FINAL DESIGN MEMORANDUM
MIDDLE CREEK DRAINAGE BASIN
AND 'D' STREET LIFT STATION TRUNK SEWERS
CITY OF LINCOLN, NEBRASKA

JANUARY 2007

KM-0506221

EXECUTIVE SUMMARY

A. Middle Creek Basin Sewer Evaluation

1. "A" Street Sewer Improvements

Existing sanitary sewer flows were compared to the capacity of the trunk sewer in "A" Street. The review was based on the 'Existing" developed areas within the basin and the City's design equation for sizing of sanitary sewers. A computerized evaluation of flows and capacities was also completed.

This review as well as field experience by City personnel showed several locations along the trunk sewer that are surcharged. These are described in Part III.

Several immediate improvements are recommended. These recommendations include several sections of parallel 15-inch and 12-inch sanitary sewer. These improvements will relieve the current surcharging and provide a small amount of additional capacity, approximately 1 cfs, within the trunk sewer. These improvements should be initiated within the next year and will provide sufficient capacity through 2009 at 2.5% growth or 2012 at 1.5% growth.

The estimated project costs for these improvements is $1,348,000.

2. Folsom Bypass Sewer Evaluation

The existing trunk sewer within the Folsom Bypass was reviewed as described above.

The computer model showed a small amount of surcharging at the downstream end of this sewer.

This surcharging because it is relatively small, is not a concern at this time. Since additional flows within this trunk sewer are not anticipated, no improvements are recommended at this time.

As described in Part III the Tier I areas within the south portion of the Middle Creek Basin may be more effectively served by sewers to be built in the Haines Branch Basin.

B. Combined Lift Station Recommendations

1. "D" Street Lift Station

Review of the lift station indicates adequate firm capacity through 2010 at 2.5% growth or 2014 at 1.5% growth. Firm capacity is the capacity with one pump out of service. With all pumps running capacity is sufficient through 2024 or 2036 assuming 2.5% and 1.5% growth rates respectively. These flow projections and total lift station capacity are shown on Chart No. 2.

The condition of the lift station structurally however, shows the need for some improvements very soon. Because of the need for these repairs and the need to provide additional capacity at the 'P" Street Lift Station, a new lift station to serve both Middle Creek and West "O" Basins is recommended.

2. "P" Street Lift Station

Based on previously prepared studies, the "P" Street Lift Station and 8-inch force main will reach design capacity by 2009 assuming 2.5% growth rate and 70% developed area within the West "O" Drainage Basin.

3. Combined Lift Station

Construction of a Combined Lift Station to serve the Middle Creek and West "O" Drainage Basins is recommended. This will enable the City to replace the "P" Street Lift Station to keep pace with growth in the West "O" Basin and also replace the 'D" Street Lift Station which is in need of structural and mechanical improvements.

The initial phase will include a lift station designed for 10.7 cfs firm pumping capacity. This is recommended by 2009 assuming a 2.5% growth rate. The 10.7 cfs lift station will serve these drainage basins through 2028 assuming 2.5% growth or 2044 assuming 1.5% growth rate. These flow projections are shown on Chart No. 3.

C. Northwest Trunk Sewer Recommendations

1. Initial Phase

The short-term or immediate "A" Street trunk sewer parallel relief sewers will provide capacity through 2009 or 2012, depending on growth rates within the Middle Creek Basin served by the "A" Street Trunk Sewer.

Therefore, the first phase of the proposed Northwest Trunk Sewer should be initiated by 2009 to 2012 depending on the City's flow monitoring observations.

Construction of this sewer to SW 40th Street will allow the additional 467 acres between the existing area and SW 40th Street to be served. This will accommodate growth through the year 2020 or 2030 assuming 2.5% and 1.5% growth rates respectively. See Chart No. 1.

The total Middle Creek flows are 10.42 cfs for this service area of 1,489 acres.

2. Second Phase

Extending the sewer to SW 48th Street will serve an additional 1,119 acres or 2,141 acres total. The total flow from this service area would be 14.39 cfs.

This phase should be initiated sometime between 2020 and 2030 and will accommodate the growth through the year 2035 at 2.5% growth or the year 2055 at 1.5% growth as shown on Chart No. 1

3. Final Phase

The final phase will be to extend the sewer to SW 70th Street serving an additional 2,061 acres or 3,083 acres total. The total flow from this service area would then be 19.97 cfs.

This phase will also need to be coordinated with the actual planned growth and flow monitoring observations made by the City. Initiation of this phase is anticipated sometime between 2035 and 2055 and will serve development through the year 2050 at 2.5% growth rate as shown on Chart No. 1 and Table No. 1.

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I. INTRODUCTION

A. Project Background and Description

Lincoln Wastewater System (LWWS) proposes to extend the existing West 'A' Street Trunk sewer or install new trunk sewer(s) to provide capacity to service the general area bounded by SW 70th Street on the West, Folsom Bypass on the east Middle Creek on the North and the drainage basin ridge line for Middle Creek Basin on the south. These areas are identified in the Facility Plan and in the City of Lincoln Planning Department as Tier I (25 year) and Tier II (50 year) growth areas. Tier I development is located east of SW 40th Street and West of the existing development area as well as north of 'A' Street to the floodway boundary within SW-1 as well as south of the existing development (south of Van Dorn Street) as shown on Figure 2. Tier II development is located west of SW 40th Street to SW 70th Street and is bounded by Middle Creek to the north and the basin ridgeline to the south. These areas are shown in the Planning Department figure located in Appendix E and on Figures 1 and 2.

The extension or construction of a new Trunk Sewer is the next step in serving this area of Lincoln for residential development. As currently projected in the Comprehensive Plan these areas are identified as residential and urban residential. This coincides with current development activities in this area.

The existing 'A' Street trunk sewer conveys wastewater flow from the Middle Creek drainage basin east into the 'D' Street Lift Station. From there, the wastewater is pumped under Salt Creek via a 12-inch diameter force main into an 18-inch gravity sewer. The 18-inch sewer is connected to the existing 48-inch sewer in 3rd Street to convey wastewater flow into the Theresa Street WWTF.

The 'D' Street Lift Station was designed for maximum capacity of 2.88 mgd or 4.46 cfs with all pumps running. Based on historical flow records and a factor of 2, the actual flows to the lift station should be approximately 30% (15% x 2) of the design flow equation. Therefore, the existing lift station should be adequate to serve an area of 2,225 acres. This capacity provides no back-up pumping unit if one of the pumps is out of service.

The goals of this project include the following:

- Evaluate capacity of and current flows to 'A' Street Trunk Sewer.
- Identify alignment and timing for the sewer extensions to serve Tier I and Tier II areas.
- Determine alignments for sub-basin sewers to convey flow from the main sub-basin areas.
- Analyze the existing facilities and develop the best plan to deliver the wastewater from the Middle Creek Basin to either the existing Salt Valley Trunk Sewer or Salt Valley Relief Trunk Sewer, and
- Review alternatives for replacement of the West 'D' Lift Station.
- Evaluate capacity of and current flows to the Folsom Bypass Trunk Sewer.

The report includes an analysis of the capacity of the 'D' Street Lift Station and the 21-inch gravity sewer conveying flow to the lift station. The plan will not only meet the current needs, but provide a solution that enables the Tier I and Tier II growth areas identified in the Comprehensive Plan to be served as well.

B. Project Team Organization

The Lincoln Wastewater System (LWWS) is an integral partner in the development of the concepts, design, and construction of all project elements. Mr. Gary Thalken is the designated Project Representatives for LWWS.

Kirkham Michael is the Engineer for this project. KM is providing preliminary design of the sewer.

C. 'A' Street Sewer Evaluation

The existing trunk sewer in 'A' Street from Ridge Road to the West 'D' Lift Station located at 6th Street and West 'E' Street was evaluated as a part of this project. The sewer is a 12-inch diameter at West 'A' Street and Ridge Road and discharges into the West 'D' Lift Station as a 21-inch diameter pipe. The sewer is shown on Figure No. 2. The sewers capacities at each segment were evaluated against the contributing flows generated by the contributing areas based on the City's design flow equation.

D. West 'D' Street Lift Station Evaluation

The capacity of the West 'D' Lift Station was also evaluated as a part of the project. The lift station is in poor condition and should be replaced. Alternatives for replacing the lift station were reviewed including an alternative to combine the West 'D' and West 'O' Street Lift Stations. The possibility of eliminating the lift stations by installing a siphon under Salt Creek was also reviewed but found to not be feasible due to the current lift station depths compared to the depth of the Salt Valley Trunk and Relief Sewers in 4th Street east of Salt Creek.

E. Alignment Selection

An alignment study was conducted to identify the most effective route to convey flow from the Tier I and Tier II areas to the West 'D' Lift Station.

Alignment No. 1 Proposed Middle Creek Northwest Trunk Sewer Extension – Figure 3) - As shown on Figure No. 4, this proposed trunk sewer will provide service to the Tier I and Tier II areas identified on Figure No. 3. These areas are generally west of SW 36th Street north of the South Ridge Line of Middle Creek Drainage Basin and south of Middle Creek. This alignment also includes two connections to the 'A' Street sewer to relieve some of the flow from 'A' Street and also eliminates the need for the lift station located at S. Coddington Avenue and W. Millstone Road.

Alignment No. 2 Extension/Replacement of 'A' Street Sewer - This would include replacement of the existing 'A' Street Trunk Sewer within 'A' Street. This alignment was found to be less desireable because it would not eliminate the lift station on Coddington Avenue, it would be less effective at serving the areas north of 'A' Street (which are lower than 'A' Street), and construction would be more difficult through some of the areas, which are already developed.

II. GENERAL

A. 'A' Street Sewer and Folsom Bypass Sewer

The existing 'A' Street Trunk Sewer currently discharges to the West 'D' Street Lift Station located at the intersection of 6th Street and West 'E' Street. The Folsom Bypass Trunk Sewer also discharges to the West 'D' Street Lift Station.

The 21-inch diameter 'A' Street Trunk Sewer extends west approximately 3,300 linear feet parallel to 'E' Street right-of-way to the Homestead Expressway. The 21-inch diameter sewer then extends approximately 1,500 linear feet south to 'A' Street where it turns west and transitions to 18-inch diameter. The 18-inch diameter sanitary sewer extends approximately 5,300 linear feet west within 'A' Street to Southwest 27th Street. From this point a 15-inch diameter sewer extends west 1,000 linear feet where a 12-inch diameter sewer from the south and another 12-inch sewer from the west are connected to the 15-inch sewer at the manhole just east of the intersection of Southwest 30th Street and 'A' Street.

These 12-inch diameter sewers extend west in 'A' Street and to the south to serve the developing subdivisions between Southwest 40th and Southwest 30th Streets.

The 15-inch diameter "Folsom Bypass Trunk Sewer" that discharges to the West 'D' Street Lift Station extends from the lift station south within Southwest 6th Street approximately 2,500 linear feet to the Folsom Bypass. From this point the 15-inch diameter sewer continues approximately 850 linear feet along Folsom Bypass to the intersection of Folsom Lane and South Folsom Street. The 12-inch sewer then continues approximately 3,100 linear feet along Folsom Bypass to just east of Big Tree Circle.

B. West 'D' Street Lift Station

The West 'D' Street Lift Station is located near the intersection of Southwest 6th Street and West 'E' Street. The lift station pumps wastewater across Salt Creek through a 12-inch diameter force main to the 18-inch diameter sewer on the east side of Salt Creek near Southwest 2nd Street on 'D' Street. The lift station includes three 800 gpm pumps.

C. Site Description – Middle Creek Northwest Trunk Sewer

1. Location

The proposed trunk sewer extension begins at a point in the south right-of-way of Capitol Parkway just west of Salt Creek. A 1,900 linear feet section of 36-inch sewer will extend south from this manhole to the existing 'D' Street Lift Station to collect the flows from the existing 'A' Street sewer and the sewer in Folsom Bypass that currently serve the existing development within the Middle Creek Drainage Basin.

The new trunk sewer will extend west from this manhole along the Capitol Parkway right-of-way and past the new K & L Interchange to the corner of Coddington Avenue and Millstone Road. The sewer will extend westward along what would be 'F' Street right-of-way to the 1/4 Section line at what would be Southwest 48th Street. The trunk sewer then extends north approximately 1,260 linear feet and then extends west to Southwest 70th Street within or parallel to an existing power transmission line easement.

Sewer mains will extend to the north and to the south into each sub-basin to serve each area. These sewers are shown on Figure 4.

2. Datum

Elevations will be based on 1988 North American Vertical Datum (NAVD). Horizontal control will be based on the Lancaster County grid control system.

3. Flood Protection

Flood elevations for Middle Creek were determined using the "Lancaster County and Incorporated Areas Flood Insurance Study" and the "Flood Insurance Rate Maps". The latest version of both references is September 21, 2001. Flood elevations may vary along the proposed sewer route for the given storm return intervals of 10-year, 50-year, 100-year flood elevation at each of the respective locations.

D. Topographic Survey, Easements, and Material Laydown Areas

Several existing sewer mains were surveyed to verify manhole location and rim and invert elevations. The surveyed data was incorporated into the sewer modeling and sewer evaluation along with information in the City's utility database.

E. Documents

1. Drafting Standards

   The project drawings will be prepared on 22-inch by 34-inch sheets. The City of Lincoln's drafting standards will be utilized in the preparation of project drawings. Drawings will be produced using Microstation. Each sheet will have the following title:

   Middle Creek Northwest Trunk Sewer
   Lincoln, Nebraska
   2006

2. Specifications

   Specifications are not included within the project scope.

3. Existing Data

   The following data shall be used in the preparation of the Contract drawings and specifications:

   a. Lincoln Wastewater Facilities Plan Update – April 2003, prepared by Brown and Caldwell.

   b. City of Lincoln GIS data for sewer lengths, slopes and collection sewer connections elevations to the existing trunk sewer for determination of allowable submergence.

F. Applicable Standards and Guidelines

The following standards and guidelines will be used for this project:

1. City of Lincoln Standard Plans and Specifications.

2. Recommended Standards for Wastewater Facilities, Great Lakes – Upper Mississippi River Board of State Public Health and Environmental Managers (10 States Standards).

G. Project Approval Requirements

The following agencies will review and approve the Contract Documents prior to awarding the project for construction:

1. Nebraska Department of Environmental Quality for minimum sanitary requirements.

2. Lower Platte South Natural Resources District and U.S. Corps of Engineers for creek crossings of Middle Creek tributaries.

3. Nebraska Department of Roads for construction in the right-of-way near the K & L Interchange (Highway No. 77 and Capitol Parkway).

4. National Pollutant Discharge Elimination System (NPDES) Permit for control of run-off during construction.

5. Lancaster County Permits for crossing of southwest 40th Street and southwest 65th Street.

III. SEWER DESIGN

A. Design Flows

1. General

The Tier I and Tier II service areas identified in the *Lincoln Wastewater Facilities Plan Udate* (October 31, 2002, by Brown and Caldwell) were used as the basis for service areas for the preliminary evaluations. Some of these areas were modified from the Facilities Plan slightly based on a more thorough review of the topography.

2. Existing Service Areas

The existing development areas within the Middle Creek drainage basin are shown on Figure No. 1. These areas fall into two groups; one that is served by the existing 'A' Street Trunk Sewer and the other that is served by the trunk sewer in Folsom Bypass.

Approximately 1,022 acres are served by the 'A' Street Trunk Sewer and approximately 367 acres are served by the Folsom Bypass Trunk Sewer.

Each trunk sewer was divided into segments (or reaches) in accordance with the impacting point of each sub-basin within the trunk sewer. These segments and impact points are shown on Figure No. 2 and are tabulated in Table No. 2.

The sewer capacities and flows were analyzed within Table No. 2 as well as on the computer model of the sewer.

3. Future Service Area

The Tier I and Tier II sub-basins are shown on Figure No. 3. These areas and the contributing flows were used to design the proposed Middle Creek Northwest Trunk Sewer. The additional sewers needed for areas served by Folsom Bypass Trunk Sewer were not designed as they are outside of the project scope. Some of these areas may be better served by sewers constructed within the Haines Branch Basin since the topography would suggest drainage to this basin from the ridgeline that roughly parallels Van Dorn Street between Southwest 40th Street and Southwest 70th Street.

