THE CITY OF LAKE ELMO

STAFF REPORT

DATE: September 7, 2021
REGULAR

AGENDA ITEM: Approve Change Order No. 2 for the Old Village Phase 5 and 6 Street, Drainage and Utility Improvements

SUBMITTED BY: Chad Isakson, Project Engineer
REVIEWED BY: Kristina Handt, City Administrator
Marty Powers, Public Works Director
Jack Griffin, City Engineer

ISSUE BEFORE COUNCIL: Should the City Council approve Change Order No. 2 for the Old Village Phase 5 and 6 Street, Drainage and Utility Improvements?

BACKGROUND: A-1 Excavating was awarded a construction contract on March 16, 2021 to complete the Old Village Phase 5 and 6 Street Drainage, and Utility Improvements. A preconstruction meeting was held to kick off the construction of the project on April 14, 2021 with the first few months of work to be focused on the deep sewer tunneling along 32nd Street North. The tunneling work was scheduled to be completed from 622 feet east of Lambert Avenue to 250 feet west of Lambert Avenue. Due to obstructions (cobbles / boulders) found the contractor stopped drilling operations on June 3rd. Options to proceed with the project were presented to the City Council at the July 6, 2021 council meeting at which time staff received direction to proceed with finalizing a design for the construction of a city owned lift station to be installed on 32nd Street.

Work remains in progress with a milestone 1 completion date of October 15, 2021, milestone 2 completion date of October 14, 2022, substantial completion date of June 30, 2023 and final completion date of July 28, 2023. Milestone 1 is recommended to be amended to reduce the project construction progress that is required to be completed during the 2021 season to account for the redesign project delay. The milestone 1 completion requirements will now only include the construction of the improvements along 32nd Street between Lake Elmo Avenue and Lampert Avenue.

PROPOSAL DETAILS/ANALYSIS: A change order has been prepared and has been signed by A-1 Excavating, Inc. to address the project redesign, including the installation of a lift station on the city owned property on 32nd Street with the removal from the scope of work of the deep sewer tunneling that was included in the original design documents. As presented at the July 6 council meeting, the sewer redesign allows for much of the sanitary sewer gravity pipe to be raised up in elevation, eliminating the deep gravity sewer from the project, along with its risks and costs. In addition, the sanitary sewer services for all properties remains unchanged from the original design documents (gravity service vs. grinder station service) and the 15-inch trunk sewer stub that will be located at Klondike and 33rd Street for future extension to the north of the UPRR will remain at a 910 invert elevation.

The engineering team and contractor have been working diligently and collaboratively since the July 6 council meeting to finalize the design details for the new lift station and other design elements. The revised plans and specifications, dated July 30, 2021 have been prepared as an amendment to the contract and will become effective upon council approval of this change order.

At the July 6 council meeting, engineering presented an estimated project cost increase of $410,000 based on preliminary discussion and estimates with the project team. Change Order No. 2 now details the construction contract cost changes for the redesign based on the final documentation, and this report provides an updated total project cost estimate, along with an itemization of the cost changes that have occurred since that presentation.

With Change Order No. 2, the total project budget will result in an increase of $358,850 (instead of the $410,000 previously presented). The changes are itemized below:

- Construction / material final design changes resulted in an increase of $34,250 to construct the lift station. These changes are due to:
  - Increased pump size from the originally quoted pumps as a result of final design calculations.
  - Increased height of SCADA communication antenna based on the location of the lift station.
  - Revised model of check and air release valves from the materials originally quoted.
  - Added check valve from the original draft design.
- A site investigation was conducted by the dewatering contractor which resulted in feedback that point well dewatering would likely not be required for construction of the structures. This results in a savings of $75,000 in the final change order. If field conditions later identify the need for this service, there remains the potential that dewatering would need to be added into the scope of work.
- Engineering redesign fees came in under the estimated budget by $10,400 due to the existing city standards for lift stations.

Included in the $358,859 total project cost increase is an estimated $90,000 budget that the city will need to pay the power company to extend 3-phase power to the lift station site. Xcel Energy's design for extension of power to the site is in progress. Until Xcel Energy completes the design, the $90,000 estimate will be subject to change.

FISCAL IMPACT: This change order will increase the construction contract with A-1 Excavating in the amount of $203,950.00 bringing the revised construction contract to $6,697,662.39. This change order will also result in an estimated total project cost increase in the amount of $358,850.00.

RECOMMENDATION: Staff is recommending that the City Council approve Change Order No. 2 for the Old Village Phase 5 and 6 Street, Drainage and Utility Improvements. The recommended motion for the action is as follows:

"Move to approve Change Order No. 2 for the Old Village Phase 5 and 6 Street, Drainage, and Utility Improvements, thereby increasing the contract amount by $203,950.00, increasing the total project budget by $358,850.00, and updating Milestone 1 to include 32nd Street from Lake Elmo Avenue to Lampert Avenue to be constructed in 2021".

ATTACHMENTS:

1. Change Order No. 2.
2. Sanitary sewer redesign Exhibit.

CONTRACT CHANGE ORDER FORM

CITY OF LAKE ELMO, MINNESOTA
OLD VILLAGE PH 5 & 6: STREET, DRAINAGE, & UTILITY IMPROVMENTS
PROJECT NO. 2019.116

FOCUS ENGINEERING, inc.

CHANGE ORDER NO. 2 **DATE:** September 7, 2021

TO: A-1 Excavating, 8237 State Hwy 64, PO Box 90, Bloomer, WI 54724

This Document will become a supplement to the Contract and all provisions will apply hereto. The Contract Documents are modified as follows upon execution of this Change Order.

CHANGE ORDER DESCRIPTION / JUSTIFICATION:

This change order is being processed at the direction of the City to amend the Contract as follows:
1) Construct lift station and forcemain along 32nd Street as identified in the construction documents (attached).
2) Eliminate sanitary sewer jacking from the contract. This change order accounts for all work completed and attempted by the contractor on the jacking pits and jacking operation on the project.
3) Changes Milestone 1 scope to be 32nd Street from Lake Elmo Avenue from 32nd Street to Lampert Avenue.

During the trenchless installation of a 24-inch casing pipe, the contractor claims an obstruction was encountered and the casing pipe cannot be further advanced, in the opinion of the Contractor, utilizing the construction methods employed by the Contractor. By executing this change order the contractor is agreeing to construct the improvements in accordance with the revised plans and specifications dated July 30, 2021 and attached and made part of this change order; which includes the construction, installation, and testing of a sanitary lift station, complete in place, and fully operational as intended by the design documents. By executing this change order the contractor is further agreeing that all other costs and claims incurred to date on this project, relating to the sewer tunneling work, including mobilization, demobilization, materials, labor,and delays in schedule are resolved in full, and contractor warrants that no claims will be made now or in the future regarding any work completed for any costs incurred on this project related to the sewer tunnelling, to the date of this change order.

Attachments (list documents supporting change): Final Lift Station Construction Documents Dated July 30, 2021

ITEM	DESCRIPTION OF PAY ITEM	UNIT	QTY	UNIT PRICE	INCREASE/(DECREASE)
	SEE ITEMIZATION				$203,950.00
				NET CONTRACT CHANGE	**$203,950.00**

Amount of Original Contract	$	6,488,157.83
Sum of Additions/Deductions approved to date (CO #1)	$	5,554.56
Contract Amount to date	$	6,493,712.39
Amount of this Change Order (ADD) (~~DEDUCT~~) (~~NO CHANGE~~)	$	203,950.00
Revised Contract Amount	$	6,697,662.39

The Contract Period for Completion Milestone 1 will be (UNCHANGED) (~~INCREASED~~) (~~DECREASED~~)	0	days
*However, the scope of improvements required to be completed has been reduced.		
The Contract Period for Completion Milestone 2 will be (UNCHANGED) (~~INCREASED~~) (~~DECREASED~~)	0	days
The Contract Period for Substantail Completion will be (UNCHANGED) (~~INCREASED~~) (~~DECREASED~~)	0	days
The Contract Period for Final Completion will be (UNCHANGED) (~~INCREASED~~) (~~DECREASED~~)	0	days

APPROVED BY ENGINEER: FOCUS Engineering, inc.

ENGINEER

9/7/2021

DATE

APPROVED BY CONTRACTOR

BY

9-3-21

DATE

APPROVED BY OWNER: CITY OF LAKE ELMO, MINNESOTA

BY

DATE

BY

DATE

CHANGE ORDER NO. 2

OLD VILLAGE PH 5 & 6: STREET, DRAINAGE, & UTILITY IMPROVMENTS
CITY OF LAKE ELMO, MINNESOTA
PROJECT NO. 2019.116

FOCUS ENGINEERING, inc.

ITEM	DESCRIPTION OF PAY ITEM	UNIT	CHANGE ORDER			DESCRIPTION / JUSTIFICATION
			QUANTITY	UNIT PRICE	AMOUNT	
CO2-1	Select Granular Borrow - Mod. 5% (CV) (P) (Bioinfiltration Basin) (FILL AROUND LIFT STATION)	CY	200.0	$19.00	$3,800.00	Revise sanitary sewer design on 32nd Street to remove deep gravity tunneling from the contract and construct a lift station and forcemain on 32nd Street.
CO2-2	Pipe Foundation Rock (UNDER VALVE VAULT - FILL TO SUITABLE SOILS)	TON	250.0	$9.00	$2,250.00	
CO2-3	8" PVC Pipe Sewer (C900) (DR-25)	LF	545.0	$86.00	$46,870.00	
CO2-4	14" PVC Pipe Sewer (C900) (DR-25)	LF	-295.0	$121.00	-$35,695.00	
CO2-5	8"X4" PVC Wye, C900	EA	3.0	$330.00	$990.00	
CO2-6	14"X4" PVC WYE, C900	EA	-3.0	$800.00	-$2,400.00	
CO2-7	Saddle Tap for 1.25" HDPE to 8" PVC C900	EA	9.0	$750.00	$6,750.00	
CO2-8	Saddle Tap for 1.25" HDPE to 14" PVC C900	EA	-9.0	$770.00	-$6,930.00	
CO2-9	Sanitary Sewer 8" Outside Drop	LF	-11.0	$300.00	-$3,300.00	
CO2-10	Sanitary Sewer Manhole Extra Depth	LF	-19.4	$270.00	-$5,238.00	
CO2-11	24" Casing Pipe (Jacked/Augered w/ 15" PVC SDR 26 Carrier Pipe)	LF	-872.0	$610.00	-$531,920.00	
CO2-12	Clean and Televise Sanitary Sewer	LF	-718.0	$2.00	-$1,436.00	
CO2-13	B618 Concrete Curb & Gutter (AT LIFT STATION)	LF	50.0	$14.50	$725.00	
CO2-14	8" Concrete Driveway Pavement	SY	50.0	$97.00	$4,850.00	
CO2-15	*CONSTRUCT LIFT STATION	LS	1.0	$561,415.00	$561,415.00	
CO2-16	6" C-900 DR18 PVC FOREMAIN	LF	1,190.0	$67.00	$79,730.00	
CO2-17	TEMPORARY SHORING (AT LIFT STATION)	LS	1.0	$50,441.00	$50,441.00	
CO2-18	CONC. EDGE REINFORCING	LF	88.0	$51.00	$4,488.00	
CO2-19	RESTOCK 14" PVC, C-900	LF	295.0	$34.00	$10,030.00	
CO2-20	DROP MANHOLES PRODUCED/NOT USED	EA	2.0	$3,940.00	$7,880.00	
CO2-21	SANITARY SEWER 14" OUTSIDE DROP	LF	11.0	$875.00	$9,625.00	
CO2-22	MANHOLE BASE PRODUCED/NOT USED	EA	1.0	$1,025.00	$1,025.00	

TOTALS - CHANGE ORDER NO. 2 **$203,950.00**

*CONSTRUCT LIFT STATION: Inlcudes all structures, pumps and hatches, mechanical process piping, electrical wiring and conduits, control panel, programming and SCADA, generator, coatings, and all else necessary for an fully functional and operable lift station facility.

SECTION 09 91 50

SHOP PAINTING

PART 1 GENERAL

1.01 SUMMARY

A. Provide shop painting of steel work, miscellaneous metals, and equipment as specified and shown on Drawings.

B. Related Sections:
1. Section 09 91 50 - Shop Painting
2. Section 33 32 10 – Wet Well and Valve Vault
3. Section 40 23 10 - Process Water and Waste Piping
4. Section 40 23 20 - Process Piping Valves
5. Section 40 23 30 - Process Piping Specialties
6. Section 40 23 40 - Piping Hangers and Supports

1.02 REFERENCES

A. ASTM: American Society of Testing Materials

B. National Association of Pipe Fabricators (NAPF)

C. Society for Protective Coatings (SSPC):
1. Volume 1 - Good Painting Practice
2. Volume 2 - Systems and Specifications

1.03 SUBMITTALS

A. Refer to Section 01 33 00 - Submittal Procedures

B. Product Data:
1. Submit data sheet for each coating system.
2. Provide Certificate of Compliance stating the surface preparation and coating application is in accordance with this Section.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
1. Deliver all materials in original, factory-sealed containers bearing manufacturer’s intact and legible label with the following information:
   a. Material identification by name or number.
   b. Manufacturer’s stock number, batch number, and date of manufacture.
   c. Color name and number.

