent and the pipe is not a pressurized system, 1.4 cfs is the maximum flow that the existing pipe can carry to the Salt Valley Trunk (SVT) Line (at MH#B2-101). The Haines Branch was built in the 1920's to serve the State Regional Center.

> **Tier I Condition**. Over the next 25 years, growth in the Salt Creek Basin is expected to occur in various places. First, some development is expected east of Salt Creek in basin S-2 and a portion of S-5. This area totals 2,766 acres and will contribute approximately 18.1 cfs of wastewater to the system. Second, a similar sized area is expected to be developed to the west of Salt Creek in the east portions of basins SW-4, SW-5, and SW-6. This area is located south of the Haines Branch area, has an area of 2,955 acres, and currently has no collection system. When fully developed, it will generate a flow of approximately 19.2 cfs. Third, the eastern portion of basin SW-3 is expected to be developed within 25 years and will add flow into the Haines Branch system. This projected development of 816 acres will generate a flow of about 6.1 cfs. The total area expected to contribute to the Salt Valley Trunk in 25 years is 26,070 acres.



Lincoln Wastewater System Facilities Plan Update

CITY OF LINCOLN

SANITARY SEWER BASINS

Figure 8-1

TIER I DEVELOPMENT

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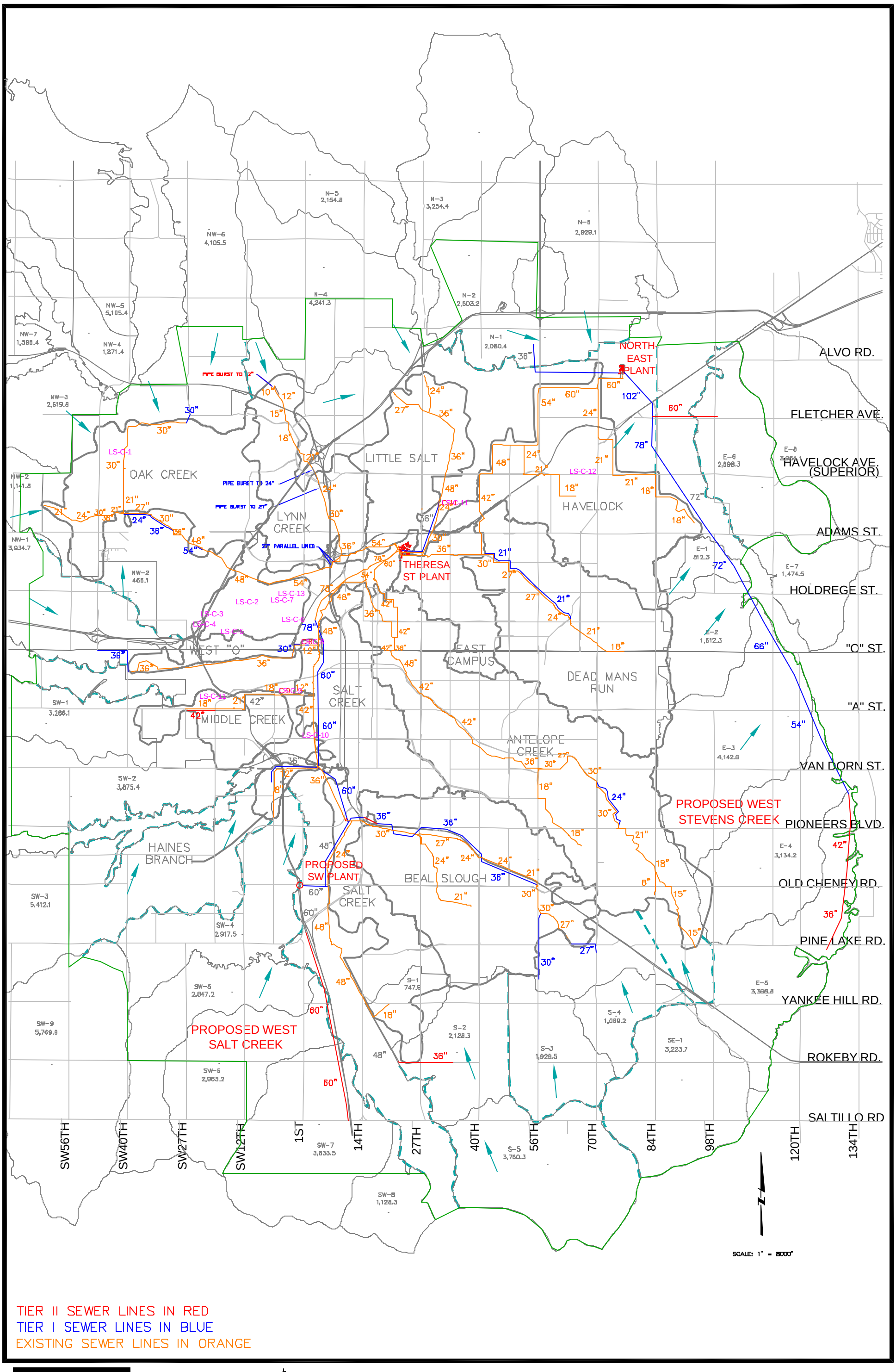

BROWN AND CALDWELL

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MONTGOMERY WATSON HARZA

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

Figure 8-2
TIER II DEVELOPMENT

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Tier I Recommendations. As the previous sections are divided into three parts (Salt Creek, West Salt Creek, and Haines Branch), the recommendations presented in this section follow a similar format. The combination of all of this proposed development (26,070 acres) exceeds the design capacities of the first two phases of the SVT when it was built. To rectify this situation, the entire SVT (including the two phases that have been built) can be upsized to accommodate this new development.

The SVT Relief Sewer will follow the alignment to Old Cheney Road as described in the 1998 Salt Valley Trunk Relief Sewer - Phase I to V Report. See the Summary of Recommendations for a review of the lengths and sizes of this alignment. As basin S-2 and a portion of basin S-5 are developed, a 33-inch line will be needed to extend from the existing 48-inch line (Phase V of the SVT Relief Sewer) located at MH#B0s-37 to the south for approximately 5,000 LF. The average slope of the SVT Relief Sewer from Pioneers Boulevard to Yankee Hill Road was calculated to be 0.0019 or 0.19 percent, which is the slope assumed for this pipe.

Approximately 2,955 acres are expected to be developed on the west side of Salt Creek (according to the Future 25-year Condition). This area is referred to as the Proposed West Salt Creek Basin (WSC). Using the assumed slope of 0.0019 (0.19 percent), another 33–inch line is required to facilitate 100 percent development in this area.

With the Haines Basin service area expanding by 816 acres, the wastewater collection system will be required to carry 6.1 cfs of wastewater. The existing 12-inch pipe capacity is 1.4 cfs. Considering the age of this pipe, the recommendation is to replace the existing 12-inch line with a 24-inch line and extend it to a total length of 5,300 LF.

Tier II Condition. The design for the SVT Relief Sewer has assumed additional service area acreage of about 5,000 (for a total of 22,000 acres). The anticipated Future 50-year Condition includes a service area much larger than this (total of 41,732 acres). Tier II growth is expected to continue in the same three areas as projected for Tier I. The future service area in basin S-5 will continue to expand and the flows from this area (which include basin S-2 and totals approximately 5,900 acres) will ultimately contribute 35.6 cfs to the system. The area west of Salt Creek, which includes most of basins SW-4, SW-5, SW-6, and SW-7, has a developable area of approximately 8,539 acres and is expected to generate a flow of 49.7 cfs. Other basins that are expected to develop within 50 years will add flow into the Haines Branch. The east portion of basin SW-3 and the north portion of basin SW-4 together constitute close to 4,000 acres and represent a total flow potential of 25.1 cfs. That brings the total required capacity of the Haines Branch interceptor sewer to 27.5 cfs where it joins the SVT line at Pioneers Boulevard.

Tier II Recommendations. The current six-phase improvement plan for the SVT Relief Sewer needs to be completed, but the sizes of the Relief Sewer need to be discussed in relation to the decision to build another treatment plant. At the upstream end of the basin, a 48-inch line will be needed to extend from the end of the existing 48-inch line to the south for approximately 4,650 LF. A 36-inch line will also need to be extended to the east for 4,850 LF.

