Exhibit 3.2.5

Black & Veatch Water Supply System
Final Conceptual Design Report

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM
FINAL CONCEPTUAL DESIGN REPORT

Prepared By

BLACK & VEATCH
101 N. WACKER DRIVE, SUITE 1100
CHICAGO, IL 60606

February 12, 2010

TABLE OF CONTENTS

Tables

Appendix

1.0 INTRODUCTION

1.1 BACKGROUND

Tenaska has entered into a water reuse partnership with the Sanitary District of Decatur to provide reclaimed water from the Sanitary District of Decatur's (SDD) wastewater treatment facility (WWTF) to meet the non-potable water needs of the proposed Taylorville Energy Center (TEC) located approximately 26 miles southeast of Decatur.

The SDD WWTF is a conventional, municipal wastewater treatment facility that treats wastewater from industrial, domestic, and commercial sources. To produce the quality of water required by the TEC, the SDD system will require modifications to segregate high chloride industrial flows from low chloride domestic flows so that they can be treated in separate treatment trains at the plant. Once segregated, the domestic treatment train will be modified to provide biological phosphorus removal in addition to the existing treatment processes. Effluent water from the existing processes will be filtered and disinfected to provide the level of water quality needed at the TEC. After treatment, the reclaimed water will be pumped to the TEC from the SDD facility by a dedicated pump station and pipeline.

1.2 SUMMARY OF WORK

To provide the required quantity and quality of reclaimed water from the SDD WWTF to the TEC, several improvements will need to be made to the existing SDD collection and treatment facilities. In addition, a new dedicated pipeline will be required to convey the reclaimed water. The improvements are summarized as follows and shown schematically in Figures 3-1 through 3-3 in the Appendix:

1. Collection System Improvements
   The collection system improvements are required to adequately segregate the high chloride industrial wastewater flows from the low chloride domestic wastewater flows entering the SDD WWTF.

2. Preliminary Treatment Improvements
   The preliminary treatment improvements are required to allow continuous operation of the industrial headworks (screening & grit removal) facility. Currently, these facilities are only run intermittently during a peak storm event and require upgrades to maintain the required reliability for continuous operation.

3. Primary Treatment Improvements

The primary treatment improvements are required to allow continuous operation of the industrial primary clarifiers and associated primary sludge pumping. Currently, these facilities are only run intermittently during a peak storm event and require upgrades to maintain the required reliability for continuous operation.

4. Secondary Treatment Improvements

Biological phosphorus removal on the domestic treatment train will be employed to reduce the level of phosphorus in the reclaimed water going to the TEC. This will reduce fouling potential in the TEC cooling towers and reduce long term O&M costs at the TEC.

5. Tertiary Treatment Addition

An intermediate pump station will be provided to allow construction of filtration and disinfection equipment closer to grade. The filtration is required downstream of the secondary treatment system to remove suspended solids to an adequate level for feed water of high quality treatment streams at the TEC. In addition, a new disinfection facility is required to prevent biological growth in the pipeline to the TEC. The tertiary treatment system will include a dedicated pump station to convey the required quantity of reclaimed water to the TEC.

6. TEC Pipeline

A 26-mile, 16-inch diameter pipeline will be constructed from the SDD WWTF tertiary treatment building to the TEC site to convey the reclaimed water. Sufficient isolation and air release valves will be provided to prevent air binding and to allow isolation of portions of the pipeline for maintenance. The pipeline will be routed primarily along Illinois Route 48 from the Decatur area to the TEC site. Once onsite at TEC, the reclaimed water will undergo subsequent treatment for specific end uses at the facility. The water system onsite at the TEC is not covered under this report.

2.0 WATER QUANTITY AND QUALITY

2.1 WATER QUANTITY

The quantity of reclaimed water required by TEC was provided to Black & Veatch by Tenaska, Inc. and is presented in Table 2-1:

Table 2-1: TEC Water Demand

Water Demand Scenario	Description	Temperature Basis	Water Demand, gpm
Scenario 1	Winter	25° F	805
Scenario 2	Winter	25° F	885
Scenario 3	Annual Average	53° F	968
Scenario 4	Annual Average	53° F	1,063
Scenario 5	Summer	90° F	1,270
Scenario 6	Summer	90° F	1,395

The TEC water supply system will be sized to provide the flows shown in Table 2-1 and will include a safety factor of approximately 20% so that the system will be sized to handle flows up to a peak instantaneous rate of 1,700 gpm. This safety factor is provided to cover changes in the design of the TEC from now until construction as well as potential deviations in summer high temperature requiring additional reclaimed water for cooling.

2.2 WATER QUALITY

The quality of reclaimed water to be supplied to the TEC cannot currently be quantified due to the fact that the SDD WWTF effluent contains comingled treated wastewater from both industrial and domestic sources. As part of the TEC water supply system improvements, the industrial and domestic influent wastewaters will be segregated and treated in separate treatment trains at the SDD facility to minimize the total dissolved solids concentrations in the reclaimed water. The treated domestic wastewater will be the source of the reclaimed water and will be of a higher quality than the current effluent water quality from the SDD facility.

The reclaimed water quality will vary slightly on a daily basis due to the inherent variability of domestic wastewater quality. In addition, during storm events, the quantity of water received at the SDD facility can increase greatly due to the combined sewer areas served by the SDD. This increased flow can affect the potential quality of the reclaimed water through two means: 1) the increased flow will dilute the concentration of the constituents in the domestic influent wastewater to the SDD facility and 2) the increased flow will cause the wastewater treatment unit processes to operate at a higher than normal rate. These two changes will help lower certain dissolved constituents in the reclaimed water (such as chlorides, sulfates, etc), but can have a detrimental effect on soluble organics removal and suspended solids removal. Table 2-2 provides an anticipated water quality of the reclaimed water along with an anticipated range for each constituent.

Table 2-2: Anticipated Reclaimed Water Quality

Water Quality Constituent	Anticipated Average Concentration	Anticipated Concentration Range
BOD_5, mg/L	3	2 – 8
Ammonia, mg/L	<0.18	<0.18 – 0.25
TOC, mg/L		19 – 52
pH, units	7.4	6.67 – 7.74
NO_3-N, mg/L	2	1 – 3
Phosphorus, mg/L	<1.0 as PO_4 <0.3 as P	<1.0 as PO_4 <0.3 as P
Sulfate, mg/L	43	6.35 – 53.7
TDS, mg/L	559	500 – 1000
TSS, mg/L	5	2 – 10
Total Alkalinity, mg/L	200	100 – 300
Calcium, mg/L	51	32 – 86
Chloride, mg/L	113	50 – 181

Table 2-2: Anticipated Reclaimed Water Quality (cont'd)

Water Quality Constituent	Anticipated Average Concentration	Anticipated Concentration Range
Copper, mg/L	0.037	0.01 - 0.04
Cyanide as CN^-, mg/L	0.0057	0.003 - 0.007
Iron as Fe, mg/L	0.99	0.75 - 1.25
Manganese, mg/L	0.136	0.069 - 0.34
Magnesium, mg/L	24	13 - 37
Aluminum, mg/L	0.63	0.12 - 1.6
Nickel, mg/L	0.005	<0.005 - 0.0066
Lead, mg/L	0.006	<0.0025 - 0.75
Silica, mg/L	4.6	3 - 14
Sodium, mg/L	74	36 - 140
Zinc, mg/L	0.1	0.021 - 0.28

3.0 WASTEWATER TREATMENT PROCESS

The proposed treatment process for the reclaimed water to be sent to the TEC involves a combination of existing processes at the SDD WWTF along with new or modified treatment processes to achieve the desired reclaimed water quality. Figures 3-1 through 3-3 present schematics of the proposed treatment process recommended for the TEC Water Supply System. In addition, a proposed site plan is shown on Figure 3-4.

3.1 COLLECTION SYSTEM SEGREGATION

The plant treats raw wastewater from industrial, commercial, and residential sources. In addition, a portion of the SDD collection system serves a combined sewer area that collects both wastewater and stormwater. To maintain low chloride concentrations in the reclaimed water supply, the industrial and domestic influent flows to the wastewater treatment facility will need to be segregated.

Flow enters the plant via four force mains: two 60” diameter lines from the east (herein referred to as the eastside interceptor system), a 48” diameter line from the north, and a 60” diameter line from the north (both lines herein referred to as the Stevens Creek interceptor system). The eastside interceptor system conveys primarily domestic, commercial, and stormwater flows while the Stevens Creek interceptor system conveys primarily industrial flows.

As part of this project, the influent streams will be segregated such that primarily domestic and primarily industrial flows will be treated by separate facilities. This will allow the treated domestic wastewater to be used to produce reclaimed water since the domestic wastewater has a much lower dissolved solids concentration than the industrial wastewater and thus will provide a much better quality of water for the TEC.

The rerouting of a portion of the industrial flows from the two largest industrial dischargers to the SDD system, ADM and Tate & Lyle from the eastside interceptor system will need to be conducted in the existing collection system. This work is described in more detail below.

3.1.1 ADM Flow

There are three separate discharge points flowing south out of the ADM facilities into the eastside interceptor system (which conveys primarily domestic flow to the SDD WWTF).

Flow from two of ADM's south discharge points is very small and it is recommended that these discharge points remain. The bulk of southbound flow out of the ADM facility is conveyed in a force main that ADM installed connecting to SDD's interceptor system just south of SDD's Lake Shore pump station. This flow, which is approximately 6 mgd and contains elevated levels of chloride, will need to be re-routed north out of the ADM facility and into SDD's Damon Avenue pump station. Currently the remaining ADM flow exits their facility north to the Damon Avenue pump station in a 24" force main. A new 20" diameter force main running parallel to the existing 24" force main will need to be constructed from ADM to the Damon Avenue pump station along with a pump station located on the ADM site. The length of new force main is approximately 10,000 linear feet.

3.1.2 Tate and Lyle Flow

There are two main points of discharge from Tate & Lyle into the SDD collection system – one feeds the Eastside Booster pump station (approximately 0.7 mgd) and the second, which is the bulk of the flow (~ 2 to 3 mgd) flows by gravity into the Broadway sewer. This is a wastewater stream with a high chloride concentration that should be kept out of the eastside interceptor system. This can be accomplished with a new pump station that would need to be built prior to the flow entering into the Broadway sewer and a new force main constructed from the pump station to the Damon Avenue pump station. An emergency force main running south out of the Damon Avenue Pump Station exists and could be reused although the force main is PVC and the Tate & Lyle flow is very high temperature. For the purposes of this conceptual design, it was assumed that a new, dedicated force main would be installed in the same trench as the existing emergency force main. The new force main will be 14-inch diameter ductile iron pipe and will be approximately 13,500 feet in length. Land would need to be acquired for the Tate & Lyle pump station as no SDD owned property is available in the area.

3.1.3 Damon Avenue Force Main

The Damon Avenue Pump Station has two discharge force mains, one to the West and one to the South. The older, south route eventually discharges into the eastside interceptor system. In 2003, a new west route out of the pump station was completed and it is used as the primary conveyance for flows from the pump station. The south force main became an emergency line and is no longer used as part of the "normal operation". As discussed above, the south force main routing could be used to pump Tate & Lyle wastewater to the Damon Avenue Pump Station although major improvements to this line would be necessary. With all of the flow from the Damon Avenue Pump Station being discharged into the west force main and to maintain industrial/domestic segregation, there are six individual diversion structures in the force main that will need modifications.

3.2 WWTF SEGREGATION AND DIVERSION

To maintain segregation of the influent industrial and domestic wastewater to keep the chloride concentrations in the reclaimed water to TEC low, some amount of work is required to keep the flows segregated and to adequately treat the segregated flows and still meet the IEPA NPDES permit to the Sangamon River.

The WWTF is permitted to treat 40 mgd annual average flow and 125 mgd peak flow. It is not the intent of this project to modify the permitted capacity of the plant; however, the function of some of the treatment facilities will be modified, as described herein.

Staff from the SDD has conducted a detailed evaluation of flow sources based on analysis of local limits at the largest industries, and review of population and water consumption data. These estimates were developed in 2008 based on the previous twelve months of data. SDD has determined that dry weather flows from industries account for 16.8 mgd on an average annual basis. Average dry weather flows from domestic and commercial sectors account for about 10.9 mgd, for a total annual average flow of approximately 27.7 mgd. Table 3-1 shows design wastewater flow rates after segregation. It was necessary to make assumptions regarding the portion of infiltration and inflow (I&I) associated with each source.

Table 3-1: Design Segregated Raw Wastewater Flow Rates

Condition	Domestic	Industrial	Combined
Historical Dry Weather Average Flow, mgd	10.9	16.8	27.7
Design Minimum Month Average Flow, mgd	12.9	22.1	35.0
Design Annual Average Flow, mgd	15.7	24.3	40.0
Design Maximum Month Average Flow, mgd	18.1	26.0	44.1
Design Peak Day Average Flow, mgd	63.9	61.1	125.0

3.2.1 Domestic Influent Diversion Structure

The existing domestic influent diversion structure receives influent flow from the eastside interceptor system which then flows into the domestic headworks facility.

Modifications will be made to the domestic influent diversion structure to allow wet weather flow to flow to the industrial treatment train while keeping the industrial dry weather flow segregated from the domestic treatment train. Three concrete walls will be constructed inside the diversion structure channels to segregate the flow. On each new wall, a downward opening gate will be installed to allow the SDD operators to send a portion of the wet weather flow from the domestic influent diversion structure to the industrial headworks facility.

3.2.2 Primary Effluent Diversion Structure

The domestic primary clarifiers and the industrial primary clarifiers both discharge into the same primary effluent channel. The industrial flow enters the channel approximately 300 feet downstream of where the domestic flow enters the channel. Since the domestic and industrial flow streams need to be segregated, a primary effluent diversion structure will be constructed in the primary effluent channel, upstream of the connection to the industrial primary clarifiers.

The wall of the existing primary effluent channel will be demolished and a new concrete structure will be constructed with slide gates, a connection to a 96” diameter pipe, odor control covers and an odor control system. The domestic primary effluent will be diverted to the BNR basins flow splitter.

3.3 PRELIMINARY TREATMENT IMPROVEMENTS

The SDD WWTF has two separate preliminary treatment facilities which include screening and grit removal. A schematic of the existing treatment facility and proposed improvements for the preliminary treatment system is shown in Figure 3-1 and found in the Appendix. The industrial and domestic dry weather flows will be segregated prior to these two facilities so that one will receive primarily industrial wastewater and the other will receive primarily domestic wastewater. Wet weather flows will be split between the two preliminary treatment facilities using high level overflow weirs located in the existing diversion structure upstream of the domestic preliminary treatment facility.

All of the existing mechanical equipment in the industrial headworks facility is approaching the end of its useful life. Currently, this facility is used only for peak wet weather flows and, as such, is only operated occasionally. As such, the older equipment satisfies the current SDD needs when used on an intermittent basis only, and allows for extended out of service periods during dry weather to make the necessary repairs and perform maintenance on the older equipment. After the TEC water supply system is placed into service, the industrial headworks facility will be operated continuously with an annual average flow of 17 mgd. Considering the age of the existing mechanical equipment and the proposed continuous use, it is recommended that the screenings and grit removal equipment in the industrial preliminary treatment facility be replaced or rehabilitated to provide reliable service.

The domestic preliminary treatment facility, on the other hand, is relatively new and no equipment replacement work is necessary for the screenings and grit removal processes.

3.3.1 Influent Screening

Structure 003 is the existing screen building that is part of the industrial headworks facility. The building contains two mechanically cleaned bar screens, manufactured by Jeffrey. Each screen is five feet wide and has and ½ inch bar spacing. The screenings from the bar screen are deposited onto a horizontal belt conveyor which discharges into a screenings container in the basement of Structure 003. There is also a bypass channel with a trash rack that is manually cleaned.

It is recommended that both mechanically cleaned bar screens, the horizontal belt conveyor and the trash rack be replaced with new equipment.

The mechanically cleaned bar screens will be replaced with two new front entry perforated plate fine screens. The perforated plate openings will be six millimeters in diameter. Each new screen will deposit its screenings into dedicated screenings washer compactors, which will wash the screenings to remove organic matter and will then compact and dewater the screenings for discharge into the screenings container. A new belt conveyor will not be required since the screenings washer compactor will use integral screw conveyors to dewater the screenings and transport them to the screenings container. The trash rack will be replaced “in kind”.

Headworks facilities are a main source of odors at a wastewater treatment facility. In order to reduce the odors, the headspace in the screen influent channels, the screen channels and the screen effluent channels will be ventilated to carbon tower units for odor control.

The addition of the two new fine screens and the new screenings washer compactors will require additional room that is not available in Structure 003. Structure 003 will require a building addition of approximately 2,400 square feet.

A list of the new equipment for Structure 003 – Screen Building is presented in Table 3-2 below:

Table 3-2: Structure 003 – Screen Building Equipment

Type of Equipment	Quantity	Recommended Equipment
Raw Wastewater Screens	2	Front entry perforated plate screen; 6 mm openings sized for 37.5 mgd peak flow capacity
Trash Rack (for manual bypass of screens)	1	Stainless steel bars with ½" spacing
Screenings Processing	2	Screenings washer compactor
Odor Control System	2	Calgon "High Flow Ventsorb"; 1,000 scfm

3.3.2 Grit Removal

Structure 004 and 005 are the basins that house the existing industrial flow grit removal units, Detritor #1 and Detritor #2, respectively. The detritors are 40' diameter basins that include detritus style grit removal rakes and overflow weirs. Each basin also includes a sump pit which collects grit for removal.

The detritor equipment is in fairly good condition in relation to the other headworks equipment. This equipment does not need to be replaced, but it is recommended that the grit collector gear drive for each detritor be refurbished. In addition, the sump pit in each detritor needs to be enlarged and a flush water connection added at each sump pit for flushing and cleaning.

Structure 006 (Grit Building) is next to the Detritors. The Grit building contains two recessed impeller grit pumps which remove the collected grit from each of the detritor sump pits. The grit pumps discharge the grit into two Wemco grit concentrator/classifiers that remove water and organics from the grit. The grit concentrator/classifiers deposit the grit onto a horizontal belt conveyor which discharges into a grit container.

All of the equipment in the Grit Building has reached it useful service life and will be replaced with similar units.

The two recessed impeller grit pumps in the Grit Building should be replaced with four new recessed impeller grit pumps to provide necessary redundancy. The pump capacity will be approximately 250 gpm for each pump. The grit pumps will discharge the grit to two new grit concentrator/classifiers, which will deposit dewatered grit onto a new horizontal belt conveyor.

A list of the new equipment for Structure 006 – Grit Building is presented in Table 3-3 below:

Table 3-3: Structure 006 – Grit Building Equipment

Type of Equipment	Quantity	Recommended Equipment
Grit Pumps	4	Recessed impeller pumps; 180 gpm capacity
Grit Concentrator/Classifiers	2	Wemco “Hydrocyclone/Classifier”; 180 gpm capacity
Grit Conveyance	1	Horizontal belt conveyor

3.4 PRIMARY TREATMENT IMPROVEMENTS

The SDD WWTF has six primary clarifiers, three for the domestic flow and three for the industrial flow. Similar to the industrial headworks equipment, the industrial side primary clarifier equipment requires some rehabilitation prior to being put into continuous operation. A schematic of the existing treatment facility and proposed improvements for the primary treatment system is shown in Figure 3-1 and found in the Appendix.

3.4.1 Primary Clarifiers

Structures 007, 008 and 010 are primary clarifiers #1, #2 and #3, respectively and will serve as the industrial primary clarifiers. Primary clarifiers #1 and #2 both have a diameter of 100 feet with a 12 foot side wall depth. Primary clarifier #3 is 130 feet in diameter with a 12 foot side wall depth. All three clarifiers have primary sludge removal and scum removal. Table 3-4 summarizes the existing primary clarifier capacity for both the domestic train and the industrial train.