B. Storage:
1. Store materials in an environmentally controlled location as recommended by paint manufacturer’s product information guidelines.
2. Store materials not in actual use in tightly covered containers.
3. Comply with health and fire regulations of governing authorities having jurisdiction.

C. Handling:
1. Handle materials in a manner that precludes the possibility of contamination or incorrect product catalyzation.

2. Do not open containers or mix components until surface preparation has been completed and approved by the coating inspector.
3. Maintain containers used for storage, mixing, and application in a clean condition, free of foreign materials and residue.

D. Allow painted items to fully cure before shipping or handling.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Standard of Quality: Unless indicated otherwise, design is based on:
1. Sherwin Williams Company www.sherwin-williams.com
2. Tnemec Company www.tnemec.com
3. Approved equal.

B. Approved Substitutions:
1. Substitutions: Substitutions that decrease film thickness, or that are of other generic types, will not be approved for this Project.

2.02 MATERIALS

A. Regulatory Requirements:
1. Products shall comply with the United States Clean Air Act for maximum VOC content.
2. Products shall comply with state environmental and health standards.
3. All products shall be lead, chromate, mercury and heavy metals free.

B. Thinners: Use thinners approved by coating manufacturer and within their recommended limits.

C. Abrasives:
1. Abrasive materials must be in compliance with state environmental and health standards.
2. Properly size abrasives to provide the specified surface profile.

PART 3 EXECUTION

3.01 PREPARATION

A. Visually evaluate surface preparation by comparison with pictorial standards of SSPC-VIS-1.

B. Remove all surface contaminants in accordance with SSPC-SP1 Solvent Cleaning.

C. Clean and remove all rust, slag, weld splatter, weld scabs, mill scale, and loose paint.

D. Mask-off 4-inch strip from edges of heat affected areas to provide for field welding.

E. Surface profile shall be in accordance with manufacturer’s product recommendation.

F. Re-blast all surfaces:
1. Where rusting has recurred.
2. That do not meet the requirements of these specifications.

G. Interior and Exterior Steel:
1. Moderate Service: Use the following surface preparation for steel that is subject to normal exposure and moderate humidity.
a. Includes:
1) Not Used.

2. Severe Service: Use the following surface preparation for steel that is subject to frequent splashing, spilling, and exposure to high humidity and condensation.
    a. Includes:
        1) Interior and exterior structural steel.
        2) Miscellaneous metals located in valve vault.
        3) All piping, valves, equipment, and supports located in valve vault.
    b. SSPC-SP6 “Commercial Blast Cleaning”.
    c. Ductile Iron: NAPF 500-03-03 Abrasive Blast Cleaning.
3. Immersion Service: Use the following surface preparation for steel that is subject to immersion, or constant exposure to high humidity and condensation.
    a. Includes:
        1) Structural steel.
        2) Miscellaneous metals located in wet well.
        3) Piping, equipment, and supports located in wet well.
    b. SSPC-SP10 “Near White Blast Cleaning”.
    c. Ductile iron: NAPF 500-03-04 Abrasive Blast Cleaning.

3.02 SHOP PAINTING

A. Materials: Mix, thin, and apply according to the manufacturer’s written instructions.

B. Stripe coat all edges, corners, crevices, bolts, and welds.

C. Coating Schedule:

Service	Sherwin Williams	Tnemec
Moderate	Not Used	Not Used
Severe	Corothane I Galvapac DFT: 2.0 to 4.0 or Copoxy Primer DFT: 4.0 to 6.0	Series 91-H2O Hydro-Zinc DFT: 2.5 to 3.5 or Series N140 Pota-Pox Plus DFT: 4.0 to 6.0
Immersion	Copoxy Primer Color: Gold DFT: 4.0 to 6.0	Series N140 Pota-Pox Plus DFT: 4.0 to 6.0

3.03 SOURCE QUALITY CONTROL

A. Measure dry film thickness with a magnetic film thickness gage in accordance with SSPC-PA2.

B. Visually inspect dried film for runs, sags, dry spray, overspray, embedded particles and missed areas.

C. Repair defective or damaged areas.

D. Provide Certificate of Compliance stating the surface preparation and coating application is in accordance with this Section.

END OF SECTION

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SECTION 09 97 20

COATING SYSTEMS FOR WASTEWATER FACILITIES

PART 1 GENERAL

1.01 SUMMARY

A. Provide surface preparation and application of high-performance industrial coatings.

B. Related Sections:
1. Section 09 91 50 - Shop Painting
2. Section 33 32 10 – Wet Well and Valve Vault
3. Section 40 23 10 - Process Water and Waste Piping
4. Section 40 23 20 - Process Piping Valves
5. Section 40 23 30 - Process Piping Specialties
6. Section 40 23 40 - Piping Hangers and Supports

1.02 REFERENCES

A. ASTM - American Society for Testing Materials

B. NACE International (NACE)

C. International Concrete Repair Institute (ICRI)

D. Society for Protective Coatings (SSPC):
1. Volume 1: Good Painting Practice
2. Volume 2: Systems and Specifications

1.03 DEFINITIONS

A. Applicator: Person applying the product in the field at Site.

B. Dry Film Thickness (DFT): Minimum dry coating thickness.

C. SFPG: Square feet per gallon.

D. VOC: Volatile Organic Compounds.

E. Regional: The state in which the Project is located and surrounding states.

F. LEL: Lower Explosion Limit.

G. Containment: Equipment, supports, screens, tarps, or shrouds that prevent airborne debris generated during surface preparation and coating application from entering the environment, and also facilitates controlled collection of debris for disposal in compliance with current regional and federal regulations.

H. Moderate Service: Surfaces subject to normal exposure and moderate humidity. Includes concrete, concrete masonry, structural steel, miscellaneous metals, doors, and frames.

I. Severe Service: Surfaces subject to frequent splashing, spilling, and exposure to high humidity and condensation. Includes concrete, structural steel, miscellaneous metals, piping, valves, and equipment.

J. Immersion Service: Surfaces subject to immersion, or constant exposure to high humidity and condensation.

1.04 SUBMITTALS

A. Manufacturer current Product Data sheets.
   1. Coatings
   2. Abrasive(s)
   3. Additives (as applicable)

B. Safety Data Sheets (SDS) for each product specified.

C. Samples:
   1. Color chips of available colors.
   2. Recommended colors for color code marking.

D. Post-construction Contract Closeout: Daily application records using Engineer's provided format, or Contractor's form pre-approved by Engineer.

1.05 QUALITY ASSURANCE

A. Single Source Responsibility: Provide coating products from a single manufacturer.

B. Applicator Qualifications:
   1. Contractor shall provide a written statement from the coating manufacturer's authorized representative attesting that the on-site Contractor's Superintendent has been instructed on proper preparation, mixing, and application procedures for all the coatings specified for this project.
   2. Contractor shall provide all necessary equipment to monitor and record the information required on the Daily Application Record.
      a. Equipment shall be in good condition.
      b. Operational within its design range.
      c. Calibrated as required by the specified standard for use of each device.
   3. Applicator to establish quality control procedures and practices to monitor phases of surface preparation, storage, mixing, application, and inspection throughout the duration of the project. Contractor to provide a fulltime, on-site person whose dedicated responsibilities will include quality control of the corrosion protection linings.
   4. Applicator's quality control procedures and practices must include the following items:
      a. Training of personnel in the proper surface preparation requirements.
      b. Training of personnel in the proper storing, mixing, and application and quality control testing of the linings.

C. Pre-Installation Conference:
   1. Before applying any materials the Contractor, Installer and qualified technical representative of the corrosion protection lining manufacturer shall meet on-site with Engineer to discuss approved products and workmanship to ensure proper application of the corrosion protection lining components and substrate preparation requirements.
   2. Review foreseeable methods and procedures related to the corrosion protection lining of coating Work including but not necessarily limited to the following:
      a. Review Project requirements and the Contract Documents.
      b. Review required submittals, both completed and yet to be completed.
      c. Review status of substrate Work, including approval of surface preparations and similar considerations.
      d. Review requirements of on-Site quality control testing and requirements for preparing Site Quality Control Report as specified herein.
      e. Review availability of materials, tradesmen, equipment and facilities needed to make progress and avoid delays.
      f. Review required inspection and testing.
      g. Review environmental conditions, other Project conditions, and procedures for coping with unfavorable conditions.
      h. Review regulations concerning code compliance, environmental protection, health, safety, fire and similar considerations.

i. Review procedures required for the protection of the corrosion protection lining during the remainder of the construction period.

3. Record the discussions of the Pre-Installation Conference and the decisions and agreements or disagreements reached, and furnish a copy of the minutes to each party attending. Record any revision or changes agreed upon, reasons therefore, and parties agreeing or disagreeing with them.
4. Reconvene the conference at the earliest opportunity if additional information must be developed in order to conclude the subjects under consideration.

D. Performance Criteria: The surfaces to receive the protective lining shall be capable of withstanding under constant exposure to raw wastewater, permeation from hydrogen sulfide and other sewer gases, and attack from organic acids generated by microbial sources. Products must have sufficient field history to substantiate product viability for these exposures.

E. Source Quality Control: Provide each component of protective lining produced by a single manufacturer; including recommended repair mortar, repair overlay (resurfacer), base coat and topcoat materials.

F. Reference Standards: Comply with applicable provisions and recommendations of all standards listed in Section 1.2 except as otherwise shown or specified.

G. Qualifications:
1. Applicator shall have minimum of 5 years application experience on projects of similar size and scope.
2. Provide written statement from coating manufacturer's authorized representative attesting that all Applicators on this project have been instructed on proper preparation, mixing, and application procedures for coating specified.
3. Provide regional references for coating contractor for a minimum of 5 different projects of similar size and scope completed in the last 5 years, including:
   a. Contact person and phone number.
   b. Project location.
   c. Cost of coating work.
   d. Start/finish dates.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Site in original, factory-sealed containers bearing manufacturer's intact name and legible label with the following information.
1. Material identification by name or number.
2. Manufacturer's stock number, batch number, and date of manufacture.
3. Color name and number.

B. Storage:
1. Store materials in an environmentally controlled location as recommended by coating manufacturer's product information guidelines.
2. Store materials not in actual use in tightly covered containers.
3. Comply with health and fire regulations of governing authorities having jurisdiction.

C. Handling:
1. Handle materials in a manner that precludes the possibility of contamination or incorrect product catalyzation.
2. Do not open containers or mix components until surface preparation has been completed and approved by Engineer.
3. Maintain containers used for storage, mixing, and application in a clean condition, free of foreign materials and residue.

1.07 PROJECT CONDITIONS

A. Site Facilities:
   1. As necessary to maintain required ambient conditions and contract scheduling, the contractor shall provide all required equipment for supplemental heating, dehumidification and power.
   2. Maintain environmental conditions, including temperature, dew point and humidity within range recommended by coating manufacturer.
   3. Do not use heat sources that emit carbon dioxide or carbon monoxide into areas being coated.
   4. Properly locate and vent all such heat sources to the exterior such that coating systems are unaffected by exhaust products.
   5. Provide lighting to the satisfaction of Engineer to illuminate the complete workspace during blasting, coating, and inspection operations.

B. Environmental Conditions:
   1. Coating shall not be applied in rain, snow, fog, or mist.
   2. Conduct surface preparation and coating operations only when the following conditions are met.
      a. Ambient air temperature is within limits recommended by coating manufacturer.
      b. Steel surface temperature is more than 5 degrees above the dew point of the ambient air.
      c. Surfaces to be painted are clean and completely dry.
   3. Immersion Service: Continuous forced ventilation in accordance with manufacturer recommendation.
      a. At a minimum provide 3 to 5 air exchanges per hour for 12 hours after application of the prime coat and for the first 24 hours following final finish coat application.
      b. Maintain exhaust in compliance with state standards.
      c. Provide containment during abrasive blasting operations to prevent emission of abrasives, existing coatings, and contaminants onto adjacent property, street, structures, or equipment

C. Drawings do not purport to show actual field dimensions, but are intended only to establish location and scope of Work. Field-verify dimensions and assume full responsibility for their accuracy.

1.08 SEQUENCING AND SCHEDULING

A. Schedule blasting, cleaning, and painting so that contaminants from cleaning process will not come in contact with wet, newly painted surfaces.

B. Do not apply coatings until surface preparation has been approved by Engineer.

C. Do not apply finish coats until:
   1. All prime coat application is completed.
   2. All surfaces have been cleaned.
   3. All surfaces have been approved for coating by Engineer.