Toward the downstream area of the basin is where the design options present themselves. There are four that are listed on the "Lincoln Future Sanitary System – Tier II Condition," of which, the last two are recommended (#3 & #4). At the point of treating 41,000+ acres of development, a new treatment plant is strongly encouraged. The placement of this plant is the question at hand. The City of Lincoln has expressed their desire to place any future plant near the intersection of 1st and Old Cheney (option #4, which is shown on the Tier II figure). This would allow the flow of 26,349 acres of development pass on into the SVT (which would require additional upsizing – see discussion in Tier I). Option #3 places the proposed Southwest Plant near the intersection of 1st and Van Dorn. This adds flexibility to the system since it would be able to pick up any amount of flows from the Beals Slough Trunk and avoid the need to upsize any of the SVT lines downstream. The costs associated with a potential new Southwest WWTF are not included in the "Summary of Recommendations."

Second, approximately 8,539 acres are expected to develop in the West Salt Creek Basin. Using an assumed slope of 0.0019, a 36- to 48–inch line will be required to accommodate development in this area. About 5 miles of 60-inch line is shown on the map running to a new Southwest WWTF site. Cost information associated with building the Southwest WWTF has not been developed.

Third, the Haines Basin service area is expected to grow by 3,992 acres and the collection system pipeline servicing this area would be required to carry a total flow of 25.1 cfs. The capacity of the existing 12-inch pipe with a 0.15 percent slope is 1.4 cfs. The recommendation is to replace the existing 12-inch line with about a mile of new 36-inch pipe.

West "O" Street.

Tier I Condition. When the West "O" Street Basin reaches full development as represented in the Future 25-year Condition, an additional 1,900 acres of developed area will be added to the west side of the basin. This represents 12.9 cfs of future flow and causes one major problem. The capacity at the downstream end of the system is not sufficient to handle anticipated future flows.

Tier I Recommendations. Overloading of the 12-inch line can be alleviated by constructing 3,357 LF of 30-inch parallel line. If the 30-inch line is constructed with the same slope as the 12-inch VCP (0.004 ft/ft), it will provide adequate capacity to handle the 20.5 cfs of flow present when the area is 100 percent developed.

As for the Lift Station C-8, as of May 2002 it is pumping a dry weather average flow of 0.52 cfs, which represents only 6.8 percent of the theoretical flow that should be generated from this service area using the City's Design Equation. This is largely due to the fact that the area is mainly railroads and does not have a high residential population. If we were to use that same percentage of flow from using 15 percent of the City's Design Equation flows as was done with Middle Creek, the station would only require 3 cfs of pumping capacity. This capacity is available within the existing station. If wastewater from Lift Station C-9 is

diverted to this area, greater pumping capacity will be required. If this is the case, it is anticipated that 5.3 cfs of total pumping capacity would be required.

At the west end of the basin, a 36-inch extension needs to be built from the existing line west to serve the future developed area. This addition of 4,650 LF of 36-inch pipe will drain the future developed 1,897 acres with a minimum slope of 0.0005 ft.ft.

Tier II Condition and Recommendations. If the flows are diverted from C-9 to C-8, 8.7 cfs of pumping capacity will be required. A new pump station with two new 2,400 gpm pumps would need to be built with room enough for a third.

Beals Slough. The City map shows 5,370 acres of service area within the basin which will generate an estimated 32.7 cfs of wastewater. This flow will overload selected sections of the Beals Slough lateral. One location is the intersection of 56th Street and Highway 2. A 24-inch line is currently planned to parallel the existing trunk at this location and mitigate this flow problem. Nevertheless, downstream capacity constraints will cause surcharging to extend upstream along almost the entire length of the Salt Creek and Beals Slough Systems.

Tier I Condition. Future development in the Upper Beals Slough service area is expected to add about 4,411 acres to the area. This future developed area will contribute approximately 27.4 cfs to the upstream end of the existing sewer. With the exception of approximately 1,554 LF of pipeline, the entire Beals Slough Trunk Line will be overloaded with this additional flow.

Tier I Recommendations. The recommendation is for a relief sewer to be installed parallel to the entire Beals Slough Interceptor. At the upstream end, the future flows should be collected into the new line. A new 30-inch line should be extended from MH#D0-62 to the south on the east side of 56th Street. The pipe will be about 5,600 feet long and extend to Cavvy Road. The existing 27-inch line should be extended to the east to handle a portion of the future flows. It should extend east along Pine Lake Road to 70th Street for an approximate length of 2,900 LF. At the end of both of these lines, smaller diameter sewer lines should be constructed to collect future flows.

To provide the capacity necessary for the future development of Upper Beals Slough, a 36-inch line should be built to parallel the existing trunk along Highway 2. The proposed 36-inch line will connect into MH#C0-119 and run 18,800 LF to the west following the alignment suggested in the 1995 Facilities Plan.

Tier II Condition and Recommendations. Same as Tier I above.

Haines Branch. See Salt Creek discussion above.

Middle Creek.

Tier I Condition. The 25-year Tier I Condition shows additional development in the east portions of Basins SW-1 and SW-2 for a total of 704 acres of additional service area and a resulting future flow of 5.4 cfs.

Tier I Recommendations. One new 30-inch line with a slope of 0.25 percent would be able to transport the flows to the SVT. However, the existing line, if structurally sound, could provide some capacity and reduce the size required for the new parallel line. Additional information of the condition of the existing pipe is needed to determine if it should be replaced or paralleled.

The Lift Station C-9 currently has 4.5 cfs of pumping capacity and the basin's projected 2025 capacity requirement is 15.6 cfs according to the City's Design Equation for flow. The actual flow being pumped as of May 2002 is 1.2 cfs (as stated in *Lift Station Flow Records*, a spreadsheet provided by the City of Lincoln dated 16 May 2002). If it is assumed that only 15 percent of the City's Design Equation flow will pass through the station (based on historical flow records), only 2.3 cfs of pumping capacity will be required and sufficient capacity already exists. This assumes that the flow is not diverted to the north to Lift Station C-8. Not enough information was available to investigate siphon scenarios.

Tier II Condition. Per the information shown on the Future 50-year Condition maps, the east portions of Basins SW-1 and SW-2 are expected to develop. Together they represent a total of 4,472 acres of new development and a corresponding future flow of 27.8 cfs.

Tier II Recommendations. This large additional development will require a 42-inch line to transport the flows to the SVT. Again, additional information of the condition of the existing pipe is needed to see if it should be replaced or paralleled.

With the Tier II flows, the C-9 Lift Station would need one additional 800 gpm pump or one 2,400 gpm pump to replace the other three (depending on their condition) to pump the anticipated flow from this basin. The cost shown at the end of the report is for one 2,400 gpm pump to replace them all.

Antelope Creek.

Tier I Condition. In the year 2025 the projected total service area acreage in the Antelope Creek Basin will be 7,864 acres (to the southeast). The projected wastewater flows from this area will cause 5,704 LF of 30-inch VCP (material needs to be verified by the City) found between MH#D1-302 and MH#D2-42 to be overloaded and surcharge 4,276 LF of pipe upstream (MW, Feb 1998).

Tier I Recommendations. In the upstream portions of the sewer line, the existing 8- and 15-inch lines are adequate to convey the anticipated 5.1 cfs from the 665 acres additional service area to the south. Therefore, the only improvement needed is a relief sewer to parallel the existing 30-inch VCP. Assuming the same slope (0.00059), the 5,704 LF of 30-inch VCP will need to be paralleled by a new 24-inch line to provide the capacity needed.

Tier II Condition and Recommendations. Same as Tier I above

East Campus. Included in Little Salt Creek Discussion.

Oak Creek.

Tier I Condition. As Oak Creek Basin continues to grow, future development in sub-basin NW-2 will generate flow from the west (into OC-7) and sub-basins NW-3 and NW-6 will generate flows from the north (into OC-5 and the West Highlands Trunk Sewer). The Future 25-year Condition depicts about 1,100 and 1,865 acres of development respectively in these sub-basins with corresponding wastewater flows of 8.7 and 12.7 cfs. The current overloading conditions in the 27- and 30-inch lines will be exacerbated by the anticipated future growth.

Tier I Recommendations. The portions of NW-3 and NW-6 sub-basins that will contribute 12.7 cfs from the north can be handled in the existing 30-inch West Highlands Trunk Sewer. This assumes that its slope is at least 0.001 ft/ft. Once information has been provided for this line, the West Highlands Trunk Sewer can be properly analyzed for both present and future conditions.

The 27-inch and 30-inch pipes need to be paralleled to relieve the existing overloaded condition and to prepare for 21.4 cfs of future flows. Recommended new construction includes 2,196 LF of 24-inch line from MH#AA7-21 to 10, and 2,817LF of 36-inch pipe between MH#AA7-10 to 298. The slope on these pipes is assumed to be the same as the slope of the lines they parallel.