Table 3-4: Primary Clarifier Capacity

Parameter	Phase 2 #4, #5 & #6 (Domestic)	Phase 1 #1, #2 & #3 (Industrial)	Units
Design Annual Average Flow	15.7	24.3	mgd
Design Maximum Month Average Flow	18.1	26.0	mgd
Design Peak Day Average Flow	63.9	61.1	mgd
Number	3	1	
Clarifier Diameter	130	130	ft
Clarifier Surface Area (Each	13,273	13,273	sf
Number		2	
Clarifier Diameter		100	ft
Clarifier Surface Area (Each)		7,854	sf
Total Clarifier Surface Area	39,820	28,981	sf
Design Average Surface Overflow Rate	395	837	gpd/sf
Design Max Month Surface Overflow Rate	454	899	gpd/sf
Design Peak Day Surface Overflow Rate	1,604	2,109	gpd/sf

To allow for continuous operation, the sludge collector mechanism for primary clarifiers #1, #2 and #3 should be rehabilitated and re-painted. The sludge collector mechanism (sludge rake arm and the influent feedwell) should be inspected and corroded or damaged components be replaced. The existing scum beach and scum skimmer arm on each primary clarifier should be replaced with a larger scum beach and new equipment. The vertical mixers in the scum collection wells should be replaced with new vertical mixers.

The existing primary effluent launders are open to the atmosphere and can be a source of odors. Under the current intermittent use, odors are not a significant problem, particularly with more dilute wet weather flow. When these clarifiers are used on a constant basis, as industrial flow clarifiers, it will be necessary to cover the headspace in the launders and remove the malodorous air to be treated through carbon tower units for odor control treatment.

A list of the new equipment for Structures 007, 008, & 009 – Industrial Primary Clarifiers is presented in Table 3-5 below:

Table 3-5: Structures 007, 008 & 009 – Industrial Primary Clarifiers

Type of Equipment	Quantity	Recommended Equipment
Scum Collection	3	Increased width scum skimmer and larger scum beach
Scum Mixer	3	Vertical mixer; 5 hp
Odor Control System	3	FRP covers over effluent channels; Calgon "High Flow Ventsorb"; 1,000 scfm

The domestic primary clarifiers are in relatively good condition and therefore, no modifications are needed.

3.4.2 Primary Control House

Structure 009 is control house #1 for primary clarifiers #1 and #2. Structure 011 is control house #2 for primary clarifier #3. Structure 009 contains 2 diaphragm pumps and 2 centrifugal pumps for pumping primary sludge. Structure 011 contains 1 diaphragm pump and 1 centrifugal pump for pumping sludge. Each structure also contains an air compressor which provides air for the diaphragm pumps.

The existing diaphragm pumps can pump 4.5 gallons per stroke with a maximum of 14 strokes per minute. This equates to a pumping capacity of 63 gpm. The existing diaphragm pumps can achieve a higher flow rate, but the pump loses capacity at higher than 14 strokes per minute. It is recommended that the controller for each diaphragm pump be replaced to achieve a higher pump capacity.

The centrifugal pumps are manufactured by Wemco and have a pumping capacity of 850 gpm. The existing pumps are constant speed. It is recommended that variable frequency drives be installed on each pump to provide variability in sludge pumping rates.

The air compressors are in poor condition. It is recommended that the existing air compressors be replaced with a new air compressor and air dryer in each location.

3.5 SECONDARY TREATMENT IMPROVEMENTS

The TEC requires reclaimed water with lower levels of phosphorus than is currently seen in the SDD WWTF effluent. Therefore, the four existing Phase 2 aeration basins will be modified to achieve enhanced biological phosphorus removal (EBPR) on the domestic treatment train. The modifications include:

1. Addition of an EBPR Basin Influent Flow Splitter
2. Addition of a Primary Sludge Fermentation System
3. Modifications to the Existing Aeration Basins
4. Modifications to the existing RAS Return Points

It has been determined that the existing blower capacity is sufficient for the new EDPR process and does not require modification.

After these modifications are made, the secondary treatment process on the domestic treatment train will have a design dry weather average capacity of 10.8 mgd with a peak wet weather capacity of 80 mgd. A schematic of the existing treatment facility and proposed improvements for the secondary treatment system is shown in Figure 3-2 and found in the Appendix.

3.5.1 EBPR Basin Influent Flow Splitter

The EBPR process requires a greater attention to process and flow control than a conventional activated sludge process; therefore, a more precise split of primary effluent is recommended to ensure that each of the individual EBPR basins perform as designed. To accomplish this, a fixed weir flow splitter will be installed on the effluent of the domestic primary clarifiers prior to entering the EBPR basins. The flow splitter will be constructed in the footprint of the existing UNOX Reactors, which will need to be demolished to provide the necessary space for the flow splitter and other EBPR facilities. The flow splitter will equally split flow between each of the EPBR basins in service using fixed overflow weirs. Overflow weirs will be mounted on both sides of a weir trough that will be dedicated to one of the four EBPR basins. Each weir trough can be isolated if its corresponding EBPR basin is out of service.

3.5.2 Primary Sludge Fermentation

As part of the EBPR process, a sufficient concentration of volatile fatty acids (VFAs) in the influent wastewater is needed to allow the process to perform as designed. Based on limited VFA data collected on the segregated domestic influent wastewater, it appears that there are insufficient VFAs present for the EBPR process, therefore, VFAs must be added to the process. VFAs can either be added from an external source by importing VFA-containing waste or generating the VFAs onsite. For the purposes of this study, it is proposed to use the domestic primary sludge already collected at the SDD WWTF to generate the VFAs needed for the EBPR process. Currently, all primary sludge from the WWTF is pumped to a common location, designated as the 210 Wetwell.

To maintain segregation of industrial primary sludge from the domestic primary sludge and to allow the domestic sludge to be used for VFA production, it is recommended to continue the use of the 210 Wetwell for industrial primary sludge and scum. The domestic primary sludge will then be pumped directly from the domestic primary clarifiers to a new VFA generation system. The existing domestic primary sludge pumps can be reused for this application; therefore, only minor piping modifications will be required to allow diversion of domestic primary sludge to the VFA generation system.

3.5.2.1 Fermentation Process

Domestic primary sludge will be fermented to create short-chain VFAs, which will be used in the EBPR process. The new primary sludge fermentation process will consist of two fermenters (two duty), two gravity thickeners (one duty, one standby), and ancillary pumping and blower equipment contained in a new building. The VFA generation system is proposed to be primarily located in the footprint of the existing UNOX Reactors, which are planned to be demolished as part of this project to provide the necessary space for new facilities.

Unthickened primary sludge (~0.5% total solids (TS)) will be pumped from the existing domestic primary clarifiers using the existing diaphragm pumps to one of two fermenter effluent boxes, where it will blend with fermented sludge (~3% TS). The mixture will be pumped using new progressing cavity pumps (one duty, one standby) to one of the two gravity thickeners. Gravity thickener effluent (containing VFAs) will flow by gravity to the EBPR process while gravity thickener underflow (~4% TS), will be pumped using new progressing cavity pumps (two duty, one standby) back to the fermenters. To control solids retention time (SRT) in the fermenters, a portion of the gravity thickener underflow will be pumped using a fourth progressing cavity pump to the existing anaerobic digesters.

In the fermenters, complex organic compounds will be hydrolyzed by heterotrophic bacteria and then converted to short-chain VFAs (primarily acetate and propionate) by VFA-forming microorganisms, called acetogens. It will be important to operate the fermenters such that growth of methanogenic bacteria is minimized, because methanogens convert VFAs to methane, which would not help the EBPR process and would result in reduced digester gas production from the existing anaerobic digesters. Preventing growth of methanogens will be accomplished in two ways. First, the SRT will be sufficiently short that methanogens, which grow more slowly than acetogens, will be washed out of the process. Secondly, the system will be provided with blowers and coarse bubble diffused aeration to aerate the fermenters intermittently. Although dissolved oxygen interferes with the metabolism of both acetogens and methanogens, the impact on methanogens is greater.

3.5.2.2 Fermenters

The fermenters will be cast-in-place, rectangular, covered concrete structures, with a common wall between them. Each fermenter will be 24 feet long by 24 feet wide, with 20-foot water depth (86,000 gallons each). Gravity-thickened sludge will enter the fermenter at floor level through distribution piping. Each fermenter will be intermittently mixed using a constant-speed, vertical-shaft, top-mounted mixer (approximately 15 horsepower (HP)). Headspace in the fermenter will be monitored for methane, the presence of which would indicate that methanogens are proliferating, requiring operator intervention by SRT reduction or aeration. Operators could also monitor fermenter oxidation reduction potential (ORP) using a portable meter. ORP could be used as a guide for applying aeration.

Aeration will be provided by two new constant-speed, positive displacement blowers (one duty, one standby, each approximately 15 HP) delivering air to a set of coarse bubble diffusers located in each fermenter. It is anticipated that only one fermenter will be aerated at a time as this process is intermittent. The fermenter basins and adjacent pump/blower room is shown in Figure 3-5.

3.5.2.3 Gravity Thickeners

The gravity thickeners will be cast-in place, circular concrete structures (approximately 30-foot diameter), with metal (or fiberglass) covers for odor control, and a metal (or fiberglass) walkway with handrails to access the drive unit at the center. Unthickened sludge will enter the unit via a vertical center pipe. Solids will settle to the floor, where they will thicken in a blanket. Clarified liquid will overflow a peripheral weir into an effluent launder. Effluent launders will have multiple access hatches to facilitate housekeeping. A rake mechanism at the floor, similar to those used in circular primary clarifiers, will move thickened sludge to a center hopper, from which it will be pumped using pumps located external to the thickeners. The gravity thickeners are shown in Figure 3-6.

3.5.3 Enhanced Biological Phosphorus Removal Process

The EBPR process recommended for implementation is the Johannesburg process, which requires multiple treatment environments to achieve various biochemical reactions. This process is summarized in Table 3-9. This EBPR process will produce secondary effluent with low ammonia and low soluble phosphorus concentrations to meet the 1.0 mg/L total phosphorus (TP) requirement for the TEC water supply. Nitrate and nitrite (collectively abbreviated NO_x-N) will be removed by denitrification in anoxic zones to prevent interference with phosphorus removal.

As shown in Figure 3-7 and 3-8, the existing aeration basins will be modified such that the upstream 30 percent of tank length will become the three unaerated zones (RAS anoxic, anaerobic, and anoxic) needed for the process. The remaining 70 percent of tank length will be subdivided into three diffuser grids consisting of new diffusers and piping. Air will be supplied to the new diffusers using the existing blowers, which have sufficient capacity for the new process and do not require modification. Table 3-6 presents the required biological treatment volumes needed for the EBPR process.

Table 3-6: EBPR Treatment Volumes (Each of Four Basins)

Design Criteria	Value	Units
Existing Aeration Basin Volume (Existing Water Depth)	213,300	cf
Existing Aeration Basin Volume (Revised Water Depth)	192,600	cf
Required RAS Anoxic Zone Volume	19,300	cf
Required Anaerobic Zone Volume	19,300	cf
Required Anoxic Zone Volume	19,300	cf
Required Oxic Zone Volume	134,700	cf

Each unaerated zone will be separated by new walls spanning the tank width (51 feet). Each unaerated zone will consist on a serpentine channel constructed by the addition of an intermediate wall in each zone. Each channel will be approximately 12 feet wide and 51 feet long. The top of the three new walls separating each unaerated zone will be slightly submerged (i.e., top of wall slightly below water surface) to allow scum passage. Each channel will be mixed using two constant-speed, submersible mixers (approximately 5 HP), oriented horizontally. Therefore, there will be two mixers per unaerated channel, four mixers per unaerated zone, 12 mixers per treatment train, and 48 mixers overall (approximately 240 HP installed).

The EPBR secondary influent will be conveyed by gravity from the flow splitter to a new EBPR basin influent channel that runs north-south along the unaerated zones of each basin. Three manually-operated gates in each influent channel will allow secondary influent to be directed to any of the three unaerated zones. It is expected that approximately 25 percent of the secondary influent will be routed to the first zone (RAS anoxic zone), and 75 percent will be routed to the second zone (anaerobic zone). Secondary influent will not be allowed to enter the third zone (anoxic zone) from the influent channel. Peak secondary influent flows will overflow a weir at the end of the influent channel and enter the aerobic zone thus bypassing the unaerated zones. Because the dividing walls between each unaerated zone will be submerged, some mixed liquor will pass over the walls. However, in a given zone, most of the mixed liquor will flow around the opening at the end of the channels. From one zone to another, most of the mixed liquor will flow into a mixing chimney adjacent to the secondary influent channel. Flow will exit each mixing chimney at floor level. From the anoxic zone to the oxic zone, water level in the basin will drop a few inches over the overflow wall, which will prevent back-mixing of aerated mixed liquor into the anoxic zone.

To accomplish these modifications, the water depth in the oxic zone must be dropped approximately two feet to allow for gravity flow through the new unaerated zones. The water depth reduction will allow the existing aeration blowers to produce higher discharge volumes and thus provide sufficient air for nitrification on the domestic side while also providing sufficient air for the industrial treatment train. Table 3-7 presents the current blower aeration capacities and Table 3-8 presents estimated aeration air requirements for the domestic and industrial treatment trains.

Table 3-7: Existing Aeration Blower Capacities

Design Criteria	Value	Units
Small Blowers	4 @ 9,300	icfm
Large Blower	1 @ 17,900	icfm
Total Installed Capacity	55,100	icfm
Total Firm Capacity	37,200	icfm

Table 3-8: Aeration Air Required

Design Criteria	Max Month Organic Loading	Peak Hydraulic Loading	Unit
Domestic Oxic Zone (4 Basins Online)	13,000	20,000	icfm
Industrial Aeration Basins (3 Large Basins Online)	17,000	24,000	icfm
Total Airflow	30,000	44,000	icfm

Currently, the tankage that will become the oxic zone is aerated using three grids of 9-inch diameter, ceramic disc diffusers. These diffusers have reached the end of their useful life and will be replaced, along with the associated PVC piping. During detailed design, ceramic and membrane disc diffusers will be considered. In each EBPR basin, mixed liquor will be pumped from the end of the oxic zone to the third mixing chimney (in the anoxic zone) using two submersible, axial-flow pumps (each approximately 2,700 gpm). These pumps will use variable speed drives to allow the mixed liquor recycle (MLR) flow in each train to be reduced to approximately half the nominal capacity of one pump.

Table 3-9: Johannesburg Process Summary

Stage/Zone	Environment	Metabolism
RAS anoxic	Receives return activated sludge (RAS) flow from the domestic side secondary clarifiers via the existing RAS pump station; optionally this zone receives a portion of secondary influent and supplemental short-chain volatile fatty acids (VFAs). Negligible dissolved oxygen (DO), but nitrate and possibly nitrite (NOx-N) present.	Denitrification – Heterotrophic bacteria grow using organic compounds and NOx-N, producing nitrogen gas. These organic compounds originate from biomass decay, secondary influent, fermented primary sludge, or a combination thereof.
Anaerobic	Receives denitrified RAS and a majority of the secondary influent along with supplemental VFAs. Negligible dissolved oxygen (DO) and negligible NOx-N.	Heterotrophic bacteria ferment complex organic compounds, producing VFAs. Polyphosphate accumulating organisms (PAOs) uptake and store VFAs (as complex organic compounds) using energy from stored polyphosphate, resulting in orthophosphate (PO_4) release. VFAs originate from secondary influent, local fermentation, or externally fermented primary sludge.
Anoxic	Receives flow from anaerobic zone plus mixed liquor recycle (MLR) from the end of downstream aerobic zone; this zone optionally receives a portion of the secondary influent as well as supplemental VFAs. Negligible DO, but NOx-N present.	Denitrification – Heterotrophic bacteria grow using organic compounds and NOx-N, producing nitrogen gas. These organic compounds originate from biomass endogenous decay, secondary influent, fermented primary sludge, or a combination thereof. PAOs use stored organic compounds for growth while performing “luxury” PO_4 uptake. PO_4 is stored as polyphosphate to provide energy for subsequent VFA uptake in the anaerobic zone.
Aerobic (or “oxic”)	Receives flow from the anoxic zone Aerated, therefore DO present NOx-N also present, but not significantly used for metabolism in this zone.	Heterotrophic bacteria grow using organic compounds and oxygen. Nitrification - autotrophic bacteria grow using inorganic carbon, ammonia, and oxygen, producing NOx-N. PAOs use stored organic compounds for growth while performing “luxury” PO_4 uptake. PO_4 is stored as polyphosphate to provide energy for subsequent VFA uptake in the anaerobic zone.

3.5.4 Secondary Clarifiers

The existing secondary clarifiers that will be used as part of the EBPR process are in good condition and can be used without modifications. A total of eight existing clarifiers will be used. These clarifiers are currently designed so that additional segregation of domestic and industrial return activated sludge (RAS) collected from the clarifiers is not necessary. The domestic RAS will be pumped to the head of the EBPR process to help maintain a sufficient biological population for treatment. Settled activated sludge in excess of the quantity needed for biological population maintenance will be wasted to the digester complex as it is currently done with no modifications anticipated.

Modifications to the RAS pipeline where it currently enters the existing aeration basins will be required. The RAS will be metered and the flow split to each of the four EBPR basins will be controlled using control valves to allow an equal split between the four EBPR basins. The flow meter and control valve will be located in the existing aeration basin inlet channel that will be modified for use as separate metering/valve vaults for each basin. Table 3-10 presents design criteria for the existing secondary clarifiers in the domestic and industrial treatment trains.

Table 3-10: Secondary Clarifier Design Criteria

Parameter	Phase 2 (Domestic)	Phase 1 (Industrial)	Units
Annual Average Flow	15.7	24.3	mgd
Maximum Month Average Flow	18.1	26.0	mgd
Peak Day Average Flow	63.9	61.1	mgd
Number	8	11	
Clarifier Diameter	120	125	ft
Clarifier Surface Area (Each)	11,300	12,600	sf

Table 3-10: Secondary Clarifier Design Criteria (cont'd)

Parameter	Phase 2 (Domestic)	Phase 1 (Industrial)	Units
Clarifier Surface Area (Total)	90,500	135,000	sf
Total Clarifier Surface Area with one out of service	79,200	122,700	sf
Average Surface Overflow Rate[1]	200	200	gpd/sf
Max Month Surface Overflow Rate[1]	230	210	gpd/sf
Peak Day Surface Overflow Rate[1]	810	500	gpd/sf

Note: [1] With one clarifier out of service

The existing domestic treatment train RAS pump station is sufficiently sized for the anticipated domestic load. Table 3-11 presents the design criteria for the RAS pumps

Table 3-11: Domestic RAS Pumping

Design Criteria	Value	Units
Number of RAS Pumps	10	
Capacity of Each Pump	4.6	mgd
Total Installed Capacity	46	mgd
Firm Capacity	41	mgd
Required RAS Pumping Capacity at Max Month	9	mgd
Required RAS Pumping at Peak Day	18	mgd

3.6 INTERMEDIATE PUMP STATION

A portion of the domestic secondary clarifier effluent will be pumped to a new tertiary treatment facility for the purposes of providing additional treatment prior to pumping to the TEC. A schematic of the existing treatment facility and proposed improvements for the tertiary treatment system (including the intermediate pump station) is shown in Figure 3-3 and found in the Appendix. The required flow will be diverted to the new treatment processes using an intermediate pump station located just upstream of the existing Junction Structure S-2. This pump station will consist of a below grade wetwell and valve vault and will be constructed of cast in place reinforced concrete.

The pump station will be equipped with three discharge mounted, VFD operated submersible pumps (two duty and one standby). This sizing and arrangement will provide the flexibility needed to pump the full range of anticipated water demands to the tertiary treatment facility. The anticipated winter low demand is 805 gpm, which will be able to be met using one submersible pump at reduced speed. The average demand is anticipated to be 1,063 gpm, which will be able to be met with two pumps running at reduced speed. The anticipated peak water demand is 1,700 gpm, which can be met with two pumps running at full speed. Each individual pump discharge line will have its own check valve and isolation plug valve that will be housed in a separate below grade vault before connecting to a common 12 inch diameter discharge header that will be routed to the new tertiary treatment building. All piping associated with the intermediate pump station will be ductile iron pipe. A plan and section of the proposed intermediate pump station is included in Figures 3-9 and 3-10.