1.09 PRODUCTS MANUFACTURERS

A. Coatings/Fillers:
   1. Acceptable Manufacture: Subject to compliance with specified requirements, acceptable manufacturers and products are:
      a. BASF www.basfbuildingsystems.com
      b. General Polymers Corporation (GPC) www.generalpolymers.com
      c. AW Cook (Cemtec Concrete Repair) www.awcook.com
      d. Sherwin-Williams (SWC) www.sherwin.com
      e. Tnemec (TCI) www.tnemec.com

B. Sealant Caulking:
   1. Sika-Flex 1A by Sika Corporation www.sikausa.com
   2. BASF Caulks & Sealants
   3. Thiokol Polysulfide Caulk
   4. Or approved equivalent

C. Corrosion Inhibitor:
   1. Holdtight 102 by HoldTight, Houston, TX www.holdtight.com

D. Lead Abatement Additive:
   1. Blastox by TDJ Group, Cary, IL www.blastox.com
   2. Or approved equivalent

E. Substitutions: Manufacturer of comparable products submitted in compliance with Section 01 25 13.

F. Substitution of fast-cure products or acceleration additives must receive prior approval by Engineer.

1.10 MATERIALS

A. Regulatory Requirements:
   1. Products shall comply with the United States Clean Air Act for maximum VOC content.
   2. Products shall comply with state environmental and health standards.
   3. All products shall be lead, chromate, mercury and heavy metals free.

B. Thinners: Use thinners approved by coating manufacturer and within their recommended limits.

C. Abrasives:
   1. Abrasive materials must be in compliance with state environmental and health standards.
   2. Properly size abrasives to provide the specified surface profile.
   3. The use of abrasives exceeding 1 percent free silica is prohibited.

PART 2 EXECUTION

2.01 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for application and notify Engineer in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected.

B. Notify Engineer in writing of anticipated problems using specified systems with substrates primed by others.

C. Prepare existing materials or substrates to be coated to meet the requirements of specified coating system.

D. Starting of painting Work will be construed as Contractor's acceptance of surfaces and conditions within any particular area.

2.02 PREPARATION

A. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items not to be painted, or provide surface-applied protection prior to surface preparation and painting. Following completion of painting, reinstall removed items.

B. Clean and remove all rust, slag, weld splatter, weld scabs, mill scale, loose paint, and surface contaminants

C. Chip or grind off flux, spatter, slag or other laminations left from welding. Grind welds and other sharp projects smooth.

D. Re-blast all Surfaces:
   1. Where rusting has recurred.
   2. That do not meet the requirements of this Section.

E. Feather edges of existing coating to form a smooth transition prior to spot priming.

F. Scarify previously applied coatings in accordance with coating manufacturer's recommendations.

G. All substrates: Prepare surface profiles in accordance with manufacturer's recommendations.

H. Prime all bare metal and touch-up damaged shop-applied prime coat with specified primer. Prepare and coat in accordance with this Section.

I. Concrete:
   1. Allow new concrete to cure 28 days.
   2. Verify dryness by testing in accordance with ASTM D4263.
      a. Floors: If moisture is detected, perform Moisture Vapor Emission Testing in accordance with ASTM F1869.
      b. Moisture content not to exceed 3 pounds per 1,000 square feet in a 24-hour period.

J. Fill cracks and voids according to coating manufacturer's recommendations.

K. Surface Preparation Classifications:
   1. P1: SSPC-SP1 – Solvent Cleaning.
      a. Scarify surface by sanding.
      b. Brush blast if recommended by coating manufacturer.
   2. P2: SSPC-SP2 – Hand Tool Cleaning.
   3. P3: SSPC-SP3 – Power Tool Cleaning
   4. P4: SSPC-SP13 – Surface Preparation of Concrete
      a. Prepare concrete, concrete block, cement plaster, and drywall by removing all efflorescence, chalk, dust, dirt, grease, and other oils, and by roughening as required to remove glaze.
      b. Scrap and grind fins and protrusions flush with surface.
      c. Rake mortar joints clean.
      d. Brush blast if recommended by coating manufacturer.
   5. P5: SSPC-SP5 – White Metal Blast Cleaning.
   6. P6: SSPC-SP6 – Commercial Blast Cleaning.
   7. P7: SSPC-SP7 – Brush-Off Blast Cleaning.
   8. P9:
      a. Clean wood surfaces to be painted of all dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required.
      b. Sandpaper smooth those finished surfaces exposed to view.
   9. P10: SSPC-SP10 – Near White Blast Cleaning.
   10. P11: SSPC-SP11 – Power Tool Cleaning to Bare Metal.
   11. P12: SSPC-SP WJ4Waterjet cleaning of Metals – light cleaning
   12. P13: SSPC-SP13 – Surface Preparation of Concrete:
      a. 4.3.1.: Abrasive Blast.
      b. 4.3.2.: High Pressure Water Cleaning.
   13. P14: SSPC-SP16 – Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
   14. P15: NAPF 500-03-04 Abrasive Blast Cleaning.

L. Re-blast all Surfaces:
   1. Where rusting has recurred.
   2. That do not meet the above requirements.

2.03 MATERIALS PREPARATION

A. Mix and prepare materials in accordance with manufacturer's directions.

B. Maintain containers used in mixing and application in a clean condition, free of foreign materials and residue.

C. The following is prohibited:
   1. Field mixing of partial containers.
   2. Field mixing of lead abatement additive.

3. Field tinting.

2.04 APPLICATION

A. Surface preparation and coating system are as indicated in the “Coating Schedule” at the end of this Section, or noted on Drawings.

B. Use equipment and techniques best suited for substrate and type of material being applied.

C. Apply in accordance with manufacturer’s directions.
   1. Do not apply in snow, rain, fog, mist, or damp surfaces.
   2. Allow wet surfaces to dry thoroughly and attain the temperature and conditions specified before proceeding with or continuing the painting operation.
   3. Work may continue during inclement weather only if areas and surfaces are enclosed and temperatures within the area can be maintained within limits specified during application and drying periods.

D. Avoid degradation and contamination of surfaces and avoid intercoat contamination.
   1. Surfaces shall be free from grease, oil, abrasives, and other contaminants that may have an adverse effect on coating application, bonding, curing, or performance.
   2. Clean contaminated surfaces before applying next coat.
   3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable system.

E. Brush-apply primer or intermediate on all welds and edges prior to general application of finish coat.

F. Apply caulking to flange interfaces, gaps, and intermittent weld seams.

G. Provide finish coats that are compatible with primers used. Prime and intermediate coats shall be lighter than subsequent coat.

H. Provide application thickness to specific mil requirements. Mil thicknesses referenced are in dry mil thickness.

I. All paint systems are “full coverage.” Where discrepancies between manufacturer’s square foot coverage and mil thickness occur, use mil thickness requirements.

J. Where voids are present exposing the substrate or undercoats, apply additional coats until a uniform color and finish is obtained. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

K. Do not apply additional coats until Engineer has had the opportunity to inspect and approve previous coat.

L. Unless otherwise indicated, match color of adjacent walls or equipment when painting conduit, miscellaneous brackets, hangers, and supports.

M. Smooth out runs or sags immediately, or remove and recoat entire surface.

N. Allow preceding coats to dry before recoating. Recoat within time limits specified by coating manufacturer.

O. Do not apply coatings to the following surfaces (unless directed by Engineer):
   1. Factory or installer-finished items.
   2. Anodized aluminum, stainless steel, or other pre-finished metal.
      a. Exception: Galvanized steel.
   3. Moving parts of operating devices.
   4. Sprinkler heads or other fire detection/suppression elements.
   5. Code required labels or equipment nameplates.

2.05 COLOR CODING

A. Pipes Exposed or Concealed in Accessible Pipe Spaces:
   1. Provide with color band and arrow indicating direction of flow, and legend adjacent to valves, at not more than 20-foot spacing on straight pipe runs, adjacent to change in direction, and on both sides where pipes pass through walls or floors.
   2. Color-coding shall be based on pipe contents in accordance with the “Pipe Color Schedule” at the end of this Section, or noted on Drawings.

B. Bands: Color and of width indicated.

C. Arrows: Install adjacent to each band and legend to indicate direction of flow in pipe.

D. Legends:
   1. Print in uppercase letters and letter sizes as listed in this Section to match “arrow”.

2.06 QUALITY CONTROL

A. Contractor shall provide all necessary equipment to monitor and record the information required on the Daily Application Record.
   1. Equipment shall be in good condition.
   2. Operational within its design range.
   3. Calibrated as required by the specified standard for use of each device.

B. Maintain a copy of the following information at the site:
   1. Product Data Sheets.
   2. Safety Data Sheets (SDS).
   3. Contract Document and submittals.
   4. Daily Application Record.
      a. Record information (in English) on form located at the end of this Section.

C. Owner’s representative will be on site to observe the application of each coating, and the preparation of each substrate.

D. Provide safe and complete access to all surfaces for observation by Owner and/or Engineer.

E. Prepare rigging so that all surfaces are within arm’s reach of observer.

F. Measure wet paint with wet film thickness gages.

G. Provide DFT measurements for all coatings in accordance with SSPC-PA2.

H. Perform Holiday testing in accordance with NACE SPO 188-2006 as directed by Engineer.

I. Correct any deficiencies observed or detected by field testing as directed by Engineer.

2.07 CLEANING AND PROTECTION

A. During progress of Work, remove discarded materials, rubbish, cans, and rags at end of each workday from the Site.

B. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.

C. Upon completion of Work:
   1. Clean window glass and spattered surfaces.
   2. Remove spattered paint by washing and scraping, using care not to scratch or otherwise damage finished surfaces.

D. Protect Work of other trades against damage. Correct any damage by cleaning, repairing or replacing, and repainting.

E. Provide “Wet Paint” signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided for protection of Work, after completion of painting operations.

F. At completion of Work of other trades, touch-up and restore damaged or defaced surfaces.

2.08 SCHEDULES

A. See the following pages.

Coating Systems

SYSTEM NUMBER	TYPE	SUBSTRATE / SERVICE	SURFACE PREP	MFG	FIRST COAT	DFT (Mils)	SECOND COAT	DFT (Mils)	FINISH COAT	DFT (Mils)	NOTES
C1	Glass Flake Filled Epoxy	Concrete Immersion and Severe Service	P13 4.3.1	SWC	Corobond 100	4.0 – 6.0	Sherglass	8.0 - 15.0	Sherglass	8.0 –15.0	Fill all bugholes and voids with Steel Seam FT910.Or Duraplate 2300
				TCI	Series N140	4.0 – 6.0	Series 142	16.0 – 20.0			Fill all bugholes and voids with Series 215 or Series 218.
C1a	Epoxy Chemical Resistant	Concrete Immersion (Industrial Wastewater)	P13 4.3.1	SWC	Corobond 100	4.0 -6.0	Duraplate 6000	40.0 – 80.0			Fill all bugholes and voids with Steel Seam FT910.Or Duraplate 2300
				TCI	Series 201	4.0-6.0	Series G435	40.0 – 80.0			Fill all bugholes and voids with Series 215 or Series 218.
C2	100% Solids Amine Cured Epoxy	Concrete Immersion Service	P13 4.3.1	SWC	Duraplate 235	4.0 - 6.0	Duraplate 6000	40.0-80.0			Fill all bugholes and voids with Steel Seam FT 910 or Duraplate 2300. .
				TCI	Series 201	4.0 – 6.0	Series 22	18.0 - 40.0			Fill all bugholes and voids with Series 215 or Series 218.
C3	Fast-Set Urethane (Flexible)	Concrete Immersion Severe Service	P13 4.3.1	SWC	Dura-Plate 235	6.0 – 8.0	Polycote 115	80.0 – 100.0			Fill all bugholes and voids with Steel Seam FT 910.or Duraplate 2300.
				TCI	Series N140	4.0 – 6.0	Series 406	80.0 – 100.0			Fill all bugholes and voids with Series 215 or Series 218.
				SWC	Corobond 100	4.0 – 6.0	Duraplate 6000	80.0 – 125.0			Fill all bugholes and voids with Steel Seam FT 910 or Duraplate 2300.
				TCI	Series 201	4.0 – 6.0	Series G435	80.0 – 125.0			Fill all bugholes and voids with Series 215 or Series 218.
C5	100% Solids Mortar System	Concrete Immersion and Severe service	P13 4.3.1	SWC	Corobond 100	4.0 – 6.0	Duraplate 6000 mortar	125.0 – 250.0			Fill all bugholes and voids with Steel Seam FT 910 or Duraplate 2300.
				TCI	Series 201	4.0 – 6.0	Series 434	125.0 min.			Fill all bugholes and voids with Series 215 or Series 218.
C7	Acrylic Blockfiller/ Cementitious Acrylic	Concrete & Masonry Exterior Exposure	P4	SWC	Porous Substrates-Heavy Duty Block Filler	60 - 80 SFPG	Ultra-Crete	4.0 - 8.0	Ultra-Crete	4.0 - 8.0	Do not use Blockfiller on smooth concrete and masonry surfaces.
				TCI	Porous substrates Series 130	60 – 115 SFPG	Series 181	4.0 – 8.0	Series 181	4.0 – 8.0	Do not use Blockfiller on smooth concrete and masonry surfaces.
C8	Cementitious Acrylic/ WB Epoxy	Concrete & Masonry Interior Exposure	P4	SWC	Porous Substrates Cement-plex 875	80 – 100 sq/ft gallon	Pro Industrial WB Catalyzed Epoxy	2.0 – 4.0	Pro Industrial WB Catalyzed Epoxy	2.0 – 4.0	Do not use Blockfiller on smooth concrete and masonry surfaces.
				TCI	Porous Substrates Series 130	60 – 115 SFPG	Series 113 / 114	4.0 – 6.0	Series 113 / 114	4.0 – 6.0	Do not use Blockfiller on smooth concrete and masonry surfaces.