Approximately 429 acres are included within Tier I and 1,632 acres within Tier II along the "A" Street Corridor, for a total cumulative area of 2,061 acres to be served by the proposed trunk sewer. The majority of flow from the existing areas will be served by the existing "A" Street sewer except for a small amount diverted from the "A" Street sewer to the new trunk sewer due to abandonment of the lift station on Coddington Avenue and interconnections sewers from "A" Street to the new trunk sewer.

Approximately 314 additional acres located along Van Dorn Street within Tier I will need to be served by sewers within the Haines Branch or by a sewer improvement along Folsom Bypass. For this study, it is assumed these Tier I areas will be served within the Haines Branch and do not contribute to the flows to the West 'D' Lift Station. The flows from the existing areas served by Folsom Bypass will continue to flow to the "D" Street Lift Station.

4. Northwest Trunk Sewer Design Flows

Utilizing cumulative areas for Tier I and Tier II for a total of 2,061 acres the total flow contributed to the proposed trunk sewer is 13.92 cfs using the City's design equation. However, some additional flows that are currently collected in the 'A' Street sewer will be relieved to the new trunk sewer. The flow diverted from 'A' Street at Southwest 30th Street plus the flows from the elimination of the lift station at Coddington Avenue and Millstone Road will be approximately 1.16 cfs (520 gpm). The total design flow for the new trunk sewer will be 15.08 cfs, for Tier II condition.

5. Design Flow Summary

A tabulation of design flows and capacities for the wastewater system components is shown in Table 1. Also included are graphical charts showing the design flow by year assuming various population growth rates. The graphs depict flows to the lift station as well as sewer design flows.

Table 1 and the charts following Table 1 show the design flow at various times for each of the reviewed system components including the West A Trunk Sewer, West "D" Lift Station, West "P" Lift Station, and proposed trunk sewer for Middle Creek Drainage Basin.

As observed in Chart No. 1, the West "A" Street Trunk Sewer has reached capacity. The City has observed some problem areas in this sewer and this has been confirmed in the computer analysis discussed later in this report.

Some immediate improvements are recommended to the "A" Street Trunk Sewer as a short-term solution. These are reviewed later in this report, under Part III B.3.

The "D" Street Lift Station capacity is sufficient for the foreseeable future, however the structural condition of this lift station is a concern, See Chart No. 2.

The lift station at West "P" Street was reviewed previously under a separate City project. The lift station's capacity is expected to be exceeded by 2009. The Charts were also used to design and phase the proposed northwest trunk sewer assuming 1.5% or 2.5% growth rates. The City will continue flow monitoring to evaluate the progress of development and associated flows to determine timing of proposed projects.

6. Sub-Basin Areas and Design Flows

Tables 2 and 3 summarize the areas and design flows for each of the sub-basins within the "Existing", "Tier I", and "Tier II" stages of development in accordance with the identified areas from the City's comprehensive plan and as refined by the mapping done for this report.

These design flows were used in conjunction with the computer model to evaluate the existing sewer mains and to design the sewer and sewer main improvements.

The contributing areas, sewer impact points, sewer segments, and contributing flows for the Northwest Trunk Sewer are shown in Table 3. The required sanitary sewer sizes and slopes are also shown in Table 3. This flow data was used in the computer model to design the proposed Middle Creek Northwest Trunk Sewer.

Table 1
Summary of Design Flows

Facility Sanitary Sewer or Lift Station	Cumulative Area & Flow Existing		Cumulative Area & Flow Tier I		Cumulative Area & Flow Tier II		Existing Capacity	Capacity As Area
	(Acre)	(cfs)	(Acre)	(cfs)	(Acre)	(cfs)	(cfs)	(acre)
Folsom Bypass Trunk Sewer	367	3.05	367	3.05	367	3.05	3.36	415
'A' Street Trunk Sewer	1,022	7.48	1,022	6.32*	1,022	6.32*	7.10	965
Proposed N.W. Trunk Sewer	NA	NA	429	4.65*	2,061	15.08*	NA	NA
Sewer Design Values, West A Portion of Middle Creek	1,022	7.48	1,451	10.19	3,083	19.92	NA	NA
Sewer Design Values, Middle Creek Basin	1,389	9.81	1,818	12.45	3,450	22.03	NA	NA
Sewer Design Values, West O	1,042	7.61	2,942	19.11	2,942	19.11		
'D' Street Lift Station Design Values, Middle Creek Basin	1,389	2.94	1,818	3.74	3,450	6.69	4.46	2,225
'P' Street Lift Station Design Values, West O Basin	1,042	3.50	2,942	8.79	2,942	8.79	4.41	1,350
Proposed Combined 'D' Street and 'P' Street Lift Station Design Values	2,431	6.44	4,760	12.53	6,392	15.48	NA	NA

Notes:

1. For Sewer Design Q = 0.01726A ^0.8 + 0.003A (A = Area in Acres)
2. For Lift Station Design
   Middle Creek Basin Q = {0.01726A^0.8 + 0.003A} x 0.30
   'O' Street Basin Q = {0.01726A ^0.8 + 0.003A} x 0.46 – use same format as others.
3. For combined Lift Station Q = Q 'O' Street + Q Middle Creek
4. Flow and Area Information for 'O' Street Basin from "Final Design Memorandum, Lincoln Wastewater System, West 'O' Street Trunk Sewer Extension".

* Includes 1.16 cfs diverted from 'A' Street Sewer

CHART - 1 MIDDLE CREEK FLOWS AND SEWER CAPACITY, A STREET SEWER PORTION

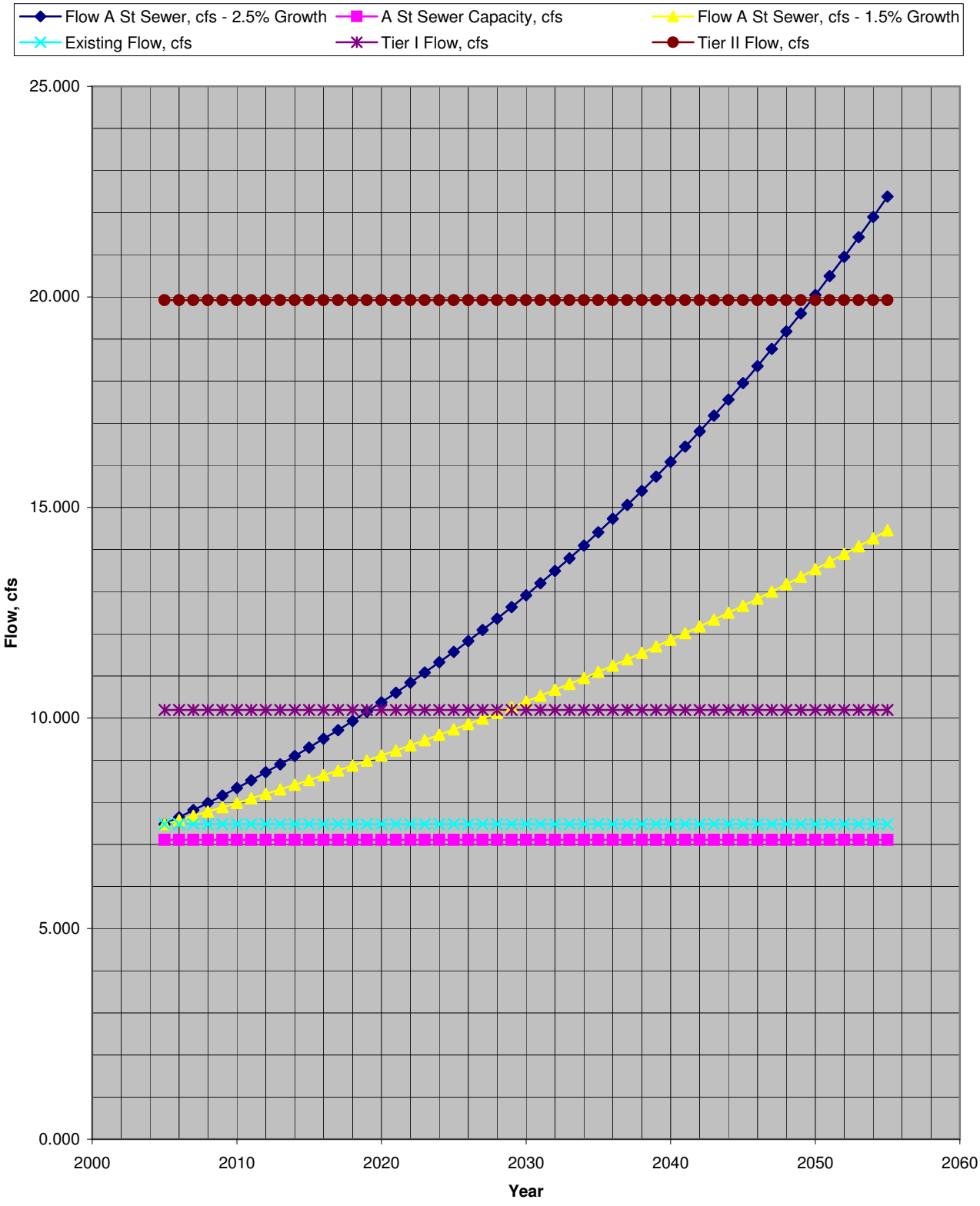


CHART - 2 D ST LIFT STATION CAPACITY AND FLOWS (A STREET AND FOLSOM FLOWS)