A list of the equipment and design criteria for the intermediate pump station is presented in Table 3-12 below:

Table 3-12: Intermediate Pump Station Design Criteria

Number of Pumps	3
Type of Pumps	Submersible
Pump Rated Capacity	850 gpm
Pump Rated Head	31 ft
Motor Size	15 hp
Drive Type	Variable Frequency Drive
Check Valve	8” swing check valve
Discharge Valve	8” eccentric plug valve; manual actuator

3.7 TERTIARY TREATMENT SYSTEM

Secondary effluent will be pumped to the Tertiary Treatment Building where additional suspended solids reduction and disinfection will take place prior to pumping to the TEC. A schematic of the proposed tertiary treatment system is shown in Figure 3-3 and found in the Appendix. A plan and section view of the Tertiary Treatment Building is shown in Figure 3-11 and Figure 3-12.

3.7.1 Filtration

The anticipated total suspended solids (TSS) concentration in the secondary effluent coming off of the secondary clarifiers will be in the range of 10-20 mg/L. In order to meet the desired reclaimed water quality needed for the TEC, the TSS must be reduced to between 5-10 mg/L. To achieve this level of suspended solids reduction, the secondary effluent will be pumped (by the intermediate pump station) to two cloth disk filters (one duty, one standby), located in the Tertiary Treatment Building. The cloth disk filters will be a packaged unit as manufactured by Krueger (among others). This type of filter includes filter cloth mounted radial and housed inside a stainless steel tank. Secondary effluent will flow by gravity, through the cloth media to the internal portion of the disk, through the center shaft and out the filter effluent discharge line.

As solids accumulate on and within the cloth media, a mat is formed and the liquid level in the tank increases. At a predetermined tank level (or time interval), a backwash cycle will be initiated. Solids are washed from the surface of the cloth media by applying a negative pressure on the media using a backwash pump. Discharge from the backwash pump will be conveyed to the existing Return Sludge Pump Station.

The design criteria for the filters are presented in Table 3-13 below:

Table 3-13: Filter Design Criteria

Filter Type	Cloth Media Disk
Number of filter units	2
Number of disks per unit	9
Design average flow, each, gpm	1,063
Design peak flow, each, gpm	1,700
Total surface area (submerged), each, ft^2	353
Surface loading rate	
At average flow, gpm/ft^2	3.0
At peak flow, gpm/ft^2	4.8

Table 3-13: Filter Design Criteria (cont'd)

Backwash pumps	
Max. number of units per filter	1
Total capacity, gpm	59
Max motor, hp	7.5
Effluent TSS, mg/L	5 -10

3.7.2 Disinfection

Effluent from the disk filters will flow by gravity to a chlorine contact basin (CCB) where sodium hypochlorite and anhydrous ammonia will be added for disinfection. The CCB will consist of six channels arranged in a serpentine configuration designed to provide sufficient contact time for disinfection to take place prior to leaving the treatment facility. Since the treated water in not planned to be used for public consumption, providing 15 minutes of detention time in the CCB at peak flows is adequate for achieving disinfection while maintaining a residual for controlling biological growth in the transmission pipeline to the TEC.

A second sodium hypochlorite feed point will be located on the discharge header of the reclaimed water pump station. The purpose of the second feed point is to ensure that complete disinfection and adequate residual is maintained in the transmission pipe until the reclaimed water reaches the TEC site. At the anticipated low water demand, the detention time in the pipeline can exceed 30 hours. Since free chlorine has a fairly high decomposition rate, it is recommended that a chloramine residual is used in the pipeline instead of free chlorine.

The average total sodium hypochlorite dose required (for both feed points) is estimated to be approximately 16 mg/L using a 12.5% sodium hypochlorite solution. At the average water demand of 1,063 gpm, the sodium hypochlorite required will be approximately 180 gallons per day. SDD currently accepts bulk sodium hypochlorite deliveries at their hypochlorite unloading and storage station, although this facility is only used in the summer and is located outdoors. Heat tracing and insulating this equipment for use year round, as would be needed for the TEC water supply disinfection, would be costly. Therefore, a new bulk sodium hypochlorite unloading station and storage tanks will be provided in the Tertiary Treatment Building.

To provide sufficient storage of the disinfectant chemicals, a minimum of fifteen days of storage at average usage is recommended, which equates to approximately 3,000 gallons of storage for bulk sodium hypochlorite. This storage will be provided in two circular fiberglass reinforced plastic (FRP) storage tanks installed within a cast in place concrete containment area.

The design criteria for the sodium hypochlorite feed system are presented in Table 3-14 below:

Table 3-14: Sodium Hypochlorite Feed System Design Criteria

Chemical	Sodium hypochlorite solution
Specific Gravity	1.2
Concentration (as delivered)	12.5%
Average dosage, mg/L	16.0
Chemical storage	Two 1,500 gallon FRP storage tanks
Chemical feed equipment	3 diaphragm metering pumps

Anhydrous ammonia will be used to convert free chlorine to chloramines. The storage and dosing system will consist of 150 lb cylinders of gaseous anhydrous ammonia, vacuum pumps, ejectors and a non-potable water line for making the solution. The ammonia solution will be fed at the inlet of the CCB and a second feed point will be into the 16 inch pipeline just before it crosses the river. A vault is already needed in this location to provide isolation for the river crossing. Two diffusers (one duty, one standby) will be included in the pipe inside the vault.

The design criteria for the anhydrous ammonia feed system are presented in Table 3-15 below:

Table 3-15: Anhydrous Ammonia Feed System Design Criteria

Chemical	Anhydrous ammonia
Average dosage, mg/L	1.0
Chemical storage	Up to six 150 lb. cylinders
Chemical feed equipment	3 diaphragm metering pumps

3.7.3 Reclaimed Water Supply Pump Station

From the chlorine contact basin the disinfected reclaimed water will flow by gravity into the reclaimed water pump station's below grade wet well. The reclaimed water pump station will be equipped with three VFD operated vertical turbine pumps (two duty and one standby) with provision for one additional pump for future expansion. The pumps will have the ability to deliver the full range of anticipated water demands in a similar operational manner as the intermediate pumps as described in Section 3.6 above.

The wet well has been sized to provide a 60 minute detention time at the anticipated annual average water demand. This additional storage will be useful in the event of a process upset in the tertiary treatment system that could prevent the water from being conveyed to the TEC for a short time period.

For installation and maintenance of the reclaimed water pumps, a mono rail system will be provided. The pumps will be designed so that the pump column can be disassembled into five foot sections, which will easy installation and removal of the pump with the need for an extremely tall HSPS room.

A list of the equipment for the reclaimed water supply pump station is presented in Table 3-16 below:

Table 3-16: Reclaimed Water Supply Pump Station Design Criteria

Wetwell Volume, gallons	63,780
Number of Pumps	3
Type of Pumps	Vertical turbine
Pump Rated Capacity	850 gpm
Rated Discharge Head	335 ft TDH

Table 3-16: Reclaimed Water Supply Pump Station Design Criteria (cont'd)

Number of Stages	6
Motor Size	150 hp
Drive Type	Variable Frequency Drive
Check Valve	12" swing check valve
Discharge Valve	12" butterfly valve; electric actuator

3.7.4 Monitoring and Controls

It is anticipated that the TEC operators will be able to monitor all major functions and alarms of the intermediate pump station, filtration, disinfection, reclaimed water pump station. This monitoring will take place via remote access to the tertiary treatment building control system. To facilitate operation of the TEC water supply system, the ability of the TEC operators to control portions of the system needs to be further evaluated.

4.0 RECLAIMED WATER SUPPLY PIPELINE

To convey reclaimed water from the SDD WWTF to the TEC site, a pipeline approximately 26 miles long is required. As part of this conceptual design, initial sizing, routing, and conceptual design of major crossings were conducted. Details of this work are described below. Figure 4-0 shows an overall view of the pipeline alignment and figure index. Figures 4-1 through 4-15 show the proposed pipeline route, special crossings, location of valves and fittings. Figure 4-16 includes the ground surface profile and hydraulic grade line. Table 4-1 summarizes the pipeline components and quantities.

Table 4-1: Pipeline Components

Description	Quantity
Total length of pipeline	140,000 linear feet (26.5 miles)
Permanent easements (30 ft wide)	34 acres
Temporary easements (20 ft wide adjacent to permanent easement; 15 ft wide adjacent to road right-of-way)	49 acres
Total length of direction drill (quantity of drills)	4,520 linear feet (25)
Total length of jack and bore (quantity of bores)	1,100 linear feet (7)
Total number of road/highway crossings	29
Total number of driveway crossings	21
Gate valves and air release valves	97 each

4.1 PIPELINE SIZING

A preliminary evaluation of three pipeline sizes, 14", 16", and 18", was performed to determine the life cycle cost associated with each line size as well as the maximum operating pressure. The capital cost and annual pumping cost associated with each pipeline size is shown in Table 4-2 below.

Table 4-2: Pipeline Size Cost Comparison

Cost Item	14” Pipeline	16” Pipeline	18” Pipeline
Construction Cost	$21,320,000	$22,130,000	$23,030,000
Annual Operating Cost	$21,000	$14,000	$10,000
20yr Present Worth	$21,580,000	$22,310,000	$23,160,000

The expected pipeline operating pressures for each evaluated pipeline size is shown in the following table.

Table 4-3: Pipeline Size Operating Pressure Comparison

Pipeline Operating Pressure	14” Pipeline	16” Pipeline	18” Pipeline
Operating Pressure at Minimum Water Demand, psi	88	62	49
Operating Pressure at Average Water Demand, psi	126	82	60
Operating Pressure at Maximum Water Demand, psi	256	149	98

In addition to the high pipeline pressure required when pumping at maximum TEC water demand, using a 14" pipeline would make it difficult to provide a pump that could accommodate the pressure variations between minimum and maximum operating pressure without wasting significant energy during normal and low flows. The pressure variations seen with the 16" and 18" pipe would be much easier to meet with a single stage pump and would be more efficient.

Although the life cycle cost of the 14” pipeline is slightly lower than that for the 16” pipeline, it is recommended that a 16” pipeline be used for the following reasons:

1. To limit the system’s maximum operating pressure, and
2. To reduce the wide pressure differential between low and high demand that would result with a smaller line and make pump sizing difficult.

4.2 DESIGN CONSIDERATIONS

4.2.1 Pipeline Material

Based on the cost and durability, ductile iron pipe (DIP) is recommended for the pipe material. Steel pipe is typically not price competitive in this size range in Illinois. PVC is not as durable as DIP.

At the expected operating pressures, 250 pressure class DIP with cement mortar lining is recommended and the standard asphaltic coating typically used with DIP is acceptable for the exterior. The pipe material for horizontal directional drill and jack and bore locations will also be Class 250 DIP. Restrained joints will be required at line valves, fittings, horizontal directional drills, and jack and bore locations. The length of restrained joint pipe required at valves and fittings is estimated based on test pressure, depth of cover, non-submerged soil condition, and expected soil type.

4.2.2 Pipe Trench

The depth of cover will be 4 feet minimum in right-of-way and non-agricultural areas. The depth of cover will be 5 feet minimum in agricultural areas, under roadways, and across Highway 51 right-of-way. The pipe bedding will extend at least 6 inches below the pipe and at least up to the spring line of the pipe. Pipe bedding material will be CA-6 aggregate meeting the requirements of IDOT's Standard Specifications for Road and Bridge Construction. Suitable excavated material may be used as backfill. Unsuitable and excess excavated material will need to be disposed of off site. The top one foot of the trench backfill is anticipated to be topsoil. Typical trench cross sections for 4 foot and 5 foot cover are shown in Figure 4-17.

4.2.3 Corrosion Protection

Polyethylene wrap (encasement) is typically used in this area of Illinois for corrosion protection of DIP and is recommended for this application. To provide protection of steel casing piping at jack and bore locations, cathodic protection is recommended for the lengths of steel pipe.

4.2.4 Line Valves

Intermediate or sectionalizing line valves are recommended at approximately 2,500 foot intervals. The line valves allow sections of the pipeline to be isolated during pressure testing and in the event of a line break so the affected section can be repaired without dewatering the entire pipeline. Resilient wedge gate valves are the recommended valve type for this application and are compatible with pipeline pigging operations.

Valves will be located in vaults for easy accessibility and maintenance. The valve vaults will also include the required air release valves for conceptual design purposes. The vaults will be precast concrete with a lockable aluminum access hatch. A plan and section for the valve vault are shown in Figure 4-18.

4.2.5 Air Release Valves

Air release valves are required at high points to vent air during filling and normal operation of the pipeline. The plan drawings (Figures 4-1 through 4-15) show preliminary locations for air release valves based on the pipeline profile. Additional detailed analysis for surge and vacuum relief is required to confirm sizing and spacing. As stated previously, the air release valves will be located in valve vaults common with the line valves. A plan and section for the valve vault are shown in Figure 4-18.

4.2.6 Road and Highway Crossings

Based on the field investigation, horizontal directional drills (HDD) are proposed at selected road crossings, as shown on the plan drawings, to minimize impacts to traffic. A typical HDD detail is shown in Figure 4-18. At the Highway 51 crossing, a jack and bore is proposed between the right-of-way lines. A typical jack and bore detail is shown in Figure 4-18.

4.2.7 Creek and Sangamon River Crossings

At crossings of creeks and the Sangamon River, as shown on the plan drawings, horizontal directional drills are proposed for construction to minimize impacts to these water bodies.

4.2.8 Utility Crossings

A detailed utility investigation was not performed at this stage of the project, although one should be conducted to include above and below grade utilities. This investigation should be performed in conjunction with a pipeline location study in the next phase of design. Utilities to be investigated should include natural gas, petroleum, electric, water, sewer, telephone, fiber optic, cable, and drainage, at a minimum.

During the field investigation conducted during this phase of the project, several natural gas and petroleum pipeline crossings were noted by marked signage. The approximate locations of these crossings are shown on the plan drawings. A jack and bore is proposed at the crossings of natural gas and petroleum pipelines due to the hazardous nature of these pipelines and based on utility requirements.

The proposed alignment did take into consideration avoiding overhead power lines and the limited locations were water lines were observed based on the presence of fire hydrants along roadways.

4.2.9 Private Easements

A significant portion of the proposed pipeline route will be through private permanent easements. The private permanent easements are primarily through agricultural areas. The proposed width for private easements is 30 foot wide for permanent easements centered on the pipeline and an adjacent 20 foot wide temporary construction easement. For portions of the proposed pipeline route in the right-of-way, a 15 foot wide temporary construction easement adjacent to the right-of-way is proposed. A typical plan and profile for the easements is shown in Figure 4-17. The cost of easements could vary widely, as the real estate market and negotiations with individual property owners is highly variable.

4.2.10 Profile and Hydraulic Grade Line

The ground surface profile and hydraulic grade lines at minimum, average and maximum flow rates are shown in Figure 4-16. The ground surface profile was prepared along the pipeline alignment from the Illinois Natural Resources online geospatial data clearinghouse. The pipeline grade will generally follow the ground surface profile. In order to control flow through the pipe and maintain a full pipe along the entire alignment, a pressure sustaining valve (PSV) at the TEC site is required.

4.3 ROUTING

The most direct route between the SDD WWTP and the TEC site is parallel to Route 48. The Norfolk Southern Railroad also parallels Route 48 along the west side. There are several towns and villages along Route 48 between Decatur and the TEC site, including Boody, Blue Mound and Stonington.

The investigation of the pipeline route was performed utilizing high resolution aerial maps from the Macon County GIS and aerial maps from Google Earth for the Christian County. In addition, a field reconnaissance trip was performed to confirm the suitability of main pipeline route and several potential bypass routes. Tasks performed during the field investigation include:

- Confirm the feasibility of the proposed pipeline route and potential bypass routes based on topography, and above grade utilities and features.

- Check stream and river crossings to determine the most practical type of construction (i.e. open cut or HDD/bored crossing).
- Establish the key aspects of the routing around the towns and villages.
- Investigate the Highway 51 crossing coming out of Decatur.
- Investigate potential railroad crossings.
- Photograph the key elements for the project file and cost estimating effort.

Details of the proposed routing are described in the following sections.

4.3.1 SDD WWTF to Highway 51

As shown in Figures 4-14 and 4-15, from the Reclaimed Water Pump Station on the SDD WWTF site, the pipeline extends south across the Sangamon River. From the river, the pipeline continues south in SDD and Macon County Conservation District property, between the old SDD sludge lagoons to Dipper Lane. The pipeline continues south in the Dipper Lane right-of-way to St. Louis Bridge Road. After crossing St. Louis Bridge Road, the pipeline continues in private easements extending south to the Norfolk Southern Railroad tracks. The alignment turns southwest in private easements and parallels the railroad tracks and Route 48 up to the Highway 51 right-of-way.

4.3.2 Highway 51 to Boody

As seen in Figure 4-13, after crossing Highway 51, the pipeline continues southwest in private easements parallel to the railroad tracks and Route 48. The pipeline alignment crosses Mt. Auburn Road and continues southwest. Approximately 2,000 feet south of Mt. Auburn Road, large overhead power lines parallel the railroad tracks, therefore to avoid the power line easement, the pipeline alignment jogs to the west of the overhead power lines. Continuing in private easements, the pipeline crosses South Wyckles Road and then turns west at Elwin Road to bypass the town of Boody.

4.3.3 Boody to Blue Mound

As shown in Figures 4-8 to 4-12, the pipeline alignment continues in the Elwin Road right-of-way and crosses Boody Road. At Nevada Road, the pipeline turns south and continues in the Nevada Road right-of-way crossing Public Road and Zion Chapel Road, continuing south to the railroad tracks. At the railroad tracks, the alignment turns southwest and in private easements parallel to the railroad tracks and Route 48. The pipeline crosses several natural gas pipelines and Damery Road. Approximately 7,200 feet southwest of Damery Road, the alignment turns west, continuing in private easements to the intersection of South Lincoln Memorial Parkway and Mosquito Creek

Road. This route avoids the Bethel Cemetery. The pipeline continues in the Mosquito Creek Road right-of-way and then turns south and continues in the Archery Club Road right-of-way. At the railroad tracks, the alignment turns southwest and continues in private easements and crosses West Andrews Road. At West Andrews Road, the pipeline turns west and continues in the West Andrews Road right-of-way to bypass the Village of Blue Mound.

4.3.4 Blue Mound to Stonington

As can be seen in Figures 4-5 to 4-8, following in the West Andrews Road right-of-way, the pipeline continues west crossing Pleasant View Road to N2100E Road. The alignment then turns south and follows in the N2100E Road right-of-way, crossing Blue Mound Road. At the railroad tracks, the pipeline turns southwest and continues in private easements and crosses E2300N Road, N2000E Road, E2200N Road, and E2100N Road. At E2100N Road, the pipeline turns west and follows in the E2100N Road right-of-way to bypass the Village of Stonington.

4.3.5 Stonington to TEC

As can be seen in Figures 4-1 to 4-5, following in the E2100N Road right-of-way, the pipeline continues west crossing N1900E Road, N1800E Road, and N1700E Road. Approximately 1500 feet east of N1800E Road, the pipeline crosses two petroleum pipelines. The alignment then turns south and follows in the N1700E Road right-of-way, crossing E2000N Road and E1900N Road. Just north of E2000N Road, the pipeline crosses a natural gas pipeline. Just north of E1900N Road, the pipeline crosses a petroleum pipeline. At the railroad tracks, the pipeline turns southwest and continues in private easements, crossing E1800N Road, N1600E Road, and E1700N Road. Approximately, 1200 feet southwest of N1700E Road, the pipeline crosses a petroleum pipeline. Approximately, 6800 feet southwest of N1700E Road, the pipeline then turns west and terminates at the TEC site.

4.3.6 Alternative Routes

Alternative routes may be considered if obtaining easements or other issues arise with the main route that would be highlighted during a detailed pipeline location study recommended during the next phase of design. Several alternative routes exist along the pipeline alignment.

- Utilizing the Route 48 right-of-way involves crossing the railroad tracks at least twice. In addition, there is a risk that in the future IDOT will widen Route 48 and require the pipeline to be relocated.

- Continuing in private easements along the west side of the railroad tracks through the towns was investigated. The town of Boody has high tension overhead power lines along the west side of the railroad tracks and adjacent residential areas.
- The Village of Blue Mound is somewhat congested around the area of the grain elevators along the west side of the railroad tracks.
- The Village of Stonington is congested around the area of the grain elevators along the west side of the railroad tracks.