Coating Systems

SYSTEM NUMBER	TYPE	SUBSTRATE / SERVICE	SURFACE PREP	MFG	FIRST COAT	DFT (Mils)	SECOND COAT	DFT (Mils)	FINISH COAT	DFT (Mils)	NOTES
C9	Epoxy	Concrete & Masonry Interior Exposure	P4	SWC	Porous Substrates- Heavy Duty Blockfiller	60 – 80 SFPG	Macropoxy 646	3.0 – 6.0	Macropoxy 646	3.0 – 6.0	Do not use Blockfiller on smooth concrete and masonry surfaces.
				TCI	Porous Substrates Series 130	60 – 115 SFPG	Series N69	4.0 – 6.0	Series N69	4.0 – 6.0	Do not use Blockfiller on smooth concrete and masonry surfaces. Note: Substitute N69 with Series 49 for low-VOC, high solids
C10	Elastomeric Acrylic	Concrete & Masonry Exterior Exposure	P4	SWC	Loxon XP	90 – 115 sq/ft gallon	Loxon XP	90 – 115 sq/ft gallon			
				TCI	Series 156	4.0 – 8.0	Series 156	4.0 – 8.0			Fill porous block with Series 130
C11	Coal Tar	Concrete Exterior Exposure Below Grade Soil Side	P13 4.3.1	SWC	High Mil Shertar	14.0 –20.0					
				TCI	Series 46H-413	14.0 –20.0					
C12	Silane / Siloxane Blend	Concrete & Masonry Exterior Exposure Water Repellent	P4	SWC	Loxon 40% Silane	75 – 125 SFPG					
				TCI	Series 662	75 – 150 SFPG					
D1	Epoxy/ Acrylic Urethane	Ductile Iron Exterior Exposure Outside Diameter Non-Immersion	P15	SWC	Macropoxy 646	3.0 – 6.0	Macropoxy 646	3.0 – 6.0	Acrolon Ultra	2.0 – 3.0	
				SWC	Macropoxy 646	3.0-6.0	Sherloxane 800	4.0 – 6.0			
				TCI	Series N69	3.0 – 5.0	Series N69	4.0 – 6.0	Series 1095	2.0 – 3.0	Note: Substitute N69 with Series 49 for low-VOC, high solids
				TCI	Series N69	3.0 – 5.0	Series 1095	4.0 – 6.0			
D2	Epoxy	Ductile Iron Interior Exposure Outside Diameter Non- Immersion	P15	SWC	Macropoxy 646	3.0 - 6.0	Macropoxy 646	3.0 - 6.0			Note: Substitute N69 with Series 49 for low-VOC, high solids
				TCI	Series N69	3.0 – 5.0	Series N69	4.0 – 6.0			Note: Substitute N69 with Series 49 for low-VOC, high solids
D3	100% Solids High-Build Epoxy	Ductile Iron Outside Diameter (Municipal wastewater & H_2S Vapor Exposure)	P15	SWC	Duraplate 235	3.0 - 6.0	Duraplate 6000	40.0 – 60.0			
				TCI	Series N140	3.0 – 5.0	Series G435	15.0 – 40.0			
D4	Coal Tar Epoxy	Ductile Iron Outside Diameter Exterior Buried	P15	SWC	High Mil Shertar	14.0 –20.0					Coal Tar Epoxy is only to be used for earthen buried items and substrates

Coating Systems

SYSTEM NUMBER	TYPE	SUBSTRATE / SERVICE	SURFACE PREP	MFG	FIRST COAT	DFT (Mils)	SECOND COAT	DFT (Mils)	FINISH COAT	DFT (Mils)	NOTES
				TCI	Series 46H-413	14.0 -20.0					Coal Tar Epoxy is only to be used for earthen buried items and substrates
D5	Glass Flake Epoxy	Ductile Iron Outside Diameter Immersion Waste Water	P15	SWC	Sherglass	8.0 – 12.0	Sherglass	8.0 – 12.0			.
				TCI	Series N140	3.0 – 6.0	Series 142	13.0 – 18.0			
D6	Amine Cured Epoxy	Ductile Iron Inside & Outside Diameter Immersion Waste Water (Potable)	P15	SWC	Duraplate UHS	10.0 –20.0	Duraplate UHS	10.0 -20.0			*OAP Recommended
				TCI	Series N140	3.0 – 5.0	Series 22	16.0 – 40.0			
D7	Personal Protective Coating	Ductile Iron Outside Diameter Interior Exposed	P15	SWC	Macropoxy 646*	5.0 – 6.0	Heat Flex 3500	40-100 Mils*	Shercryl HPA	2.0 – 4.0	*Temperature Dependent Consult Sherwin-Williams Rep for Specific Recommendation
				TCI	Series 1224	6.0 – 8.0	Series 971	30.0 – 50.0	Series 1028T	2.0 – 3.0	*For personnel protection with operating temperatures up to 325F.
D8	Epoxy In-Shop Lining	Ductile Iron Inside Diameter (Municipal wastewater immersion, H_2S vapor exposure)	P15	SWC	Duraplate 6000	40.0 –60.0					Applied in-Shop. Coordinate with 02500 Epoxy Lining
				TCI	Series 431	40.0 –60.0					Applied in-shop. Coordinate with Section 02500 Ceramic Epoxy Lining.
D9	Epoxy In-Shop Lining	Ductile Iron Outside Diameter (Municipal wastewater immersion, H_2S vapor exposure)	P15	SWC	Duraplate 6000	40.0 -60.0					Applied in-Shop. Coordinate with 02500 Epoxy Lining
				TCI	Series N140	3.0 – 5.0	Series 431	30.0 – 40.0			Applied in-shop. Coordinate with Section 02500 Ceramic Epoxy Lining.
S1	Glass Flake Filled Epoxy	Steel Wastewater Immersion (Abrasive)	P10	SWC	Sherglass	8.0 – 12.0	Sherglass	8.0 – 12.0			
				TCI	Series N140	3.0 - 5.0	Series 142	8.0 - 12.0			
S2	Epoxy Chemical Resistant	Steel Immersion (Industrial Wastewater)	P10	SWC	Tank Clad HS	5.0 – 8.0	Tank Clad HS	5.0 – 8.0			
				TCI	Series 61	5.0 – 8.0	Series 61	5.0 – 8.0			*Refer to Chemical Resistance Guide to qualify specific application.
S3	Amine Cured Epoxy	Steel Immersion and	P10	SWC	Duraplate UHS Primer*	6.0 – 8.0	Duraplate UHS	18-22			*OAP Recommended

Coating Systems

SYSTEM NUMBER	TYPE	SUBSTRATE / SERVICE	SURFACE PREP	MFG	FIRST COAT	DFT (Mils)	SECOND COAT	DFT (Mils)	FINISH COAT	DFT (Mils)	NOTES
		Severe Service		TCI	Series N140	3.0 – 5.0	Series 22	16.0 - 40.0			Primer Optional Stripe coat seams with Series N140
S4	High Build Amine Cured Epoxy	Steel Immersion (Municipal wastewater & H_2S Vapor Exposure)	P10	SWC	Duraplate 6000	40.0-60.0					Hold primer DP 235
				TCI	Series N140	3.0 - 5.0	Series G435	30.0-40.0			
S5	Elastomeric Urethane	Steel Immersion Severe	P10	SWC	Duraplate 235	3.0 – 6.0	Polycote 115	30.0 – 40.0			Primer is optional
				TCI	Series 1	2.5-3.5	Series 406	30.0 - 40.0			Primer is optional
S6	Epoxy	Steel Interior Exposure	P6	SWC	Macropoxy 646	3.0 – 6.0			Macropoxy 646	3.0 – 6.0	
				TCI	Series N69	3.0 - 5.0			Series N69	3.0 - 5.0	Note: Substitute N69 with Series 49 for low-VOC, high solids
S7	Epoxy/ Acrylic Urethane	Steel Exterior Exposure Exposed	P6	SWC	Macropoxy 646	3.0 – 6.0	Macropoxy 646	2.0 – 3.0	Acrolon Ultra	2.0 – 3.0	
				SWC	Macropoxy 646	3.0 – 6.0	Sherloxane 800	4.0 – 6.0			
				TCI	Series N69	3.0 – 5.0	Series N69	2.0 – 3.0	Series 1095	2.0 – 3.0	Note: Substitute N69 with Series 49 for low-VOC, high solids
				TCI	Series N69	3.0 – 6.0	Series 1095	4.0 – 6.0			
S8	Polyurethane	All Doors and Frames	P1	SWC	Factory Primer		Macropoxy 646	2.0 – 3.0	Acrolon Ultra	2.0 – 3.0	Confirm compatibility with factory-primed surfaces prior to coating
				SWC	Factory Primer		Sherloxane 800	4.0 – 6.0			Confirm compatibility with factory-primed surfaces prior to coating
				TCI	Factory Primer		*Series 27	2.0 – 3.0	Series 1095	2.0 – 3.0	Confirm compatibility with factory-primed surfaces prior to coating.
				TCI	Factory Primer		Series 1095	4.0 – 6.0			
S9	Acrylic	Steel Interior and Exterior Moderate	P6	SWC	Sher-Cryl HPA	2.5 - 4.0	Sher-Cryl HPA	2.5 - 4.0			Factory primed metal deck and joists: Prepare surfaces according to manufacturer recommendation.

Coating Systems

SYSTEM NUMBER	TYPE	SUBSTRATE / SERVICE	SURFACE PREP	MFG	FIRST COAT	DFT (Mils)	SECOND COAT	DFT (Mils)	FINISH COAT	DFT (Mils)	NOTES
				TCI	Series 1028	2.0 - 3.0	Series 1028	2.0 - 3.0			Factory primed metal deck and joists: Prepare surfaces according to manufacturer recommendation.
S10	Epoxy	Steel Immersion	P10	SWC	Duraplate 235	4.0 – 6.0	Duraplate 235	4.0 – 6.0			For Potable Use NSF Version.
				TCI	Series N140	4.0 – 6.0	Series N140	4.0 – 6.0			Series 140 is acceptable as NSF version also
S11	Epoxy/ Polyester Polyurethane	Steel Exterior Exposure Severe	P6	SWC	Macropoxy 646	3.0 – 6.0	Macropoxy 646	3.0 – 6.0	Polylon HP	2.0 – 3.0	
				SWC	Macropoxy 646	3.0 – 6.0	Sherloxane 800	4.0 - 6.0			
				TCI	Series N69	3.0 – 5.0	Series N69	2.0 – 3.0	Series 290	2.0 – 3.0	Note: Substitute N69 with Series 49 for low-VOC, high solids
				TCI	Series N69	3.0 – 5.0	Series 1095	4.0 – 6.0			
S12	Personal Protective Coating	Steel Interior and Exterior Exposure Safe Touch	P10	SWC	Macropoxy 646*	5.0 – 6.0	Heat Flex 3500	40-100 Mils*	Shercryl HPA	2.0 – 4.0	*Temperature Dependant Consult Shewin Williams Rep for Specific Recommendation
				TCI	Series 1224	6.0 – 8.0	Series 971	30.0 – 50.0	Series 1028T	2.0 – 3.0	*For personnel protection with operating temperatures up to 325F.
S13	Epoxy In-Shop Lining	Steel Inside Diameter (Municipal wastewater immersion, H_2S vapor exposure)	P10	SWC	Duraplate 6000	30.0 –50.0					Applied in-Shop. Coordinate with 02500 Epoxy Lining
				TCI	Series 431	30.0 –50.0					Applied in-shop. Coordinate with Section 02500 Ceramic Epoxy Lining.
S14	Epoxy In-Shop Lining	Steel Outside Diameter (Municipal wastewater immersion, H2S vapor exposure)	P10	SWC	Duraplate 6000	40.0 –60.0					Applied in-Shop. Coordinate with 02500 Epoxy Lining
				TCI	Series 431	30.0 –50.0					Applied in-shop. Coordinate with Section 02500 Ceramic Epoxy Lining.
NF1	Epoxy	Galvanized and Non Ferrous Metals Interior Exposed	P14	SWC	Macropoxy 646	3.0 – 6.0	Macropoxy 646	3.0 – 6.0			
				TCI	Series N69	2.0 – 3.0	Series N69	2.0 – 3.0			
NF2		Galvanized and	P14	SWC	Macropoxy 646	3.0 – 6.0	Acrolon Ultra	2.0 – 3.0			