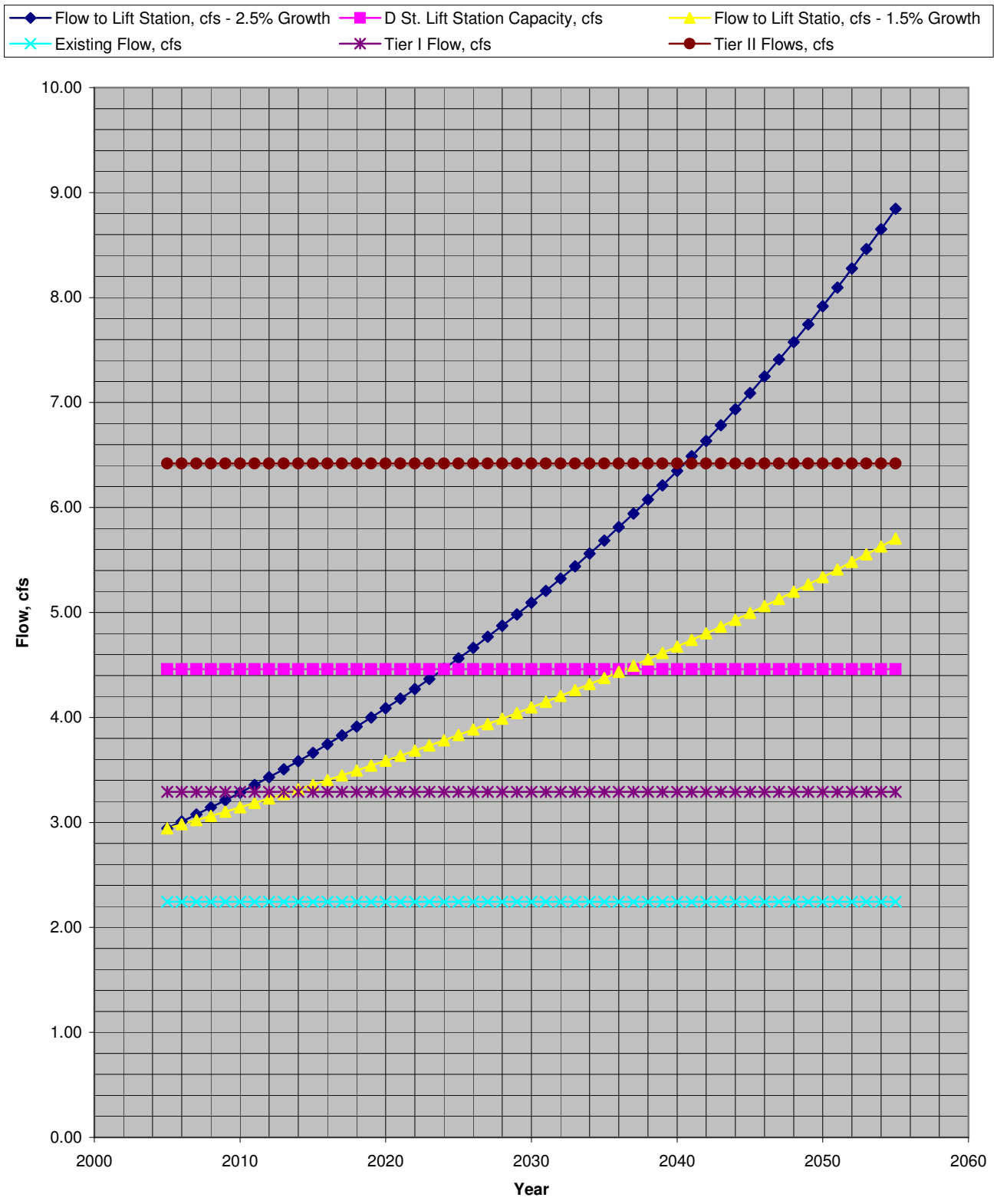


CHART 3 - FLOW TO COMBINED LIFT STATION, MIDDLE CREEK AND WEST O BASINS

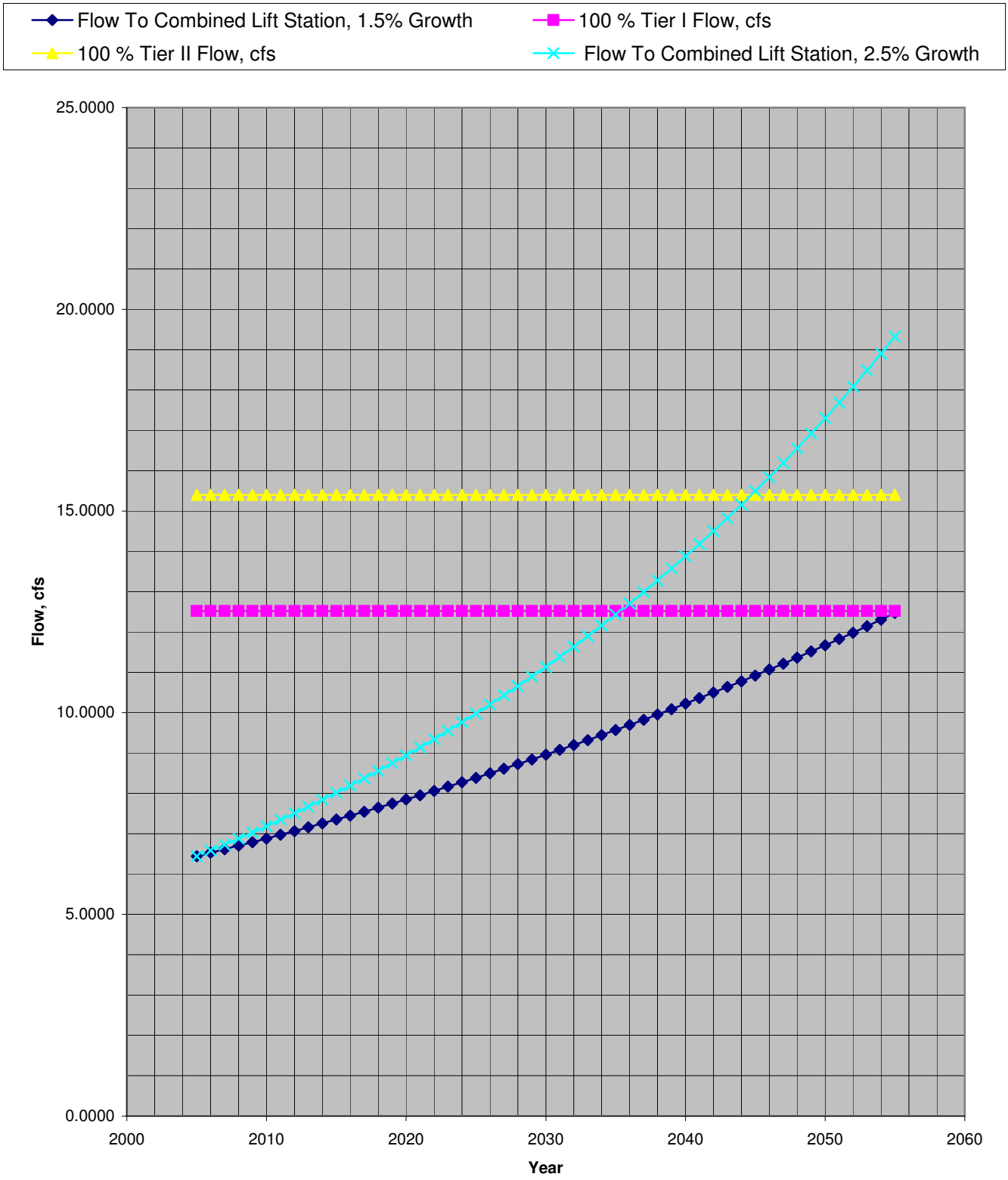


TABLE 2

EXISTING A STREET AND FOLSOM BYPASS (PARKWAY) TRUNK SEWER EVALUATIONS

IMPACT POINT	DOWNSTREAM SEWER SEGMENT	CONTRIBUTING AREAS NO.	CONTRIBUTING AREAS AREA (ACRE)	TOTAL CONTRIBUTING AREA	CONTRIBUTING FLOW(CFS)	ADDED FLOW AT IMPACT POINT**	EXISTING SLOPE %	EXISTING SEWER DIAMETER	EXISTING SEWER CAPACITY	EXCESS CAPACITY OR SHORTAGE
A' STREET SEWER										
A	A TO B	A1	8	8	0.115	0.115	1.8400	8	1.643	1.528
B	B TO C	A1	8	68	0.709	0.594	0.8200	12	3.233	2.525
		A2	60							
C	C TO D	A1	8	91	0.910	0.201	0.5500	12	2.648	1.738
		A2	60							
		A3	23							
D	D TO E	A1	8	326	2.747	1.836	0.2000	18	4.709	1.962
		A2	60							
		A3	23							
		A4	235							
E	E TO F	A1	8	505	4.025	1.278	0.1000	18	3.330	**-0.695**
		A2	60							
		A3	23							
		A4	235							
		A5	179							
F & G	F/G TO H	A1	8	637	4.933	0.908	0.3500	18	6.229	1.296
		A2	60							
		A3	23							
		A4	235							
		A5	179							
		A6	95							
		A7	37							
H	H TO J	A1	8	955	7.044	2.110	0.2500	21	7.942	0.898
		A2	60							
		A3	23							
		A4	235							
		A5	179							
		A6	95							
		A7	37							
		A8	285							
		A9	33							
I *	I TO H	A9	33	33	0.382	0.382	0.5200	8	0.873	0.491
J	J TO Q	A1	8	1022	7.478	0.434	0.2000	21	7.103	**-0.374**
		A2	60							
		A3	23							
		A4	235							
		A5	179							
		A6	95							
		A7	37							
		A8	285							
		A9	33							
		A10	67							

* SEE TABLE 3

**for use in sewer model

IMPACT POINT	DOWNSTREAM SEWER SEGMENT	CONTRIBUTING AREAS NO.	AREA (ACRE)	TOTAL CONTRIBUTING AREA	CONTRIBUTING FLOW(CFS)	ADDED FLOW AT IMPACT POINT	EXISTING SLOPE %	EXISTING SEWER DIAMETER	EXISTING SEWER CAPACITY	EXCESS CAPACITY OR SHORTAGE
FOLSOM PARKWAY SEWER										
K	K TO L	A20	70	70	0.727	0.727	0.2400	12	1.749	1.023
L	L TO M	A20	70	102	1.004	0.278	0.5600	12	2.672	1.668
		A21	32							
M	M TO N	A20	70	154	1.433	0.429	0.1300	15	2.334	0.902
		A21	32							
		A22	52							
N	N TO O	A20	70	238	2.089	0.656	0.2300	15	3.105	1.016
		A21	32							
		A22	52							
		A23	84							
O	O TO P	A20	70	345	2.886	0.797	1.1200	15	6.852	3.967
		A21	32							
		A22	52							
		A23	84							
		A24	66							
		A25	41							
P	P TO Q	A20	70	367	3.045	0.160	0.2700	15	3.364	0.319
		A21	32							
		A22	52							
		A23	84							
		A24	66							
		A25	41							
		A26	22							
WEST D LIFT STATION INFLUENT FLOWS AND DESIGN FLOWS FROM EXISTING LIFT STATION TO PROPOSED LIFT STATION							PRPOSED SLOPE (%)	PROPOSED SEWER DIAMETER	SEWER CAPACITY (CFS)	FULL FLOW VELOCITY (FPS)
Q	LIFT STATION(S)	A1 thru A26	1389	1389	9.806	9.806	0.0570	30	9.818	2.000

TABLE 3

PROPOSED MIDDLE-CREEK NORTHWEST TRUNK SEWER EXTENSION

IMPACT POINT	DOWNSTREAM SEWER SEGMENT	CONTRIBUTING AREAS NO.	AREA (ACRE)	TOTAL CONTRIBUTING AREA	TOTAL CONTRIBUTING FLOW(CFS and GPD)	ADDED FLOW AT IMPACT POINT	SLOPE %	SEWER DIAMETER	SEWER CAPACITY	FULL FLOW VELOCITY
PROPOSED TURNK SEWER										
1	1-2	AII-1	105	206	**1.843**	1.843	0.0850	15	**1.888**	1.538
		AII-2	101				0.1500	15	**2.508**	2.043
							0.4100	15	**4.146**	3.378
							0.2850	12	**1.906**	2.427
					1,190,986.217					
2	2-3	IP 1	206	479	**3.843**	2.000	0.0600	21	**3.891**	1.618
		AII-3	73				0.1000	21	**5.023**	2.088
		AII-4	127				0.1350	18	**3.869**	2.189
		AII-5	73				0.2000	18	**4.709**	2.665
					2,483,483.604					
3	3-4	IP's 1 thru 2	479	746	**5.668**	1.824	0.0650	24	**5.782**	1.840
		AII-6	91				0.0800	24	**6.414**	2.042
		AII-7	70				0.1300	21	**5.727**	2.381
		AII-8	106				0.1250	21	**5.616**	2.335
					3,662,474.191					
4	4-5	IP's 1 thru 3	746	942	**6.959**	1.292	0.0500	27	**6.942**	1.746
		AII-9	70				0.0680	27	**8.096**	2.036
		AII-10	41				0.0950	24	**6.990**	2.225
		AII-11	85				0.1500	27	**12.025**	3.024
					4,497,164.922					
5	5-6	IP's 1 thru 4	942	1327	**9.418**	2.459	0.0550	30	**9.644**	1.965
		AII-12	80				0.0600	30	**10.073**	2.052
		AII-13	266				0.0950	27	**9.570**	2.407
		AII-14	39				0.1500	27	**12.025**	3.024
					6,085,951.826					
6	6-7	IP's 1 thru 5	1327	1594	**11.078**	1.660	0.0450	33	**11.248**	1.894
		AII-15	77				0.0510	33	**11.974**	2.016
		AII-16	71				0.0730	30	**11.110**	2.263
		AII-17	42							
		AII-18	77							
					7,158,546.681					
7	7-8	IP's 1 thru 6	1594	1994	**13.512**	2.435	0.0400	36	**13.374**	1.892
		AII-19	38				0.0450	36	**14.186**	2.007
		AI-1	149				0.0650	33	**13.518**	2.276
		AI-2	89							
		AI-3	124							
					8,732,055.811					
8	8-9	IP's 1 thru 7	1994	2061	**13.915**	0.403	0.0450	36	**14.186**	2.007
		AI-4	67				0.0700	33	**14.028**	2.362
					8,992,323.508					
	RELIEF FLOW FROM 'A' STREET SEWER *				14.915	1.000	0.2800	10	**1.162**	2.130
	NW TRUNK SEWER DESIGN WITH RELIEF SEWER FLOW				15.077	1.000	0.0650	36	**17.049**	2.412
					9,743,159.085		0.1500	30	**15.926**	3.244

*Flow diverted from A Street sewer to relieve overloaded segment near Coddington and additional flow from elimination of lift station at Coddington Rd. and Millstone Rd.

B. Sewer Modeling

A computerized hydraulic sewer model was developed to evaluate the existing flows from the Middle Creek drainage basin to the existing trunk sewer in West 'A' Street as well as to evaluate the existing trunk sewer along the Folsom Bypass. The model was also used to evaluate Tier I and II flows to the proposed trunk sewer.

The model evaluates the flow condition in the existing gravity sewers upstream from the 'D' Street Lift Station. The model determines if a pipe segment between manholes is operating in a submerged or gravity mode by taking into consideration the downstream water depth and the flow. The model then uses the Manning's equation for gravity flow or the Hazen-Williams equation for a submerged condition to determine the upstream depth of water. Working from the downstream condition to the upstream manhole of each pipe segment, the model calculates the depth of water until the last manhole is reached.

The results of the model are presented graphically on the profiles included in Appendix B to allow the user to quickly evaluate the flow condition in each segment. The model also evaluates the Tier I and II flows to the proposed trunk sewer north of 'A' Street.

1. Evaluation and Capacities of Existing Sewers

The existing sanitary sewers that collect wastewater and discharge to the 'D' Street lift station were modeled to determine their capacity for conveying existing and future wastewater flows. The following describes each component of the existing conveyance system.

a. Existing 'A' Street Trunk Sewer

The existing 'A' Street Trunk Sewer begins at the upstream end near Timber Ridge and 'A' Street. This 12-inch sewer collects flows from Woodland Ridge, Timber Ridge, Timber Valley and the drainage sub-basin west of 27th Street. The sewer extends east in 'A' Street from just east of Southwest 30th to Southwest 25th as a

15-inch diameter and an 18-inch sewer for portions of this segment. The 18-inch sewer continues east in 'A' Street to Southwest 13th Street where it turns north as a 21-inch diameter sewer extending to a point just north of SW 13th and 'E' Street. The 21-inch sewer then extends to the east to the West 'D' Street Lift Station on Southwest 6th Street between West 'D' and West 'E' Streets.

A computer analysis of the trunk sewer in 'A' Street showed that several segments of the sewer are surcharged under the peak flow condition based on the 'Existing' areas from the comprehensive plan. The contributing flows are based on the City's design equation.

Segments EF, F/G-H, HJ, and JQ are operating under submerged condition for all or a portion of their length. Segment E-F/G is submerged between SW 24th and SW 26th where the sewer appears to have been laid at a slope that is flatter then the sections immediately upstream and downstream of this location. These areas are highlighted on Figure 2.

The segments downstream of impact point F/G at SW Coddington Avenue are operating under submerged condition because of the flows from the contributing areas.

b. Existing Folsom Bypass Trunk Sewer

The existing 12-inch diameter trunk sewer starts at the upstream end at Big Tree Circle within the Burlington Northern Railroad right-of-way. The 12-inch sewer extends to the northeast to the intersection of Folsom Lane and Folsom Street. The 15-inch sewer continues north to the last portion along Southwest 6th Street to the West 'D' Street Lift Station.

The model indicates submergence of the sewer in segment PQ between West 'B' and West 'D' Streets. These areas are highlighted on Figure 2. The sewers upstream of west 'B' Street have sufficient capacity for the flows generated by the "Existing" service area.

c. Existing West 'D' Lift Station and Force Main

The existing West 'D' Street Lift Station includes 3-800 gpm pumps. The approximate capacity with three pumps running is 2,000 gpm, 4.46 cfs. Based on an estimated peak flow to the lift station of 30% of the City of Lincoln area based design flow equation, the lift station with all three pumps running will serve an area up to 2,225 acres. The lift station pumps into a 12-inch diameter force main that discharges to an 18-inch sewer. This sewer is connected to the 48-inch diameter sewer at 3rd and West "D" Streets. Flows up to 3,400 gpm (7.58 cfs) can be easily accommodated by the force main however, the 18-inch sewer capacity is limited to 2,400 gpm (5.35 cfs). Assuming 2.5% growth rate, the lift station capacity will be exceeded in 2024 and the 18-inch sewer capacity will be exceeded in 2032. The need for structural repairs is a more immediate concern for the West "D" Lift Station.

According to the City's design memorandum previously completed for the West 'O' Street Drainage Basin, the 'P' Street Lift Station capacity will be exceeded some time between 2005 and 2009. Other components in the West 'O' Street Basin will also become under-sized before 2009 including the 12-inch trunk sewer to the 'P' Street Lift Station, the 8-inch force main, and the 12-inch sewer at the force main discharge. Additionally, the West "D: Lift Station structure is in poor condition and improvements are needed at this time.

In lieu of replacing all of these components and making the structural repairs to the West 'D' Street Lift Station, a new lift station can be constructed south of 'O' Street to replace both of the lift stations. This plan will reduce maintenance and provide a more long range plan to serve both the West 'O' Street Basin and Middle Creek Basin into the future including Tier II development by designing the lift station to be phased as dictated by development.

2. Evaluation and Capacities of Proposed Middle Creek Northwest Trunk Sewer and Siphon.

The computer model was used to assist with the design of a new trunk sewer to serve areas within the Middle Creek Drainage Basin west of Southwest 36th Street. The new trunk sewer was designed to serve the Tier I and Tier II areas as previously identified in Part III A and Table 3. The sewer was also designed to collect some relief flow from the existing 'A' Street Trunk Sewer in order to relieve the submerged condition of the 'A' Street Trunk Sewer downstream of SW 15th Street and to eliminate the lift station at SW Coddington Avenue and Millstone Road.

The proposed Middle Creek Northwest Trunk Sewer will also collect the entire flow from the "Existing" service areas including the 'A' Street Trunk Sewer flows and Folsom Bypass Trunk Sewer flows at a point north of the existing 'D' Street Lift Station. The existing lift station will be abandoned.

The flows will cross Middle Creek through an inverted siphon (depressed sewer) to a proposed lift station that will replace both the West 'D' Street Lift Station and the 'P' Street Lift Station.

3. Sanitary Sewer Improvements

a. "A" Street Trunk Sewer

As previously discussed, the existing "A" Street Trunk Sewer is experiencing some surcharging as observed in the field by the City and as shown in the sewer model. These locations are shown on Figure 2 and on the profiles of the "A" Street Trunk Sewer included within this report.

Various improvements were reviewed to alleviate this surcharging and to accommodate some short-term (under 5 years) growth. Two of the Tier I areas, immediately east of SW 40th Street, totaling 238 acres (149 plus 89) have started to develop and the short term improvements recommended will be sufficient for the "existing" flows plus approximately 50% of these two areas, 1 cfs.

To relieve the surcharging and accommodate an additional 1 cfs from the west limit of the sewer, a parallel 15-inch sewer is recommended from the West "D" Lift Station to West "A" Street at SW 12th Street. To accommodate the additional 1 cfs, parallel 12-inch sewers are recommended at three locations on "A" Street, SW 16th to west of SW 18th, west of SW 23rd to SW 25th Streets, and SW 27th to SW 30th Streets.

These short-term improvements are expected to provide additional capacity thru 2012 at 1.5% growth or 2009 at 2.5% growth. The formulation of these improvements has also been structured around the City's current short-term budget.

b. Northwest Trunk Sewer

As previously reviewed, the Tier I and Tier II flow is 13.92 cfs. An additional 1.16 cfs would be relieved form "A" Street to the new trunk by eliminating the lift station located at Coddington Avenue and Millstone Road, for a total flow of 15.08 cfs. Although some of the Tier I flow can be accommodated in the "A" Street sewer with the short-term improvements, it is recommended that the new Northwest Trunk Sewer be designed for the full 15.08 cfs. This

will allow for a small amount of excess capacity, which is good considering some of the previously discussed surcharging in the "A" Street sewer. The proposed Northwest Trunk Sewer project should be planned for construction by 2010 to 2012.

c. Combined Lift Station

As previously discussed, the "D" Street Lift Station has immediate needs with respect to structural condition, although the capacity is adequate through 2024 at 2.5% growth with all pumps running. (No contingency). The firm capacity of the lift station is sufficient through 2010 at 2.5% growth rate. Firm capacity is the capacity with one pump out of service.

The "P" Street Lift Station is expected to be over design capacity by 2009 as is the 8-inch force main from this lift station.

Considering the above, a combined lift station project should be constructed before 2010. The construction of additional capacity at this lift station can be phased to stay ahead of growth in the Middle Creek Basin and West "O" Street Basin.

An initial lift station capacity of 10.61 cfs, 4,760 gpm will provide capacity through 2035 at 2.5% growth. This would include a lift station with three pumps. Two pumps operating simultaneously would be designed to deliver at least 4,760 gpm.

A concrete structure with wet well and dry well and an above grade masonry control building is recommended and costs for such a lift station are included in Section V. The lift station site is recommended west of Salt Creek just north of the rail yard at approximately "J" Street. The force main would cross Salt Creek and follow "J" Street to 3rd and "J" where it will be connected to the existing 48-inch sewer in 3rd Street.