5.0 PROJECT COSTS & IMPLEMENTATION

5.1 CONSTRUCTION COSTS

To implement the TEC Water Supply System, improvements to the SDD's existing collection system and treatment processes need to be implemented. In addition, new filtration and disinfection facilities will be needed to provide the necessary water quality to the TEC. A new intermediate pump station at the SDD site as well as a final reclaimed water pump station will be required as part of this project along with a 26-mile pipeline from the SDD site to the proposed TEC site.

These improvements need to be made for technical or long term, life cycle cost reasons although the cost of some of these improvements should be shouldered by both Tenaska and the Sanitary District of Decatur. The opinion of probable construction cost for the proposed TEC Water Supply System is shown in Table 5-1 and includes a preliminary breakdown of costs allocated to Tenaska and SDD.

As can be seen in Table 5-1, the only major project component that is shown as being shared by both Tenaska and SDD is the secondary treatment improvements since the TEC only needs a portion of the domestic effluent. The breakdown shown in the table is based on a direct ratio of average flow requirements. The total average dry weather domestic flow to the secondary treatment system is approximately 10.8 mgd while the average water demand from the TEC is estimated to be approximately 1.53 mgd. Therefore, Tenaska's share of the secondary treatment improvements shown in the table is 14.2% of the total cost of the secondary treatment improvements.

The other costs are allocated to either Tenaska or SDD based on whether or not the improvements were required to supply the TEC with the required water quality or quantity. The preliminary and primary treatment improvements were allocated to SDD as this work is primarily done to extend the life and reduce the long term maintenance cost of the industrial headworks facility and the industrial primary clarifiers. An argument could be made that these improvements would not need to be made without the TEC since these facilities are used only intermittently during peak wet weather and once the TEC is online, these facilities will need to be able to operate continuously.

For the purposes of this draft report, an initial determination was made of the allocation of costs. Detailed negotiation of cost sharing for each of these improvements needs to take place between SDD and Tenaska.

The construction cost opinion includes 2010 costs and should be escalated depending on the timing of the construction. It is assumed for the purposes of this cost opinion that the project will be publically bid through the Sanitary District of Decatur's normal procurement process and thus no sales tax has been added to these figures.

Table 5-1: Opinion of Probable Construction Cost

Cost Item	Tenaska Cost, 2010$	SDD Cost, 2010$	Total Cost, 2010$
Collection System Segregation	$5,167,000	$0	$5,167,000
SDD WWTF Sitework	$1,101,000	$0	$1,101,000
WWTF Segregation and Diversion	$680,000	$0	$680,000
Preliminary Treatment Improvements	$0	$3,522,000	$3,522,000
Primary Treatment Improvements	$0	$1,505,000	$1,505,000
Secondary Treatment Improvements	$1,603,000	$9,685,000	$11,288,000
Intermediate Pump Station	$437,000	$0	$437,000
Tertiary Treatment System	$3,927,000	$0	$3,927,000
Reclaimed Water Supply Pipeline	$22,882,000	$0	$22,882,000
Subtotal	**$35,797,000**	**$14,712,000**	**$50,509,000**
Contingency (30%)	$10,738,000	$4,412,000	$15,150,000
Opinion of Probable Construction Cost	**$46,535,000**	**$19,124,000**	**$65,659,000**
Engineering Services	$5,585,000	$2,294,000	$7,879,000
Opinion of Probable Project Cost	**$52,120,000**	**$21,418,000**	**$73,538,000**

5.2 ANNUAL OPERATING AND MAINTENANCE COSTS

The estimated annual operating and maintenance costs are presented in Table 5-2 below and include electricity, chemical, labor, and maintenance costs. The chemical costs were allocated to Tenaska since this includes the additional chemicals for disinfection and chlorine residual of the reclaimed water to the TEC. The electricity and maintenance costs (parts & materials) were allocated to either Tenaska or the SDD based on the split of costs as discussed above for the construction costs.

For the labor costs, it was assumed that one additional full time equivalent O&M professional would be required based on the additional treatment process and added complexity of the system. For the purposes of this draft report, it was assumed that the costs for this additional labor would be split 50/50.

Other annual costs that could be included in the final pricing agreement for water purchase include depreciation of existing assets, equipment replacement funds as well as other legal and administrative costs associated with the continual sale of water by SDD to the TEC. These other costs have not been evaluated and therefore are not included in this report.

Table 5-2: Estimated Annual O&M Costs

Annual Cost Item	Annual Cost for Tenaska, 2010$/yr	Annual Cost for SDD, 2010$/yr	Total Annual Cost, 2010$/year
Electricity	$121,000	$113,000	$234,000
Chemicals	$73,000	$0	$73,000
Maintenance (Parts/Materials)	$15,000	$9,000	$24,000
Labor (Operation & Maintenance)	$87,000	$87,000	$174,000
Total Annual O&M Cost	**$296,000**	**$209,000**	**$505,000**

5.3 SCHEDULE & IMPLEMENTATION

The new TEC Water Supply System is needed to be online in as little as 24 months from financial close of the TEC project. Meeting this schedule using a traditional design, bid, build delivery method, will be extremely difficult and will require close coordination between stakeholders (Tenaska, SDD, and all engineering consultants involved). In addition, to meet this schedule, both the design and construction will need to be expedited and will potentially increase the overall costs of the project from that shown in Section 5.1 above. Procurement of major equipment and materials (major pipelines) would be needed to help meet this tight schedule.

If an early release of preliminary engineering work were possible, including the required routing studies for the collection system and pipeline work, the 24 month timeline would be a bit easier to meet although procurement of equipment (and possibly some materials) as early as possible would still be required. It is anticipated that the construction would be broken into three major components: collection system work, SDD WWTF work, and the TEC water supply pipeline work.

A breakdown of the desired schedule to meet the 24 months timeline from financial close would be

Preliminary Engineering Duration:	4 months (preferably before financial close)
Final Design Duration:	7 months
Bidding & Contract Award Duration:	3 months
Anticipated Construction Duration:	14 months
Total Project Duration:	28 months

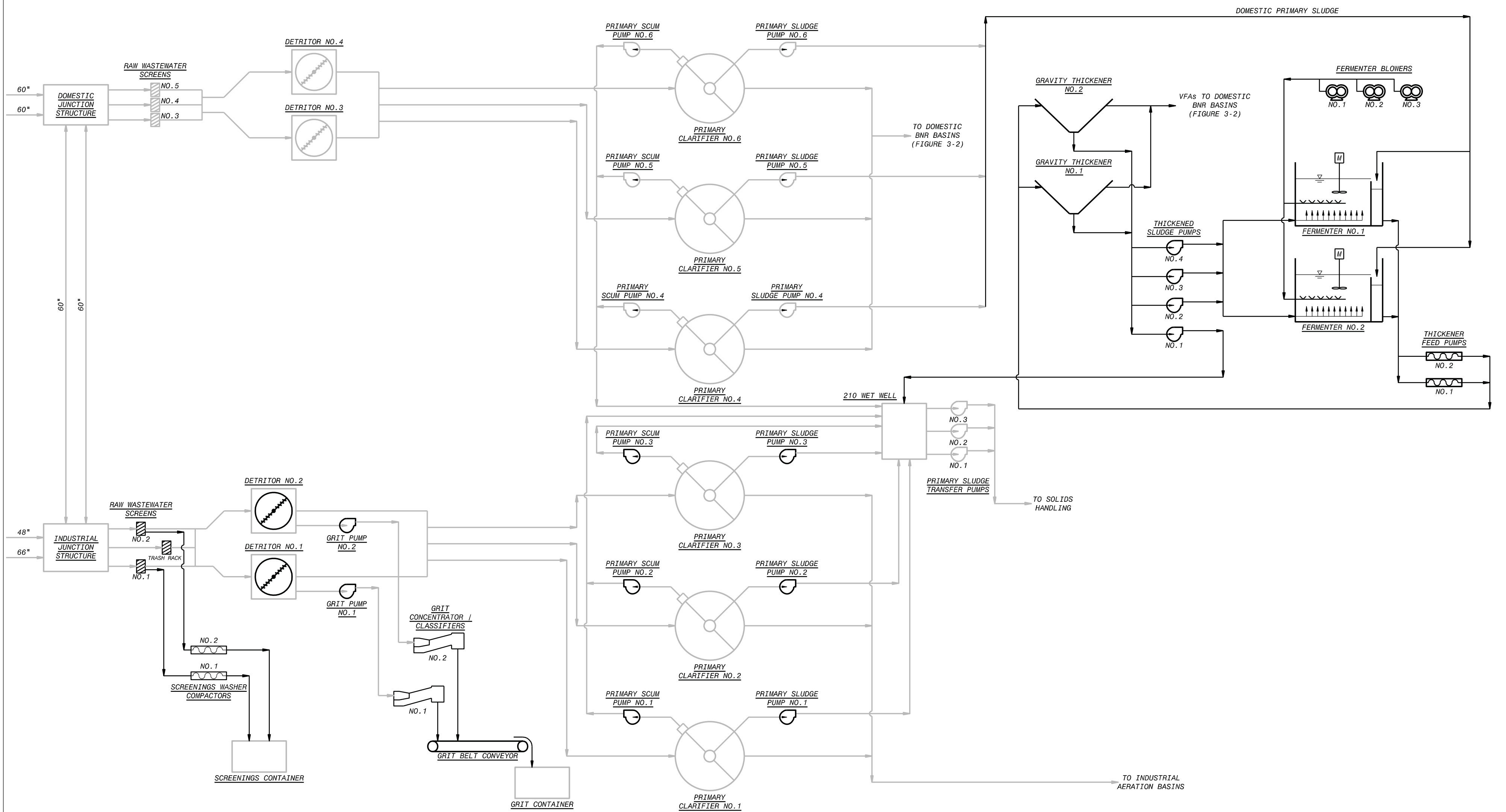
The preliminary engineering effort would include detailed routing studies for both the collection system and pipeline work to determine what easements are necessary to acquire for the project.

IEPA approvals of the work is anticipated to required three months and will take place at the end of final design. In order to meet the 24 month schedule, this review period will need to take place during bidding and contract award phase, which carries some risk as changes required to the design due to IEPA requirements would have to be dealt with by change order. Historically, IEPA comments are not significant, especially if they have reviewed intermediate submittals and discussions and coordination with them have taken place during the design.

Work on the SDD site will primarily take place on equipment/tankage that can be taken out of service during construction and will require only minimal plant interruptions. Demolition of the existing UNOX Reactors can proceed at anytime as these tanks are not currently used and fully isolated from the operating components of the facility. The tertiary treatment system can be constructed while the existing treatment facility is operational.

To provide greater assurance that the project can be done within 24 months of the financial close of the TEC project, the use of an engineering, procurement, construction (EPC) delivery method should be considered. Using the EPC delivery method, the construction could be started much earlier in the process with the preparation and release of multiple packages. If an EPC contractor is selected prior to the financial close of the TEC project, it could be possible to reduce the 24 month schedule, although additional analysis of this schedule reduction would need to be performed and is outside the scope of this report.

Appendix



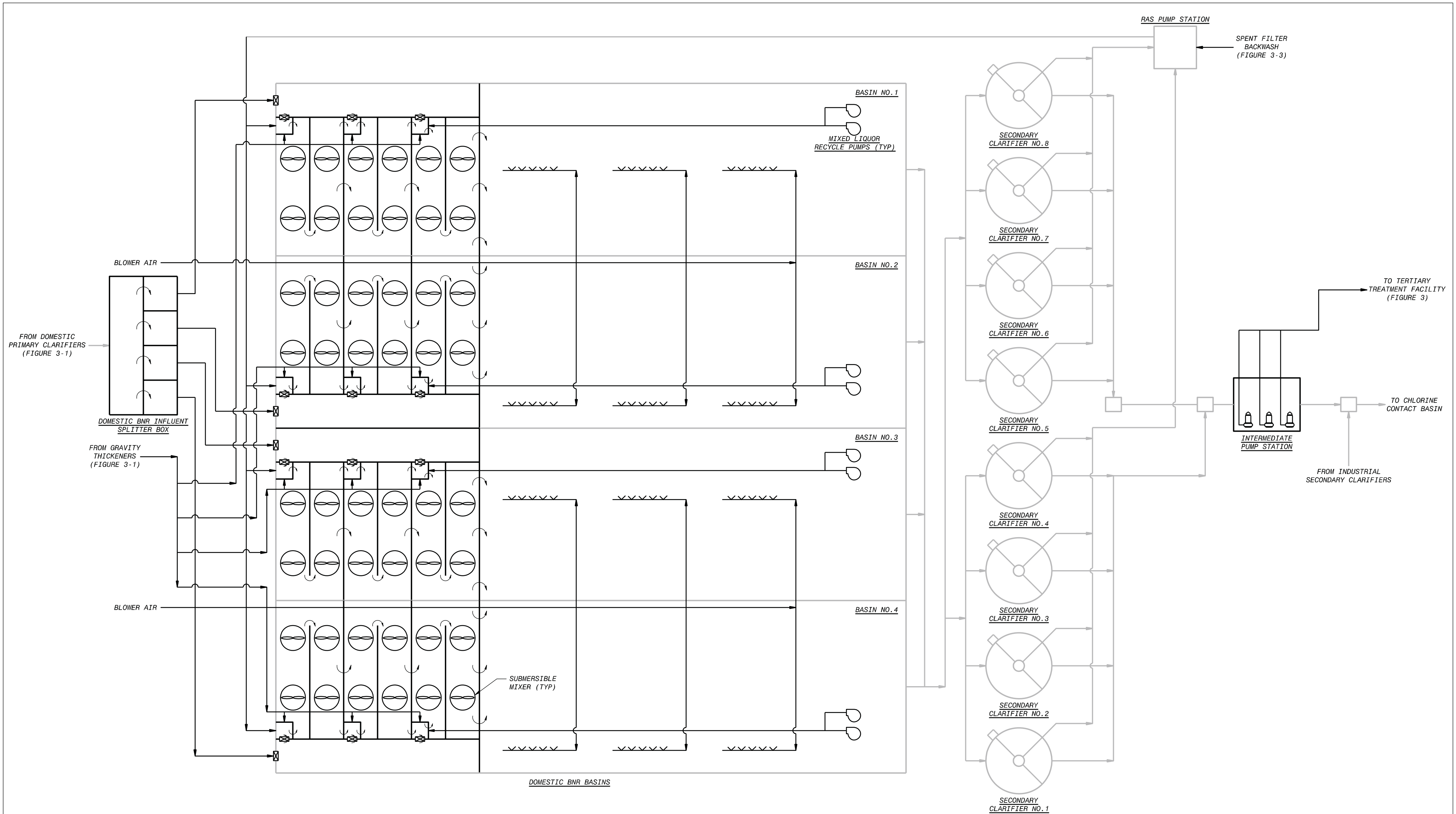
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

PROCESS FLOW SCHEMATIC
PRELIMINARY AND PRIMARY TREATMENT

FIGURE 3-1

CYGNET ID: 166171-0200-WWPT-C-H0000Z6PL
Date/Time, Plotted : 10/27/2009 3:56:57 PM



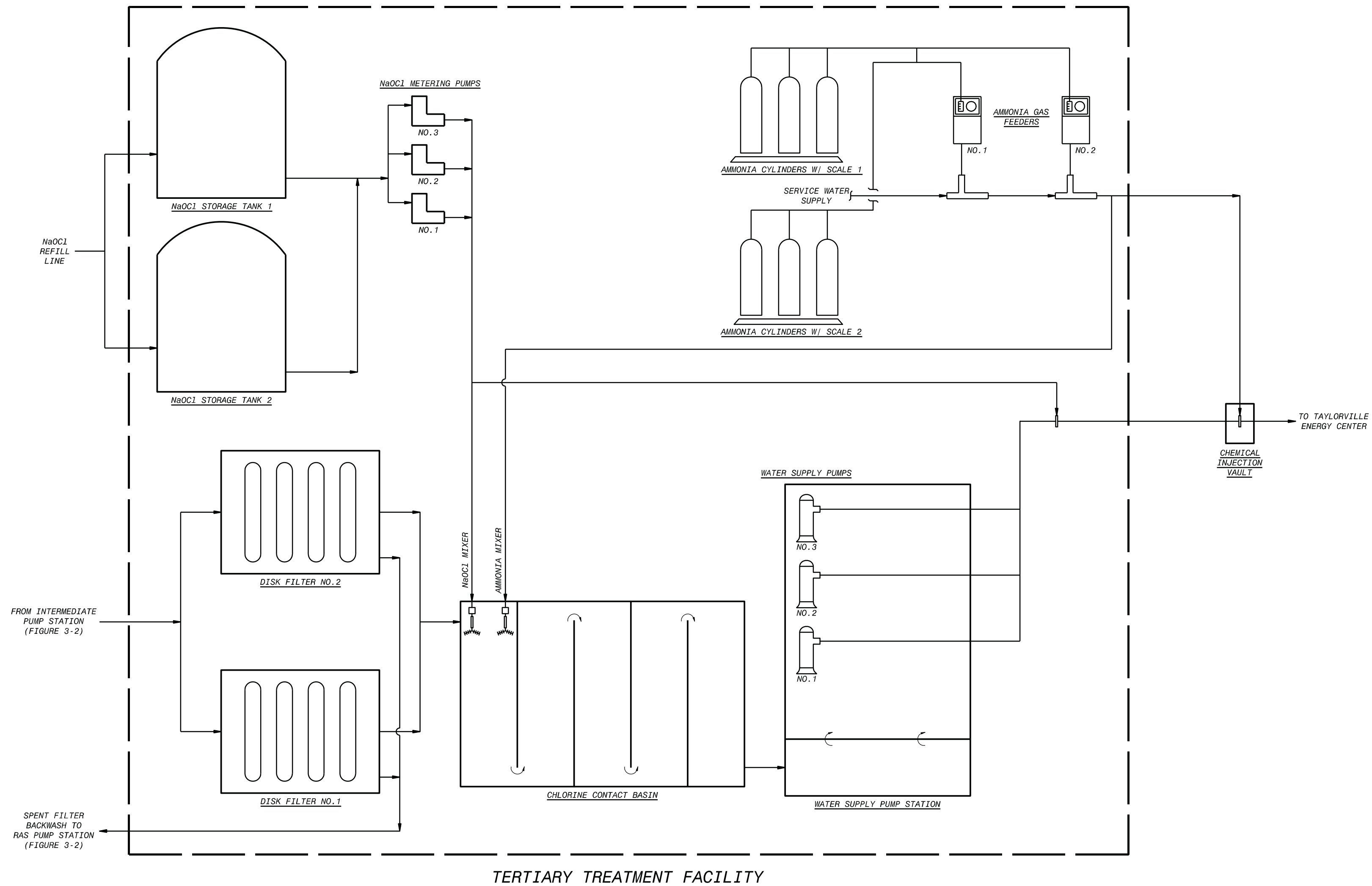
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

PROCESS FLOW SCHEMATIC
SECONDARY TREATMENT

FIGURE
3-2

CYGNET ID: 166171-0200-WWST-C-H0000Z711
Date/Time, Plotted : 10/28/2009 10:32:08 AM