Coating Systems

SYSTEM NUMBER	TYPE	SUBSTRATE / SERVICE	SURFACE PREP	MFG	FIRST COAT	DFT (Mils)	SECOND COAT	DFT (Mils)	FINISH COAT	DFT (Mils)	NOTES
	Epoxy/ Acrylic Urethane	Non Ferrous Metals Exterior Exposed		SWC	Sherloxane 800	4.0 – 6.0					
				TCI	Series N140	2.0 – 3.0	Series 1095	2.0 – 3.0			
				TCI	Series 1095	4.0 – 6.0					
PVC1	Epoxy/Acrylic Urethane	PVC Exterior Exposed	P1a	SWC	Macropoxy 646	3.0 – 6.0	Acrolon Ultra	2.0 – 3.0			
				SWC	Sherloxane 800	4.0 – 6.0					
				TCI	Series N140	2.0 – 3.0	Series 1095	2.0 – 3.0			
				TCI	Series 1095	4.0 – 6.0					
PVC1	Epoxy	PVC Interior Exposed	P1a	SWC	Macropoxy 646	3.0 – 6.0	Macropoxy 646	3.0 – 6.0			
				TCI	Series N69	2.0 – 3.0	Series N69	2.0 – 3.0			
PVC2	Acrylic	PVC	P1a	SWC	Shercryl HPA	2.0 – 4.0	Shercryl HPA	2.0 – 4.0			
				TCI	Series 1029	2.0 – 3.0	Series 1029	2.0 – 3.0			
IP1	Acrylic	Insulated Pipe	P1	SWC	Shercryl HPA	2.0 – 4.0	Shercryl HPA	2.0 – 4.0			
				TCI	Series 1029	2.0 – 3.0	Series 1029	2.0 – 3.0			
WPG1	Acrylic	Wood Plaster Gypsum	P9	SWC	Pro Ind Acrylic	2.5 – 4.0	Pro Ind Acrylic	2.5 – 4.0			
				TCI	Series 151	1.0 – 2.0	Series 1029	2.0 – 3.0			
WPG2	Latex/ Vinyl Acrylic	Architectural Gypsum Board	P1	SWC	Promar 200 primer	1.0 – 1.5	Promar 200	1.5 – 2.0	Promar 200	1.5 – 2.0	
				TCI	Series 51	1.0 – 2.0	Series 1029	2.0 – 3.0	Series 1029	2.0 – 3.0	
F1	Silicate Blend	Concrete Floor Mild Exposure	P4	SWC	Sher-Crete Lithium Silicate Concrete Hardner	300-350 Sq/ft gal	Sher-Crete Lithium Silicate Concrete Hardner	350-400 Sq/ft gal			
				TCI							

Coating Systems

SYSTEM NUMBER	TYPE	SUBSTRATE / SERVICE	SURFACE PREP	MFG	FIRST COAT	DFT (Mils)	SECOND COAT	DFT (Mils)	FINISH COAT	DFT (Mils)	NOTES
F2	1/8-inch Thick Aggregate-Filled Pigmented Epoxy	Concrete Floor Pigmented Heavy Traffic Chemical Resistant	P13 4.3.1	SWC	GP 3579	4.0 – 6.0	GP 3561	Double Broadcast 1/8th inch	GP3746	6.0 – 8.0	Provide mockup to gain agreement on texture and establish job standard prior to application
				TCI	Series 201	4.0 – 6.0	Series 237	Double Broadcast 1/8-inch	Series 280	6.0 – 12.0	Provide mockup to gain agreement on texture and establish job standard prior to application
F3	1/8-inch Thick Decorative Quartz-Filled Epoxy	Concrete Floor Decorative Quartz Heavy Traffic 4 coat system	P13 4.3.1	SWC	GP 3579	4.0 – 6.0	GP 3561	Double Broadcast 1/8th inch	GP 3746 GP 4850	6.0 – 8.0 210-15	Provide mockup to gain agreement on texture and establish job standard prior to application
				TCI	Series 201	4.0 – 6.0	Series 222	Double Broadcast 1/8-inch	Series 284 Series 295	14.0 – 16.0 2.0 – 3.0	Provide mockup to gain agreement on texture and establish job standard prior to application
F4	High Build Decorative Flake-Filled Epoxy	Concrete Floors Decorative Flake Heavy Traffic	P13 4.3.1	SWC	GP 3579	4.0 – 6.0	GP 3589	8.0 – 10.0 Broadcast Flake	GP 3746 GP 4850	8.0 – 10.0 8.0 – 10.0	Provide mockup to gain agreement on texture and establish job standard prior to application
				TCI	Series 281	6.0 – 8.0	Series 224	8.0 – 10.0 Broadcast with Flake	Series 284 Series 295	8.0 – 12.0 2.0 – 3.0	Provide mockup to gain agreement on texture and establish job standard prior to application
F5	Epoxy	Concrete Floors Pigmented Epoxy Light Traffic, Low Impact	P13 4.3.1	SWC	Macropoxy 646	5.0 – 10.0	Macropoxy 646	5.0 – 10.0	GP 4638 Urethane	2.0 – 3.0	Urethane is Optional it provides UV Protection & added surface film
				TCI	Series N69	5.0 – 10.0	Series N69	5.0 – 10.0	Series 290	2.0 – 3.0	Urethane is Optional it provides UV Protection & added surface film Note: Substitute N69 with Series 49 for low-VOC, high solids

NOTES: Any Secondary Chemical Containment and Immersion Grade Chemical Resistant commodities will be specified on case by case basis by the Protective Coatings Management Group in conjunction with Manufacturer's Chemical Resistant Guides.

Prepared concrete surfaces must be filled if the surface is too rough. Fairing the surface to fill bugholes and voids to near smooth is mandatory prior to coating application. Some surface texture after filling may be approved and recommended for adhesion of subsequent coats.

(OAP) stands for Optically Activated Pigment which may be used for supplementary visual holiday detection. OAP is not a replacement for NACE standard SPO-188-2006.

Galvanized metal is not recommended for wastewater immersion due to adverse chemical reaction(s).

ROOM FINISH SCHEDULE

LOCATION	COATING SYSTEM No.
Wet Well	
New and Existing Concrete	C2
New and Existing Pipe	D2, D3
Valve Vault	
New Concrete	C9
New Pipe and Valves	D2, D3

WASTEWATER TREATMENT PLANTS
Piping Color Code (Ten State Standard)

PIPE CONTENT	COLOR STANDARD	SHERWIN WILLIAMS COLOR No.	TNEMEC COLOR No.
Sewage (Wastewater) Line	Gray	4025	55BL

END OF SECTION

DAILY APPLICATION RECORD

DATE				----------RECORD EVERY 3 HOURS----------					
				Surface Temperature (Deg. F.)	Air Temperature (Deg. F.)	Material Temperature (Deg. F.)	Relative Humidity (%)	Dew Point (Deg. F.)	Weather Conditions
TIME START		AM	PM						
		AM	PM						
		AM	PM						
		AM	PM						
		AM	PM						
TIME STOP		AM	PM						

Area Prepared
Area Coated
Type of Material & Quantity Applied:

SIGNED

PROJECT NAME:	**SEH FILE No.:**
OWNER:	**CONTRACTOR:**

SECTION 26 32 13

ENGINE GENERATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes packaged engine-generator sets for standby power supply with the following features:
   1. Unit-mounted cooling system.
   2. Unit-mounted control and monitoring.
   3. Fuel system.
   4. Outdoor enclosure.

B. Related Requirements:
   1. Section 40 90 00 “Lift Station Controls and Devices”.

1.02 SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   2. Include thermal damage curve for generator.
   3. Include generator efficiency at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
   4. Include generator characteristics, including, but not limited to kw rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:
   1. Include plans and elevations for engine-generator set and other components specified.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Identify fluid drain ports and clearance requirements for proper fluid drain.
   4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
   5. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.
   6. Provide available enclosure colors.

1.03 INFORMATIONAL SUBMITTALS

A. Source quality-control reports, including, but not limited to the following:
   1. Certified summary of prototype-unit test report.
   2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
   3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
   4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
   5. Report of sound generation.
   6. Report of exhaust emissions showing compliance with applicable regulations.
   7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

B. Warranty

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 260000, Operation and Maintenance Data," include the following:
      a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
      b. Operating instructions laminated and mounted adjacent to generator location.
      c. Training plan.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: One for every 10 of each type and rating but no fewer than one of each.
   2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
   3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
   4. Tools: Each tool listed by part number in operations and maintenance manual.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.07 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years from date of Substantial Completion.

1.08 OPERATING PARAMETERS

A. Load range: 30-100% of rated capacity.

B. Maximum Allowable Voltage dip: 35%

C. Maximum Allowable Frequency dip: 10%

D. Altitude: Less than 1200 feet

E. Ambient Temperature: 15 to plus 40 deg C.

F. Emissions: EPA, Stationary non-emergency application.

G. Fuel: Natural Gas

H. Duty: Standby

I. Voltage/Frequency: 480/277V, 60 Hz

J. Power Factor: .8, lagging.

K. Minimum size: 50 kW/62.5kVA

L. Load step and summary list:

Stage	Equipment	Voltage	Load (kVA)	Load (HP)	Starter/VFD
1	Pump 1	480V		12	VFD
1	Controls	120V	3		NA
2	Pump 2	480V		12	VFD

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
   1. Caterpillar

B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. NFPA Compliance:
   1. Comply with NFPA 37.
   2. Comply with NFPA 70.
   3. Comply with NFPA 110 requirements for standby power supply system.

B. UL Compliance: Comply with UL 2200.

C. Engine Exhaust Emissions: Comply with current EPA Tier requirements and applicable state and local government requirements. Tier requirement for natural gas generator rated for stationary Emergency applications.

D. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

2.03 ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.

C. Induction Method: Naturally aspirated.

D. Governor: Adjustable isochronous, with speed sensing.

E. Emissions: Current EPA requirements for emergency stationary applications.

F. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
   1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

G. Capacities and Characteristics:
   1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
   2. Voltage characteristics as listed above.
   3. Unit shall be capable to operate loads as indicted on drawings with minimal capacity as shown. Upsize unit to meet load capabilities and specification requirements.
   4. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components.

H. Generator-Set Performance for Sensitive Loads:
   1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
      a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
   2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
   3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
   4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
   5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
   6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
   7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
   8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
   9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
      a. Provide permanent magnet excitation for power source to voltage regulator.
   10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.04 ENGINE

A. Fuel: Natural Gas

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:
   1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
   2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
   3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity. Provide dedicated 20A receptacle and plug for 120V, 1-phase connection.

F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
   1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
   2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
   3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
   4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
   5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
      a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 degrees F (82 degrees C), and noncollapsible under vacuum.
      b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

G. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
   1. Minimum sound attenuation of 25 dB at 500 Hz.
   2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 70 dBA or less.

H. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

I. Starting System: 24-V electric, with negative ground.
   1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
   2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
   3. Cranking Cycle: As required by NFPA 110 for system level specified.
   4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
   5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
   6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 degrees C regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
   7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
   8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
   9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
      a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
      b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 degrees F (minus 40 degrees C) to 140 degrees F (plus 60 degrees C) to prevent overcharging at high temperatures and undercharging at low temperatures.
      c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.
g. Provide dedicated 20A receptacle and plug for 120V, 1-phase connection.

2.05 GASEOUS FUEL SYSTEM

A. Natural Gas Piping: Comply with current codes and per detail.

B. Gas Train: Comply with NFPA 37.

C. Engine Fuel System:
1. Vapor-Withdrawal System:
a. Carburetor.
b. Secondary Gas Regulators: One for each fuel type.
c. Fuel-Shutoff Solenoid Valves: NRTL-listed, normally closed, safety shutoff valves; one for each fuel source.
d. Fuel Filters: One for each fuel type.
e. Manual Fuel Shutoff Valves: One for each fuel type.
f. Flexible Fuel Connectors: Minimum one for each fuel connection.

D. Coordination
1. Gas Service Connections: Coordinate with utility companies and components they furnish as follows:
a. Comply with requirements of gas supplier for providing gas services.
b. Coordinate installation and connection of utilities and services, including provision for gas-metering components.
c. Local utility shall provide underground service from main to metering equipment at Owners control panel. Contractor shall coordinate with local utility to sequence work.

2.06 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

B. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A.

D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine-generator set battery.

E. Indicating Devices : As required by NFPA 110, including the following:
1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. EPS supplying load indicator.
5. Ammeter and voltmeter phase-selector switches.
6. DC voltmeter (alternator battery charging).

7. Engine-coolant temperature gage.
8. Engine lubricating-oil pressure gage.
9. Running-time meter.
10. Current and Potential Transformers: Instrument accuracy class.

F. Protective Devices and Controls in Local Control Panel: Shutdown devices and common visual alarm indication as required by NFPA 110 system, including the following:
1. Start-stop switch.
2. Overcrank shutdown device.
3. Overspeed shutdown device.
4. Coolant high-temperature shutdown device.
5. Coolant low-level shutdown device.
6. Low lube oil pressure shutdown device.
7. Air shutdown damper shutdown device when used.
8. Overcrank alarm.
9. Overspeed alarm.
10. Coolant high-temperature alarm.
11. Coolant low-temperature alarm.
12. Coolant low-level alarm.
13. Low lube oil pressure alarm.
14. Air shutdown damper alarm when used.
15. Lamp test.
16. Contacts for local and remote common alarm.
17. Run-Off-Auto switch.
18. Control switch not in automatic position alarm.
19. Low cranking voltage alarm.
20. Battery-charger malfunction alarm.
21. Battery low-voltage alarm.
22. Battery high-voltage alarm.
23. Generator overcurrent protective device not closed alarm.