C. Pipe Design

1. Pipe Materials

The pipe materials for this project include centrifugally cast fiberglass reinforced polymer mortar pipe (CCFRPMP – Hobas), filament wound fiberglass reinforced polymer mortar pipe (FWFRPMP – Flowtite), solid and profile wall polyvinyl chloride pipe (PVC), and reinforced concrete pipe (RCP). The PVC sewer pipe ends will need to be grouted at each connection to a manhole.

These pipe materials will be specified as listed below for the following sizes and installation methods.

Pipe Diameter (inches)	Pipe Materials
36" & smaller-trenched	CCFRPMP, FWFRPMP, PVC, RCP
36" & smaller-tunneled (two-pass)	CCFRPMP, FWFRPMP, PVC, RCP

RCP will be furnished with rubber gasket and concrete joints and an internal plastic liner (T-Lok).

2. Embedment, Backfill, and Spoil

a. Pipe Embedment

Filter fabric will be placed around the pipe embedment to prevent migration of the embedment into the surrounding soils for CCFRPMP, FWFRPMP, and PVC.

b. Trench Backfill

Backfilling requirements will be similar to previous LWWS projects. Fill under grass areas will be compacted to a minimum of 90%-92% density and fills under roads and streets will be compacted to a minimum of 95% density of standard proctor.

c. Spoil Materials

Excess spoil will be disposed of by the Contractor.

d. Groundwater Barriers

Groundwater barriers will be placed approximately every 500-1,000 feet along the alignment and shown on the drawings.

D. Manholes

Manholes shall be placed at the intersections of all sanitary sewer lines, changes in horizontal or vertical alignment, at pipe diameter or material changes, and at the end of any terminating line. Manhole spacing for the straight portions of the sewer shall be approximately 400 feet or as appropriate for site specific conditions. City of Lincoln standard manholes, constructed of concrete or fiberglass, will be used in all locations. Alternative material may be considered. These will require resistance to hydrogen sulfide with data provided from testing that has been completed. An internal plastic liner will be provided for concrete manholes. The exterior of all manholes will be damp-proofed to maintain the plastic liner. Manholes will be covered with a concrete flat slab on grade and pressure tight manhole cover. No manhole steps will be included in the manholes.

Testing of the sewer will be conducted from manhole to manhole before installing the next section of the sewer. Testing will include TV, Mandrel test, and an air pressure test.

E. Special Construction

1. Horizontal Auger Boring

Horizontal auger boring will be allowed using steel casing pipe with CCFRPMP, FWFRPMP, or PVC as the carrier pipe within the primary liner. Horizontal auger boring will be required for the following locations:

a. Railroad Crossings
b. Highway Crossings at K & L Interchange

F. Restoration

1. Seeding

Areas disturbed by construction activities shall be reseeded in accordance with the City of Lincoln standards or restored as negotiated by City Real Estate when obtaining permanent and temporary construction easements.

G. Utility/Railroad/NDOR Coordination

1. Utilities in Project Area

Digger's Hotline of Nebraska should be contacted prior to final design to determine existing utilities in the project area. Drawings illustrating the utilities should be requested. The following is a listing of utilities in the project area:

a. Alltel Communications
b. Aquila
c. Lincoln Water System (LWS)
d. Lincoln Wastewater System (LWWS)
e. City of Lincoln – Watershed Management (Stormwater)
f. Lincoln Electric System (LES)
g. MCI
h. Time Warner Cable
i. Magellan Pipeline Company (Fuel Oil Pipeline)

2. Burlington Northern and Santa Fe Railway (BNSFR)

BNSFR right-of-way will need to be contacted when Phase II is initiated to coordinate the sewer crossing.

3. Nebraska Department of Roads (NDOR)

The NDOR will need to be contacted when Phase II is initiated to coordinate roadway crossings near the K & L Interchange.

IV. LIFT STATION DESIGN

A. General

The proposed combined lift station to serve the West 'O' Street and Middle Creek Drainage Basins would be constructed south of 'O' Street where new trunk sewers would flow to the lift station from the north and the south to convey the flows to the lift station. A new force main would be constructed from the lift station across Salt Creek to the Salt Creek Relief Sewer.

B. Design Flows

The lift station would be initially sized at approximately 10.7 cfs (6.91 mgd) to accommodate flows from the Middle Creek Drainage Basin and from the West 'O' Street Drainage Basin through the year 2028 assuming 2.5% growth or the year 2044 assuming 1.5% growth as shown in Chart 3.

The lift station would be expanded ultimately to 15.63 cfs (10.1 mgd) to accommodate the remaining flows from the West 'O' Street Basin and the Middle Creek Tier II flows.

A summary of design flows is included in Table 1 and Chart 3.

C. Lift Station Site and Construction

The lift station site is identified on Figure 4. The proposed construction would be cast-in-place concrete wet-well dry-well structure in rectangular shape with a masonry structure above-grade to house the control and electrical equipment.

The structure would be constructed to be expanded in the future to accommodate future development and the increased flows.

Additional pumping equipment would be added for the increased flows.

The pumping equipment would initially include three pumps sized to deliver approximately 4,800 gpm with two pumps on. The addition of three more pumps in the future would be designed to provide 7,000 gpm with five pumps running. At least one pump may need to be provided with a variable speed drive in the first

phase to meet the head condition with only one pump running. We would recommend that all pumps be provided with VFD's to reduce wear on valves, piping, and pumps and to provide greater flexibility in pump operating range.

D. Force Main

An 18-inch force main is proposed. The 18-inch force main will have flow velocity of 2 fps at the minimum flow of 1,600 gpm (one half of the peak flow of 2,900 gpm from the existing developed areas). The maximum total dynamic head under the future (ultimate) flow condition of 7,000 gpm will be approximately 95 feet (41 psi). The Salt Creek force main crossing will be constructed by directional drilling techniques. Alternatively, a dual force main system could be used to allow phased construction and redundancy.

V. RECOMMENDATIONS AND PROJECT COSTS

A. Recommendations

1. General

The sewer model completed with this design memorandum and the previously completed West 'O' Street Memorandum show that portions of the existing 'A' Street Trunk Sewer, 'P' Street Lift Station and Force Main, and 12-inch trunk sewer to the 'P' Street Lift Station are now or will soon be over-loaded.

The overloaded segments of the "A" Street Trunk Sewer are shown on Figure 2. Short-term improvements are recommended to relieve the overloading and provide some additional capacity through 2012.

The "P" Street Lift Station is nearing capacity and the "D" Street Lift Station is in need of repairs, especially structurally. These improvements should be initiated before 2009 based on the report previously prepared for the City, with the proposed Northwest Trunk Sewer to follow.

Phasing of the Northwest Trunk Sewer would proceed from east to west. The combined lift station will need to be constructed before or in conjunction with the new trunk sewer.

The following summarizes the recommended improvements and the proposed phasing.

2. Phase I – Immediate Needs

"A" Street parallel relief sewers

These recommended parallel relief sewers should be constructed within the next year. These relief sewers will provide some additional capacity and will relieve the current surcharging in the "A" Street Trunk Sewer. These improvements will provide capacity through the year 2009 based on 2.5% growth or through the year 2012 based on 1.5% growth as shown in Chart 1.

- 15-inch sewer from "D" Street Lift Station to "A" Street at Highway 77 — 4,950 LF
- 12-inch sewer from SW 16th Street to SW 18th Street — 810 LF
- 12-inch sewer from West of SW 23rd to West of SW 25th Street — 775 LF
- 12-inch sewer from SW 27th Street to East of SW 30th Street — 1,000 LF

3. Phase II – Combined Lift Station Needs

Lift Station and sewers to connect lift station to existing "P" Street and "D" Street Stations.

According to previous studies for the West "O" Street Drainage Basin, the "P" Street Lift Station and force main will be undersized for flow capacity by 2009. The "D" Street Lift Station also needs repairs in the very near future. Therefore, these Phase II improvements should be initiated by 2009. This initial phase of the lift station will be sized to handle flows through the year 2028 at 2.5% growth or the year 2044 at 1.5% growth per Chart 3. Sewers to connect this lift station to the West "O" and Middle Creek Basins are also included in this phase.

- Combined Lift Station, 6.91 MGD 1 LS
- Middle Creek Siphon 400 LF
- 36-inch sewer from "D" Street Lift Station to Combined Lift Station 2,300 LF
- 36-inch sewer from 36-inch "O" Street sewer to Combined Lift Station 1,300 LF
- 15-inch sewer from "O" Street to 36-inch West "O" Street sewer 1,150 LF
- 18-inch force main from lift station to 48-inch sewer at 3rd and "J" Streets. 2,000 LF
- Abandon existing lift stations at "P" Street and "E" Street. 2 Each

4. Phase III – Initial Phase of Northwest Trunk Sewer

This phase will serve an additional 467 acres (above existing acres along West "A" Street) or 2.94 cfs. Assuming development from east to west, 467 acres will be included at approximately SW 40th Street.

Depending on flow monitoring observations and planned development, this phase may need to be initiated sometime between 2009 and 2012. Assuming a growth rate of 2.5%, these improvements will serve development through the year 2020; assuming a growth rate of 1.5%, these improvements will serve development through the year 2030 as shown on Chart 1. These sewer segments will be sized to accommodate the ultimate flows from future sewer phases to the west through the Tier II stage.

Northwest Trunk Initial Phase Sewers

- 36-inch sewer from Salt Creek to K & L Interchange 4,360 LF
- 30-inch sewer from K & L Interchange to SW 40th Street 11,715 LF
- 10-inch relief sewer at SW 30th Street 1,225 LF

5. Phase IV – Second Phase of Northwest Trunk Sewer

This phase will serve an additional 1,119 acres or additional 6.91 cfs above the existing areas and flows along "A" Street. This sewer will extend to SW 48th Street.

Depending on flow monitoring and planned development, this phase may need to be initiated sometime between 2020 and 2030. Assuming a growth rate of 2.5% these improvements will serve development through the year 2035; assuming a growth rate of 1.5%, these improvements will serve development through the year 2050 as shown on Chart 1. Sewer segments will be sized as described in 4 above.

Northwest Trunk Second Phase Sewers

- 30-inch sewer from SW 40th Street to SW 48th & "F" Street — 2,665 LF
- 24-inch sewer from SW 48th Street and "F" Street to SW 48th Street north of drainage channel — 1,315 LF

6. Phase V – Final Phase of Northwest Trunk Sewer

This phase will serve the remaining 942 acres or 5.53 cfs. This sewer will extend to SW 70th Street.

Depending on flow monitoring and planned development, this phase may need to be initiated sometime between 2035 and 2055. Assuming a growth rate of 2.5%, these improvements will serve development through the year 2050.

- 24-inch sewer from SW 48th north of "F" Street to SW 60th Street — 3,550 LF
- 18-inch sewer from SW 60th Street to SW 65th Street — 1,565 LF
- 12-inch sewer from SW 65th Street to SW 70th Street — 2,075 LF

7. Increase Lift Station Capacity to 10.08 MGD

Ultimately the combined lift station design capacity will be 10.08 MGD. This is recommended before 2028 assuming 2.5% growth or before 2044 assuming 1.5% growth. The City's continued flow monitoring will help to establish the necessary timing of this increase to capacity. The lift station expansion would therefore be expected in conjunction with either Phases IV or V.

B. Basis of Project Costs

Capital costs developed for the sewer alignments were based on opinions of cost for previous projects and invoices from previous LWWS projects. All lengths for pipelines and tunnels were scaled from the 2003 aerial photographs obtained from the City's GIS department. All project costs are provided in February 2006 dollars. Additional amounts for contingencies; easement acquisition; and engineering, legal, and administrative costs were added to obtain a total opinion of probable project cost for each alignment.

C. Construction and Engineering Costs

Costs were calculated on a linear foot basis for the sewer on each alignment. Additional costs were included for manholes, street repairs, utility relocations, and seeding. Fifteen percent of the direct construction cost was added to each alignment alternative as an allowance for unknowns that can be expected at this level of estimating contingencies. Fifteen percent of the direct construction cost was allocated for engineering. An additional five percent of direct construction cost was allocated for miscellaneous items. Legal administrative, and easement costs associated with each alignment were tabulated separately.

D. Present Value Opinion of Probable Project Cost

1. General

Following are the project construction costs including engineering costs for each phase of the recommended improvements.

The opinions of probable project costs are listed in Tables 4 thru 9. The project cost for each alternative includes capital costs, general requirements, and contingencies. Engineering, costs are also included. Legal, administrative, and easement acquisition costs are included in Section E.

2. Immediate Needs

Following are project costs for the immediate recommended improvements to the "A" Street Trunk Sewer to relieve surcharging and provide additional flow capacity through 2009 assuming 2.5% growth rate. These improvements will be adequate through 2012 assuming 1.5% growth rate.

Table 4

Phase I
Immediate Needs Project Costs

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	PRICE
A STREET PARALLEL RELIEF SEWERS					
1	Mobilization, General Conditions, Overhead and Profit	1	LS	$190,000.00	$190,000.00
2	15" Sanitary Sewer	4,950	LF	$65.00	$321,750.00
3	12" Sanitary Sewer	2,585	LF	$60.00	$155,100.00
4	Sanitary Sewer Manhole				
	manhole base, ring, and cover	20	EA	$2,000.00	$40,000.00
	vertical foot cost	300	VF	$400.00	$120,000.00
5	Tap and Connect to Existing Manhole	9	EA	$2,000.00	$18,000.00
6	Traffic Control	1	LS	$20,000.00	$20,000.00
7	Seeding	25,000	SY	$2.50	$62,500.00
8	Other surface Restoration, paving, rock, etc.	355	SY	$65.00	$23,075.00
	SANITARY SEWER SUBTOTAL				**$950,000**
	CONSTRUCTION SUBTOTAL				**$950,000**
	CONTINGENCIES			"15%"	$143,000
	ENGINEERING			"15%"	$143,000
	OTHER			"5%"	$48,000
	TOTAL PHASE I COST				**$1,284,000**

3. Phase II – Combined Lift Station – First Phase

Following are the project costs for the combined lift station and force main, connecting sewers from the "P" Street and "D" Street Lift Stations, and the abandonment of the existing lift stations. This phase is sub-divided into three projects in Table 5 below

Table 5

Phase II
Lift Station Abandonment and Connecting Sewers Project Costs

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	PRICE
COMBINED 6.91 MGD LIFT STATION AND FORCE MAIN INCLUDING SALT CREEK CROSSING					
1	Mobilization, General Conditions, Overhead and Profit	1	LS	$512,000.00	$512,000.00
2	site grading and seeding	1	LS	$15,000.00	$15,000.00
3	site piping	1	LS	$35,000.00	$35,000.00
4	structural excavation and backfill				
	excavation and backfill	6,700	CY	$20.00	$134,000.00
	sheeting	12,000	SF	$40.00	$480,000.00
	dewatering	1	LS	$60,000.00	$60,000.00
5	cast-in-place concrete				
	base slab	110	CY	$400.00	$44,000.00
	walls	280	CY	$600.00	$168,000.00
	top slab	50	CY	$650.00	$32,500.00
	stoops and misc	5	CY	$350.00	$1,750.00
6	control building				
	masonry	2,200	SF	$20.00	$44,000.00
	roof slab	1,150	SF	$20.00	$23,000.00
	roofing, sheetmetal, and gutters	1,150	SF	$15.00	$17,250.00
	doors, hardware, and access hatches	1	LS	$50,000.00	$50,000.00
7	below grade waterproofing	6,100	SF	$5.00	$30,500.00
8	painting	2,500	SF	$5.00	$12,500.00
9	stairs and railings	1	LS	$50,000.00	$50,000.00
10	equipment (sewage and sump pumps)	1	LS	$200,000.00	$200,000.00
11	hoist	1	LS	$50,000.00	$50,000.00
12	process piping and valves				
	piping	150	LF	$200.00	$30,000.00
	valves and fittings	1	LS	$45,000.00	$45,000.00

	gauges and misc. accessories	1	LS	$25,000.00	$25,000.00
13	electrical and standby power	1	LS	$350,000.00	$350,000.00
14	controls	1	LS	$75,000.00	$75,000.00
15	ventilation equipment and ductwork	1	LS	$75,000.00	$75,000.00
	LIFT STATION SUBTOTAL				**$2,559,500**
16	Mobilization, General Conditions, Overhead and Profit	1	LS	$60,000.00	$60,000
17	18" force main including Salt Creek Crossing	2000	LF	$120.00	$240,000
18	18" 90 degree bends	4	EA	$600.00	$2,400
	FORCE MAIN SUBTOTAL				**$302,000**
P STREET LIFT STATION ABANDONMENT AND CONNECTING SEWERS					
1	Mobilization, General Conditions, Overhead and Profit	1	LS	$15,000.00	$15,000.00
2	Abandon Existing Lift Station - P Street	1	LS	$50,000.00	$50,000.00
	LIFT STATION ABANDONMENT SUBTOTAL				**$65,000**
3	Mobilization, General Conditions, Overhead and Profit	1	LS	$118,000.00	$118,000
4	15" sanitary sewer pipe	1150	LF	$65.00	$74,750
5	36" sanitary sewer pipe	1300	LF	$165.00	$214,500
6	42" sanitary sewer pipe	100	LF	$175.00	$17,500
7	sanitary sewer manhole				
	manhole base, ring and cover	8	EA	$2,000.00	$16,000
	vertical foot cost	135	VF	$400.00	$54,000
8	tap and connect to existing manhole	2	EA	$2,000.00	$4,000
9	traffic control	1	LS	$15,000.00	$15,000
10	seeding	8200	SY	$2.50	$20,500
11	other surface restoration, paving-rock-etc	985	SY	$65.00	$64,025
	SANITARY SEWER SUBTOTAL				**$598,000**