The 48-inch reinforced concrete pipe (RCP) system starting one manhole further downstream has two problem areas. The first segment between MH#A6-209 and 208 is 98 LF and has a capacity 20.7cfs short of that required to meet future needs. This flow can be handled by installing a parallel a 54-inch pipe at the same low slope – 0.0001. The second problem segment is 687 LF with a slope of 0.000029 and does not have adequate capacity for the 25-year flow condition. If the 1,888 LF segment between MH#A6-199 and 196 could be unearthed and re-laid with a uniform slope, it would have the capacity needed (39.1cfs). A concern with this scenario is that the pipe may have been originally installed with an inconsistent slope due to utility conflicts.

The existing 54-inch RCP segment of the line also needs a minor improvement to convey the future flows. From MH#B6-321 to B6-319, 6.5 cfs of capacity is needed to accommodate future flows. A 27-inch parallel line is recommended to provide the future capacity required for this 438 LF segment of line.

Tier II Condition and Recommendations. Same as Tier I above.

Little Salt Creek.

Tier I Condition. As development occurs to the north, about 1,661 acres of service area will be added in current Basin LS-5. This area has a potential to contribute 11.5 cfs to the system. This additional flow will overload the existing system from the C-11 pump station to the plant. It is evident that the current infrastructure cannot handle all potential development in the Northeast Salt Creek Basin (the rest of N-4 and N-5).

Future development in the East Campus may contribute 6.5 cfs at MH#C6-349, which is just half a mile east of the Theresa Street WWTF. This, combined with potentially 7.8 cfs from Deadmans Run, if flows are diverted from the Northeast WWTF, will mean the 36-inch East Campus Trunk will be carrying 14.3 cfs. When combined with the upstream flows of Little Salt Creek (currently 13.0 cfs) at the mentioned manhole, the Little Salt Creek Trunk will have reached its capacity of 27.3 cfs. This potential diversion of 7.8 cfs from Deadmans Run does not provide any sewer capacity for development to the north of the existing Little Salt Creek sub-basins.

Tier I Recommendations. When the future flow of 11.5 cfs is combined with the current flow at Lift Station C-11 (13.0 cfs), the total flow will be 24.5 cfs. Currently, the station has two pumps with a total capacity of 10.7 cfs. The lift station does have room for four more pumps. Therefore, if three 2,400 gpm rated pumps were installed (16 cfs), the new capacity could accommodate the future flows (24.5 cfs). This size of pump is preferred due to the commonality of parts with the existing pumps.

As this wastewater is pumped into the gravity system, additional capacity to the Theresa Street WWTF will be needed. A new 33-inch pipe parallel to the existing 7,427 LF of 36-inch trunk line is recommended to provide the needed capacity.

Tier II Condition. In 50 years it is anticipated that an additional 1,017 acres will be developed in Basin N-4. This area has a potential to contribute an additional 6.1 cfs to the system for a total future flow of 17.6 cfs.

Tier II Recommendations. As this future flow (17.6 cfs) combines with the current flow at Lift Station C-11 (13.0 cfs) they form a total of 30.6 cfs. A 36-inch pipe should be installed parallel to the existing trunk line from the lift station to the Theresa Street WWTF to handle this flow.

As far as pump capacity is concerned, four 2,400 gpm rated pumps would need to be installed to accommodate the future flows (30.6 cfs).

Lynn Creek.

Tier I Condition. Due to the topography of the surrounding basins, Oak Creek and Little Salt Creek will collect sewage from the future development areas to the north. According to the anticipated Future 50-year Condition, Lynn Creek Basin laterals will need to be extended to serve 354 acres of future development (a portion of Basin NW-6), but no major flows from the north are anticipated.

Tier I Recommendations. Due to the relatively small area of anticipated development in the Lynn Creek Basin, there are only three segments of the existing interceptor with insufficient capacity to handle future flows. Fortunately, the additional capacity can probably be achieved through pipe bursting rather than more expensive means such as paralleling or replacement. Starting at the upstream end, the 200 LF of 10-inch pipe between MH#A9-63 and 62 should be expanded to an inside diameter of 12 inches. (It is assumed in this area that the slope of the existing 12-inch line upstream of MH#A9-56 is equal to or greater than 0.008.) The 780 LF of 21-inch pipe between MH#B8-67 to B7-343 needs to be enlarged to a 24-inch pipe. Finally, between MH#B7-341 and 340 there is 503 LF of 24-inch VCP that needs to be expanded to 27-inches in diameter to allow for the additional flow of 3 cfs.

Tier II Condition and Recommendations. Same as Tier I above.

Deadmans Run.

Tier I Condition. The areas to the east of the plant do not affect the flow of the Deadmans Run Trunk Sewer. The Deadmans Run and Havelock Basins have a ridge as their eastern border that prevents flow from any future developments further east from entering the Deadmans Run Trunk Sewer. To the north of the Northeast WWTF, portions of sub-basins N-1 and N-2 (1,434 total acres) will add 10.3 cfs of wastewater once they are developed.

The Havelock Basin will pick up an additional 6.0 cfs of wastewater from future development and Deadmans Run Trunk Sewer must carry that flow from MH#D9-70 to the Northeast WWTF. The only segment that will have problems transporting this flow is the pipe immediately downstream from that manhole. All of the subsequent piping has sufficient capacity.

Tier I Recommendations. Hydraulic calculations indicate that three segments of the Deadmans Run Trunk Sewer downstream of Theresa Street WWTF will experience an overloaded condition when the anticipated Tier I development occurs. The first problem involves 18-inch RCP between MH#D4-486 and D5-45. The average capacity needed in this 1,949 LF stretch of pipe is 0.7 cfs. Although the line could be modified by pipe bursting to a final diameter of 21 inches, the recommendation is to do nothing since the costs outweigh the benefits.

The second portion of pipe that is under capacity is between MH#D5-121 and 152. This 21-inch RCP is barely overloaded with an average need of 0.4 cfs. Again, this should not be a concern as the resulting surcharging is not expected to create any problems.

The third segment is where improvements need to be made. The sanitary sewer line from MH#D5-153 to C6-195, with the exception of two segments, is currently overloaded with the design constraints. This line ranges from 24 to 30 inches in diameter and runs for 11,265 LF. A new 21-inch pipeline paralleling the existing sewer line will provide the capacity needed between MH#D5-153 and C6-195. This would aid in transporting the increasing I/I that has been reported in the basin's sewer system. It may be prioritized as a

secondary improvement due to the depth of the line as a result of which additional static head is granted to the area.

For future conditions, additional improvements will be required. The development anticipated north of the Northeast WWTF around the intersection of I-80 and 56th Avenue is expected to generate 10.3 cfs. This wastewater flow, if discharged to the existing 60-inch line west of the plant, would overload it. Therefore, a separate new 27-inch line beginning southeast of the intersection and extending eastward to the Northeast WWTF is recommended.

Tier II Condition. The only change from the Tier I Condition to the Tier II Condition is in basins N-1 and N-2. These sub-basins will continue to grow to 2,695 total developed acres and will add an additional 17.7 cfs to the sanitary sewer flow.

Tier II Recommendations. To accommodate the Tier II conditions, a 33-inch line will be required instead of the 27-inch line to convey flows from the I-80 and 56th Avenue intersection to the Northeast WWTF.

Havelock.

Tier I Condition. The Tier I Condition shows no new development areas that would contribute flows to the Havelock Interceptor.

Tier I Recommendations. Because both the present and future conditions do not present any capacity problems for the trunk line, no action is recommended.

Tier II Condition and Recommendations. Same as Tier I above.

West Stevens Creek.

Tier I Condition. In 25 years it is projected that 7,520 acres will be developed in the Stevens Creek Basin. This development is expected to generate 45 cfs according to the City's Flow Equation. It is anticipated that all of this flow will be directed to the east along the west side of Stevens Creek.

Tier I Recommendations. The new trunk line will need to be constructed along the west side of Stevens Creek to collect the flows generated in this area. The required diameters for the proposed pipe will be 48 inches and below, assuming a 0.0015 slope.

Tier II Condition. The Tier II Condition anticipates the development of an additional 12,428 acres within the Stevens Creek Basin, with an accompanying wastewater flow of 62.4 cfs. All of the flow will be directed to the east along the west side of Stevens Creek.

Tier II Recommendations. Recommendations for the Tier II Condition have already been made by the City via an inter-department communication dated March 12, 2002 from the Engineering Department to the Planning Department.