G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

H. Connection to Datalink: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.

I. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

J. Remote Emergency-Stop Switch: Mount on enclosure exterior unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.07 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.
1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous, long-time trip setting shall be capable of setting down to a minimum of 50% breaker rating.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.08 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide six lead alternator.

E. Range: Provide broad range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Dripproof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
   1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
   2. Maintain voltage within 15 percent on one step, full load.
   3. Provide anti-hunt provision to stabilize voltage.
   4. Maintain frequency within 5 percent and stabilize at rated frequency within 2 seconds.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Subtransient Reactance: 12 percent, maximum.

2.09 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be hinged. Instruments and control shall be mounted within enclosure.
   1. Sound Attenuation Level: 70dB at 25 feet.

B. Description: Prefabricated or pre-engineered, galvanized-steel-clad, integral structural-steel-framed, enclosure; erected on concrete foundation.

C. Hinged Doors: With padlocking provisions.

D. Space Heater: Thermostatically controlled and sized to prevent condensation.

E. Lighting:
   1. Interior light with switch and LED weather-resistant lighting.

F. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

G. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
   1. Automatic Dampers: At engine cooling-air inlet and discharge. Damper shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
   2. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.

H. Two Convenience Outlets: Factory wired, GFCI. Power from factory provided power distribution center.

I. Provide generator prime mover shutdown kit on exterior of enclosure to meet requirements of NEC Article 445.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
   1. Material: Natural rubber separated by steel shims.
   2. Shore "A" Scale Durometer Rating: 60.
   3. Number of Layers: as required by manufacture.
   4. Minimum Deflection: 1 inch (25 mm).

B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Equipment Mounting:
   1. See drawings for concrete pad. Coordinate conduit routing with floor and pad installation.

2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Install packaged engine-generator to provide access, without removing connections or accessories, for periodic maintenance.

D. Install packaged engine-generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on room floor. Secure sets to anchor bolts installed in concrete bases. Concrete base/floor is detailed on structural drawings.

E. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints.

F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine-generator to allow service and maintenance.

C. Connect engine exhaust pipe to engine with flexible connector.

D. Connect fuel piping to engines with a gate valve and union and flexible connector.
1. Natural-gas piping, valves, and specialties for gas distribution per details on drawings and applicable codes.
2. Install manual shutoff valve in a remote location to isolate natural-gas supply to the generator enclosure or room.

E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.04 IDENTIFICATION

A. Equipment" and Section 260553 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections.

D. Tests and Inspections:
   1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
      a. Visual and Mechanical Inspection
         1) Compare equipment nameplate data with drawings and specifications.
         2) Inspect physical and mechanical condition.
         3) Inspect anchorage, alignment, and grounding.
         4) Verify the unit is clean.
      b. Electrical and Mechanical Tests
         1) Perform insulation-resistance tests in accordance with IEEE 43.
            a) Machines larger than 200 horsepower (150 kilowatts). Test duration shall be 10 minutes. Calculate polarization index.
            b) Machines 200 horsepower (150 kilowatts) or less. Test duration shall be one minute. Calculate the dielectric-absorption ratio.
         2) Test protective relay devices.
         3) Verify phase rotation, phasing, and synchronized operation as required by the application.
         4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
         5) Conduct performance test in accordance with NFPA 110.
         6) Verify correct functioning of the governor and regulator.
   2. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
      a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
      b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
      c. Verify acceptance of charge for each element of the battery after discharge.
      d. Verify that measurements are within manufacturer's specifications.
   3. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
   4. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
   5. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
   6. Exhaust Emissions Test: Comply with applicable government test criteria.
   7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
   8. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 percent and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
   9. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

E. Coordinate tests with tests for transfer switches and run them concurrently.

F. Test instruments shall have been calibrated within the last 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

G. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

H. Provide a 4 hour run test utilizing load bank. Monitor current, voltage, temperature, record reading every 15 minutes. Test shall be operated a 1/2 load for 1 hour, 3/4 load for 1 hour, and full load for 1 hours.

I. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

J. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

K. Remove and replace malfunctioning units and retest as specified above.

L. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

M. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.06 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Training session shall be a minimum of 4-hours on-site to review all components of the generator set.

B.

END OF SECTION

SECTION 33 32 10

WET WELL AND VALVE VAULT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Precast concrete Structure.
   2. Submersible wastewater pumping units and appurtenances.
   3. Pump access equipment.
   4. Internal piping.

B. Related Sections:
   1. Section 01 33 00 - Submittal Procedures
   2. Section 09 91 50 - Shop Painting
   3. Section 09 97 20 - Coating Systems for Industrial Facilities
   4. Section 40 23 00 - Process Piping General Provisions
   5. Section 40 23 10 - Process Water and Waste Piping
   6. Section 40 23 20 - Process Valves and Operators

1.02 REFERENCES

A. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings

B. ASTM:
   1. A48 - Gray Iron Castings
   2. A126 - Gray Iron Castings for Valves, Flanges and Pipe Fittings
   3. C478 - Precast Reinforced Concrete Manhole Sections

C. UL 778 - Standard for Safety Motor-Operated Water Pumps

1.03 DESCRIPTION

A. Submersible pumping units installed directly in a wet pit.

B. Units can be easily raised or lowered along vertical guide bars without operator entering the pit or manually disconnecting any piping.

C. Units can be raised to ground level for inspection and repairs.

D. Units automatically connect to discharge connection when lowered into place.

E. Number of Pumping Units: Two

F. Pumping units and discharge connection shall be supplied by the same manufacturer

1.04 SUBMITTALS

A. Shop Drawings:
   1. Shop drawings in accordance with Section 01 33 00 – Submittal Procedures.
   2. Anchor bolt details.
   3. Precast concrete vault details and dimensions.
   4. Equipment assemblies.
   5. Wiring diagram.

B. Product Data:
   1. Manufacturer's installation instructions.
   2. Coating data sheets.
   3. Operating and maintenance data in accordance with Section 01 78 23.
   4. Warranty for pumping units and appurtenant equipment.

C. Certified installation inspection and start-up report.

D. Name and address of factory-approved service facility.

1.05 QUALITY ASSURANCE

A. Provide certificates from the manufacturer certifying that the following materials meet the respective requirements.
   1. Precast concrete vault.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Precast Concrete Wet Well and Valve Vault:
   1. ASTM C478.
   2. Dimensions: See Drawings.
   3. Provide cover for traffic loading.
   4. Interior Contact Surfaces:
      a. Refer to Section 09 97 20 - Coating Systems for Industrial Facilities
   5. Joints: Gasketed.
   6. Integral cast base.
   7. Pipe Connections: Use tapered hole locators and positive sealing expandable rubber boots, unless noted otherwise in Drawings.
   8. The structure base shall be integrally cast with the bottom barrel section

2.02 ACCESSORIES

A. Wet Well and Valve Vault Access Hatches:
   1. Wet Well hatch Single leaf 36"X56"
   2. Valve Vault hatch: Single Leaf 36"X42"
   3. Orientation as shown on Drawings.
   4. Doors: 1/4-inch aluminum diamond pattern plate designed to withstand a live load of 300 pounds per square foot except:
   5. Channel Frame: 1/4-inch aluminum with an anchor flange around the perimeter.
   6. Hinges: 316 Stainless steel with stainless steel pins.
   7. Hardware: 316 stainless steel, including all parts of latch and lifting mechanism assemblies, hold open arms and guides and all brackets and fasteners.
   8. Covers shall be counterbalanced.
   9. Equip each hatch with a recessed hinged hasp for padlocking. All hasps and padlocking parts shall be 1/4-inch type 316 stainless steel.
   10. Finish: Mill finish with bituminous coating applied to surface in contact with concrete.
   11. Seal: Shall have built in neoprene gasket.
   12. Maximum allowable deflection shall be 1/150 of the span.
   13. Safety Grate:
      a. Secondary protective grating panel shall be 1-inch thick aluminum "I" bar grating.
      b. Grating panel color and finish shall be Safety Yellow powder- coating.
      c. Grating panel shall be hinged with tamper proof stainless steel bolts, and shall be supplied with positive latch to maintain unit in an upright position.
      d. A 6-inch viewing area shall be provided on each lateral unhinged side of grating panel, for visual observation and limited maintenance procedures.
      e. A padlock hasp for owner-supplied padlock shall be provided.

B. Pump Guide Bars and Brackets:
   1. Guide rail and lift out system provided for each Raw Sewage Pump.
   2. Guide bars, supports and fasteners:
      a. 316 stainless steel.
      b. Two (2) Schedule 40 pipe guide bars per pump with supports at bottom, top and midpoint.
      c. Attach intermediate support brackets to discharge piping at minimum 10-foot intervals.
   3. Diameter: As recommended by manufacturer.
   4. Length: As required to extend from lower guide holder or discharge connection to upper guide holder mounted on the access frame.

C. Cable Holder:
   1. Cable holder: fabricate from 316 stainless steel and attach below pump access cover.
   2. Manufacturer's standard configuration.
   3. Cable shall be configured for easy attachment to davit crane wire rope in order to pull Raw Sewage Pumps out of wet well for maintenance.

D. Vent Pipe: Refer to the Drawing for sizing and location.

E. Manhole Steps:
   1. Provide as shown in the Drawing.
F. The concrete mix
   1. shall be Type I or II cement with entrained air content of not less than 4 percent and not more than 7 percent, Grade A concrete with a cement-water ratio of 0.50 and a minimum compressive strength of 4,000 psi at 28 days.
   2. Precast structure shall have attained the specified design strength when delivered to the project site.
G. Top Slab:
   1. Type II precast reinforced concrete having the dimensions shown on the detail drawings. Frames for access hatches and vent pipe shall be cast in the slab when fabricated. Cutouts to accommodate all piping entering the wetwell shall be performed or pre-cut and provided with a seal or water stop to ensure a watertight connection between pipe and wetwell.

PART 3 EXECUTION

3.01 INSTALLATION

A. Precast Concrete Wet Well:
   1. Construct wet well and cover in accordance with Drawing details and elevations.
   2. Provide dewatering.
   3. Provide trench excavation, foundation, and backfill.
   4. Place wet well on compacted granular subgrade.
   5. Contractor to submit wet well buoyancy calculations from a Minnesota licensed professional engineer to prevent uplift and provide minimum safety factor of 1.1 based on groundwater elevation of 887.00.
   6. Fill joints between barrel sections and around pipe connections with mortar or approved joint compound.
   7. Touch-up coating abrasions and joints after installation.

END OF SECTION

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SECTION 40 23 00

PROCESS PIPING GENERAL PROVISIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section pertains to:
   1. Submittals
   2. Quality Assurance
   3. Delivering, Handling, and Storage
   4. Installation
   5. Process Piping General Provisions items:
      a. Process Piping Materials
         1) Interior and Non-Buried
            a) Process Water and Waste Piping and Fittings
            b) Piping Valves and Operators
            c) Piping Specialties
            d) Piping Hangers and Supports
         2) Underground Utility
            a) Process Water and Waste Piping and Fittings for Utilities
            b) Piping Specialties for Utilities

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME)
   1. ASME B31.1.0 ASME code or pressure piping

B. American Society for Testing and Materials (ASTM):
   1. A53-90b - Specification for pipe, steel, black and hot dipped zinc coated welded and seamless.
   2. A126-93 - Specification for gray iron castings for valves, flanges and pipe fittings.
   3. A240.83 - Specification for heat-resisting chromium and chromium-nickel stainless steel plate, sheet and strip for pressure vessels.
   4. A312 - Specification for Seamless, Welded, and Cold Worked Austenitic SS Pipe.
   5. A351 - Specification for Castings, Austenitic, for Pressure Containing Parts.
   6. A380 - Specification for Corrosion Protection, Acid Pickling.
   7. A403 - Specification for Wrought Austenitic Stainless Steel Piping Fittings.
   8. A480 - Specification for Stainless Steel Finish.
   9. A530-88 - Specification for General Requirements for specialized carbon and alloy steel pipe.
   10. A536 - Specification for Ductile Iron Castings
   11. A554 - Specification for Welded Stainless Steel Mechanical Tubing.
   12. A554-81 - Specification for as-welded wrought austenitic stainless steel fittings for general corrosive service at low and moderate temperatures.
   13. A743 - Specification for Castings, Iron-Chromium-Nickel, for General Applications.
   14. A744 - Specification for Castings, Iron-Chromium-Nickel for Severe Service.
   15. A774 - Specification for Stainless Steel Welded Fittings.
   16. A778-82 - Specification for welded unannealed austenitic stainless steel tubular products.
   17. D1171 - Specification for Elastomer Deterioration.
   18. A774-91 - Specification for as-welded wrought austenitic stainless steel fittings for general corrosive service at low and moderate temperatures.
   19. A778-90a - Specification for welded, unannealed austenitic stainless steel fittings for general corrosive service at low and moderate temperatures.
   20. B62-93 - Specification for composition bronze or ounce metal castings.
   21. F439-93a - Specification for socket type chlorinated polyvinyl plastic (CPVC) pipe fittings.
   22. F441-93 - Specification for chlorinated polyvinyl chloride (CPVC) Schedule 40/80 piping.