D STREET LIFT STATION ABANDONMENT AND CONNECTING SEWERS					
1	Mobilization, General Conditions, Overhead and Profit	1	LS	$15,000.00	$15,000.00
2	abandon existing lift station - D Street	1	LS	$50,000.00	$50,000.00
	LIFT STATION ABANDONMENT SUBTOTAL				**$65,000**
3	Mobilization, General Conditions, Overhead and Profit	1	LS	$181,000.00	$181,000
4	Middle Creek Siphon	400	LF	$300.00	$120,000
5	36" sanitary sewer pipe	2,300	LF	$165.00	$379,500
6	sanitary sewer manhole				
	manhole base, ring and cover	7	EA	$2,000.00	$14,000
	vertical foot cost	120	VF	$400.00	$48,000
7	Siphon Structures	2	EA	$35,000.00	$70,000
8	tap and connect to existing manhole	1	EA	$2,000.00	$2,000

9	traffic control	1	LS	$15,000.00	$15,000
10	seeding	7,600	SY	$2.50	$19,000
11	other surface restoration, paving-rock-etc	900	SY	$65.00	$58,500
	SANITARY SEWER SUBTOTAL				**$907,000**
	CONSTRUCTION SUBTOTAL				**$4,496,500**
	CONTINGENCIES			"15%"	$674,000
	ENGINEERING			"15%"	$674,000
	OTHER			"5%"	$225,000
	TOTAL PHASE II COST				**$6,070,000**

4. Phase III – Initial Phase Northwest Trunk

Following are the project costs for the first phase of the Northwest Trunk Sewer to SW 40th Street.

Table 6

Phase III
Initial Phase of Northwest Trunk Sewer Project Costs

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	PRICE
NORTHWEST TRUNK SEWER TO SW 40TH STREET					
1	Mobilization, General Conditions, Overhead and Profit	1	LS	$875,000.00	$875,000
2	10" sanitary sewer pipe	1,225	LF	$65.00	$79,625
3	30" sanitary sewer pipe	11,715	LF	$165.00	$1,932,975
4	36" sanitary sewer pipe	4,360	LF	$175.00	$763,000
5	sanitary sewer manhole				
	manhole base, ring and cover	24	EA	$2,000.00	$48,000
	vertical foot cost	397	VF	$400.00	$158,800
6	tap and connect to existing manhole	3	EA	$2,000.00	$6,000
7	traffic control	1	LS	$15,000.00	$15,000
8	seeding	48,000	SY	$2.50	$120,000
9	other surface restoration, paving-rock-etc	6,000	SY	$65.00	$390,000
	SANITARY SEWER SUBTOTAL				**$4,388,000**
	CONSTRUCTION SUBTOTAL				**$4,388,000**
	CONTINGENCIES			"15%"	$658,000
	ENGINEERING			"15%"	$658,000
	OTHER			"5%"	$219,000
	TOTAL PHASE III COST				**$5,923,000**

5. Phase IV – Second Phase Northwest Trunk

Following are the project costs for the second phase of the Northwest Trunk Sewer to SW 48th Street.

Table 7

Phase IV
Second Phase of Northwest Trunk Sewer Project Costs

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	PRICE
NORTHWEST TRUNK SEWER TO SW 48TH STREET					
1	Mobilization, General Conditions, Overhead and Profit	1	LS	$195,000.00	$195,000
2	24" sanitary sewer pipe	1,315	LF	$135.00	$177,525
3	30" sanitary sewer pipe	2,665	LF	$165.00	$439,725
4	sanitary sewer manhole				
	manhole base, ring and cover	12	EA	$2,000.00	$24,000
	vertical foot cost	190	VF	$400.00	$76,000
5	traffic control	1	LS	$15,000.00	$15,000
6	seeding	4,500	SY	$2.50	$11,250
7	other surface restoration, paving-rock-etc	550	SY	$65.00	$35,750
	SANITARY SEWER AND FORCE MAIN SUBTOTAL				**$974,000**
	CONSTRUCTION SUBTOTAL				**$974,000**
	CONTINGENCIES			"15%"	$146,000
	ENGINEERING			"15%"	$146,000
	OTHER			"5%"	$49,000
	TOTAL PHASE IV COST				**$1,315,000**

6. Phase V – Final Phase Northwest Trunk

Following are the project costs for the final phase of the Northwest Trunk Sewer to SW 70th Street

Table 8

Phase V
Final Phase of Northwest Trunk Sewer Project Costs

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	PRICE
NORTHWEST TRUNK SEWER TO SW 70TH STREET					
1	Mobilization, General Conditions, Overhead and Profit	1	LS	$257,000.00	$257,000
2	12" sanitary sewer pipe	2,075	LF	$60.00	$124,500
3	18" sanitary sewer pipe	1,565	LF	$85.00	$133,025
4	24" sanitary sewer pipe	3,550	LF	$110.00	$390,500
5	sanitary sewer manhole				
	manhole base, ring and cover	18	EA	$2,000.00	$36,000
	vertical foot cost	212	VF	$400.00	$84,800
6	tap and connect to existing manhole	1	EA	$2,000.00	$2,000
7	traffic control	1	LS	$15,000.00	$15,000
8	seeding	24,000	SY	$2.50	$60,000
9	other surface restoration, paving-rock-etc	2,800	SY	$65.00	$182,000
	SANITARY SEWER AND FORCE MAIN SUBTOTAL				**$1,285,000**
	CONSTRUCTION SUBTOTAL				**$1,285,000**
	CONTINGENCIES			"15%"	$193,000
	ENGINEERING			"15%"	$193,000
	OTHER			"5%"	$64,000
	TOTAL PHASE V COST				**$1,735,000**

7. Combined Lift Station Expansion

Following are the project costs for the expansion of the lift station to 10.1 mgd.

Table 9

Combined Lift Station Expansion to 10.1 mgd Project Costs

ITEM NO.	ITEM DESCRIPTION	ESTIMATED QUANTITY		UNIT PRICE	PRICE
COMBINED LIFT STATION EXPANSION TO 10.1 MGD					
1	Mobilization, General Conditions, Overhead and Profit	1	LS	$43,000.00	$43,000.00
2	site grading and seeding	1	LS	$15,000.00	$15,000.00
3	site piping	1	LS	$35,000.00	$35,000.00
4	structural excavation and backfill				
	excavation and backfill	6,700	CY	$20.00	$134,000.00
	sheeting	9,000	SF	$40.00	$360,000.00
	dewatering	1	LS	$60,000.00	$60,000.00
5	cast-in-place concrete				
	base slab	110	CY	$400.00	$44,000.00
	walls	220	CY	$600.00	$132,000.00
	top slab	50	CY	$650.00	$32,500.00
	stoops and misc	5	CY	$350.00	$1,750.00
6	below grade waterproofing	6,100	SF	$5.00	$30,500.00
7	painting	1,500	SF	$5.00	$7,500.00
8	stairs and railings	1	LS	$50,000.00	$50,000.00
9	equipment (sewage and sump pumps)	1	LS	$200,000.00	$200,000.00
10	hoist	1	LS	$50,000.00	$50,000.00
11	process piping and valves				
	piping	150	LF	$200.00	$30,000.00
	valves and fittings	1	LS	$25,000.00	$25,000.00
	gauges and misc. accessories	1	LS	$25,000.00	$25,000.00
12	electrical and standby power	1	LS	$350,000.00	$350,000.00
13	controls	1	LS	$75,000.00	$75,000.00
14	ventilation equipment and ductwork	1	LS	$75,000.00	$75,000.00
	LIFT STATION SUBTOTAL				**$1,775,000**
	CONSTRUCTION SUBTOTAL				**$1,775,000**
	CONTINGENCIES			"15%"	$266,000
	ENGINEERING			"15%"	$266,000
	OTHER			"5%"	$89,000
	TOTAL LIFT STATION EXPANSION COST				**$2,396,000**

E. Easement Acquisition Costs

Easement acquisition costs were estimated based on a square foot basis for permanent easements and temporary construction easements. The costs are shown in the following tables based on linear feet of sanitary sewer. A cost of $0.50 per square foot was used for permanent easements or $10/LF based on a 20 foot wide easement and $0.10 per square foot was used for temporary construction easements, or $2/LF based on a 20 foot wide construction easement.

The following Table 10 shows legal, administrative, and easement acquisition costs for each phase.

Table 10

Legal, Administrative Easement Acquisition Costs

Phase I – "A" Street Parallel Relief Sewers	
Legal and Administrative (5%)	$64,000
Easement Acquisition 0 LF	$0
Total	$64,000
Phase II – 6.91 MGD Lift Station and Connecting Sewers	
Legal and Administrative (5%)	$300,000
Easement Acquisition 4,850 LF	$58,000
Total	$358,000
Phase III – Northwest Trunk Sewer Initial Phase	
Legal and Administrative (5%)	$295,000
Easement Acquisition 9,300 LF	$112,000
Total	$407,000
Phase IV – Northwest Trunk Sewer Second Phase	
Legal and Administrative (5%)	$66,000
Easement Acquisition 1,315 LF	$16,000
Total	$82,000
Phase V – Northwest Trunk Sewer Final Phase	
Legal and Administrative (5%)	$87,000
Easement Acquisition 7,190 LF	$86,000
Total	$173,000
Lift Station Expansion	
Legal and Administrative (5%)	$120,000
Easement Acquisition 7,190 LF	$0
Total	$120,000

Table 11

Project Cost Summary

Phase I – "A" Street Parallel Relief Sewers	
Construction and Engineering	$1,284,000
Legal, Administrative, and Easements	$64,000
Total	$1,348,000
Phase II – 6.91 MGD Lift Station and Connecting Sewers	
Construction and Engineering	$6,070,000
Legal, Administrative, and Easements	$358,000
Total	$6,428,000
Phase III – Northwest Trunk Sewer Initial Phase	
Construction and Engineering	$5,923,000
Legal, Administrative, and Easements	$407,000
Total	$6,330,000
Phase IV – Northwest Trunk Sewer Second Phase	
Construction and Engineering	$1,315,000
Legal, Administrative, and Easements	$82,000
Total	$1,397,000
Phase V – Northwest Trunk Sewer Final Phase	
Construction and Engineering	$1,735,000
Legal, Administrative, and Easements	$173,000
Total	$1,908,000
Lift Station Expansion	
Construction and Engineering	$2,936,000
Legal, Administrative, and Easements	$120,000
Total	$3,056,000

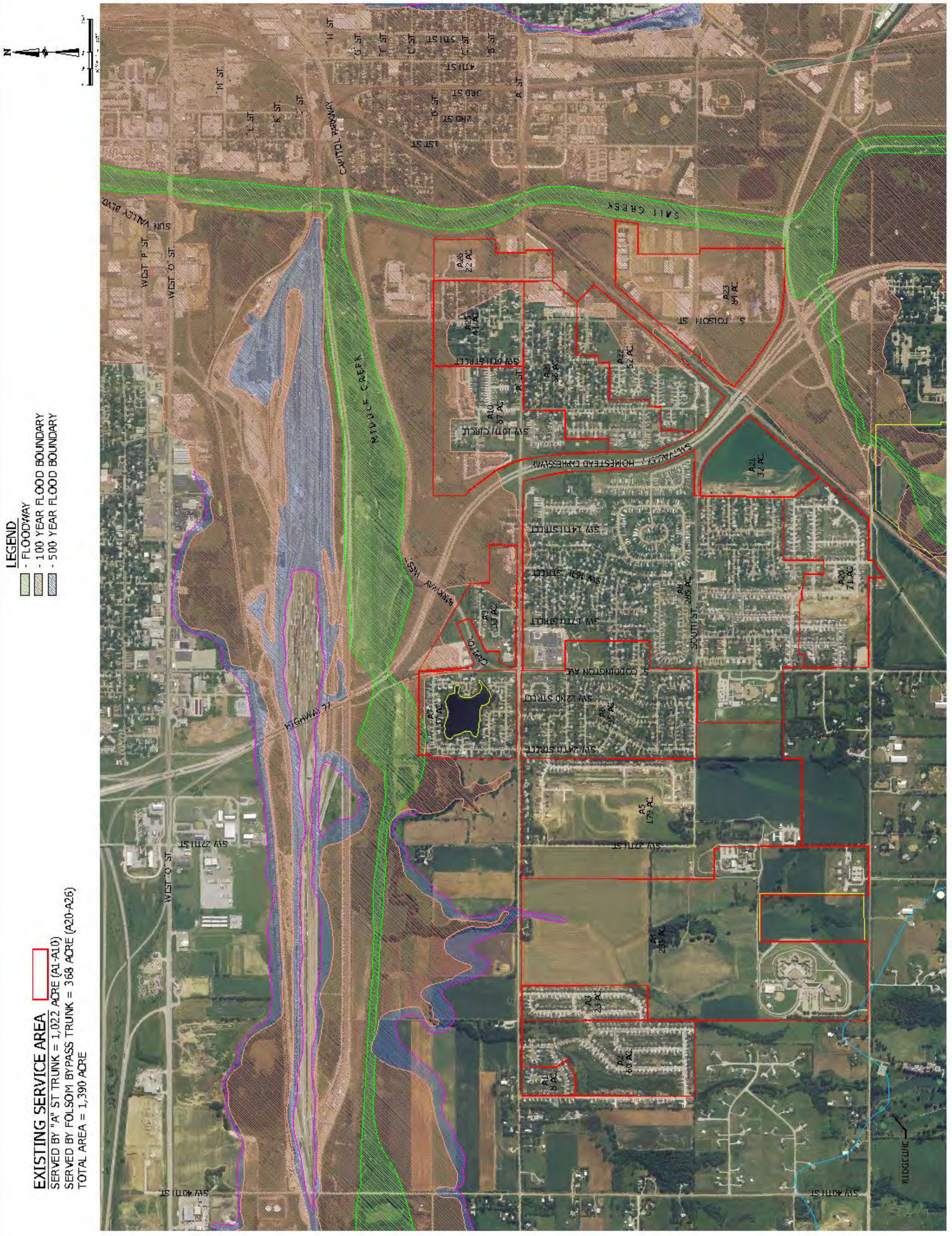
FIGURE 1

EXISTING SERVICE AREA AND SANITARY SEWER SUB-BASINS

LINCOLN WW WEST D STREET
LINCOLN WASTEWATER SYSTEM

LINCOLN NEBRASKA

KIRKHAM MICHAEL



LEGEND
- FLOODWAY
- 100 YEAR FLOOD BOUNDARY
- 500 YEAR FLOOD BOUNDARY
- SURCHARGED SEWER SEGMENTS
- EXISTING "TRUNK" SEWERS
- PROPOSED PARALLEL RELIEF SEWERS

SW 40TH ST.
RIDGELINE
SW 27TH ST.
SW 24TH STREET
SW 22ND STREET
S. EDDINGTON AVE.
SW 17TH STREET
SW 14TH STREET
SALT VALLEY - HOMESTEAD EXPRESSWAY
SW 10TH CIRCLE
SW 6TH STREET
S. FOLSOM ST.
SALT CREEK
W. HAMBLETON
CAPITOL PARKWAY EXISTING
PARKWAY WEST
MIDDLE CREEK
WEST O ST.
WEST P ST.
SUN VALLEY BLVD.
1ST ST.
2ND ST.
3RD ST.
4TH ST.
5TH ST.
A ST.
B ST.
D ST.
G ST.
H ST.
I ST.
K ST.
L ST.
N ST.