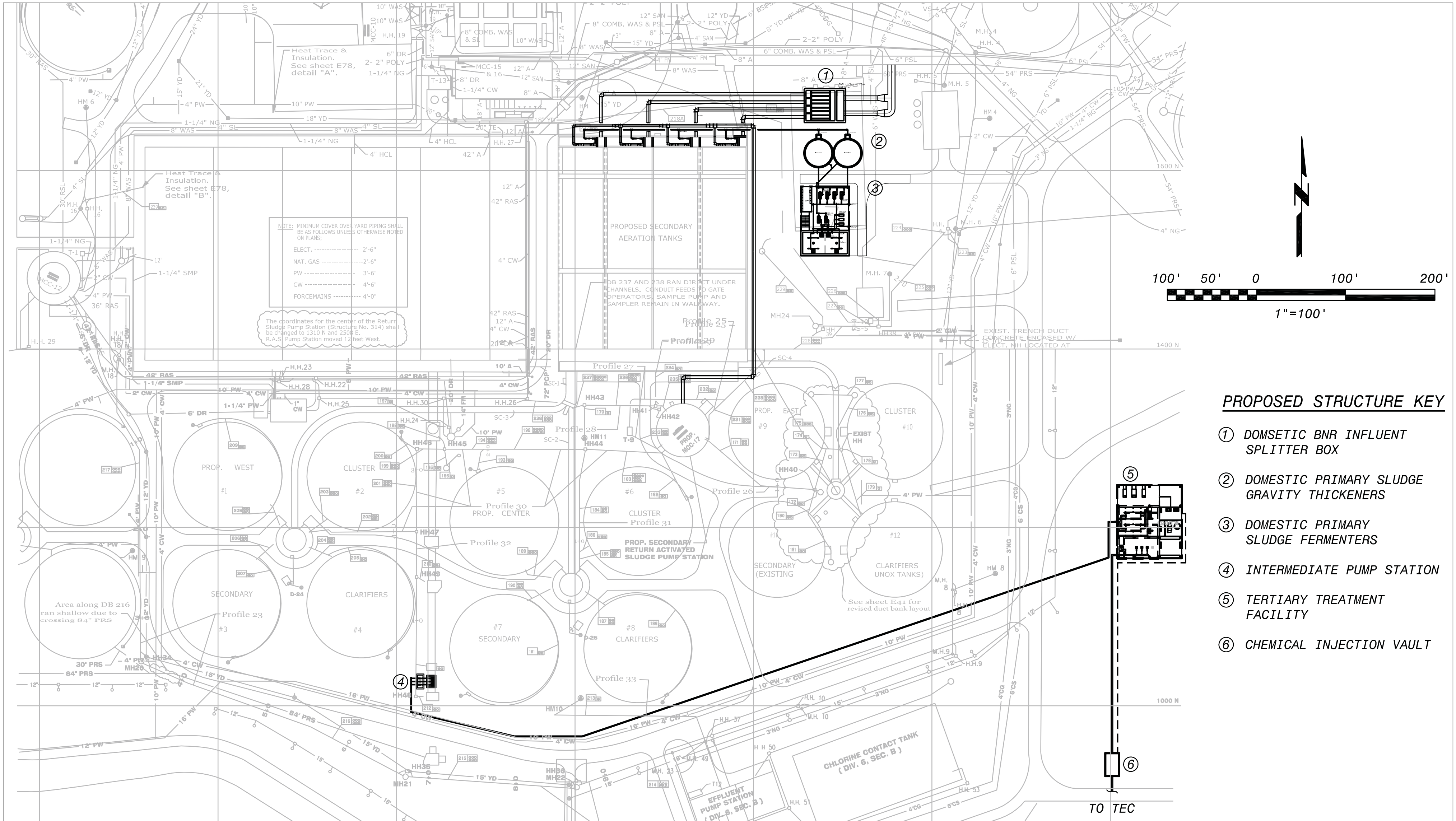
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

PROCESS FLOW SCHEMATIC
TERTIARY TREATMENT

FIGURE 3-3

CYGNET ID: 166171-0200-WWTT-C-H0000Z712
Date/Time, Plotted : 10/28/2009 11:57:30 AM



PROPOSED STRUCTURE KEY

1. DOMSETIC BNR INFLUENT SPLITTER BOX
2. DOMESTIC PRIMARY SLUDGE GRAVITY THICKENERS
3. DOMESTIC PRIMARY SLUDGE FERMENTERS
4. INTERMEDIATE PUMP STATION
5. TERTIARY TREATMENT FACILITY
6. CHEMICAL INJECTION VAULT

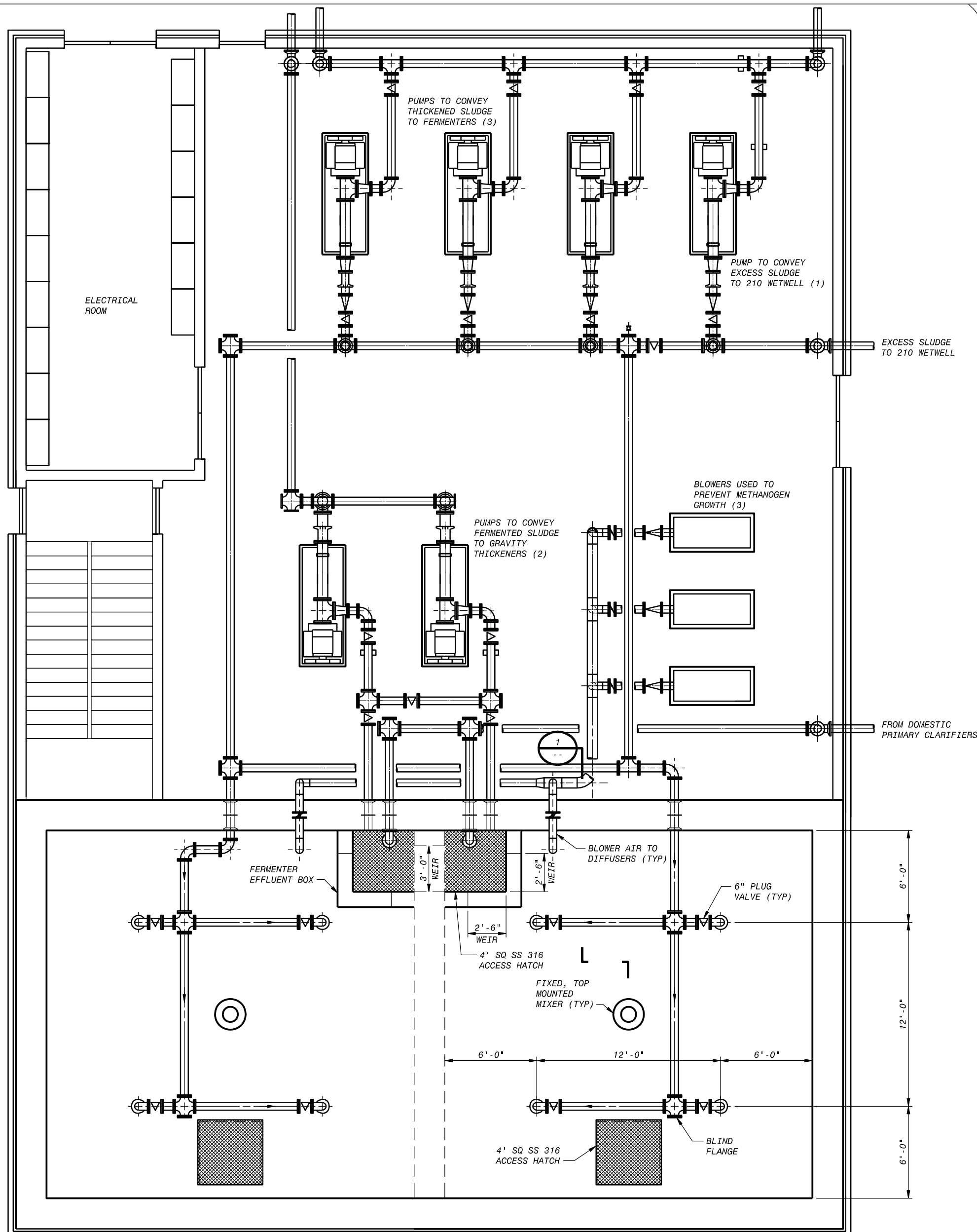
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

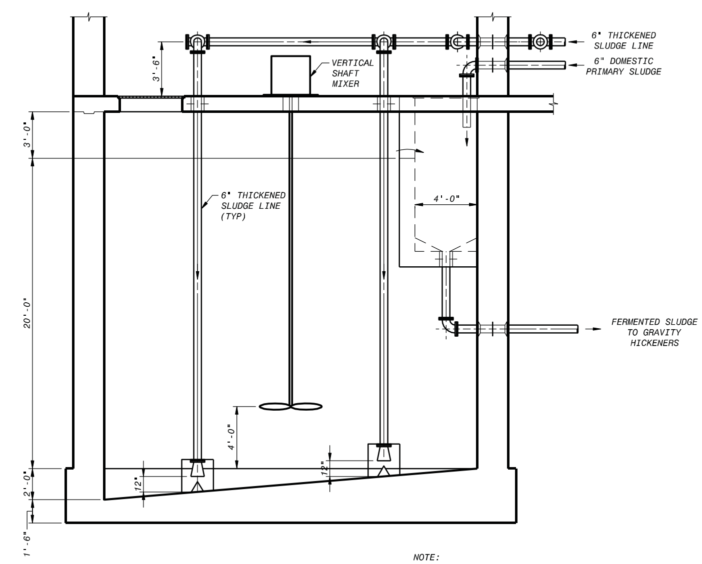
SDD SITE PLAN AND YARD PIPING

FIGURE 3-4

CYGNET ID: 166171-0200-WWTUP-C-H0000Z82N
Date/Time, Plotted : 10/19/2009 10:37:48 AM



FERMETERS PLAN
1/8" = 1'-0"



NOTE:
AIR PIPE NOT SHOWN FOR CLARITY.

SECTION
1/8" = 1'-0"

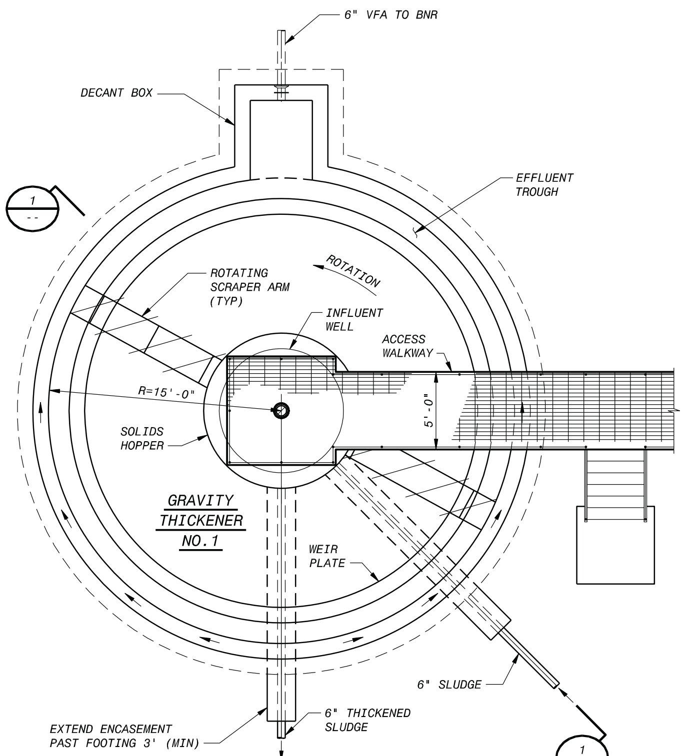
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

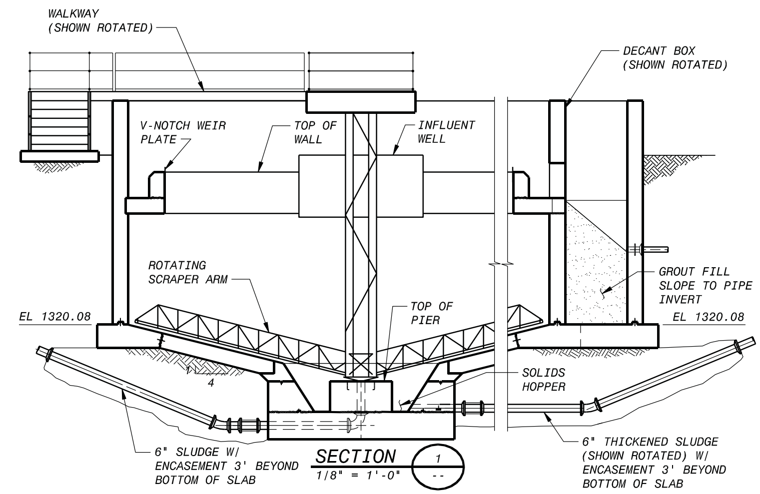
VFA GENERATION SYSTEM
FERMENTERS
PLAN AND SECTION

FIGURE 3-5

CYGNET ID: 166171-0230-WWTUP-M-H0000ZBGG
Date/Time, Plotted : 10/19/2009 10:37:48 AM



GRAVITY THICKENER PLAN
1/8" = 1'-0"



SECTION
1/8" = 1'-0"

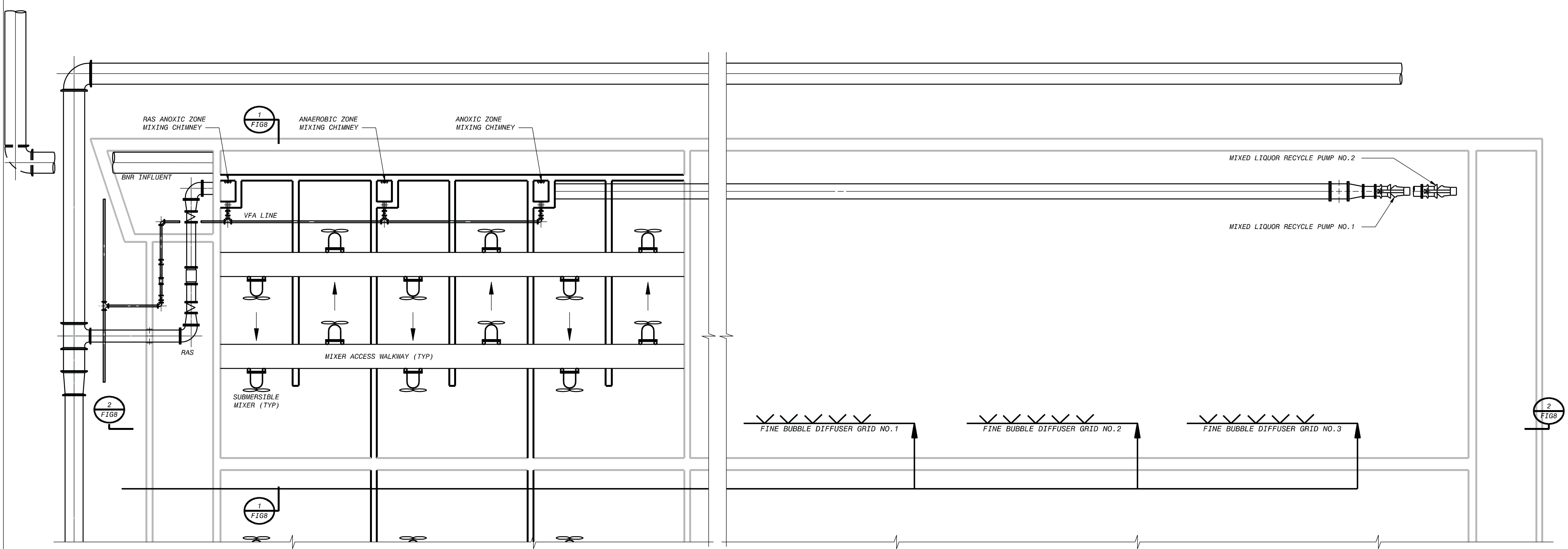
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

VFA GENERATION SYSTEM
GRAVITY THICKENERS
PLAN AND SECTION

FIGURE 3-6

CYGNET ID: 166171-0230-WWTUP-M-H0000ZB6N
Date/Time, Plotted : 10/19/2009 10:37:48 AM



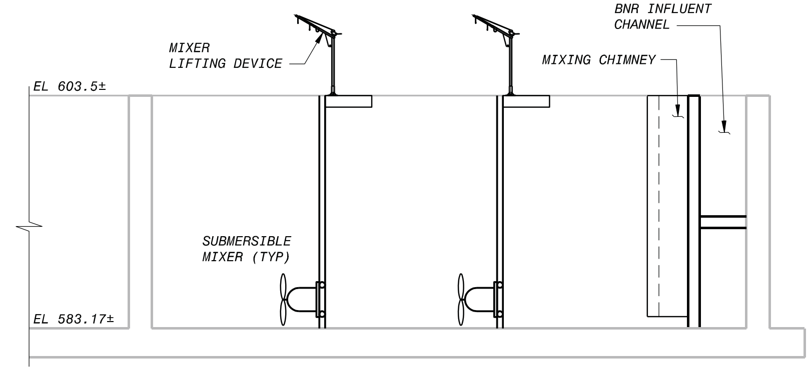
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

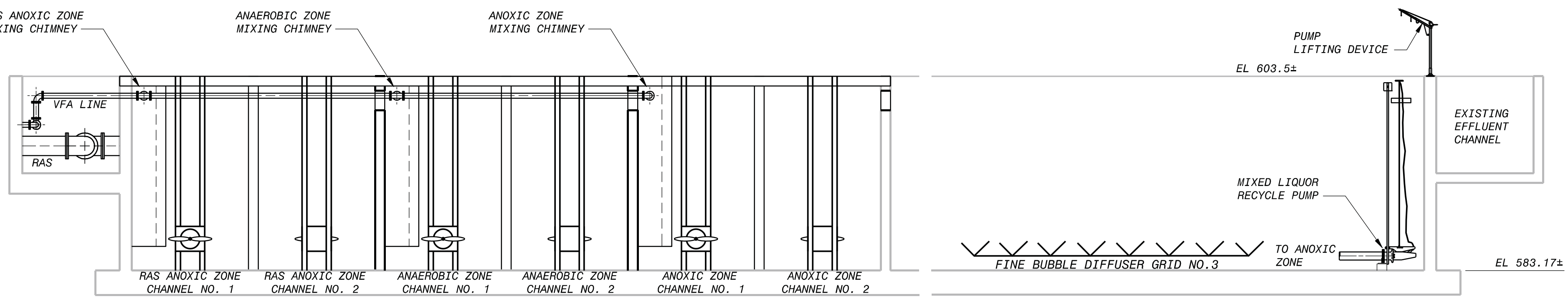
BIOLOGICAL PHOPHORUS REMOVAL
BNR BASINS
PLAN

FIGURE
3-7

CYGNET ID: 166171-0200-WWTT-M-H0000Z769
Date/Time, Plotted : 10/22/2009 9:24:56 AM



SECTION 1/FIG7
1/16" = 1'-0"



SECTION 2/FIG7
1/16" = 1'-0"

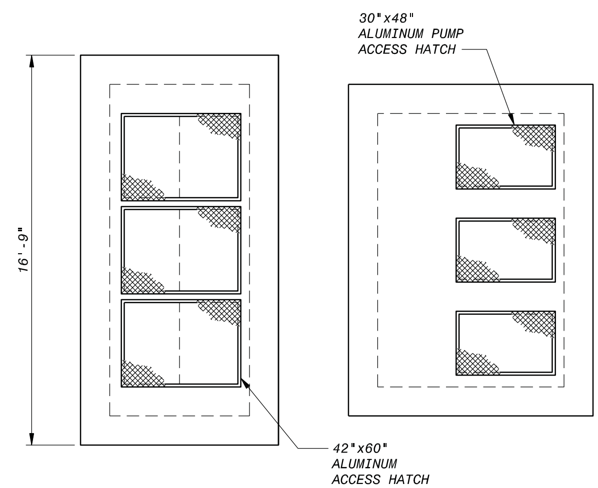
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

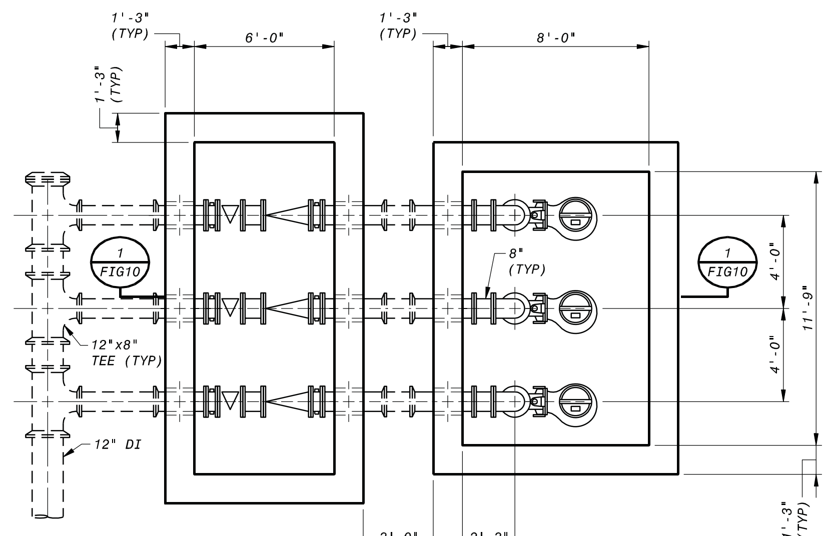
BIOLOGICAL PHOPHORUS REMOVAL
BNR BASINS
SECTIONS

FIGURE
3-8

CYGNET ID: 166171-0200-WWTT-M-H0000Z769
Date/Time, Plotted : 10/22/2009 9:24:56 AM