Summary of Collection System Needs

A summary of the recommended existing wastewater collection system needs is provided in Table 8-1. Tier I and Tier II service area sizes are presented in Tables 8-2 and 8-3.

Theresa Street WWTF

Description of Alternatives. Two factors affect treatment capacity at the Theresa Street WWTF, namely the facility's biological treatment capability and the system hydraulic capacity.

Process modeling indicates that the existing Theresa Street East Side and West Side biological treatment trains can provide secondary treatment plus nitrification (ammonia removal) to meet the anticipated permit limits for flows up to about 14 mgd. The projected maximum month flow rate for year 2025 is 27.0 mgd and for 2050 is 40.0 mgd (see Chapter 5). Therefore, approximately 26 mgd of additional treatment capacity will be required at the Theresa Street facility by 2050. For planning purposes it is assumed that the additional capacity will be provided in two approximately equally sized segments or phases.

Hydraulic modeling indicates that the Theresa Street East Side and West Side treatment trains can hydraulically pass 36 mgd. The primary clarifiers can hydraulically pass 48 mgd. The projected peak flow for design of in-plant structures for the year 2025 is 1.7 times the maximum month flow (see Chapter 4) or 47 mgd. Flows above 47 mgd should be handled by separate wet weather facilities. Expansion of the Theresa Street WWTF to handle the 2025 flow of 27 mgd should include modifications to increase the facility hydraulic capacity to 47 mgd.

Sizing for wet weather facilities was based on historical flow data from 1990 to present. This data indicates that a future wet weather peaking factor of 4.6:1 is reasonable (see Chapter 5). This is higher than the peaking factor used for design of hydraulic components within the treatment system. Consequently, wet weather facilities must be designed to accommodate the peak flows that exceed the 47 mgd hydraulic capacity. A twelve million-gallon equalization basin appears to be adequate to equalize the resulting peak wet weather flows. It is recommended that the wet weather peaking parameters be assessed in greater detail during preliminary design of the wet weather facilities.

After identifying factors that either limited capacity or increased treatment demand at the Theresa Street WWTF, four alternative methods of producing additional capacity were investigated. These alternatives include:

Alternative 1: Pretreat the largest industrial discharge (Cook Foods discharge) off-site to reduce pollutant loading at the Theresa Street WWTF and expand the Theresa Street WWTF to provide the remainder of the required treatment capacity.

Alternative 2: Utilize a side-stream treatment process to reduce the pollutant loading from the solids treatment processes and expand the Theresa Street WWTF to provide the remainder of the required treatment capacity.

Table 8-1. Summary of Recommendations for Existing Collection System

Basin	Upstream Manhole	Downstream Mahole	Existing Line Diameter (in)	Length (ft)	Unit Cost ($/ft)	Total $	Notes
Salt Creek	Old Cheney Rd	Pioneer Blvd	24	5572	220	1,230,000	Construction of 48" pipe to parallel this line (Phase V)
Salt Creek	Pioneer Blvd	Van Dorn Pkwy	36	6350	220	1,400,000	Construction of 60" pipe to parallel this line (Phase IV)
Salt Creek	Van Dorn Pkwy	"M" St	42	9396	225	2,110,000	Construction of 60" pipe to parallel this line (Phase III)
Salt Creek	"M" St	Vine St	48	4635	135	630,000	Construction of 78" pipe to parallel this line (Phase IIB)
Beal Slough	C0-119	SVT Relief Sewer	varies	18,800	165	3,100,000	Construction of 36" pipe to parallel this line
Oak Creek	AA7-10	AA7-6	27	452	195	90,000	Construction of 36" pipe to parallel this line
Oak Creek	A6-199	A6-196	48	1888	100	190,000	Unearth and re-bury at a consistent slope
West "O"	A4-66	B5-57	12	3357	220	740,000	Construction of 30" pipe to parallel this line
Dead Mans Run	D5-153	C6-195	varies	11,265	140	1,580,000	Construction of 21" pipe to parallel this line
Other Improvments						21,000,000	Includes Replacements, Lift Stations, and Manholes
Totals:				61,715		32,070,000	

Table 8-2. Lincoln Future Wastewater Collection System Acreages Served (25 year - Tier I)

Basin	Antelope Creek	Beals Slough	Dead-mans Trunk	East Campus	Haines Branch	Havelock	Lynn Creek	Little Salt Creek	Middle Creek	Oak Creek	Salt Creek	West "O" Street	West Stevens Creek	West Salt Creek	Total
Existing acreage served	7,199	5,370	4,536	865	283	3,401	2,314	2,251	1,456	3,661	4,370	1,042			36,748
Additional acreage served 25-yrs - Tier I	665	4,411	1,434		816		354	1,661	704	2,961	2,766	1,897	7,520	2,955	28,144
Total	7,864	9,781	5,970	865	1,099	3,401	2,668	3,912	2,160	6,622	7,136	2,939	7,520	2,955	64,892
Trunk line	Antelope Creek Trunk	Beals Slough Trunk	Dead-mans Trunk	Dead-mans Trunk	Salt Valley Trunk	Dead-mans Trunk	Oak Creek Trunk	Dead-mans Trunk	Salt Valley Trunk	Oak Creek Trunk	Salt Valley Trunk	Salt Valley Trunk	West Stevens Creek	Salt Valley Trunk	

	Antelope Creek Trunk	Beals Slough Trunk	Dead-mans Trunk	Oak Creek Trunk	Salt Valley Trunk	West Stevens Trunk	Total
Tier 1 acreages served by each trunk line	7,864	9,781	14,148	9,290	16,289	7,520	64,892

Table 8-3. Lincoln Future Wastewater Collection System Service Acreages (50 year - Tier II)

Basin	Antelope Creek	Beals Slough	Dead-mans Run	East Campus	Haines Branch	Havelock	Lynn Creek	Little Salt Creek	Middle Creek	Oak Creek	Salt Creek	West "O" Street	West Stevens Creek	West Salt Creek	Total
Existing acreage served	7,199	5,370	4,536	865	283	3,401	2,314	2,251	1,456	3,661	4,370	1,042			36,748
Additional acreage served 50-yrs - Tier II	665	4,411	2,695		3,992		354	2,678	4,472	2,961	5,900	1,897	19,948	8,539	58,512
TOTAL	7,864	9,781	7,231	865	4,275	3,401	2,668	4,929	5,928	6,622	10,270	2,939	19,948	8,539	95,260
Trunk line	Antelope Creek Trunk	Beals Slough Trunk	Dead-mans Trunk	Dead-mans Trunk	Salt Valley Trunk	Dead-mans Trunk	Oak Creek Trunk	Dead-mans Trunk	Salt Valley Trunk	Oak Creek Trunk	Salt Valley Trunk	Salt Valley Trunk	West Stevens Trunk	Salt Valley Trunk	

	Antelope Creek Trunk	Beals Slough Trunk	Dead-mans Trunk	Oak Creek Trunk	Salt Valley Trunk	West Stevens Trunk	Total
Tier 2 acreages served by each trunk line	7,864	9,781	16,426	9,290	31,951	19,948	95,260

Alternative 3: A modified combination of Alternatives #1 and #2.

Alternative 4: Expand the Theresa Street WWTF to provide all of the required treatment capacity.

These alternatives are summarized in Table 8-4. Note that all four scenarios assume that the trickling filter train is no longer in service.

Table 8-4. Treatment Capacity Scenarios to Meet Year 2025 and Projected Wastewater Flows at the Theresa Street WWTF

Treatment Location	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Existing Capacity @ Theresa St WWTF (mgd)	14	14	14	14
New Capacity @ Cook Foods (mgd)	*	--	*	--
New Capacity @ Solids Side-stream (mgd)	--	*	*	--
New Capacity @ Theresa St WWTF (mgd)	13	13	13	13
Total (mgd)	27	27	27	27

* These treatment facilities will reduce the organic and solids loadings on the Theresa Street WWTF but will not reduce the hydraulic capacity required at the facility and therefore do not contribute to the total capacity values shown.

Common Alternative Components. Components common to all alternatives have been identified and defined as follows:

New Nitrification Capacity at the Theresa Street WWTF. These improvements include the facilities needed to treat the projected waste loads to meet nitrification limits anticipated in the new discharge permit. They include hydraulic structures, process units, and other treatment units. For the possible off-site pretreatment of Cook Foods waste, an anaerobic upflow reactor has been proposed, with operations staffing from the Theresa Street WWTF. Side-stream treatment of flows from solids handling could be accomplished with a side-stream activated sludge treatment process, but no additional staff would be necessary.