23. D1785-93 - Specification for polyvinyl chloride (PVC) Schedule 04/80/120 (for pressure piping applications.
24. D2310-91 - Classification for machine -made (fiberglass) reinforced thermosetting resin pipe.
25. D2464-93 - Specification for threaded poly (vinyl chloride) (PVC) plastic pipe fittings, Schedule 80.
26. D2467-93 - Specification for socket type poly (vinyl chloride) (PVC) plastic pipe fittings.
27. D2997-90 - Specification for centrifugally cast (fiberglass) reinforced thermosetting resin pipe.
28. D3034-93 - Specification for type PSM poly (vinyl chloride) (PVC) sewer pipe and fittings.
29. D3350-93 - Specification for polyethylene plastic pipe and fittings material.

C. American Water Works Association (AWWA)
1. C104 - American National standard for cement - mortar lining for ductile iron pipe and fittings for water.
2. C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. C110 - American National Standard for ductile iron and gray iron fittings, 3-inch through 48-inch for water and other liquids.
4. C111 - American National Standard for rubber gasket joints for ductile iron and gray iron pressure pipe and fittings.
5. C115 - American National Standard for flanged ductile iron pipe with threaded flanges.
6. C150 - American National Standard for flanged ductile iron pipe with threaded flanges.
7. C151 - American National Standard for ductile iron pipe, centrifugally cast-in-metal molds or sand line molds, for water and other liquids.
8. C153 - American National Standard for Ductile Iron Compact Fittings for Water Service.
9. C200 - Standard for steel water pipe 6-inch or larger.
10. C203 - Standard for coal-tar protective coatings and linings for steel water pipelines - enamel and tape - hot applied.
11. C206 - Field welding of steel water pipe.
12. C207 - Standard for steel pipe flanges for waterworks service - sizes 4-inch through 144-inch.
13. C500 - Standard for gate valves, for water and sewerage systems.
14. C504 - Standard for rubber seated butterfly valves.
15. C508 - Standard for swing check valves for waterworks service, 2-inch through 24-inch NPS.
16. C509 - Standard for resilient-seated gate valves for water supply and service.
17. C510 - Standard for double check valve backflow prevention assembly.
18. C512 - Air-release, air/vacuum, and combination air valves for waterworks service.
19. C517 - Standard for Resilient-Seated Cast-Iron Eccentric Plug Valves
20. C540 - Power actuating devices for valves and sluice gates.
21. C600 - Installation of ductile-iron water mains and their appurtenances.
22. C606 - Standard for grooved and shouldered joints.
23. C651 - Standard for disinfecting water mains.

D. American Iron and Steel Institute (AISI)
1. 304 - Specification for 304 Stainless Steel Plate.
2. 304L - Specification for 304L Stainless Steel Plate.
3. 316 - Specification for 316 Stainless Steel Plate.
4. 316L - Specification for 316L Stainless Steel Plate.

E. American National Standards Institute (ANSI)
1. B-16.1 - Specification for Pipe Flanges.
2. B-16.5 - Specification for Pipe Flanges

1.03 SUBMITTALS

A. Vendor and manufacturer information:
1. Name, address, toll-free phone number and email address of manufacturers.
2. Name, address and phone number of local service representative.

B. Shop Drawings:
1. Shop Drawings in accordance with Section 01 33 00 - Submittal Procedures
2. Size, Model Number and Serial Number of each component.

3. Typical installation guides.
4. Installation, inspection and start-up report in accordance with Section 01 75 00 - Starting and Adjusting.
5. Exterior yard piping drawings (minimum scale 1-inch equals 10-feet) with information including:
    a. Dimensions of piping lengths.
    b. Centerline elevations of piping crossings.
    c. Acknowledgement of bury depth requirements.
    d. Details of fittings, tapping locations, thrust blocks, restrained joint segments, harness joint segments, hydrants, and related appurtenances.
    e. Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
    f. Line slopes and vents.
    g. Identify insulation system proposed and provide manufacturer information for system.
6. Interior piping drawings (minimum scale 1/8-inch equals 1-foot) with information including:
    a. Dimensions of piping from column lines or wall surfaces.
    b. Centerline dimensions of piping.
    c. Centerline elevation and size intersecting ductwork conduit/conduit racks, or other potential interferences requiring coordination.
    d. Locations of valves and valve actuator type.
    e. Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appetences.
    f. Acknowledgement of valve, equipment and instrument tag numbers.
    g. Provisions for expansion and contraction.
    h. Line slopes and are release vents.
    i. Piping supports and hangers:
        1) Location and style of all pipe hangers, supports and anchors.
        2) Length of pipe and pipe spools for exposed piping.
        3) Detailed piping layout for connection to existing and proposed pipe and equipment.
        4) Process pipe coating color and labeling.
    j. Identify insulation system proposed and provide manufacturer information for system.
7. Schedule of interconnections to existing piping and method of connection.

C. Test Reports:
1. Copies of pressure test results on all piping systems.
2. Reports defining results of testing and corrective action taken.
3. Notification of time and date of piping pressure tests.

D. Operation and Maintenance Manuals
1. Operation and maintenance data in accordance with Section 01 78 23 - Operation and Maintenance Data
2. Parts list and list of recommended spare parts
3. Printed warranty shall be provided within 10 days of commencement of the warranty period.

E. Evidence of experience and installations as described in Section 2.01.

F. Refer to individual specification sections for additional submittal requirements.

1.04 RELATED SECTIONS

A. Refer to the following specification sections for additional requirements:
1. Section 01 33 00 - Submittal Procedures
2. Section 09 91 50 - Shop Painting
3. Section 09 97 20 - Coating Systems for Industrial Facilities
4. Section 40 23 10 - Process Water and Waste Piping and Fittings
5. Section 40 23 20 - Process Valves and Operators
6. Section 40 23 30 - Process Specialties
7. Section 40 23 40 - Process Hangers and Supports
8. Section 40 23 60 - Process Pipe Testing

1.05 QUALITY ASSURANCE

A. The physical and chemical properties of all materials, design, performance characteristics and methods of construction and installation of all process items shall be in accordance with applicable current editions of the following standards, references, and guidelines.
   1. American Water Works Association (AWWA)
   2. American Society for Testing and Materials (ASTM)
   3. American Society of Mechanical Engineers (ASME)
   4. American National Standards Institute (ANSI)
   5. Occupational Safety and Health Act (OSHA)
   6. National Electrical Manufacturers Association (NEMA)
   7. Institute of Electrical and Electronic Engineers (IEEE)
   8. Underwriters Laboratories, Inc. (UL)
   9. The Chlorine Institute
   10. Pipe Fabrication Institute

B. All materials, equipment and their installation shall comply with the applicable sections of the following current codes:
   1. Minnesota Rules, Chapter 4720.
   2. Recommended Standards for Water Works (“10 State Standards”), Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers.

C. Provide Certificates of Compliance from the manufacturer certifying that the particular product meets the respective requirements for that item.

D. All welding shall be performed by ASME certified welders. Submit copies of the welder’s certification to the Engineer prior to any welds made.

1.06 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage, and handling in accordance with Section 01 60 00 – Product Requirements.

B. Inspection:
   1. Inspect all pipe and products as it is received to determine damage and/or missing parts.
   2. Notify Engineer of any missing, damaged, or defective products.
   3. Remove all products found to be defective by the Engineer from the site.
   4. Repair or replace damaged items in accordance with the manufacturer’s instructions.

C. Handling and Storage:
   1. Handling and storage of products shall be in accordance with Section 22 of AWWA C600.

D. Scheduling
   1. Schedule all process work in phases to accommodate the Owner’s occupancy and treatment requirements.
   2. Refer to Specification Section 01 51 00 Temporary Utilities in advance of any service interruption, disruption to construction activities, or to the existing process system operation. Do not proceed until the Owner has granted approval.

E. Provide storage and handling requirements for materials as recommended by equipment manufacturer and supplier is accordance with Section 01 78 23 Operation and Maintenance Data.

1.07 WARRANTY

A. Manufacturer agrees to repair or replace components that fail(s) in material or workmanship within specified warranty period.
   1. Standard Warranty Period: One (1) year from date of Substantial Completion. Standard warranty shall be Non-Pro-Rated with unlimited hours of operation.

B. Cost for any evaluation or inspections, removal, shipment, repair and installation by Contractor shall be included in warranty, as well as correction of defective work.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. All equipment called for in this section shall be supplied by a single manufacturer or authorized sales representative to assure uniform quality, ease of maintenance, and minimal parts storage.

B. No equipment shall be supplied by a manufacturer not regularly engaged in the manufacturing and production of equipment detailed in this section. Manufacturers must have installed and had in satisfactory use for a period of not less than 5 years, a minimum of 6 installations of equivalent equipment specified and shall submit evidence of such with the shop drawings.

2.02 GENERAL

A. Process Piping Materials
   1. Materials used shall be in accordance with the requirements for class and size as specified or shown on the Drawings.
   2. All portions of the process piping system shall be capable of handling stresses that may occur during fabrication, installation, pressure testing and intermittent or continuous operation.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with Manufacturer's recommendations and as shown on Drawings.

B. All installation of equipment shall be performed by the Contractor. All required installation hardware (such as, but not limited to, support braces, bolts, washers, nuts, and jam nuts) shall be furnished by the Contractor.

C. Manufacturer's authorized representative shall supervise critical installation procedures as necessary, inspect final installation, perform any necessary calibration and adjustment, and start up the equipment. A copy of the startup report shall be included in the O&M manual.

D. Examination
   1. Determine locations and dimensions of existing structures, piping, and equipment associated with or potentially interfering with the proper fabrication and installation of proposed work.
   2. Coordinate final length and location of required pipe connections to all process equipment to meet the recommendations and requirements of the equipment manufacturer subject to approval of the Engineer.
   3. No work shall be installed that directly connects to equipment until such time as complete Shop Drawings of said equipment have been reviewed by the Engineer.
   4. Determine and be responsible for the proper locations and character of all hangers, chases, sleeves and other openings in the construction required for all process piping work.
   5. Refer to other drawings for exact locations of partitions, walls, doors, equipment, etc.

E. Exposed Process Piping, Valves, Supports, and Accessories
   1. Provide piping systems in accordance with the manufacturer's instructions and recommendations.
   2. Provide ductwork, piping, electrical connections, valves, and appurtenances recommended by the manufacturer for proper operation to complete the operation.
   3. Install all process piping systems to facilitate accessibility for maintenance and/or replacement.
   4. Protect all work from subsequent construction activity.
   5. In place components will be salvaged at the discretion of the Owner.
      a. Remove and deliver salvaged items as directed by Owner.

b. Non-salvaged items will become property of the Contractor and promptly removed from the Site.

F. Underground Pipe Trenches
1. Excavate, backfill, and compact pipe trenches in accordance with Section 31 23 33 - Trench Excavation and Backfill.
2. Underground pipe shall have a minimum of 7.5 feet of cover unless otherwise specifically noted.
a. Pipe buried less than 7.5 feet shall be insulated in accordance with Section 33 05 05 - Process Piping Insulation for Utilities.

G. Grooved Joint Installation
1. Couplings and fittings shall be installed in accordance with manufacturer's latest installation instructions.
2. Gaskets shall be verified as suitable for the intended service.
3. The grooved coupling manufacturer's factory-trained representative shall provide on-site training in grooved product installation and the proper use of grooving tools.
4. The representative shall periodically visit the job site to ensure best practices are being followed.

H. Buried Pipe Encasement
1. Comply with AWWA C105.
2. Clean all surfaces of pipe and appurtenances prior to wrapping.
3. Provide sufficient slack to prevent damage during backfill.
4. Provide minimum 6-inch overlap at joints.
5. Secure overlap and joints with compatible adhesive tape.
6. Repair damaged wrap with tape or polyethylene patch.
7. All below ground non-stainless-steel piping, fittings, and accessories shall be encased.
a. Polyethylene Sheet: AWWA C105 Low Density
b. Thickness: 8 mil

I. Connections with Existing Piping
1. Where connection between new and existing work is made, use suitable and proper fittings to suit conditions encountered.
2. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.
3. Where connection involves potable water systems, provide disinfection methods as prescribed in these Specifications.

3.02 FIELD QUALITY CONTROL

A. Protection
1. Where new facilities have been physically connected to existing facilities, Contractor shall, at all times when pipe installation is not in progress, and at times when directed by the Engineer, keep pipeline openings, tightly closed with preformed stoppers, caps, plugs, sealed plywood, sheet metal bulkheads, sandbags, or other means acceptable to the Engineer. Closures shall be suitable to prevent entrance of animals, foreign materials, and extraneous water (storm water, ground water, dewater discharges, and other sources) into the system. Engineer may direct Contractor to secure various openings and to resecure previously closed openings, all at no additional cost to the Owner.
2. Protect underground and overhead utility like structures from damage. Provide temporary support, adequate protection and maintenance of all structures, surface and subsurface drains, sewers, and other obstructions encountered. Repair or replace any damage to the above.