TOP PLAN
3/16" = 1'-0"



SECTIONAL PLAN EL 598.0
3/16" = 1'-0"

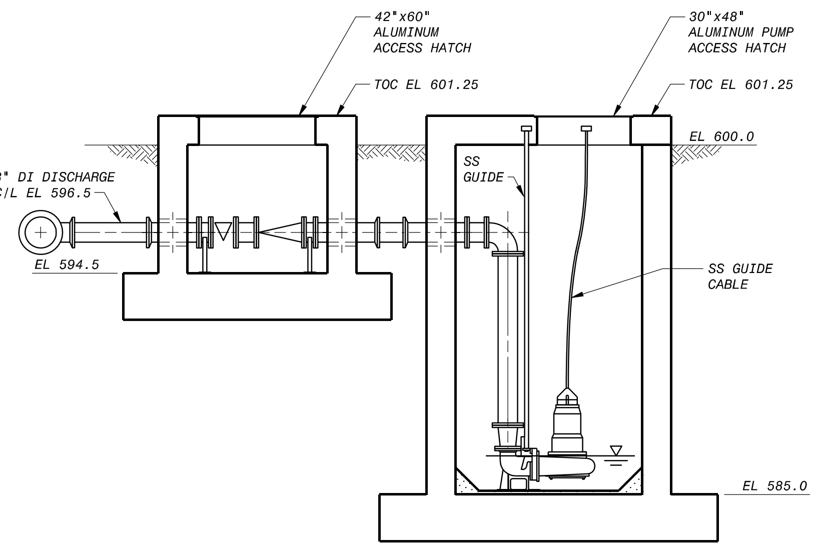
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

INTERMEDIATE PUMP STATION
TOP AND SECTIONAL PLANS

FIGURE
3-9

CYGNET ID: 166171-0230-WWTUP-M-H0000Z70Z
Date/Time, Plotted : 10/19/2009 10:37:48 AM



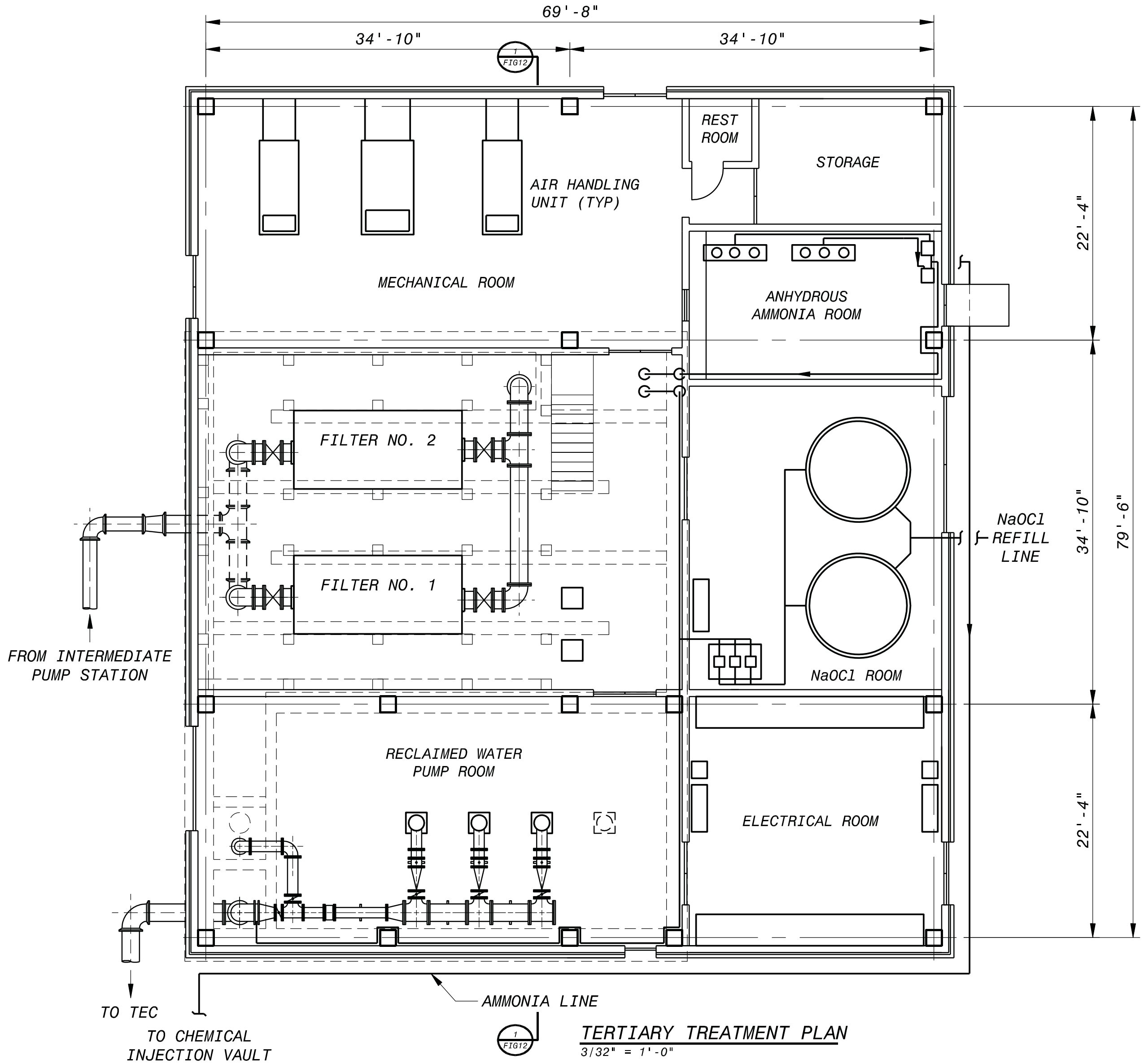
SECTION 1/FIG9
3/16" = 1'-0"

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

INTERMEDIATE PUMP STATION
SECTION

FIGURE
3-10



TERTIARY TREATMENT PLAN
3/32" = 1'-0"

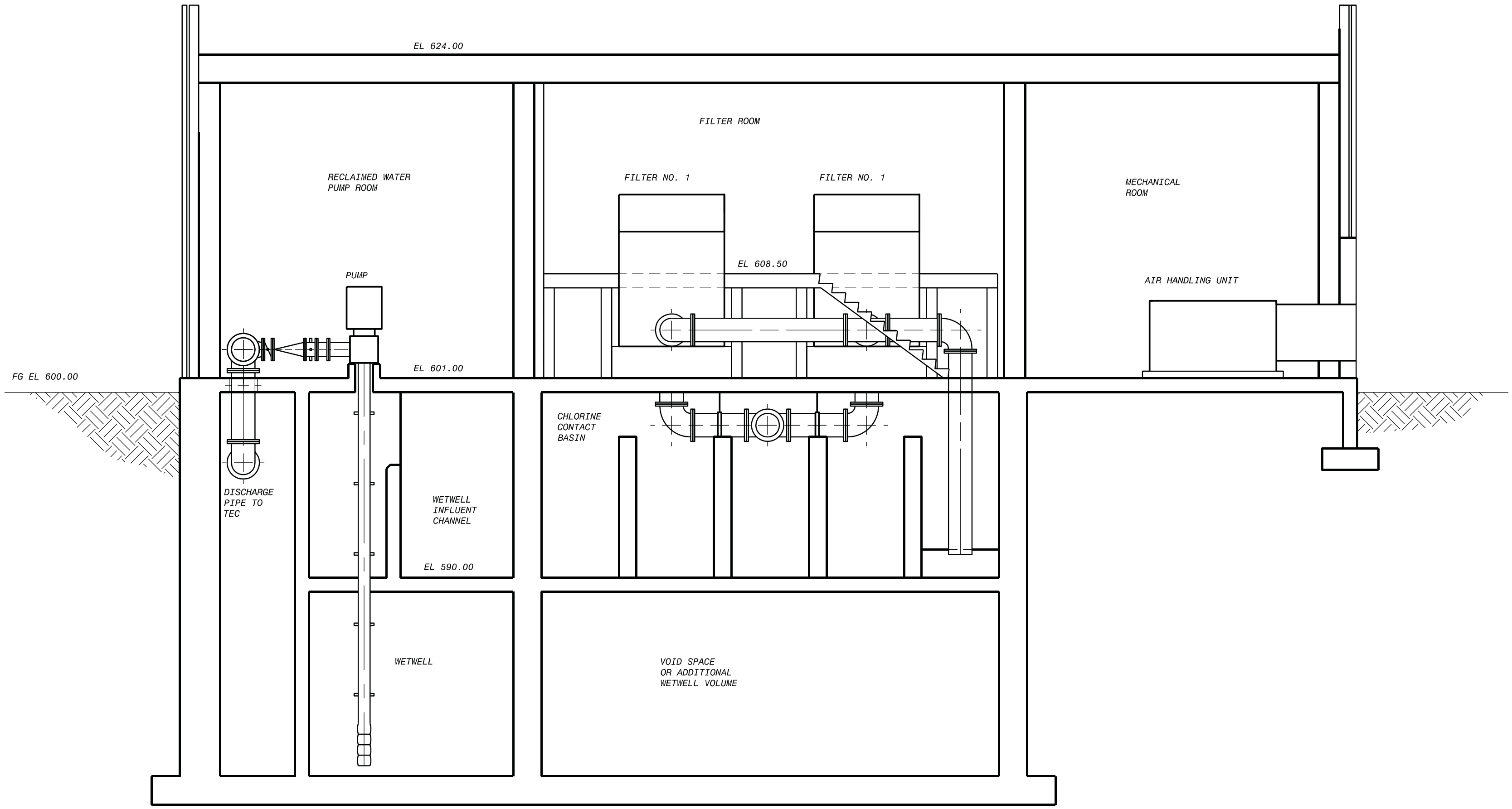
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

TERTIARY TREATMENT FACILITY PLAN

FIGURE 3-11

CYGNET ID: 166171-0200-WWTT-M-H0000Z769
Date/Time, Plotted : 10/22/2009 9:24:56 AM



SECTION 1/FIG11
1/8" = 1'-0"

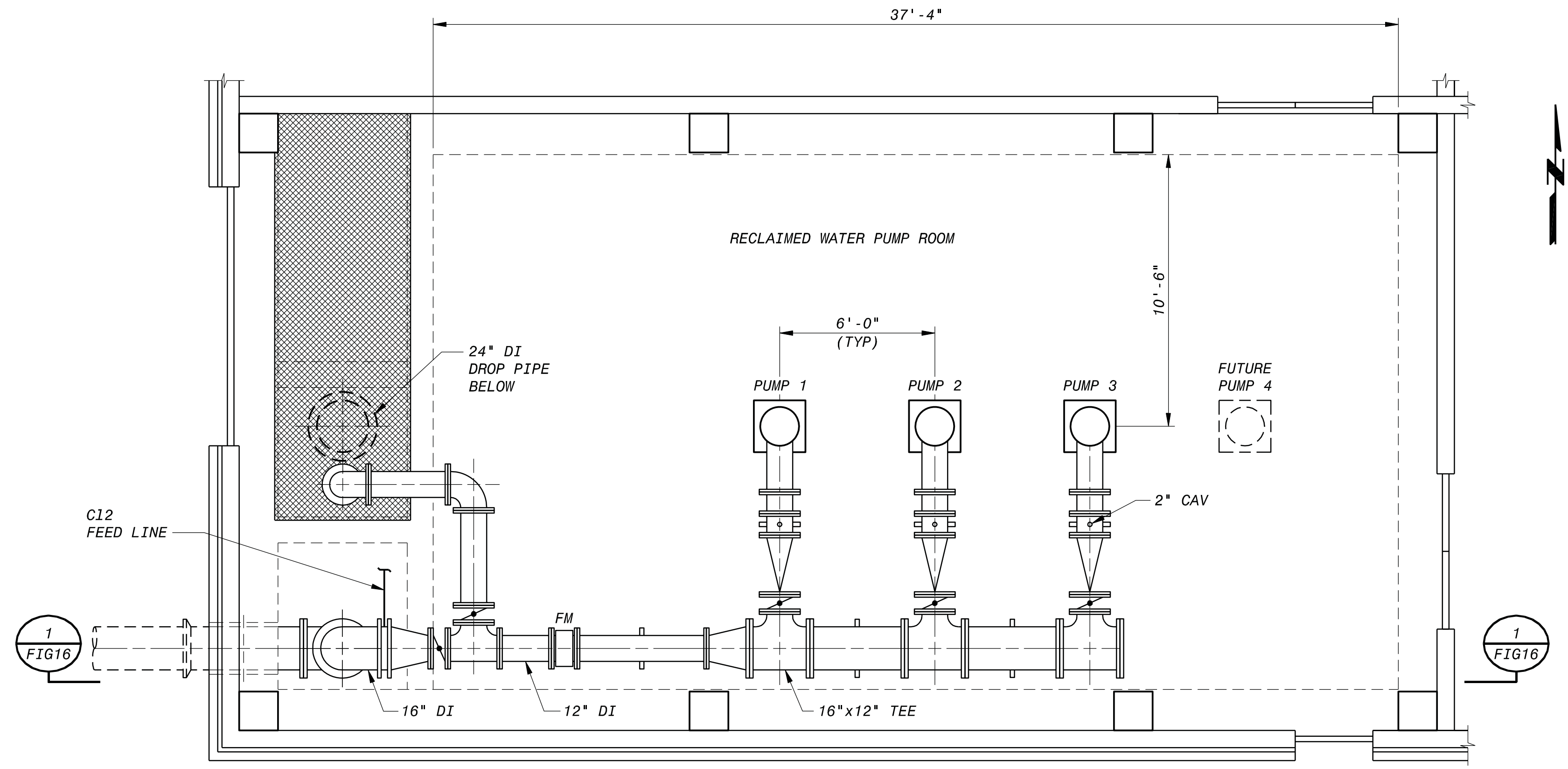
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

TERTIARY TREATMENT FACILITY
SECTION

FIGURE
3-12

CYGNET ID: 166171-0200-WWTT-M-H0000Z889
Date/Time, Plotted : 10/22/2009 9:09:58 AM

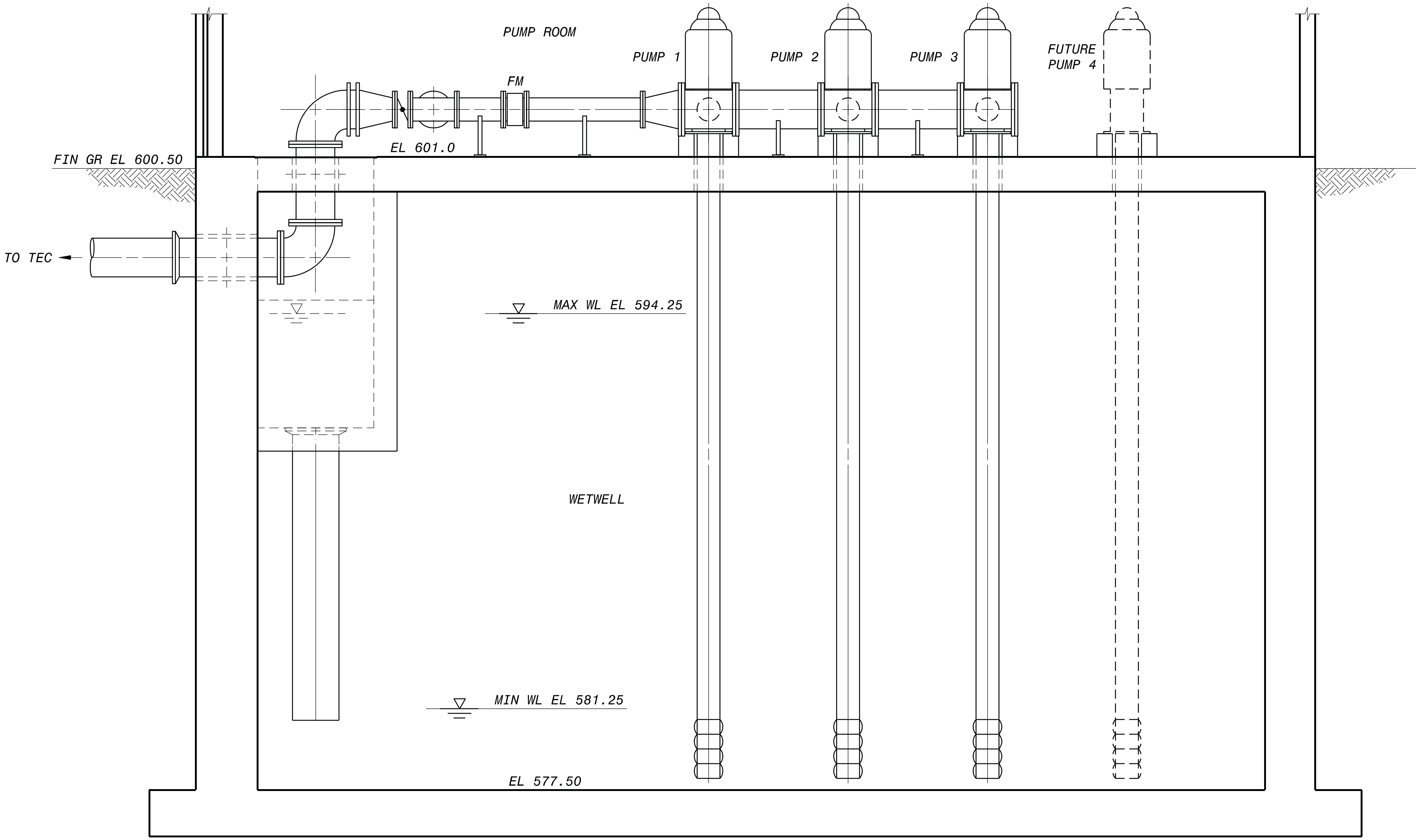


RECLAIMED WATER PUMP STATION ENLARGED PLAN

1/4" = 1'-0"

TAYLORVILLE ENERGY CENTER WATER SUPPLY SYSTEM	
CONCEPTUAL DESIGN REPORT	
RECLAIMED WATER PUMP STATION PLAN	FIGURE 3-13

CYGNET ID: 166171-0230-WWTUP-M-H0000Z770
Date/Time, Plotted : 10/19/2009 10:37:48 AM



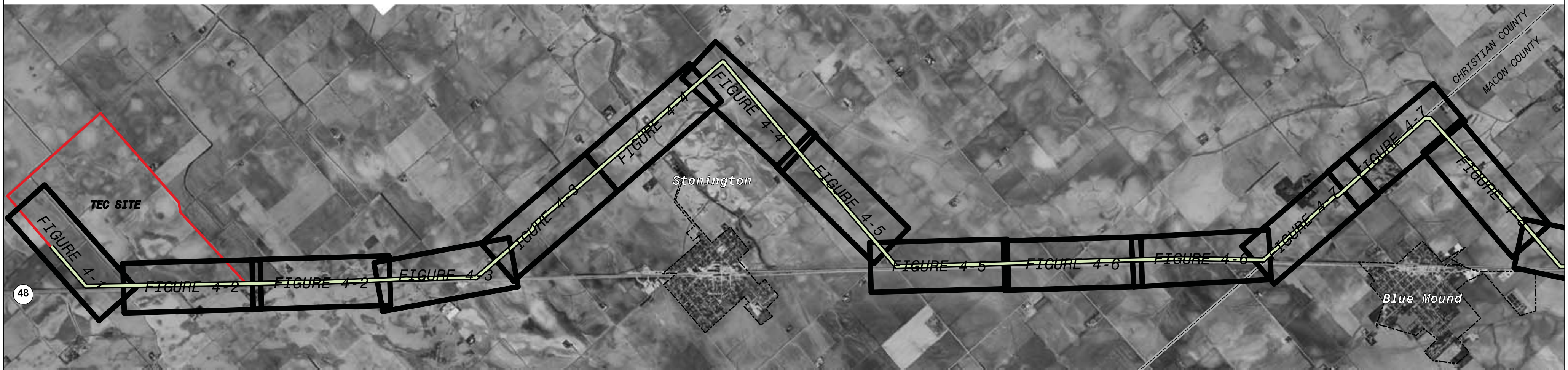
SECTION 1/FIG13
1/8" = 1'-0"