Wet Weather Treatment for the Theresa Street WWTF. These improvements will provide the capability to treat 100 percent of the projected peak wet weather flow. Although this is not presently required, it is expected to be a requirement of the anticipated SSO regulations.

Correcting Existing Deficiencies at the Theresa Street WWTF. These deficiencies are described later in this chapter.

Each of these components is addressed as part of each treatment alternative.

Key Treatment Issues

There are three key treatment-related issues at the Theresa Street WWTF:

1. Treatment to provide nitrification capacity to meet expected permit limits,
2. Treatment of currently by-passed "wet weather" flows, and
3. Treatment to accommodate sludge handling return flows.

All of these issues are addressed by each of the treatment alternatives evaluated.

Theresa Street Alternative 1 - Pretreatment of Cook Foods Wastewater

Alternative 1 involves upgrading the Theresa Street WWTF to handle a maximum month flow of 27 mgd, and a peak hourly flow of 47 mgd. The plant would require additional nitrifying treatment capacity of approximately 13 mgd. The Cook Foods COD would be reduced by approximately 90 percent in an anaerobic upflow reactor system. This anaerobic upflow treatment system would be located at the Cook Foods plant site (or adjacent to it), and be operated by personnel from the Theresa Street WWTF. Pretreatment of the Cook Foods waste would decrease the needed organic capacity of the Theresa Street WWTF due to the reduction of the organic strength of the incoming wastewater. It would not, however, affect the required hydraulic capacity of the Theresa Street facility.

Wet weather flows above 47 mgd would be temporarily stored in an equalization basin and then treated by the Theresa Street facility when influent flows returned to normal dry weather levels. The predicted maximum wet weather flow rate at the Theresa Street WWTF in 2025 is based on a peak flow of about 110 mgd (see Table 5-7).

This alternative would reduce the amount of biosolids produced at the Theresa Street WWTF and would delay the need for a fourth anaerobic digester. It would also delay the requirement for an additional belt press. Biosolids produced at the Cook Foods pretreatment facility would be treated at that site.

Table 8-5 lists the improvements required during the planning period under this alternative. Figure 8-3 shows a conceptual site plan for this alternative.

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Figure 8-3
Alternative 1 - Conceptual Site Plan

Table 8-5. Theresa Street Alternative 1 – Year 2025 Required Improvements

Treatment Component	Description
Anaerobic Upflow Reactor	▪ Construct anaerobic upflow reactor at Cook Foods. ▪ Construct biogas fired reactor heating system, including gas storage and flare at Cook Foods. ▪ Provide associated chemical feed systems, including phosphoric acid, urea, and soda ash at Cook Foods. ▪ Hire 1 additional staff to operate anaerobic system.
Increased nitrifying treatment capacity	▪ Construct 13 mgd of increased primary clarifier capacity. ▪ Construct 13 mgd of aeration basin and blower capacity. ▪ Construct 13 mgd of secondary clarifier capacity.

The estimated total project cost of the facilities listed in Table 8-5 is $19,900,000. This cost is based on the estimated capital cost of the required facilities. Detailed cost estimates are presented in Appendix F.

Theresa Street Alternative 2 - Treat Side-Streams from Solids Processing

Alternative 2 involves upgrading the Theresa Street WWTF to handle an average annual flow of 27 mgd, and a peak hourly flow of 47 mgd. The side-stream from solids handling would be treated with a separate treatment process to reduce the organic load and oxidize the ammonia. This side-stream process provides an additional source of nitrifiers that would allow the Theresa Street activated sludge process to be operated at a lower SRT.

The representative side-stream process would include an equalization basin, activated sludge basin, secondary clarifier, a sodium bicarbonate buffering system, and RAS and WAS pumping facilities, as well as the associated piping and pumping facilities to divert solids dewatering filtrate to the side-stream process. Other processes could be utilized for this alternative and should be investigated during preliminary design if Alternative 2 is implemented.

Wet weather flows above 47.0 mgd would be temporarily stored in an equalization basin and then treated by the Theresa Street facility when influent flows returned to normal dry weather levels. The predicted maximum flow rate to the Theresa Street influent is based on a peak flow of approximately 110 mgd (see Table 5-7).

Table 8-6 lists the improvements required during the planning period under this alternative. Figure 8-4 shows a conceptual site plan for this alternative.

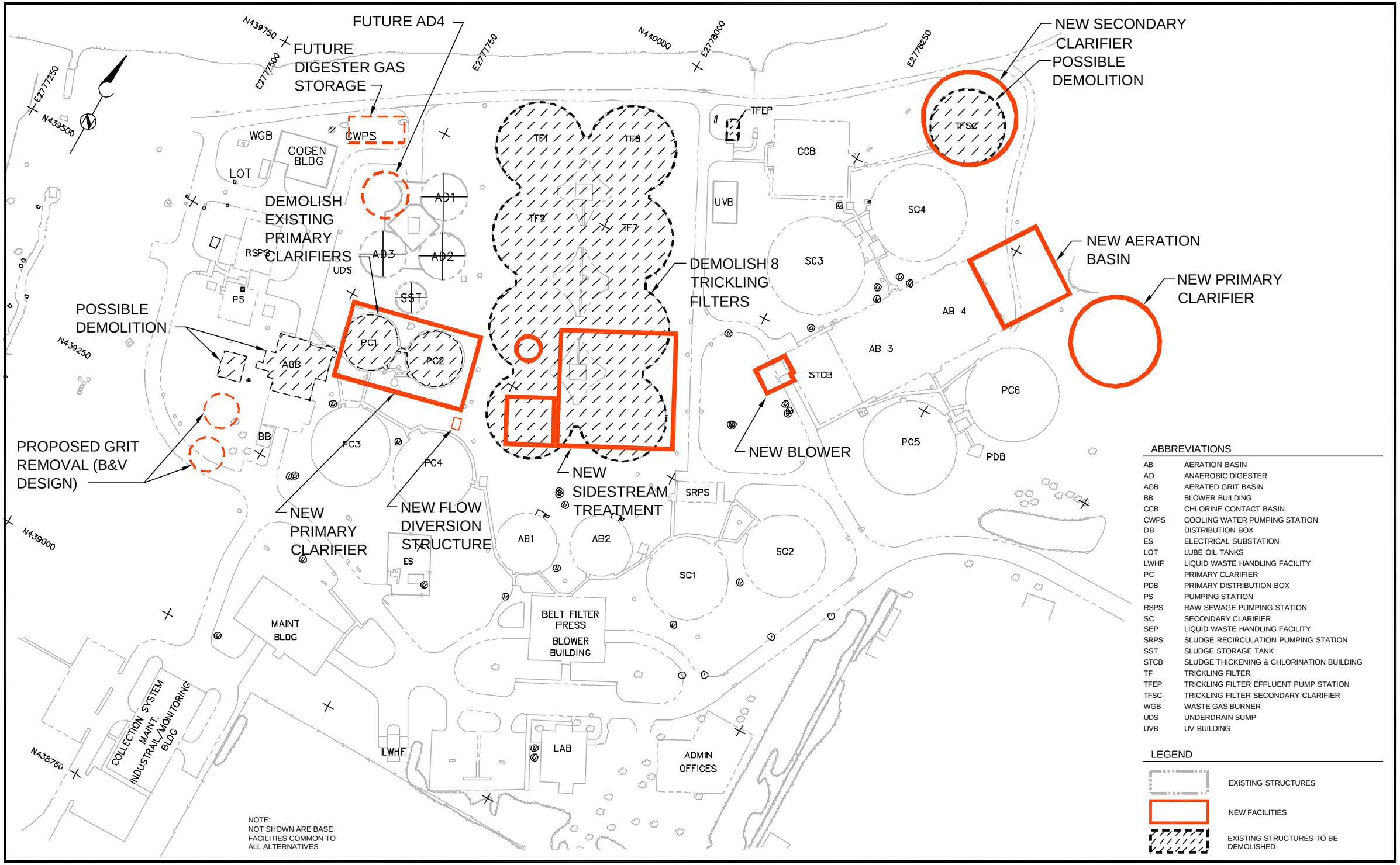

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Figure 8-4
Alternative 2 - Conceptual Site Plan

Table 8-6. Theresa Street Alternative 2 – Year 2025 Required Improvements

Treatment Component	Description
Side-Stream Treatment	▪ Construct separate process for treatment of side-stream from solids handling.
Increased nitrifying treatment capacity	▪ Construct 13 mgd of increased primary clarifier capacity. ▪ Construct 13 mgd of aeration basin and blower capacity. ▪ Construct 13 mgd of secondary clarifier capacity.