FIGURE 2

EXISTING SANITARY SEWER, LIFT STATIONS AND PARALLEL RELIEF SEWERS

LINCOLN WW WEST O STREET

LINCOLN NEBRASKA

KIRKHAM MICHAEL

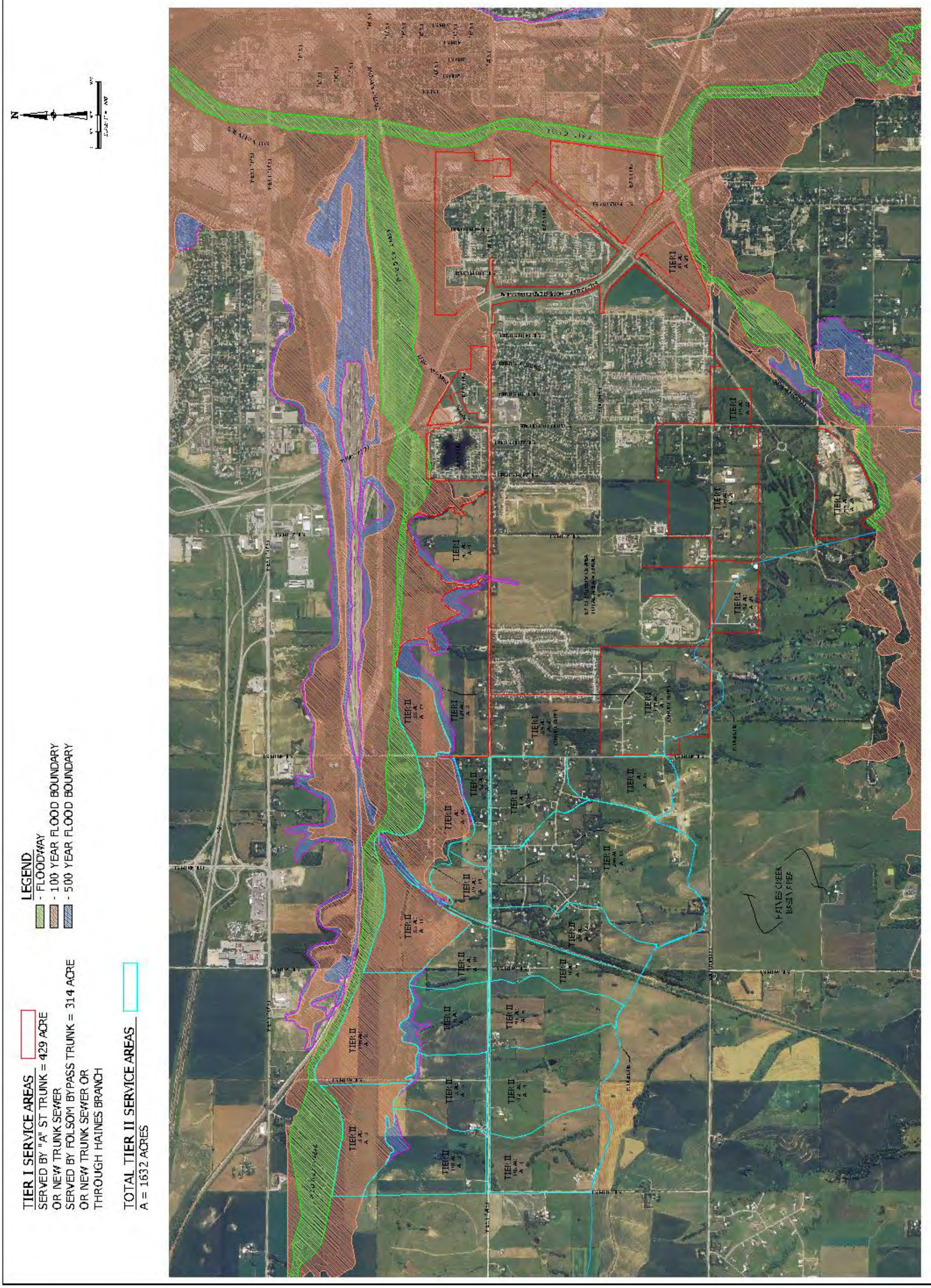
FIGURE 3

TIER I AND TIER II SERVICE AREAS AND SANITARY SEWER SUB-BASINS

LINCOLN WASTEWATER SYSTEM
3140 N. CAPITAL PARKWAY

LINCOLN NEBRASKA

KIRKHAM MICHAEL



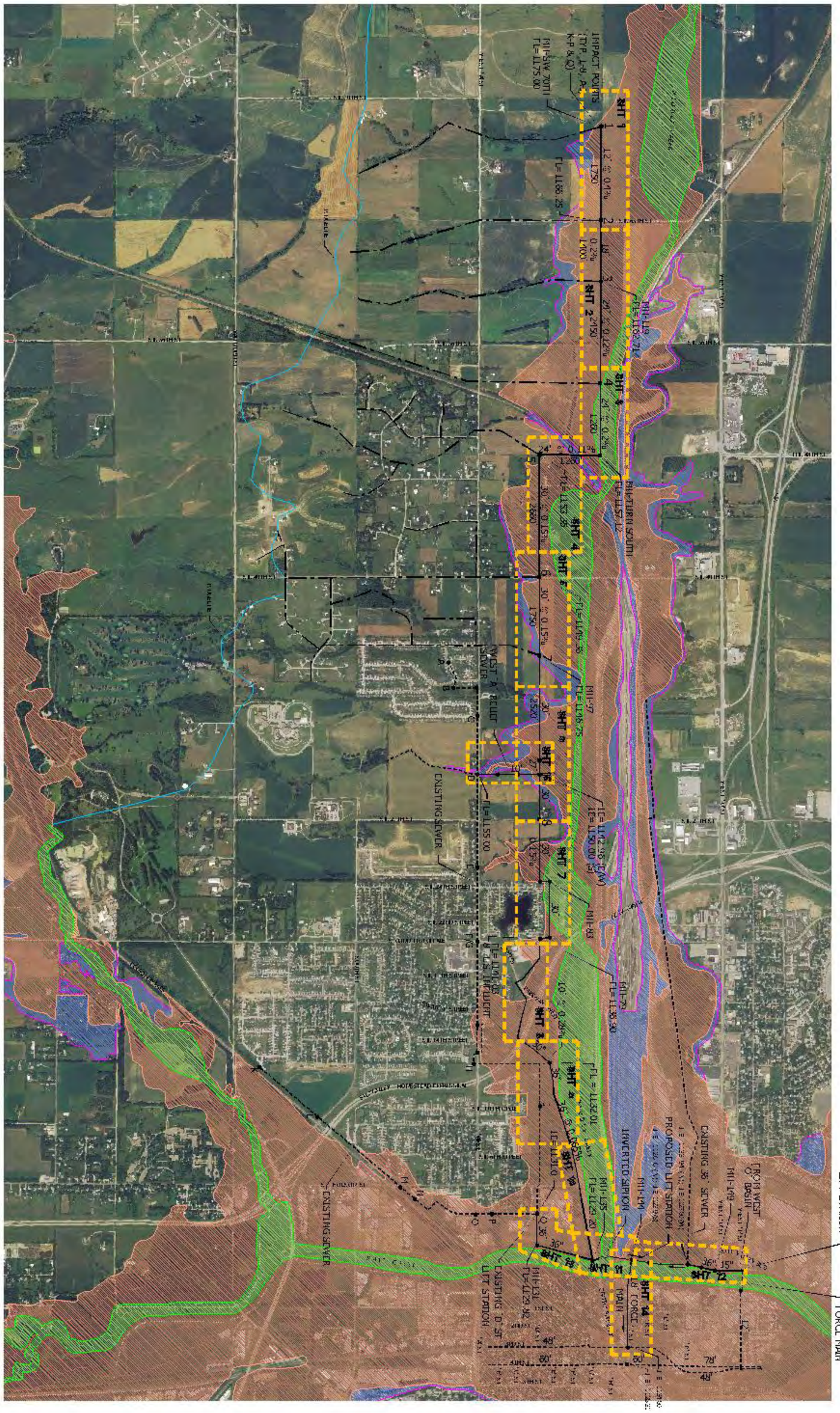


FIGURE 4

PROPOSED NORTHWEST TRUNK SEWER AND COMBINED LIFT STATION

LINCOLN WW WEST D STREET

LINCOLN NEBRASKA

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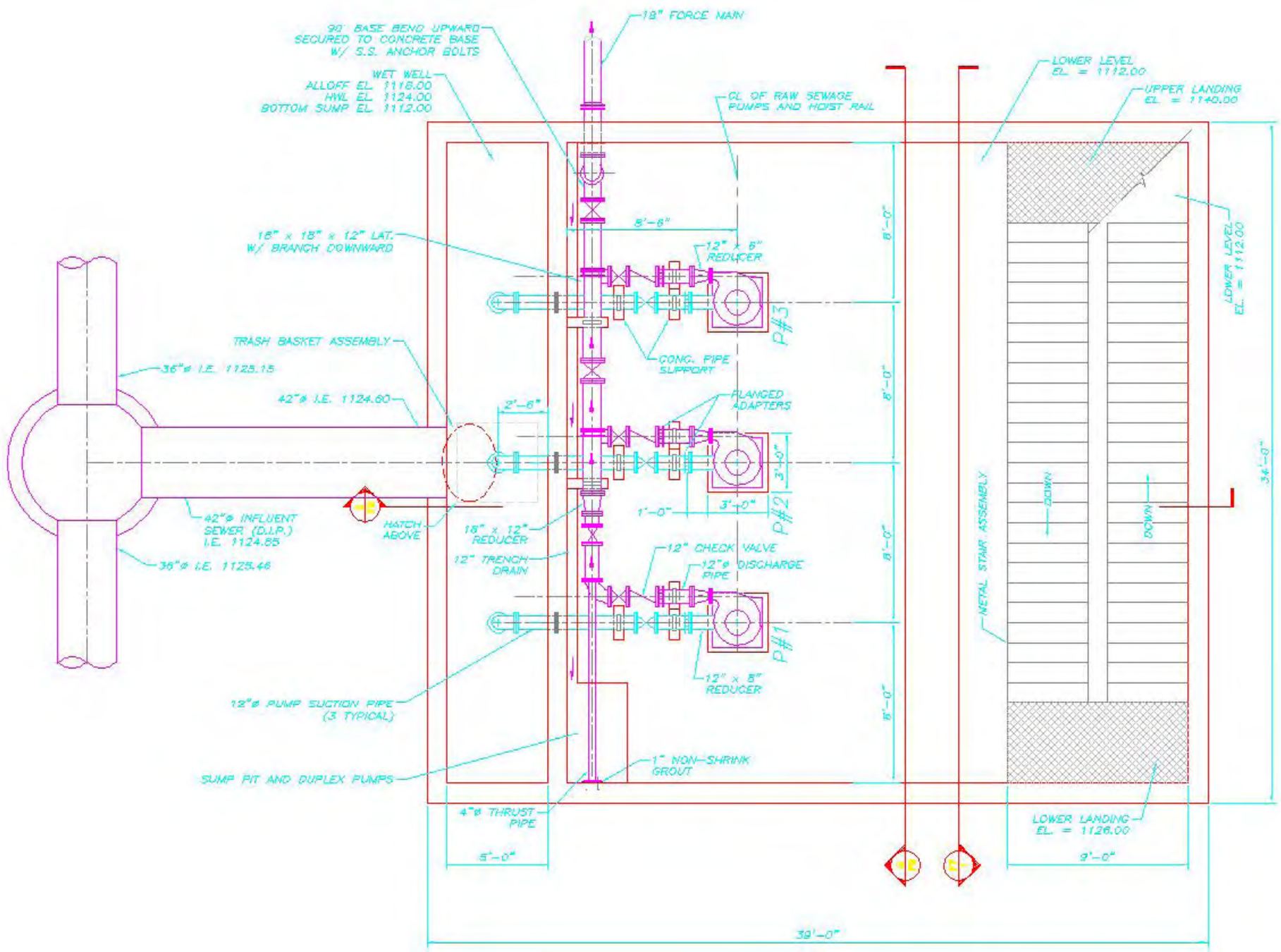

LOWER LEVEL PLAN

SCALE : 3/8"= 1'-0"

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CONSULTING ENGINEERS

NEBRASKA

revisions

LINCOLN WEST D STREET
BAS N ST.JDY AND DESIGN

LINCOLN

LIFT STATION
LOWER LEVEL PLAN

date 02/06
design SK.S.
drawn SK.S.
job no. 0070221

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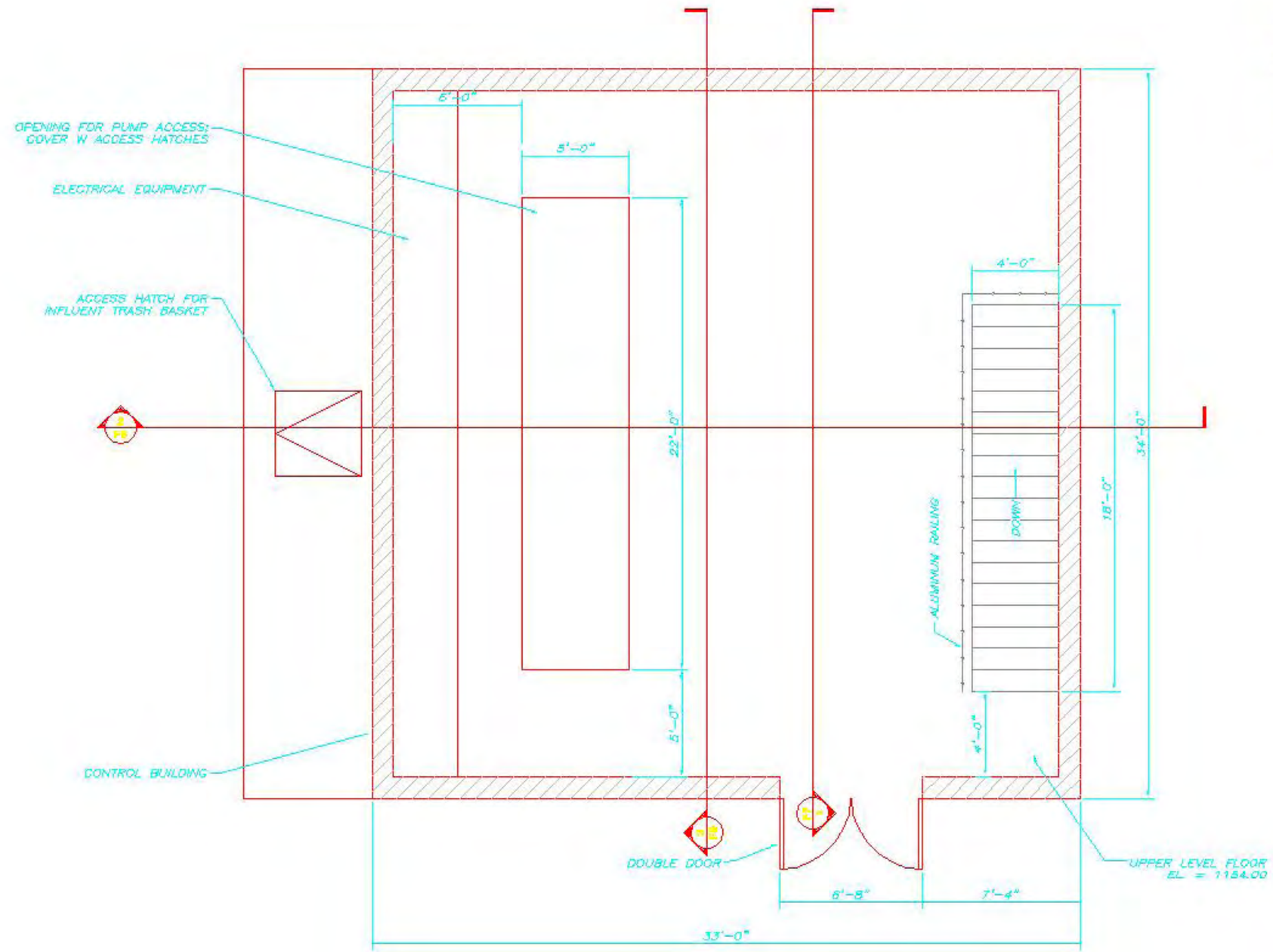