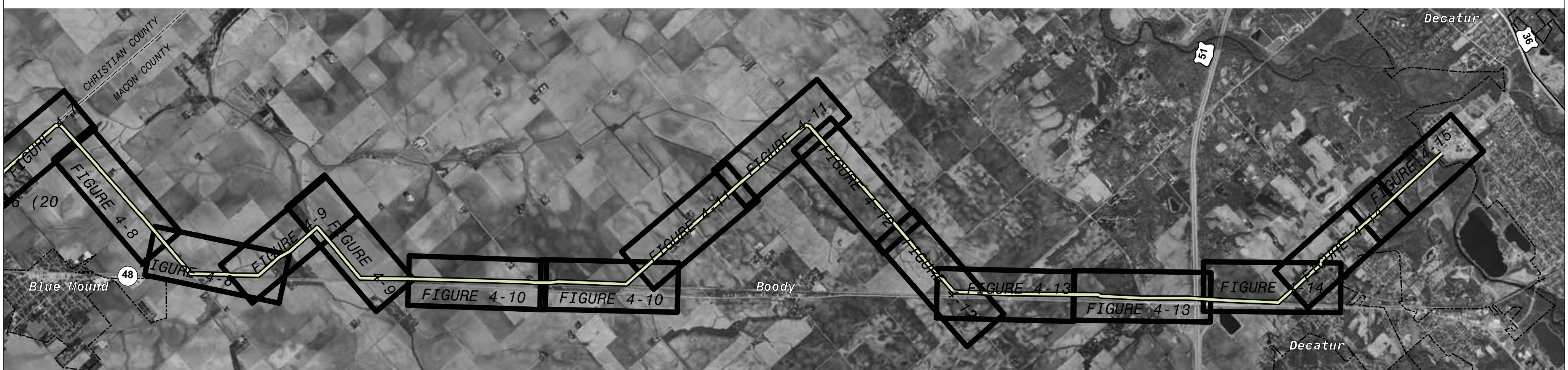
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

RECLAIMED WATER PUMP STATION SECTION

FIGURE 3-14





LEGEND

TEC Pipeline | MUNICIPALITY BOUNDARIES | COUNTY BOUNDARIES

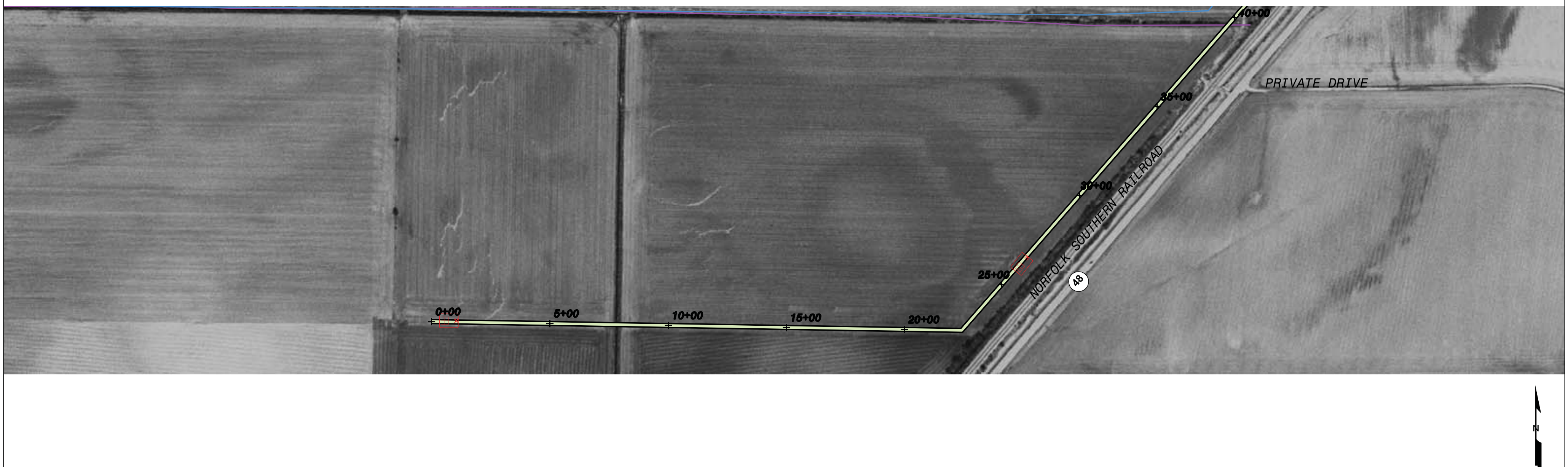
0 1,000 2,000 4,000 6,000 Feet

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-0



Legend

TEC Pipeline | JACK & BORE PIPING | DIRECTIONAL DRILL PIPING | AIR RELEASE VALVE VAULT | STREAMS | WETLANDS | MUNICIPALITY BOUNDARIES | COUNTY BOUNDARIES

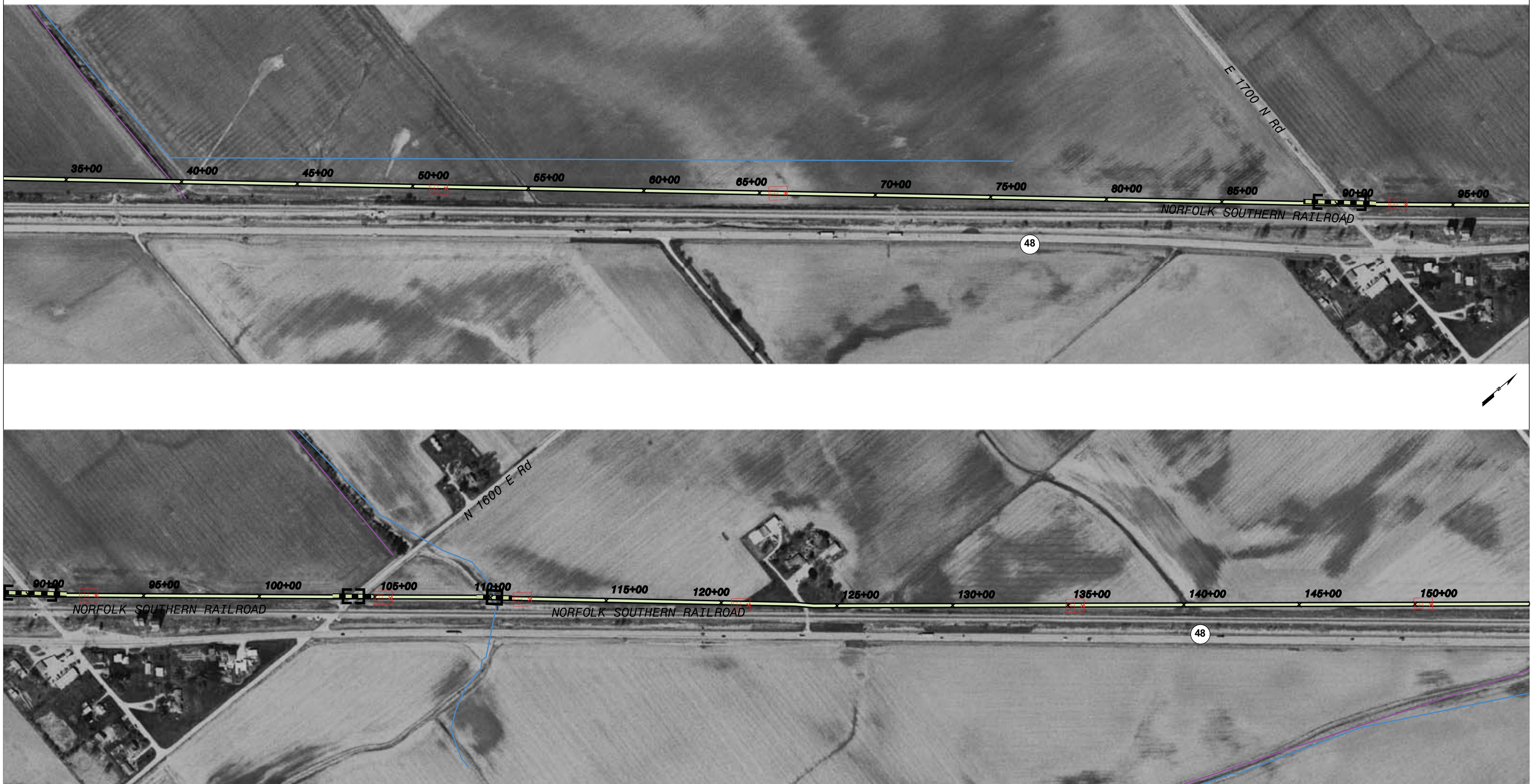
0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-1



LEGEND

TEC Pipeline | JACK & BORE PIPING | DIRECTIONAL DRILL PIPING | AIR RELEASE VALVE VAULT | STREAMS | WETLANDS | MUNICIPALITY BOUNDARIES | COUNTY BOUNDARIES

0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER WATER SUPPLY SYSTEM	
CONCEPTUAL DESIGN REPORT	
16" WATER SUPPLY PIPELINE	FIGURE 4-2

LEGEND

TEC Pipeline — JACK & BORE PIPING — DIRECTIONAL DRILL PIPING — AIR RELEASE VALVE VAULT — STREAMS — WETLANDS — MUNICIPALITY BOUNDARIES — COUNTY BOUNDARIES

0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER WATER SUPPLY SYSTEM	
CONCEPTUAL DESIGN REPORT	
16" WATER SUPPLY PIPELINE	FIGURE 4-3

TAYLORVILLE ENERGY CENTER WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-4

LEGEND

TEC Pipeline | JACK & BORE PIPING | DIRECTIONAL DRILL PIPING | AIR RELEASE VALVE VAULT | STREAMS | WETLANDS | MUNICIPALITY BOUNDARIES | COUNTY BOUNDARIES

0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-5

LEGEND

TEC Pipeline | JACK & BORE PIPING | DIRECTIONAL DRILL PIPING | AIR RELEASE VALVE VAULT | STREAMS | WETLANDS | MUNICIPALITY BOUNDARIES | COUNTY BOUNDARIES

0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-6

LEGEND

TEC Pipeline — JACK & BORE PIPING — DIRECTIONAL DRILL PIPING — AIR RELEASE VALVE VAULT — STREAMS — WETLANDS — MUNICIPALITY BOUNDARIES — COUNTY BOUNDARIES

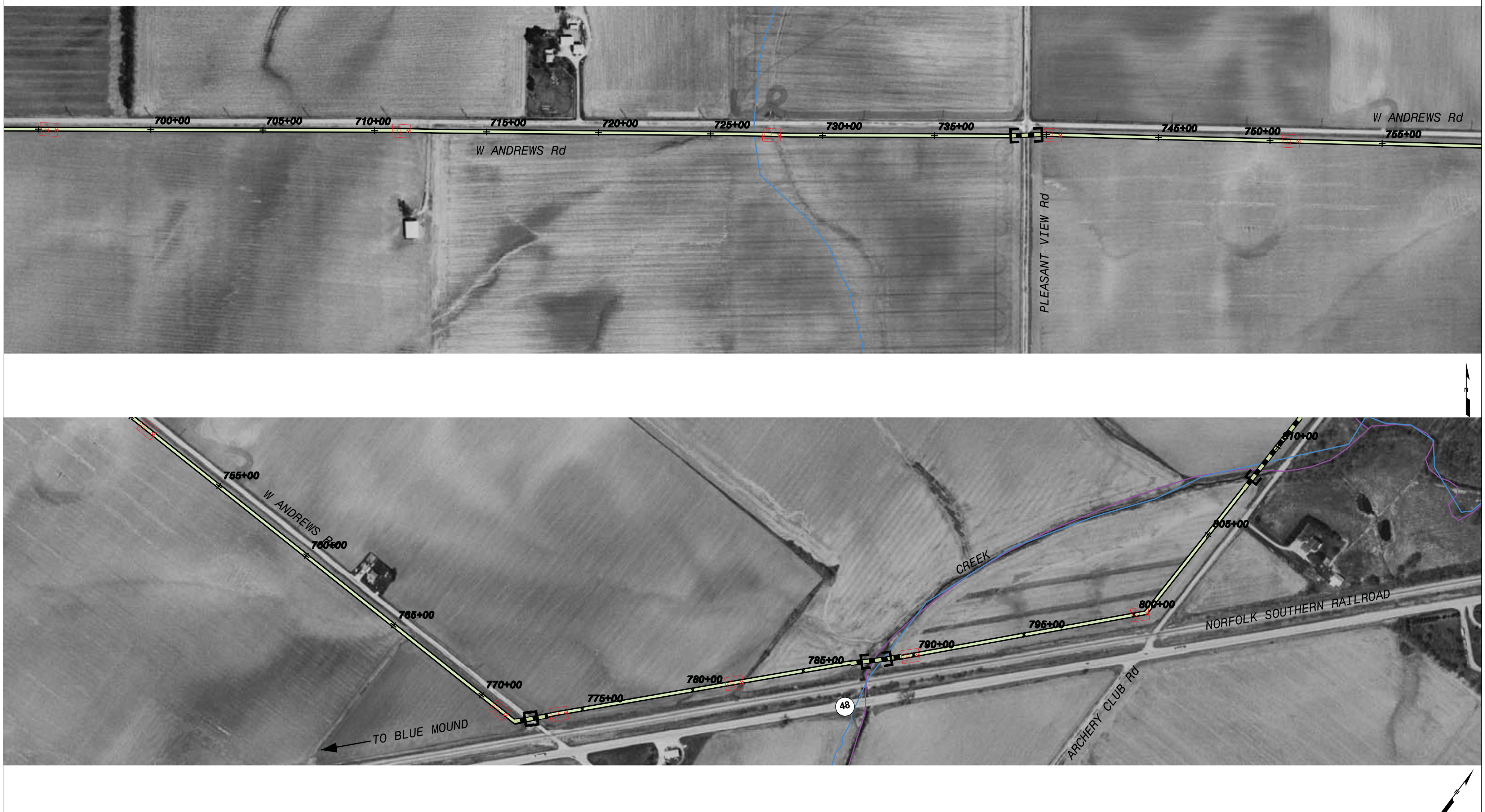
0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-7



LEGEND

TEC Pipeline | JACK & BORE PIPING | DIRECTIONAL DRILL PIPING | AIR RELEASE VALVE VAULT | STREAMS | WETLANDS | MUNICIPALITY BOUNDARIES | COUNTY BOUNDARIES

0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-8

LEGEND

TEC Pipeline
JACK & BORE PIPING
DIRECTIONAL DRILL PIPING
AIR RELEASE VALVE VAULT
STREAMS
WETLANDS
MUNICIPALITY BOUNDARIES
COUNTY BOUNDARIES

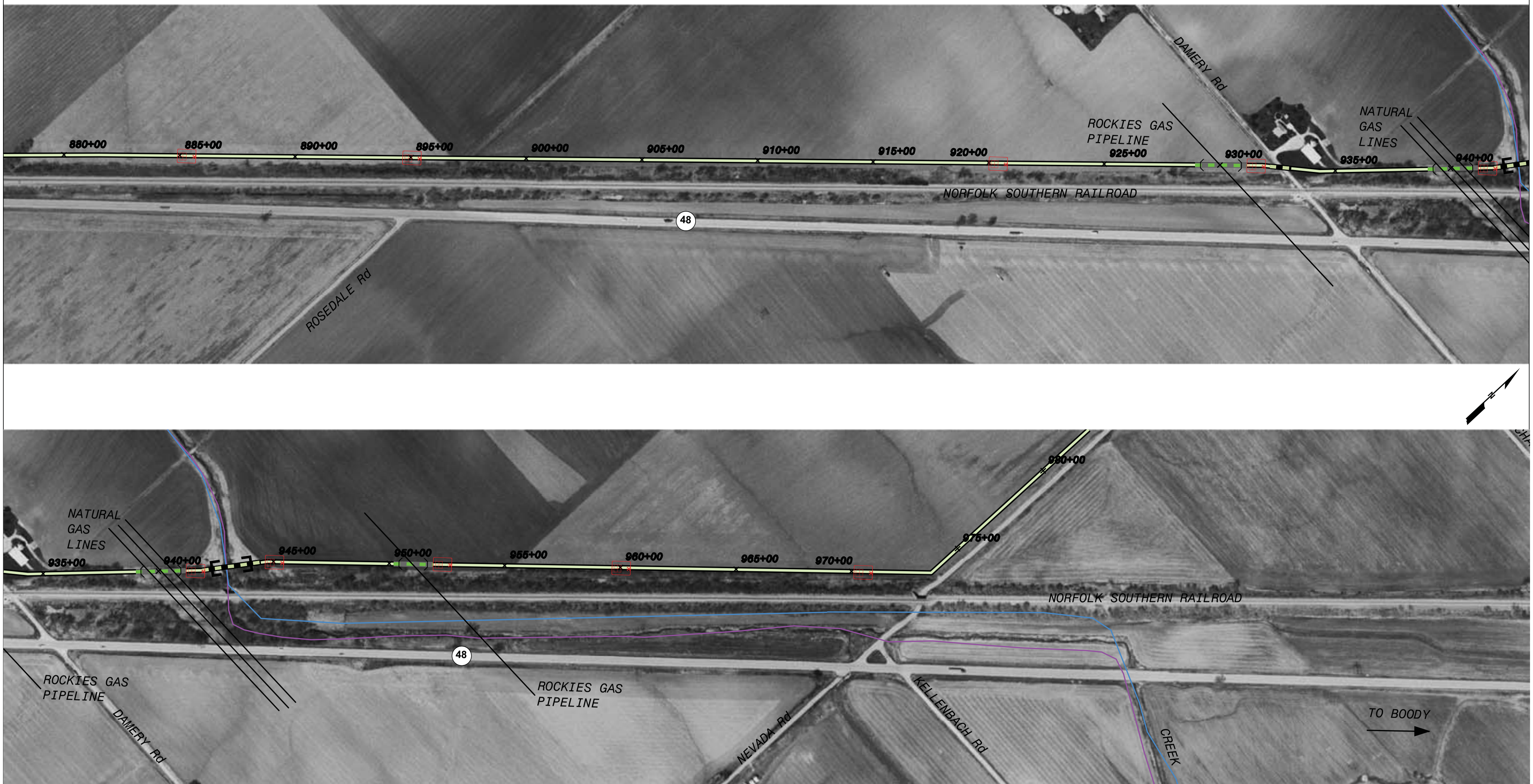
0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-9



LEGEND

TEC Pipeline | JACK & BORE PIPING | DIRECTIONAL DRILL PIPING | AIR RELEASE VALVE VAULT | STREAMS | WETLANDS | MUNICIPALITY BOUNDARIES | COUNTY BOUNDARIES

0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-10

LEGEND

TEC Pipeline
JACK & BORE PIPING
DIRECTIONAL DRILL PIPING
AIR RELEASE VALVE VAULT
STREAMS
WETLANDS
MUNICIPALITY BOUNDARIES
COUNTY BOUNDARIES