The estimated total project cost of the facilities listed in Table 8-6 is $20,700,000. This cost is based on the estimated capital cost of the required facilities. A detailed cost estimate is included in Appendix F.

Theresa Street Alternative 3 - Pretreat Cook Foods and Ammonia Side-Stream Treatment

Alternative 3 is essentially a modified, scaled-down combination of Alternatives 1 and 2 and includes upgrades to the Theresa Street WWTF to handle an average annual flow of 27 mgd and a peak hourly flow of 47 mgd. The Cook Foods COD would be reduced by approximately 90 percent with an anaerobic upflow reactor system. This anaerobic upflow treatment system would be located at the Cook Foods plant site (or adjacent to it), and be operated by personnel from the Theresa Street WWTF. The side-streams from solids handling would be treated with a separate treatment system to reduce the organic load and oxidize the ammonia. This would provide an additional source of nitrifiers that would allow the activated sludge process to be operated at a lower SRT.

Wet weather flows above 47.0 mgd would be temporarily stored in an equalization basin and then brought back into the Theresa Street facility when influent flows returned to normal dry weather levels. The predicted maximum flow rate to the Theresa Street influent is based on a peak flow of approximately 110 mgd (see Table 5-7).

This third alternative would reduce the amount of biosolids produced at the Theresa Street WWTF and would delay the need for a fourth anaerobic digester. This alternative would also delay the requirement for an additional belt press.

Table 8-7 lists the improvements required during the planning period under this alternative. Figure 8-5 shows a conceptual site plan for this alternative.

Table 8-7. Theresa Street Alternative 3 – Year 2025 Required Improvements

Treatment Component	Description
Anaerobic Upflow Reactor	▪ Construct anaerobic up-flow reactor at Cook Foods. ▪ Construct biogas fired reactor heating system, including gas storage and flare at Cook Foods. ▪ Provide associated chemical feed systems, including phosphoric acid, urea, and soda ash at Cook Foods. ▪ Hire 1 additional staff to operate anaerobic system.
Side-Stream Treatment	▪ Construct treatment reactors, alkalinity feed system, line from solids dewatering effluent, effluent pumping station, and RAS/WAS pumping station.
Increased Nitrifying Treatment Capacity	▪ Construct 13 mgd of increased primary clarifier capacity. ▪ Construct 13 mgd of aeration basin and blower capacity. ▪ Construct 13 mgd of secondary clarifier capacity.

The estimated total project cost of the facilities listed in Table 8-7 is $19,400,000. This cost is based on the estimated capital cost of the required facilities. A detailed cost estimate is included in Appendix F.

Theresa Street Alternative 4 – Expand Activated Sludge System

Alternative 4 requires that the Theresa Street WWTF handle a maximum month flow of 27.0 mgd, and a peak hourly flow of 47.0 mgd. The plant would require additional secondary treatment capacity of 13.0 mgd.

Wet weather flows above 47.0 mgd would be temporarily stored in an equalization basin and be brought back into the Theresa Street facility when influent flows returned to normal dry weather levels. The predicted maximum wet weather flow rate to the Theresa Street WWTF in 2025 is based on a peak flow of approximately 110 mgd (see Table 5-7).

This alternative would not impact the amount of biosolids produced at the Theresa Street WWTF since an aerobic process would still be used to treat the side-stream.

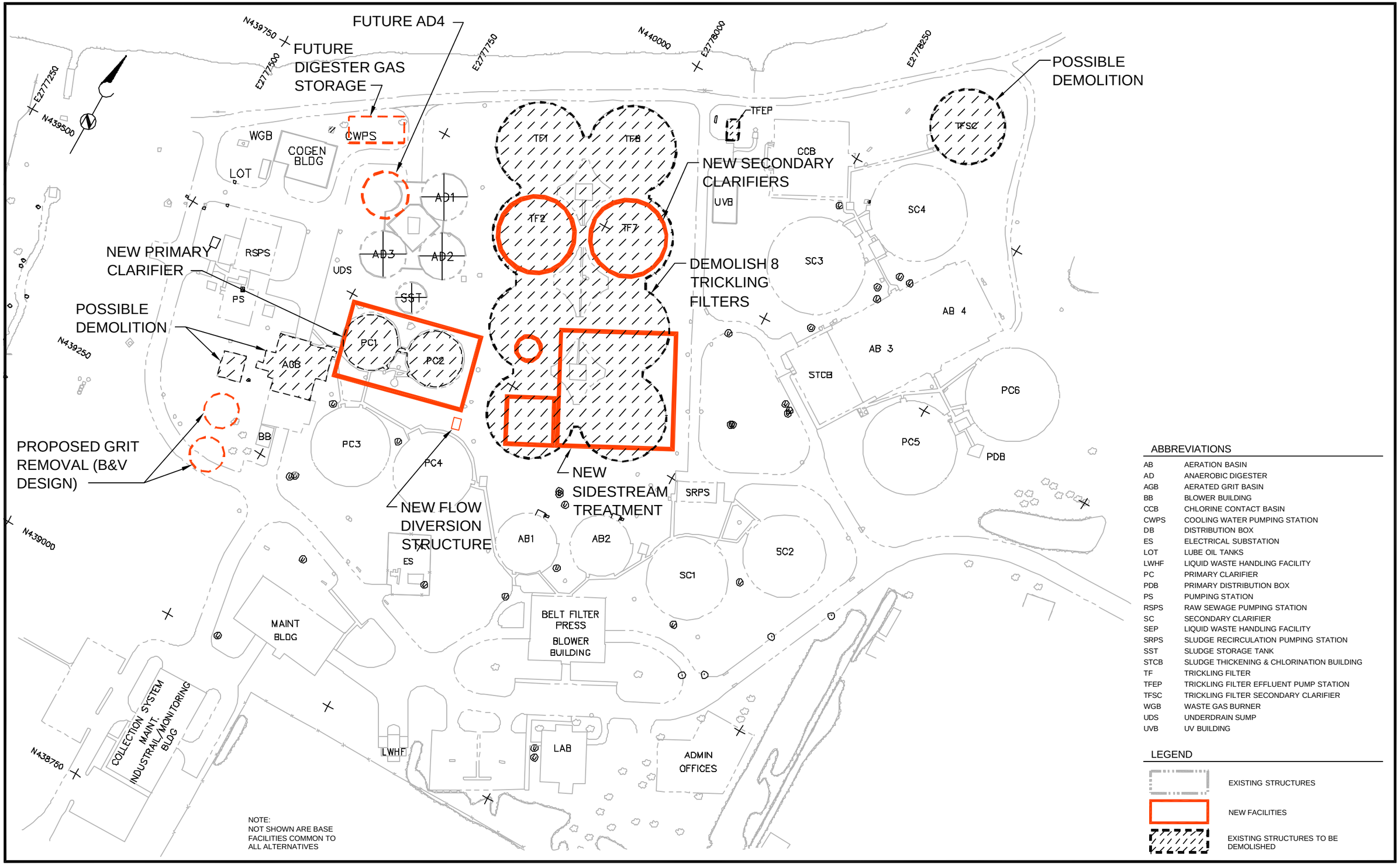

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Figure 8-5
Alternative 3 - Conceptual Site Plan

Table 8-8 lists the improvements required during the planning period under this alternative. Figure 8-6 shows a conceptual site plan for this alternative.

Table 8-8. Theresa Street Alternative 4 – Year 2025 Required Improvements

Treatment Component	Description
Increased secondary treatment capacity	▪ Construct 13 mgd of increased primary clarifier capacity. ▪ Construct 13 mgd of aeration basin and blower capacity. ▪ Construct 13 mgd of secondary clarifier capacity.

The estimated total project cost of the facilities listed in Table 8-8 is $22,700,000. This cost is based on the estimated capital cost of the required facilities. A detailed cost estimate is included in Appendix F.