UPPER LEVEL PLAN

SCALE : 3/8"= 1'-0"

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LINCOLN WEST D STREET
BASIN STUDY AND DESIGN

NEBRASKA

LINCOLN

LIFT STATION
UPPER LEVEL PLAN

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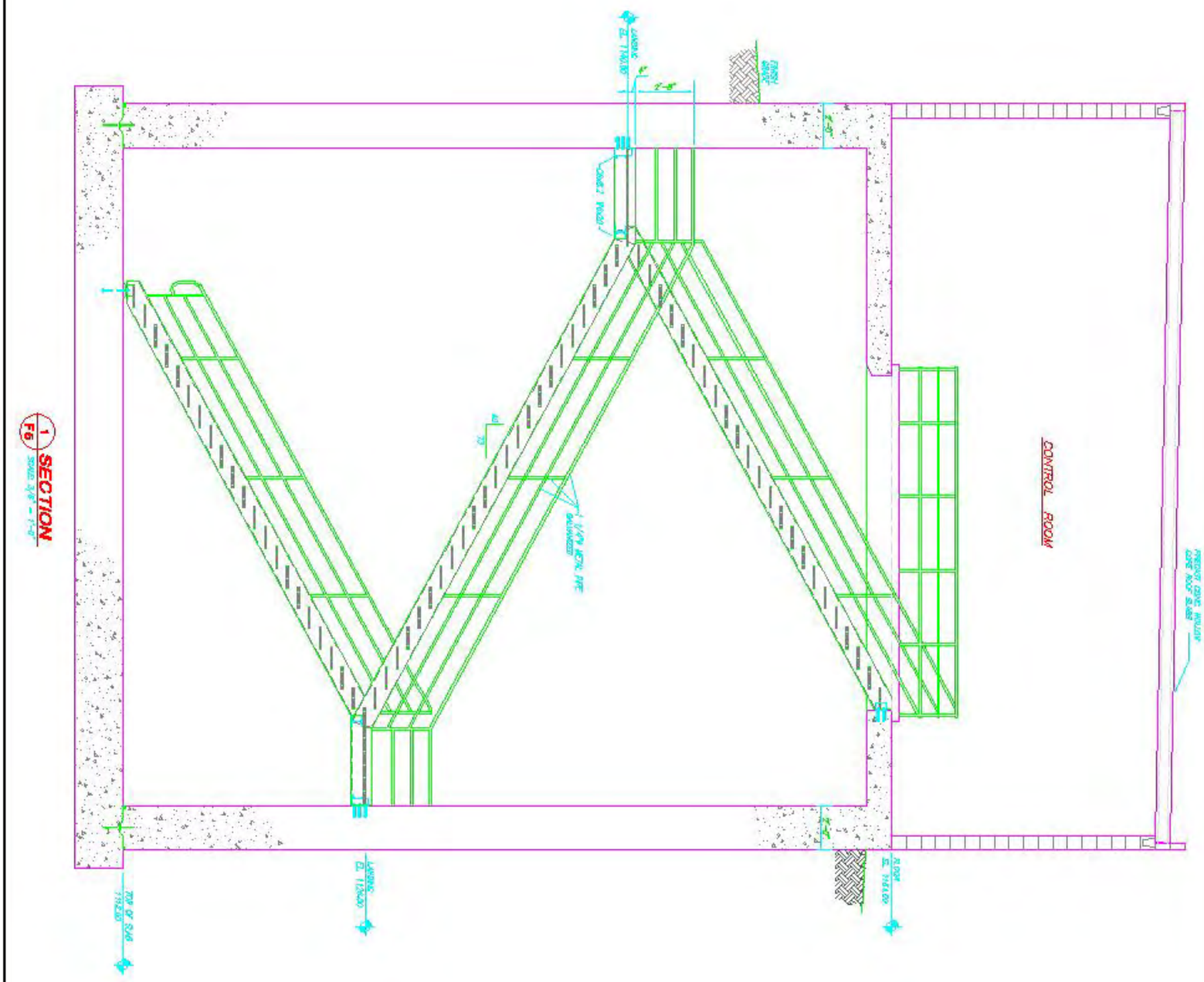

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LIFT STATION
SECTION 1

LINCOLN WW WEST D STREET
BASIN STUDY AND DESIGN
LINCOLN NEBRASKA

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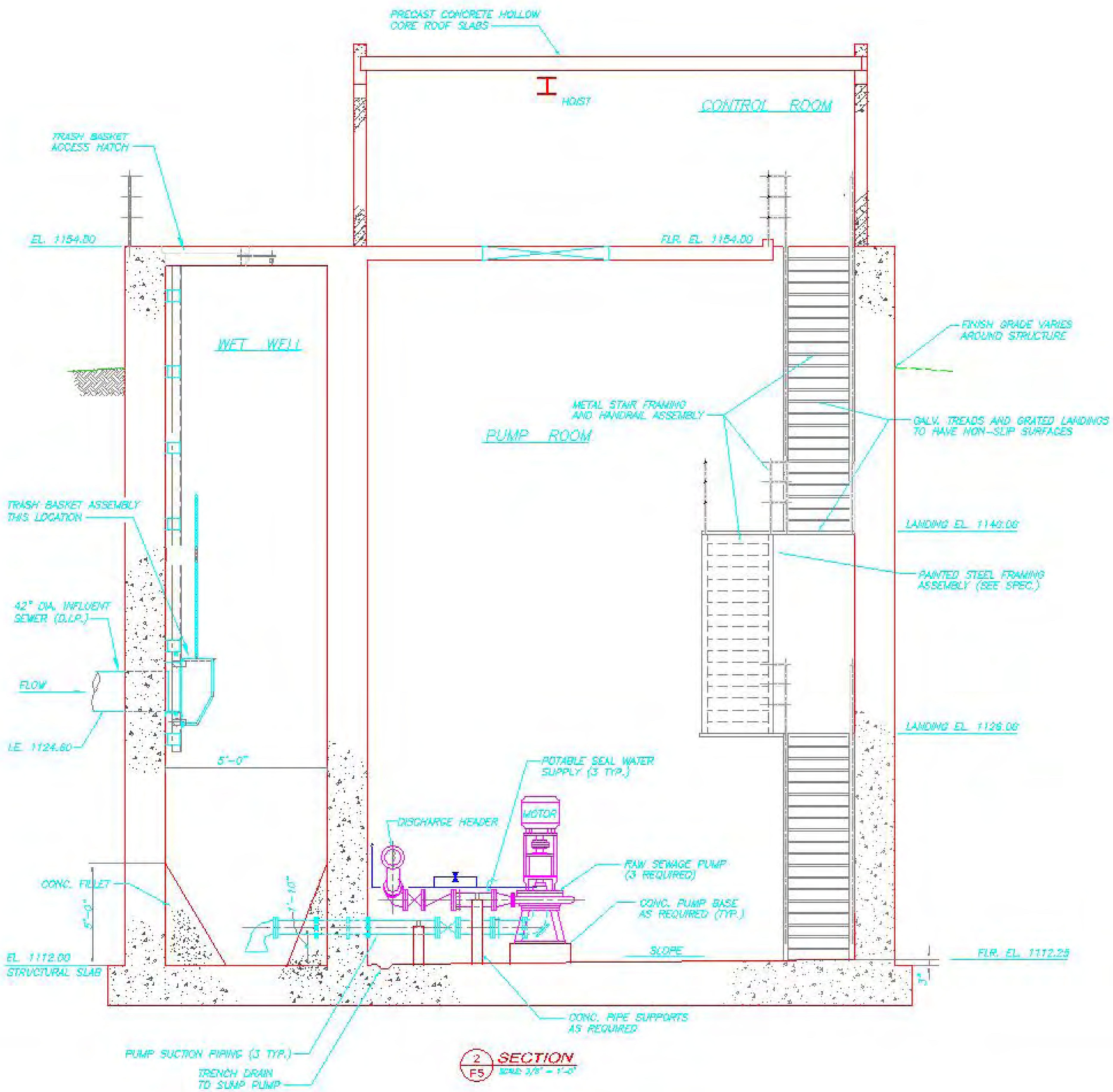

2 F5 SECTION
SCALE: 3/8" = 1'-0"

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LINCOLN WWI WEST D STREET BASIN STUDY AND DESIGN

LINCOLN NEBRASKA

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LIFT STATION SECTION 2

date 10/06 designed S.K.S. checked S.K.S. km no. 0609221

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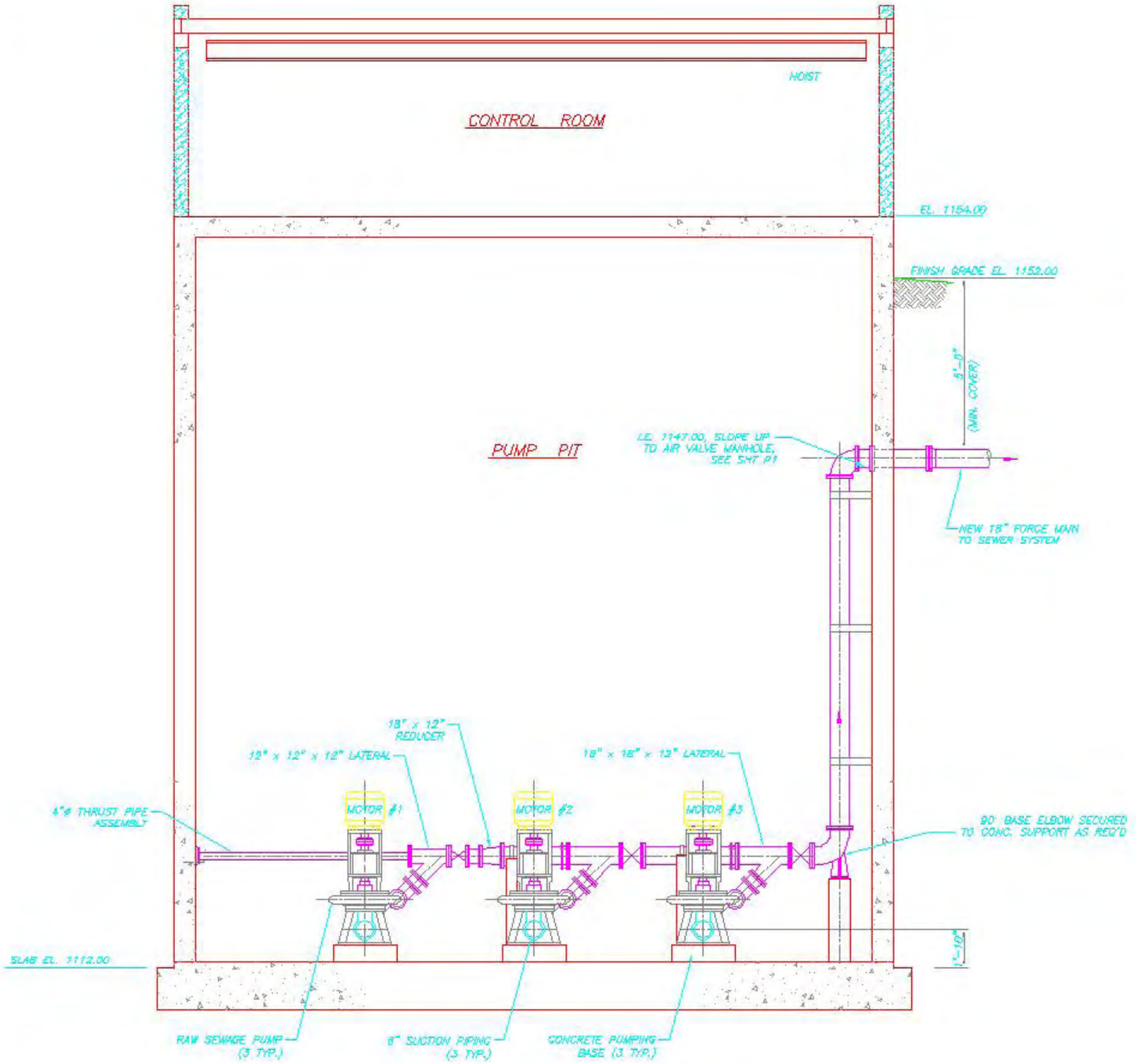

SECTION 3

SCALE: 3/8" = 1'-0"

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NEBRASKA

revisions

LINCOLN 1222 WEST D STREET
BASIN ST JDY AND DESIGN

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LIFT STATION
SECTION 3

date 05/09/22
designed S.K.S.
drawn S.K.S.
checked
project no. 0609221

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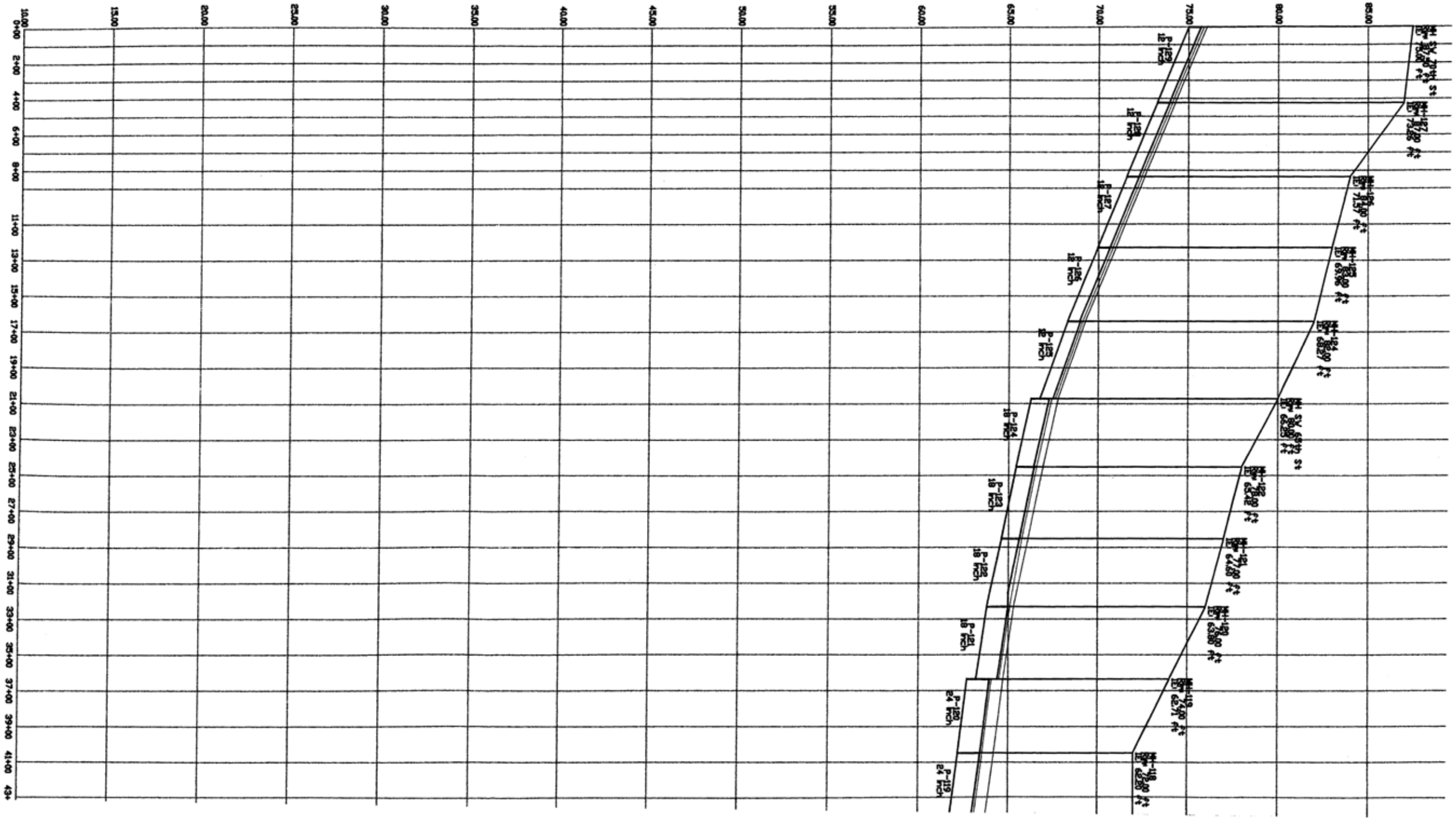