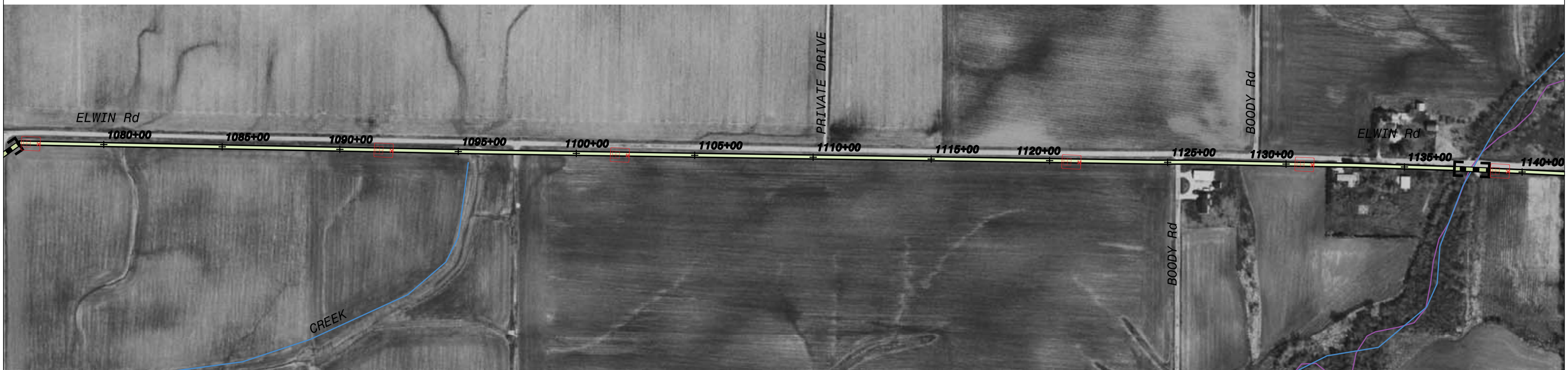
0 100 200 400 600 Feet

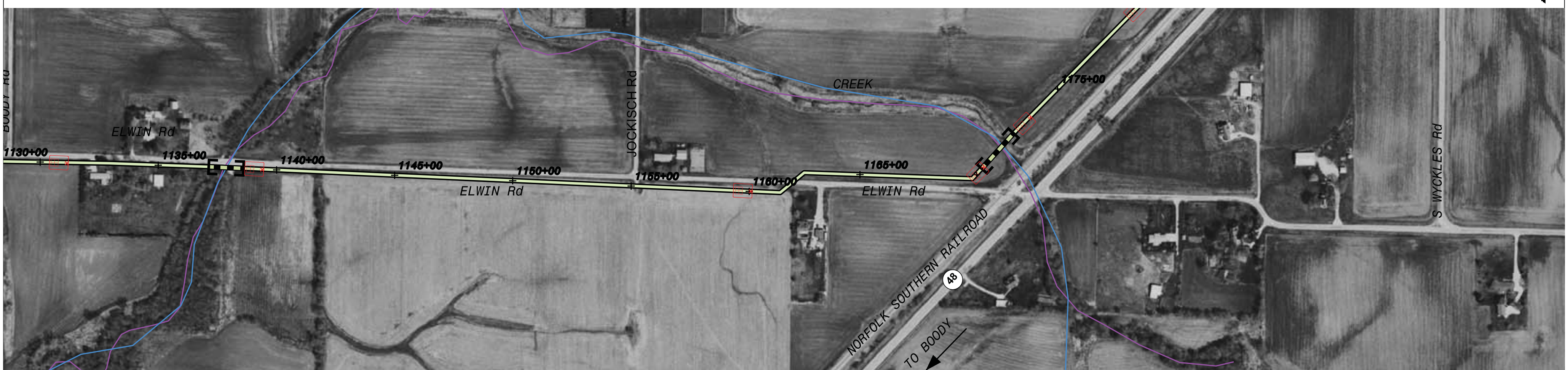
TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATERS SUPPLY PIPELINE

FIGURE 4-11





LEGEND

TEC Pipeline | JACK & BORE PIPING | DIRECTIONAL DRILL PIPING | AIR RELEASE VALVE VAULT | STREAMS | WETLANDS | MUNICIPALITY BOUNDARIES | COUNTY BOUNDARIES

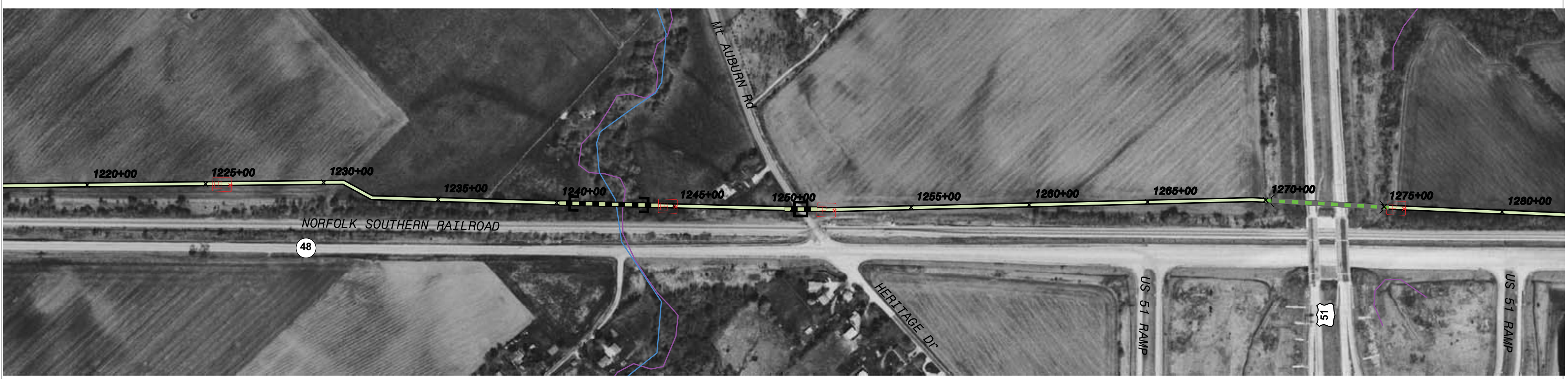
0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-12



LEGEND

TEC Pipeline — JACK & BORE PIPING — DIRECTIONAL DRILL PIPING — AIR RELEASE VALVE VAULT — STREAMS — WETLANDS — MUNICIPALITY BOUNDARIES — COUNTY BOUNDARIES

0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-13

LEGEND

TEC Pipeline | JACK & BORE PIPING | DIRECTIONAL DRILL PIPING | AIR RELEASE VALVE VAULT | STREAMS | WETLANDS | MUNICIPALITY BOUNDARIES | COUNTY BOUNDARIES

0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

FIGURE 4-14

LEGEND

TEC Pipeline — JACK & BORE PIPING — DIRECTIONAL DRILL PIPING — AIR RELEASE VALVE VAULT — STREAMS — WETLANDS — MUNICIPALITY BOUNDARIES — COUNTY BOUNDARIES

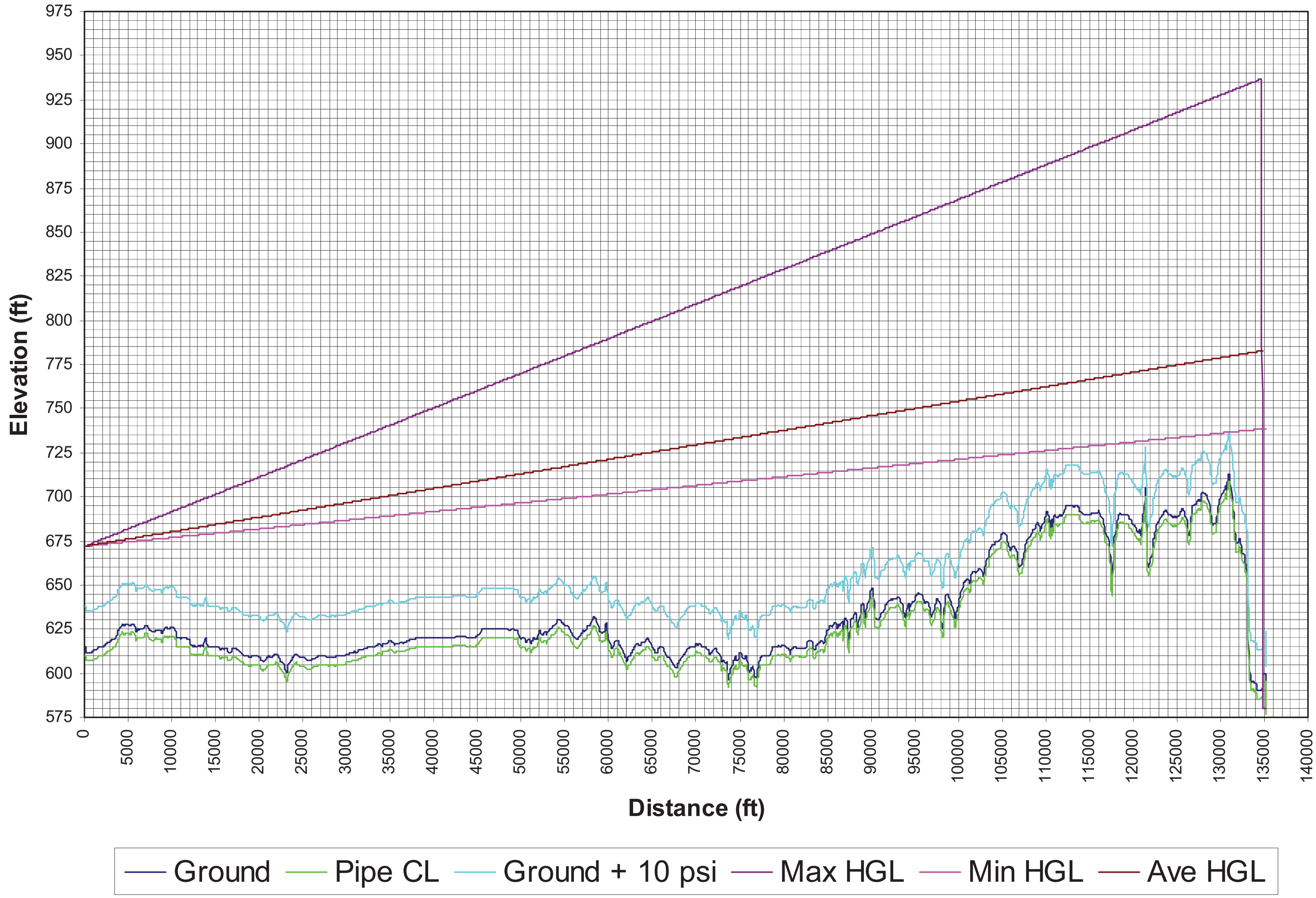
0 100 200 400 600 Feet

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

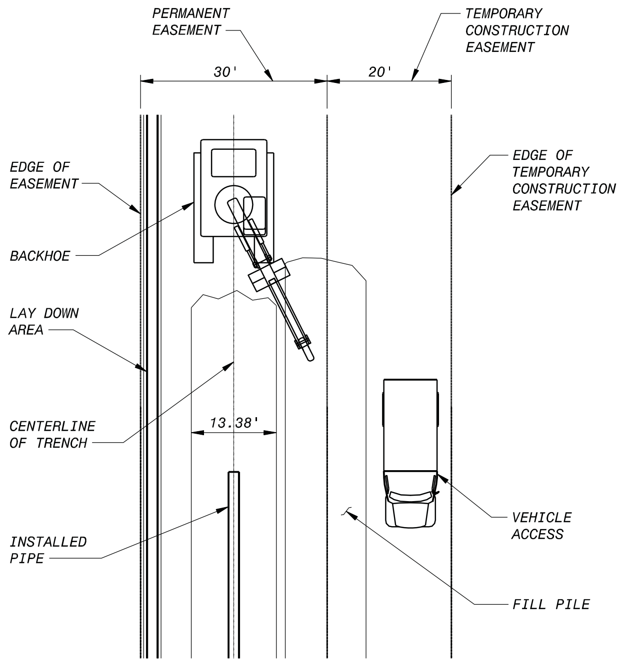
CONCEPTUAL DESIGN REPORT

16" WATER SUPPLY PIPELINE

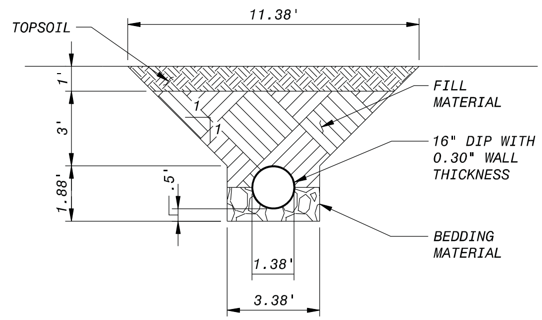
FIGURE 4-15



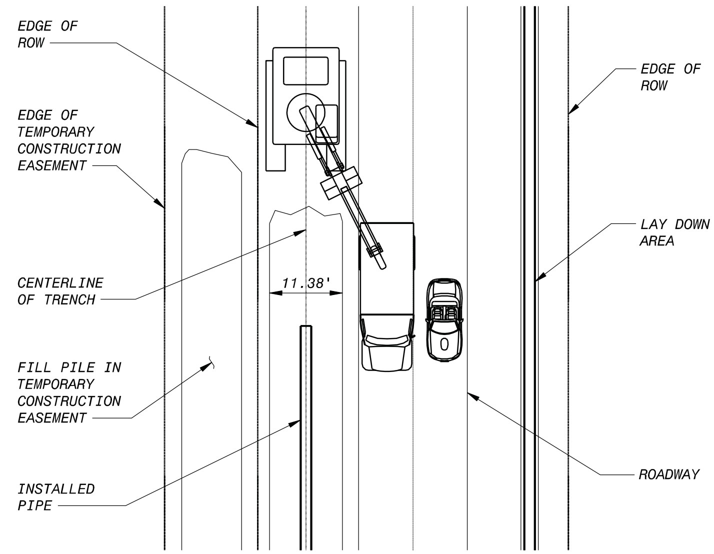
TAYLORVILLE ENERGY CENTER WATER SUPPLY SYSTEM	
CONCEPTUAL DESIGN REPORT	
PIPELINE PROFILE AND HYDRAULIC GRADE LINE	FIGURE 4-16



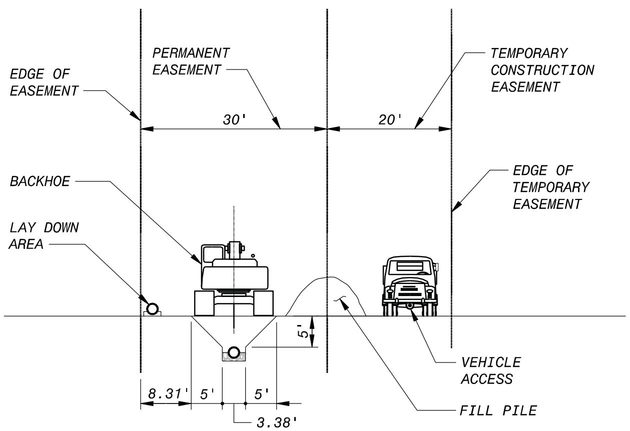
TYPICAL PLAN - WORK IN EASEMENT
NO SCALE



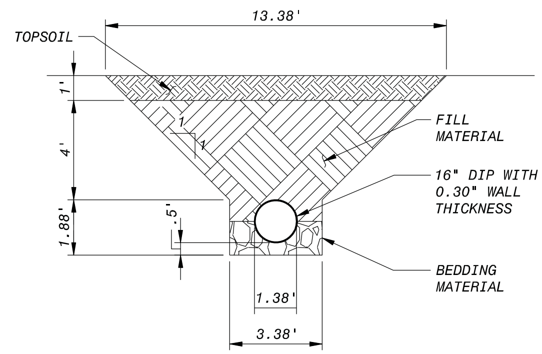
OPEN CUT TRENCH DETAIL 4 FT OF COVER
NO SCALE



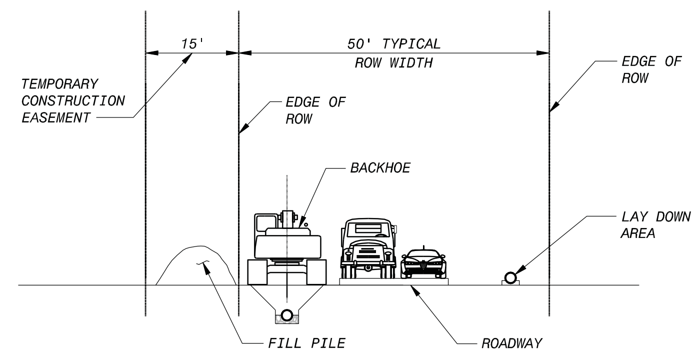
TYPICAL PLAN - WORK IN RIGHT-OF-WAY
NO SCALE



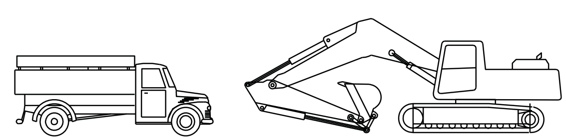
TYPICAL PROFILE - WORK IN EASEMENT
NO SCALE



OPEN CUT TRENCH DETAIL 5 FT OF COVER
NO SCALE



TYPICAL PROFILE - WORK IN RIGHT-OF-WAY
NO SCALE

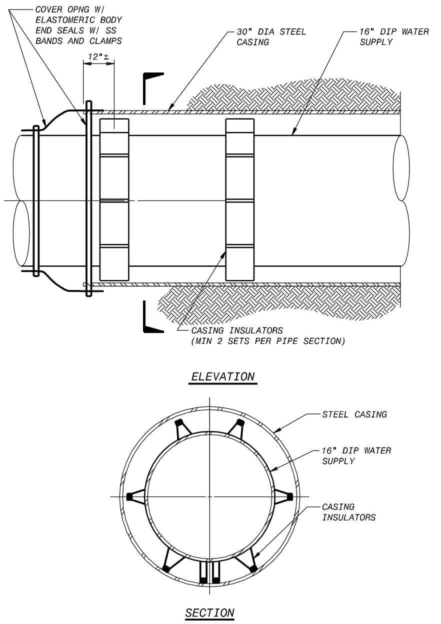


TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM
CONCEPTUAL DESIGN REPORT

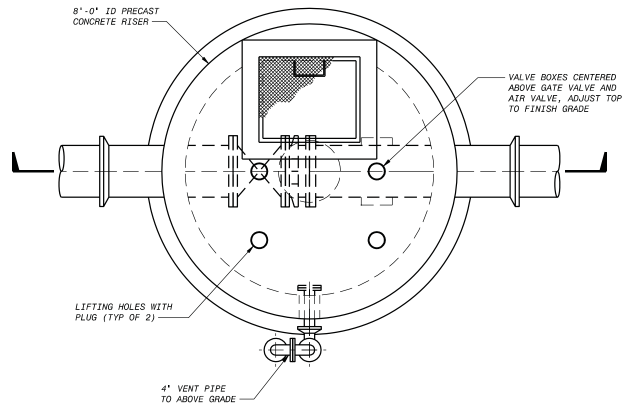
PIPELINE
TYPICAL PLANS AND SECTIONS

FIGURE
4-17

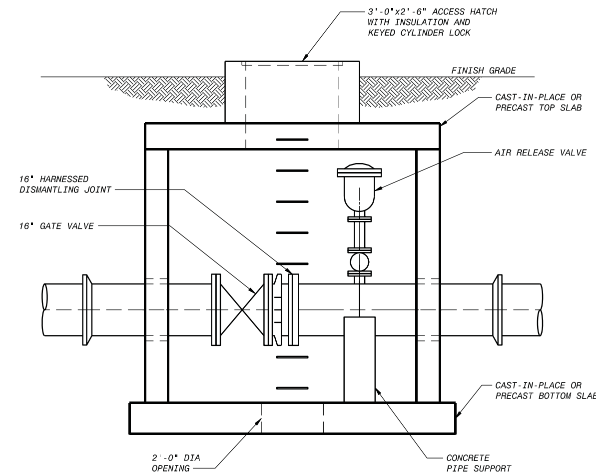
CYGNET ID: 166171-0200-WWTT-M-H0000ZHCN
Date/Time, Plotted : 10/22/2009 9:24:56 AM



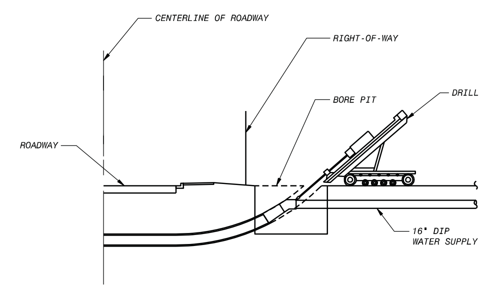
JACK AND BORE DETAIL
NO SCALE



VALVE VAULT PLAN
NO SCALE



SECTION
NO SCALE



HORIZONTAL DIRECTIONAL DRILL AT ROADWAY
NO SCALE

TAYLORVILLE ENERGY CENTER
WATER SUPPLY SYSTEM

CONCEPTUAL DESIGN REPORT

PIPELINE
MISCELLANEOUS DETAILS

FIGURE 4-18

CYGNET ID: 166171-0200-WWTT-M-H0000ZHFN
Date/Time, Plotted : 10/22/2009 9:24:56 AM