Summary of Theresa Street WWTF Alternatives

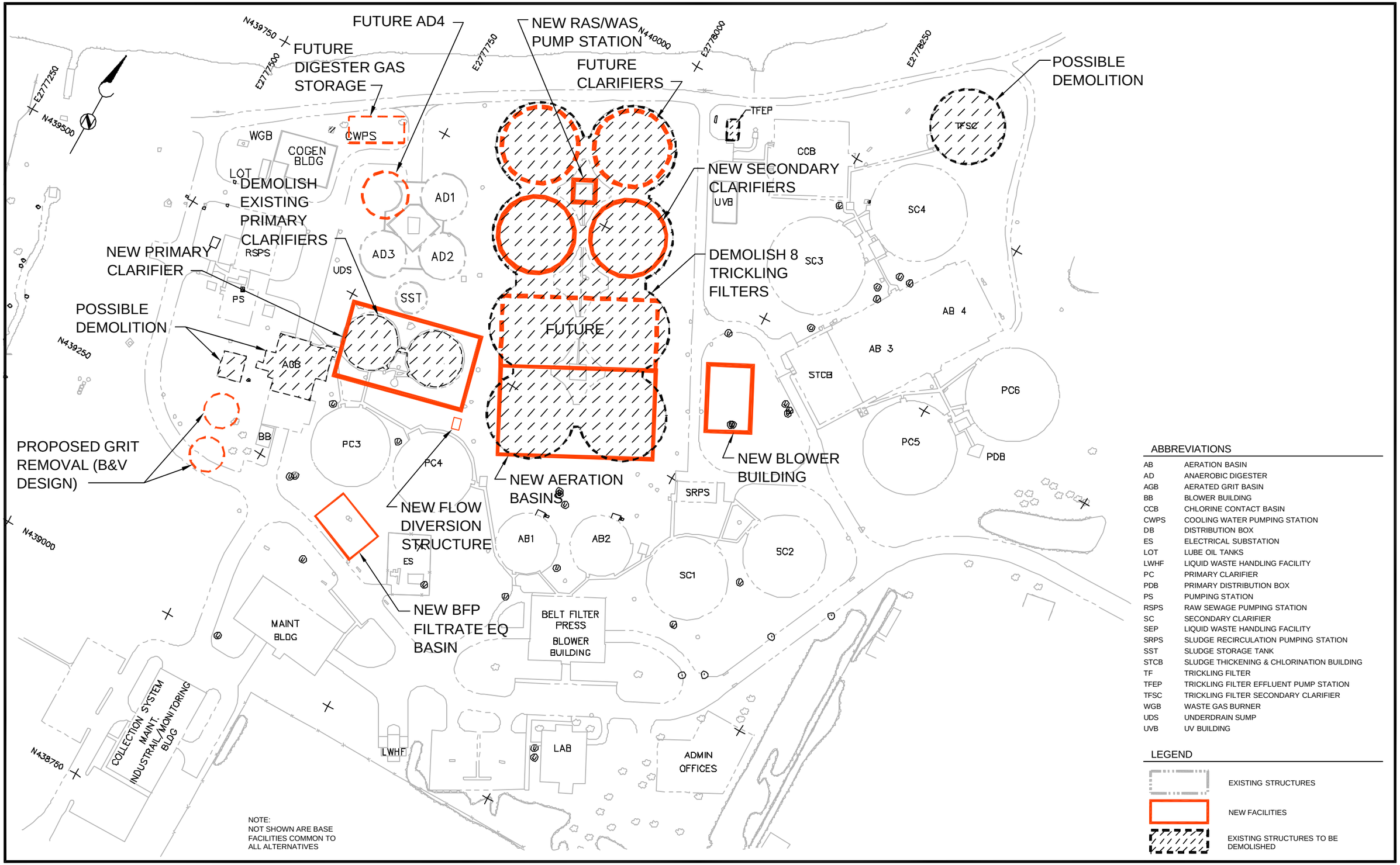
A comparison of the estimated costs for each of the alternatives considered is shown in Table 8-9 and include only those costs associated with the facilities unique to the specific alternatives. Other improvements common to all of the alternatives are presented later in this chapter.

Table 8-9. Alternative Capital Cost Summary

Alternative	Description	Total Project Cost
1	Pretreatment @ Cook Foods	$19,900,000
2	Side-stream Treatment of Filtrate Return	$20,700,000
3	Pretreatment @ Cook Foods and Side-stream Treatment of Filtrate Return	$19,400,000
4	All treatment @ Theresa Street WWTF	$22,700,000

Although the capital costs suggest that the alternatives that include pretreatment at Cook Foods or solids side-stream treatment are more economical than the more conventional wastewater treatment plant upgrade, the costs are reasonably close given the accuracy of the estimates and there are several mitigating issues that must be considered in selecting the preferred alternative.

Both Alternative 1 and Alternative 3 involve the construction and operation of dedicated, off-site treatment facilities. This condition involves substantial risk on the part of the City. If for some reason Cook Foods were to go out of business or leave Lincoln, the capital investment in the off-site treatment facilities could be lost. In addition, there is a substantial increase in operation and maintenance costs associated with operation of a separate off-site 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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Figure 8-6
Alternative 4 - Conceptual Site Plan

Alternatives 2 and 3 involve a separate side-stream treatment process to treat sludge dewatering return flows prior to their re-introduction into the main liquid treatment stream. This would reduce the organic and ammonia loading on the main liquid stream treatment system. As a result, some components of the main system could be smaller. The primary disadvantage of this separate side-stream system is that it represents a totally separate treatment system that would require separate operation and maintenance. It also represents a relatively new and therefore experimental process whose performance and subsequent impacts on the main treatment system are difficult to accurately quantify.

Theresa Street WWTF Basic Improvements

The following list identifies basic facility improvements required at the Theresa Street WWTF during the planning period regardless of the treatment alternative selected:

- Preliminary Treatment Improvements
  - South raw wastewater pumping station
  - North raw wastewater pumping station
  - Grit handling facilities
- Cogeneration facility improvements
- Anaerobic Digester complex improvements
  - Additional digester
  - Gas equalization or storage facility
  - Replace sludge valves on heating loop
  - Replace gas mixers/compressors
- West Side process improvements
  - Primary sludge pump replacement
  - Replace RAS pumps
  - New blowers
  - Secondary clarifier improvements
- East Side process improvements
  - Primary sludge pump replacement
  - Aeration system improvements
  - Secondary clarifier improvements
- DAF improvements
- Dewatering system improvements
- Maintenance shop rehabilitation
- Electrical improvements
- Collection system shop improvements
- Splitter structure improvements
- Administration building improvements
- Liquid waste handling facility improvements

- General system improvements
  - Wet weather flow facilities
  - Side-stream flow equalization
  - Hydraulic capacity improvements
- General plant/site improvements
  - Replace potable water distribution system
  - On-line process control instrumentation facilities
  - Plant site flood protection
  - Outside lighting improvements
  - Pavement rehabilitation
  - Gas line service replacements

The total project cost for these improvements is estimated to be approximately $51,800,000. A detailed breakdown of this estimate is included in Appendix F.

Northeast WWTF

As with the Theresa Street WWTF, the capacity of the Northeast WWTF may be limited by two different factors; biological treatment capability and hydraulic capacity. The evaluation performed as part of this facility planning process determined that the biological treatment capability of the Northeast WWTF is limited to approximately 4.4 mgd by the system's ability to remove ammonia at low wastewater temperatures. For the purposes of this evaluation, the existing Northeast WWTF capacity has been rounded to 5 mgd. The hydraulic capacity of the existing Northeast WWTF is estimated to be approximately 37 mgd.

The projected maximum 30-day flow for year 2025 is approximately 11 mgd, and for 2050 is 17 mgd (see Chapter 5). Therefore, approximately 6 mgd of additional treatment capacity will be required at the Northeast WWTF by 2025 and another 6 mgd of capacity will be required to accommodate 2050 flows. It is assumed that the additional capacity will be provided in two expansion phases.

Two alternatives for expanding nitrification capacity at the Northeast WWTF have been considered. The first involves elimination of the existing biotowers and expanding the activated sludge system to provide the required nitrification capacity. The second alternative involves continuing use of the biotowers prior to activated sludge to provide the necessary nitrification capacity. A preliminary evaluation indicates that the biotowers provide significant BOD_5 reduction as well as contribute to the stability and enhance the nitrification rate realized in the activated sludge process. Based on this preliminary information, it is recommended that the biotowers be refurbished and retained as a component of the Northeast wastewater treatment process. Preliminary design for the Northeast WWTF expansion should further investigate continued use of the biotowers.

Return flow from the sludge storage basin represents a significant ammonia loading at the Northeast facility that has historically occurred only on an intermittent basis. This intermittent ammonia loading promotes inconsistency in the effectiveness of ammonia removal and can negatively impact effluent quality. Two alternatives were considered to mitigate the negative impact of this return flow:

1. Construct a separate pipeline from the sludge storage basin to the Northeast facility to allow the return flow to be returned to the treatment process on a constant basis.