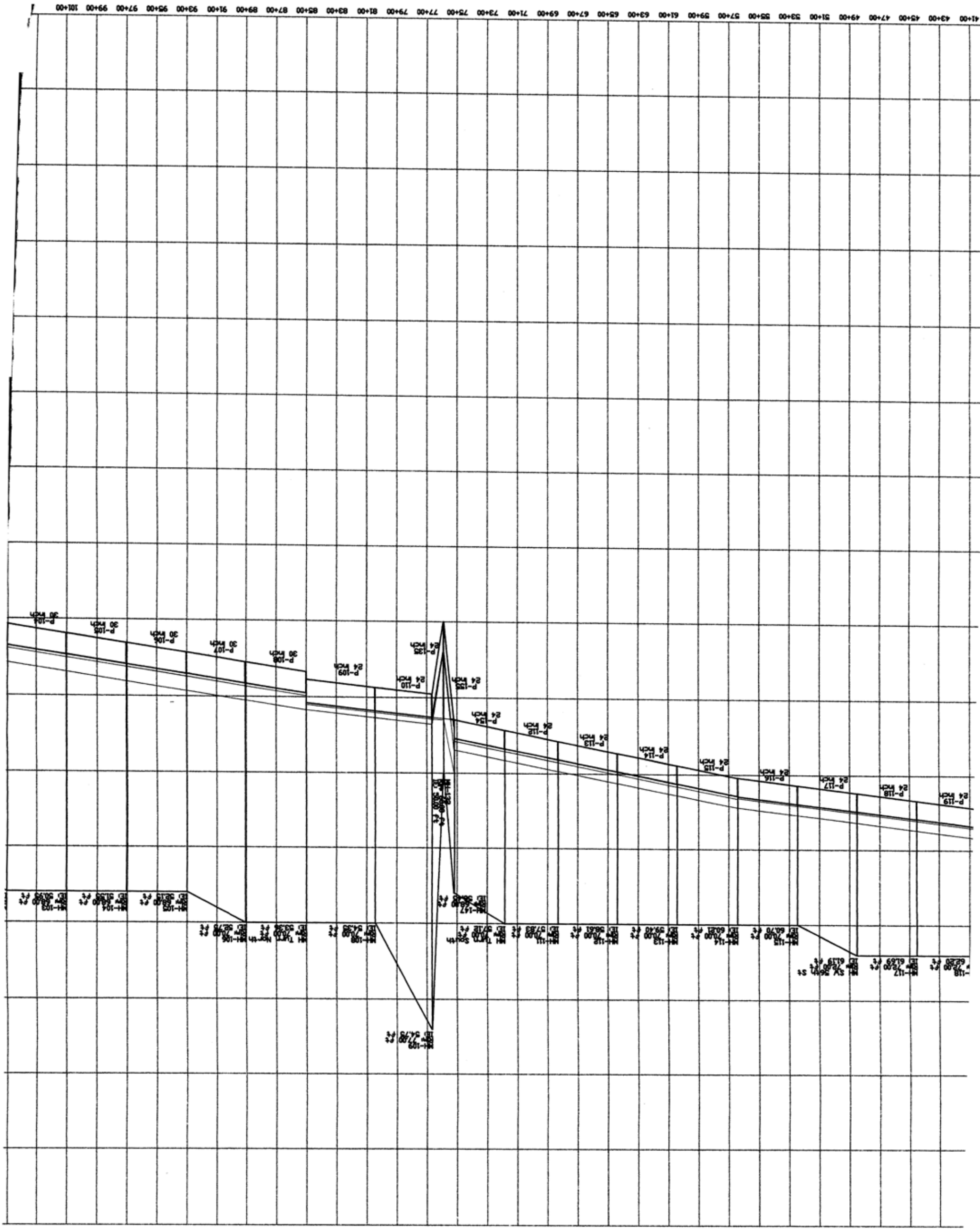
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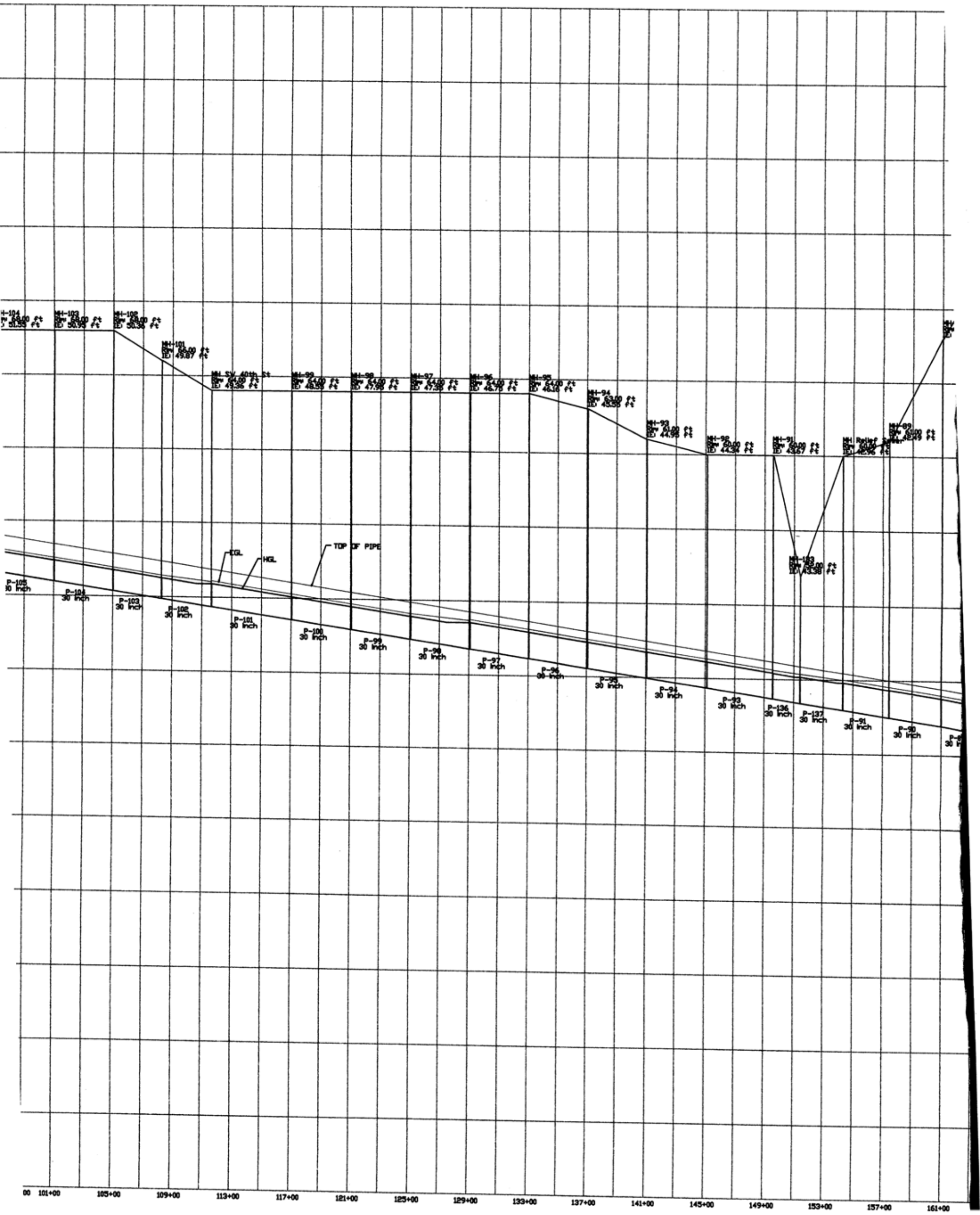
Profile No. 6
Prposed Northwest Trunk Sewer Including Connection



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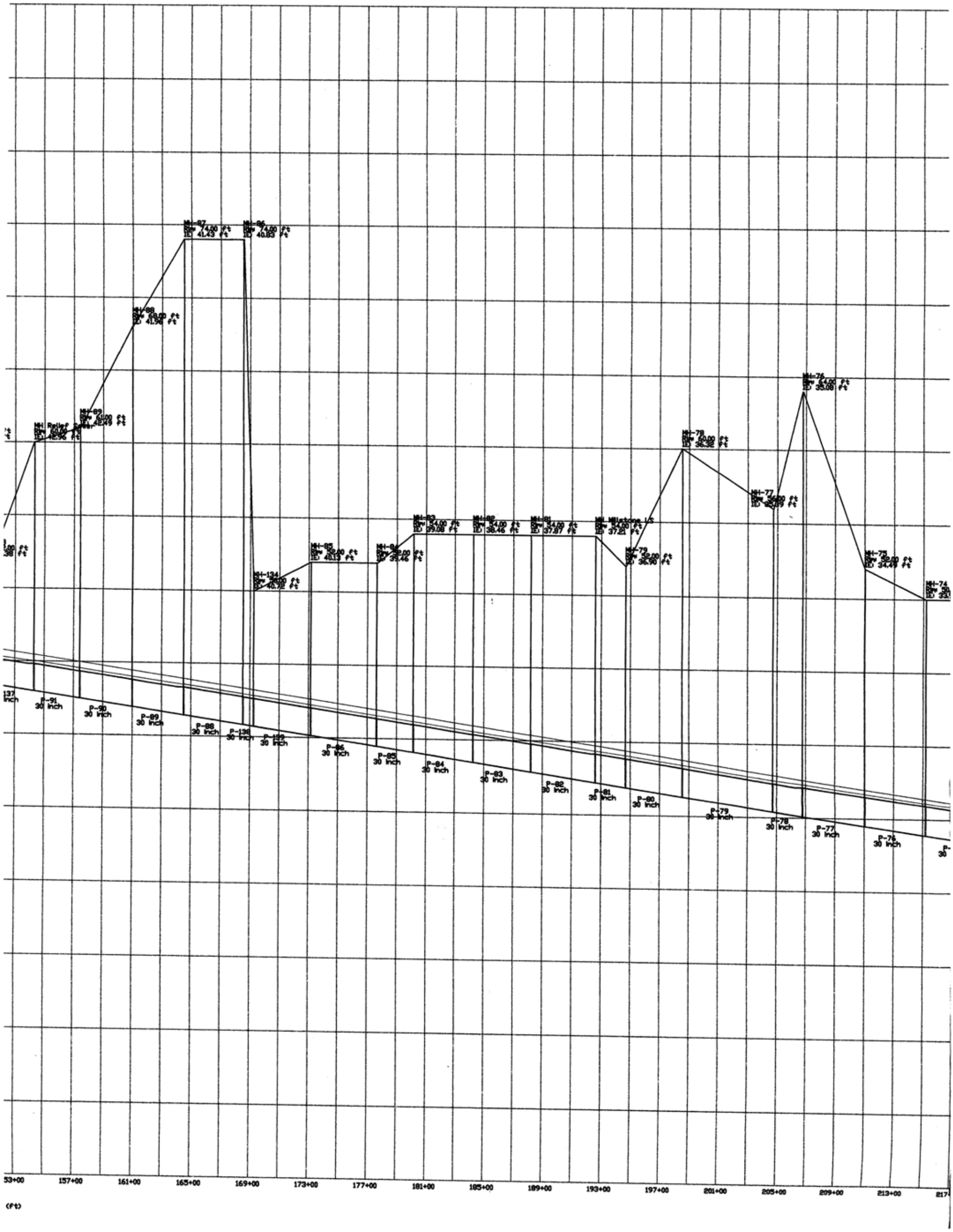

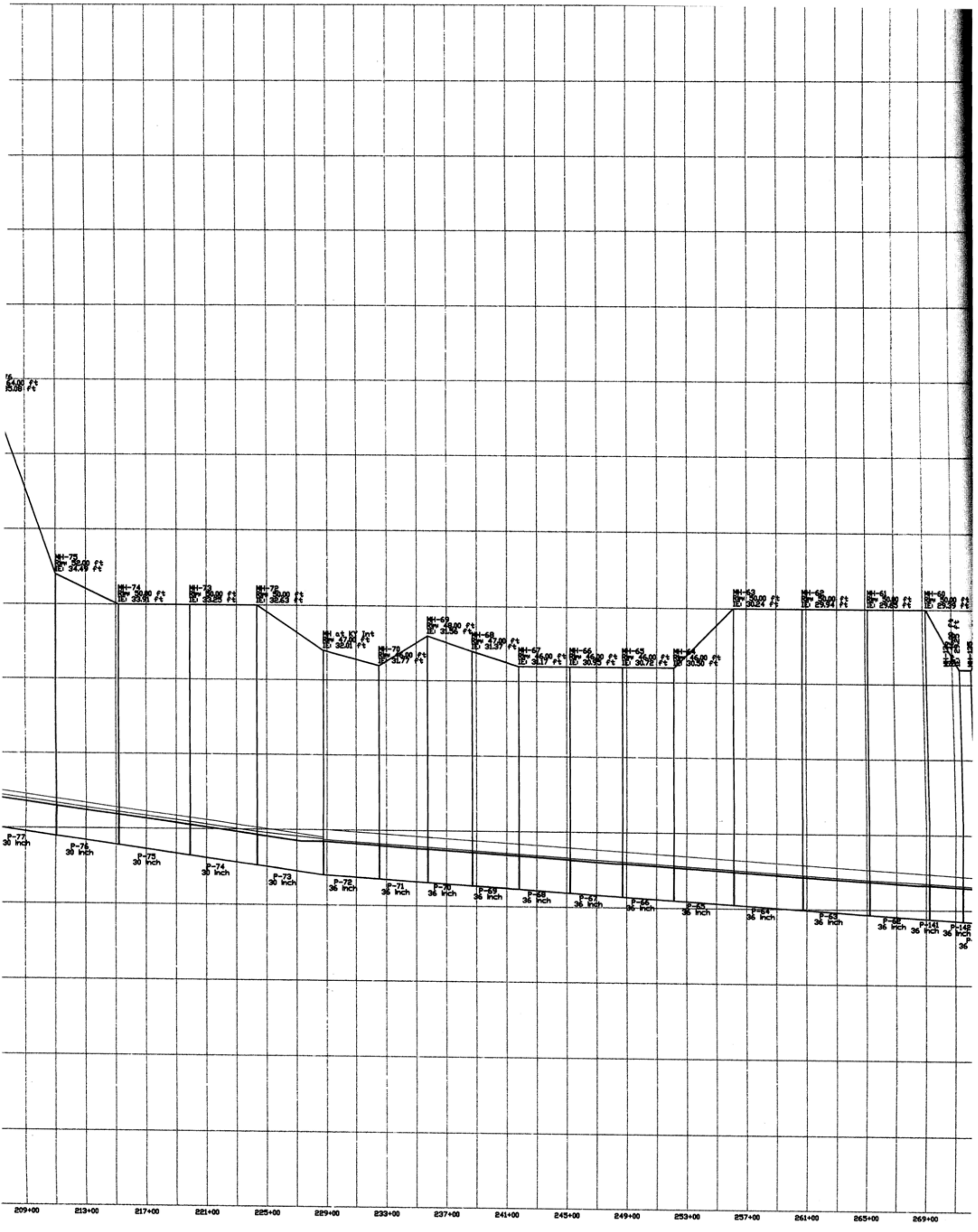
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MH-64
Rim 46.00 ft
IE1 30.50 ft
MH-63
Rim 46.00 ft
IE1 30.24 ft
MH-62
Rim 46.00 ft
IE1 29.94 ft
MH-61
Rim 46.00 ft
IE1 29.68 ft
MH-60
Rim 46.00 ft
IE1 29.39 ft
MH-125
Rim 46.00 ft
IE1 29.25 ft
MH-125
P-77
30 inch
P-76
30 inch
P-75
30 inch
P-74
30 inch
P-73
30 inch
P-72
36 inch
P-71
36 inch
P-70
36 inch
P-69
36 inch
P-68
36 inch
P-67
36 inch
P-66
36 inch
P-65
36 inch
P-64
36 inch
P-63
36 inch
P-62
36 inch
P-141
36 inch
P-142
36 inch
209+00
213+00
217+00
221+00
225+00
229+00
233+00
237+00
241+00
245+00
249+00
253+00
257+00
261+00
265+00
269+00

0 300 600 1200

SCALE: 1" = 600