2. Construction of flow equalization facilities at the Northeast WWTF to allow the return flow to be introduced into the treatment process at a constant rate.

A return pipeline is currently planned to return cooling water from the new Lincoln Electric Power Generation Facility to the Northeast WWTF. It is recommended that this pipeline be utilized to return supernatent from the sludge storage basin to the Northeast WWTF. This will minimize the capital cost of facilities associated with returning supernatent at a consistent rate.

The estimated cost associated with expansion of the Northeast WWTF to provide nitrification capacity to accommodate the projected 2025 flows is presented in Table 8-10.

Table 8-10. Northeast WWTF Phase I Expansion Cost

Description	Estimated Cost
1st Phase Expansion	$11,600,000

A detailed breakdown of these costs is provided in Appendix G.

The projected peak design flow for the year 2025 is 1.75 times the average daily flow, or about 14 mgd. Even though the Northeast facilities have the hydraulic capacity to handle peak flows in excess of 14 mgd, it is recommended that peak flows above that flow be handled with the wet weather facilities to avoid the process upsets that may result from extreme hydraulic surges.

Sizing for wet weather equalization facilities was based on historical flow data from 1990 to the present. From this data a 2025 peak wet weather flow of 46 mgd was identified for the Northeast WWTF (see Chapter 5). The design parameters for wet weather flow facilities should be assessed in more detail during preliminary design of the wet weather facilities.

As indicated in Chapter 4, the Northeast WWTF currently produces more sludge than can be agronomically applied at the disposal site. At the current sludge production and agronomic loading rates, it is anticipated that over 550 acres of land are required for Northeast sludge injection. The facility currently has only 440 acres; therefore, action to obtain more land for sludge disposal or adopt some other mechanism for disposing of sludge from the Northeast WWTF should be taken soon. In the interim, sludge may be hauled to the Theresa Street WWTF for dewatering.

At 2025 sludge production rates, it is expected that over 800 acres will be required for agronomic application of biosolids generated at the Northeast facility. If adequate agricultural land can be obtained at the Northeast biosolids site to accommodate future biosolids application requirements, it is recommended that dedicated land application of Northeast biosolids continue. If adequate agricultural land at or near the existing site is not available, an alternative biosolids handling method should be adopted.

One alternative for a long-term dewatering operation is to construct a sludge drying bed adjacent to the sludge storage basin. Sludge could be pumped from the storage basin into the sludge drying bed during the summer and hauled to application sites on private agricultural lands in the fall. Paved drying beds for the Northeast WWTF with concrete containment walls and no underdrain system are estimated to cost approximately $5.5 million.

Other options for handling Northeast sludge include constructing mechanical dewatering facilities at the Northeast WWTF or pumping or trucking liquid sludge from the Northeast WWTF to the Theresa Street facility for handling prior to land application with the Theresa Street biosolids. Sludge drying beds have been evaluated only to determine a cost for additional sludge handling facilities and are not necessarily recommended. Further evaluation of sludge handling alternatives should be undertaken as part of the preliminary design for the Northeast WWTF improvements.

Northeast WWTF Basic Improvements

In addition to the basic need to provide additional nitrification and sludge handling capacity, the Lincoln wastewater management staff has identified several other improvements necessary at the Northeast WWTF.

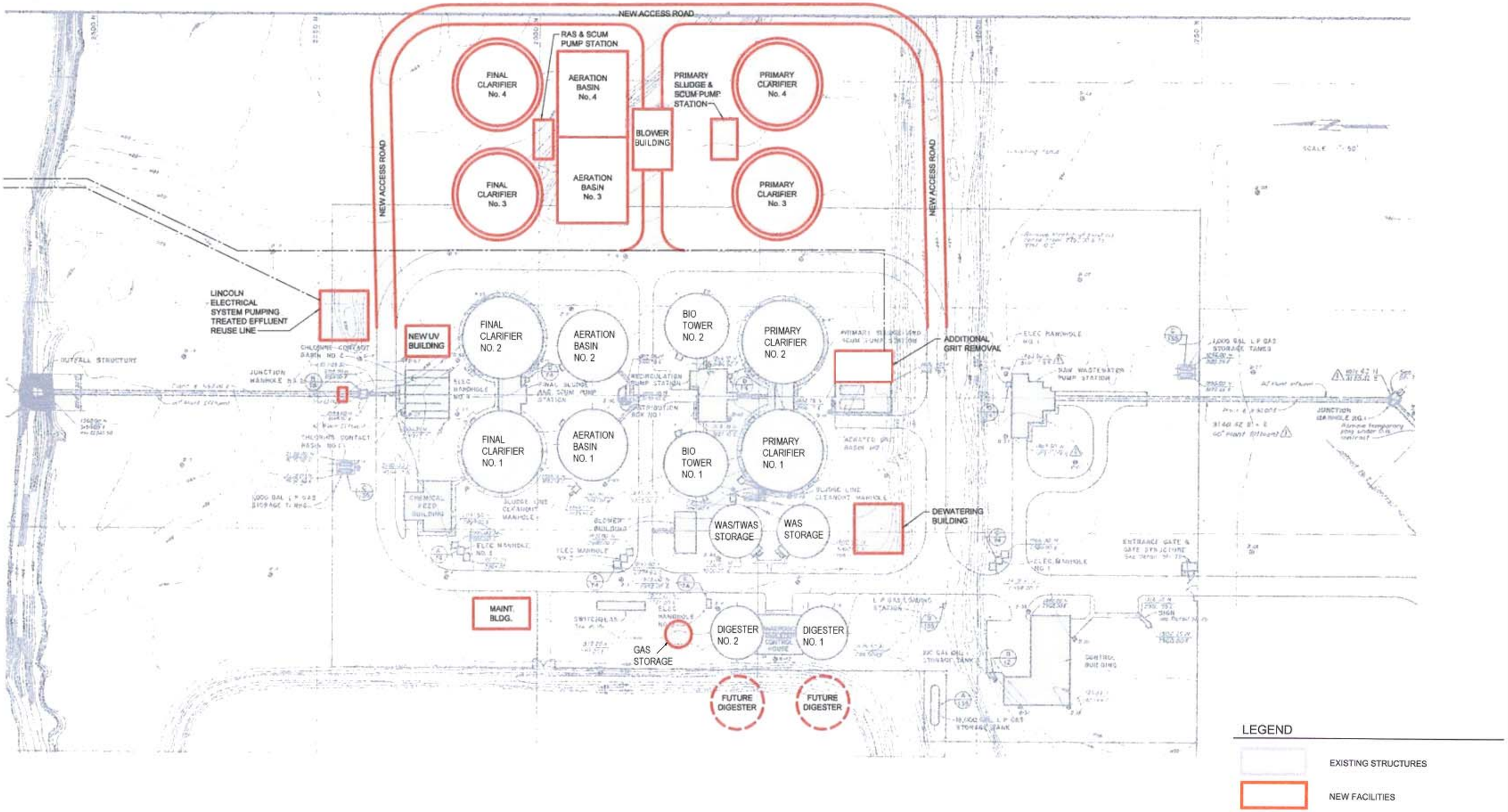
Based on information provided by Lincoln wastewater management staff, the following basic improvements need to be addressed at the Northeast WWTF during this planning period.

- Upgrade operations control center
- Replace raw wastewater pumps 1, 2, and 3
- Improve grit removal facilities
- Primary Sludge Pumping Building & Clarifiers
  - Replace clarifier sludge collector assemblies in a 5-10 year period
  - Replace weirs
  - Scum pits need rehab due to corrosion.
- Refurbish biotowers
- Secondary clarifier improvements
- Maintenance shop improvements
- Sludge handling system improvements
  - Digester improvements
  - Sludge utilization system improvements
- General system improvements
  - Wet weather flow facilities
  - Sludge storage return flow equalization
- General plant/site improvements
  - Replace outside facility lighting – needs new conduit & circuit
  - Repair and replace sidewalks and roads as required
  - Upgrade entrance gate structure

A proposed site layout for the Northeast WWTF is shown in Figure 8-7.

The estimated total project cost of these basic improvements is $26,900,000. A detailed breakdown of this estimate is included in the Appendix G.

Further discussion of the alternatives for expanding and upgrading the Theresa Street and Northeast WWTFs and planning recommendations for each facility are presented in Chapter 9.



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NORTHEAST WASTEWATER TREATMENT PLANT

Figure 8 - 7

Northeast WWTF Conceptual Site Plan