B. Refer to 40 23 50 Process Piping Testing for additional requirements.

END OF SECTION

SECTION 33 34 00

PROCESS WATER AND WASTE PIPING AND FITTINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes installation of sewage force main.
   1. Refer to Specification 33 32 40 Piping Valves & Assoc Equipment for Pumping Station for unburied, flanged piping and valves located in vaults.

B. Related Sections:
   1. Section 01 33 00 - Submittal Procedures
   2. Section 01 51 00 - Temporary Utilities
   3. Section 01 60 00 - Product Requirements
   4. Section 09 91 50 - Shop Painting
   5. Section 09 97 20 - Coating Systems for Industrial Facilities
   6. Section 40 23 00 - Process Piping General Provisions
   7. Section 40 23 20 - Process Valves and Operators
   8. Section 40 23 30 - Process Specialties
   9. Section 40 23 40 - Process Hangers and Supports
   10. Section 40 23 60 - Process Pipe Testing

1.02 REFERENCES

A. ANSI:
   1. A21.4 - Standard for Cement - Mortar Lining for Ductile Iron Pipe and Fittings
   2. A21.11 - Standard for Rubber - Gasket Joints for Ductile Iron Pressure Pipe and Fittings
   3. A21.51 - Standard for Ductile Iron Pipe, Centrifugally Cast
   4. A21.53 - Standard for Ductile Iron Compact Fittings

B. ASTM:
   1. D2241 - Specification for PVC Pressure-Rated Pipe

1.03 QUALITY ASSURANCE

A. Provide certificates from manufacturers certifying that the following materials in Part 2 meet the referenced requirements.

1.04 DELIVERY OF MATERIALS

A. Inspect all pipe and materials during the unloading process.

B. Notify Engineer of any cracked, flawed, or otherwise defective material.

C. Remove all materials found to be unsatisfactory by Engineer from the Site.

PART 2 PRODUCTS

2.01 GENERAL

A. All equipment of the same type called for in this section shall be supplied by a single manufacturer or authorized sales representative to assure uniform quality, ease of maintenance, and minimal parts storage.

B. All forcemain fittings shall be ductile iron, and all pipe sections shall be fully restrained.

2.02 MANUFACTURERS

A. DI Pipe and Fittings specified in this Section shall be manufactured by:
   1. American Cast Iron Pipe Co.,
   2. U.S. Pipe,
   3. or Equal

B. PVC Pipe specified in this Section shall be manufactured by:
   1. ISCO Industries, Inc.,
   2. or Equal

C. PVC Pipe specified in this Section shall be manufactured by:
   1. U.S. Plastic,
   2. Northern Pipe,
   3. JM Eagle,
   4. or Equal

2.03 PIPING

A. Provide:

Material	Class	Joint
Epoxy-Lined Ductile Iron Pipe	250	Push-On
Epoxy-Lined Ductile Iron Fittings	250	Mechanical

B. Provide all pipe and fittings of each material type from the same manufacturer.

C. Ductile Iron
   1. AWWA C151.
   2. Epoxy Lining:
      a. Induron product Protecto 401,
      b. Sherwin Williams product RRC High Performance Epoxy,
      c. Tnemec product Series 431 Perma-Shield PL, or
      d. Approved equal.
   3. Pipe Thickness
      a. Design buried piping per AWWA C150 for 150 psi operating pressure plus 100 psi surge. Furnish buried piping design for actual depth of bury but not less than 8-feet.
         1) Minimum ANSI/AWWA thickness Class 52.
      b. All interior ductile iron pipe shall be ANSI/AWWA thickness Class 50 (minimum)
   4. Joint Type:
      a. Buried piping:
         1) Push-on: AWWA C151.
         2) Mechanical: AWWA C110 & C111.
         3) All pipes shall be restrained.

D. Buried pipe shall be installed with polyethylene encasement. Polyethylene encasement shall have a minimum thickness of 8 mils and meet or exceed the minimum standards established by AWWA C105, current edition. Acceptable manufacturers include U.S. Pipe or approved equal.
   1. Polyethylene encasement shall meet minimum size requirement per Table 3 of Section 2.15 of DIPRA's Installation Guide for Ductile Iron Pipe.
   2. A 2-inch wide plastic adhesive tape, such as Calpico Vinyl, Polyken 900, or approved equal, shall be used for sealing seams, cuts, or tears in polyethylene encasement. Duct tape shall not be allowed.

E. High-density polyethylene (HDPE)
   1. ASTM F714, ASTM D3350
   2. Pipe Size: DIPS
   3. Pressure class:
      a. DR 17
   4. Joint Type:
      a. Butt Fused/Electrofusion.
   5. Design Loading: HL93

F. Retainer glands
   1. Furnish retainer glands for all buried pipe connections to fittings and valves, and where otherwise indicated.
   2. Material: 4140 grade alloy steel and heat treated to a Rockwall C 45/53 case hardness.
   3. Retainer glands shall be Clow F1058, Tyler Union equivalent, or equal.

2.04 ANCHOR BOLTS AND NUTS

A. Bolts for Interior Fittings and Valves:
   1. For ductile iron
      a. Heavy hex head steel per ANSI B18.2.1.
      b. Heavy hex nuts per ANSI B18.2.2.
      c. Zinc plated per ASTMB633.
      d. Steel conform to ASTM A307.
   2. Stainless steel shall be used in the following location/conditions:
      a. Submerged.
      b. Exterior flanged pipe.
      c. Lift Stations.

B. Bolts for Buried Fittings:
   1. For ductile iron
      a. 304 stainless steel; or
      b. Manufactured to ANSI/AWWA C111/A21.11 standards.
         1) Baked on fluorocarbon resin finish.
         2) Cor-Blue by NSS Industries, Plymouth, Michigan or equal

PART 3 EXECUTION

3.01 PIPE INSTALLATION

A. Inspect pipe for defects and cracks while suspended.

B. Remove all dirt and foreign material from pipe interior prior to lowering into trench.

C. Install pipe at the elevations and grades indicated by Drawings and field stakes.

D. Pipe Foundation and Backfill Procedures: See Section 31 23 33.

E. Remove all dirt and foreign material from the pipe interior prior to testing.

F. Provide temporary sanitary sewer service per Section 01 51 00.

3.02 FITTING INSTALLATION

A. Anchor fittings by means of restrained joint devices installed according to manufacturer’s recommendations.

3.03 FIELD QUALITY CONTROL

A. Refer Section 40 23 60 Process Pipe Testing.

B. Perform the following tests upon completion of force main construction and prior to connection to lift station.
   1. Pressure Test:
      a. Subject the entire length of force main to hydrostatic pressure test of 100 psi for a period of 2 hours.
      b. Measure pressure at lowest pipe elevation.
      c. Maintain constant pressure throughout test period.
      d. Provide pumps, gages, connections and other necessary apparatus.
   2. Leakage Test:
      a. Measure water volume required to maintain test pressure.
      b. Allowable leakage shall be determined by the formula:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

L = Allowable Leakage in Gallons

S = Length of Pipe Tested in Feet

D = Nominal Diameter of Pipe in Inches

P = Test Pressure in Pounds/Square Inch

C. Provide corrective measures for any line exceeding allowable leakage.

END OF SECTION

SECTION 40 23 20

PROCESS VALVES AND OPERATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes furnishing and installation of:
   1. Process Valves and operators which are:
      a. Above ground and exterior of structures.
      b. Interior of structures.
   2. Process Water and Waste Piping Valves
      a. Swing-Check Valves (2-inch through 36-inch)
      b. Gate Valve
      c. Plug Valve
   3. Process Water and Waste Piping Valve Accessories.
      a. Handwheel Operators
      b. Floor Boxes
      c. Valve Extension Stem
      d. Adjustable Stem Guides
      e. Equipment Identification Tags
   4. Anchor Bolts and Hardware
   5. Spare Parts and Special Tools

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C508 - Swing-Check Valves for Waterworks Service, 2-Inch Through 24-Inch

1.03 SUBMITTALS

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

1.04 RELATED SECTIONS

A. Refer to the following specification sections for additional requirements:
   1. Section 01 33 00 - Submittal Procedures
   2. Section 01 60 00 - Product Requirements
   3. Section 01 78 37 - Product Warranties
   4. Section 09 91 50 - Shop Painting
   5. Section 09 97 20 - Coatings for Industrial Facilities
   6. Section 40 23 00 - Process Piping General Provisions
   7. Section 40 23 10 - Process Water and Waste Piping
   8. Section 40 23 40 - Process Piping Hangers and Supports
   9. Section 40 23 60 - Process Piping Testing

1.05 QUALITY ASSURANCE

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

1.06 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

1.07 WARRANTY

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Refer to individual component sections for Approved manufacturers.

B. Reference Section 01 25 13 - Product Substitution for information pertaining to procedures for non-Basis of Bid substitutions or “or equal” items.

C. All equipment called for in this section shall be supplied by a single manufacturer or authorized sales representative to assure uniform quality, ease of maintenance, and minimal parts storage.

D. No equipment shall be supplied by a manufacturer not regularly engaged in the manufacturing and production of equipment detailed in this section. Manufacturers must have installed and had in satisfactory use for a period of not less than 5 years, a minimum of 10 installations of equivalent equipment specified and shall submit evidence of such with the shop drawings.

2.02 GENERAL

A. These specifications shall be considered as minimum requirements. The Contractor or Equipment Supplier shall add such additional features as are necessary for satisfactory operation and functioning of pumping equipment.

B. Provide valves of the same size, joint type, and body material as the corresponding piping, unless otherwise indicated.

2.03 PRODUCTS

A. Swing-Check Valves (2-inch through 36-inch)
   1. AWWA C508.
   2. Joint: Flanged.
   3. Air-cushioned.
   4. Ductile Iron Body.
   5. Approved Manufacturer/Model:
      a. Golden Anderson Figure No. 250-D.
      b. APCO Series 250,
      c. Pratt Series 8501,
      d. or equal

B. Gate Valves:
   1. Resilient Seated: AWWA C509 OR C515.
   2. Working Pressure: 200 psi.
   3. Ends: Mechanical Joint with ASTM A307 and A563 Carbon Steel OR ASTM F593 and F594 type 304 Stainless Steel bolts and nuts.
   4. Operating Stem: Non-Rising with O ring Seals.
   5. Operating Nut: 2-inch Square, Open Left.
   6. Markings to be cast on the bonnet or body:
      a. Open indicating arrow.
      b. Manufacturer’s name.
      c. Pressure rating.
      d. Year of manufacture.
      e. Size.

C. Plug Valves for In-Plant Application (3-inch through 72-inch)
   1. Non-lubricated, Eccentric Type:

a. Plugs: Resilient-faced.
b. Rectangular or round port design.
c. Port Areas:
1) Minimum 80 percent of full pipe area.
2) Provide 100 percent of full pipe area for isolation valves upstream and downstream of pumps.

2. Operators - see Drawings.
a. Provide chain wheel with chain for installations greater than 6 feet above floor at centerline.
1) Provide galvanized shrouded pocket handwheels and shearidized chains.
b. Maximum pull: 80 pounds at the rim.
c. Maximum diameter: 12 inches.
d. Electrically actuated valves shall have handwheel operators for manual operation during actuator failure.

3. Adjustable Packing on Non-submerged Valves:
a. Accessible without removing the actuator.
b. Spacer design to allow inspection for leaking.

4. Pressure Ratings for Valves:
a. Up to 12 Inches: 175 psi.
b. 14 Inches Through 36 Inches: 150 psi.
c. 42 Inches and Larger: 125 psi.

5. Valve Body:
a. Cast iron, ASTM A126, Class B.
b. Flanges: Cast iron, ANSI B16.1, Class 125.

6. Plugs:
a. Resilient-faced.
b. Cast iron, ASTM A126, Class B.
c. Eccentrically offset seating surface.
d. One-piece with integral shafts.
e. Encapsulate entire face with Buna-N rubber.
f. Port areas in Full-open Position:
1) Valves up to 20 Inches: 80 percent of adjacent pipe diameter.
2) 20 Inches and Larger: 70 percent of adjacent pipe diameter.
3) For all flow control valves on pump suction piping regardless of diameter, minimum 100 percent of full pipe area.
4) No cavities.
g. Valve Seat Mating Surface:
h. Solid, one-piece 304 stainless steel ring or welded nickel seat.
i. Precision machine to be droptight in either flow direction.

7. Shaft Bearings:
a. Replaceable, sleeve-type in upper and lower trunions.
b. Corrosion-resistant with low coefficient of friction.

8. Valve Shaft Seals:
a. Multiple V-ring or U-cup/O-ring type.

9. Mechanical Brake:
a. Provide, as required, to maintain and lock the plug in any intermediate position.

10. Valve shall be internally and eternally factory coated with minimum 8 mil DFT of 2-part epoxy for corrosion protection. See Section 09 91 50.

11. Approved Manufacturers:
a. DeZurik,
b. Keystone,
c. Clow,
d. or equal

D. Air and Vacuum Release Valves
1. The Combination Air Valve shall be designed to exhaust large amounts of air during filling, to release small amounts of accumulated air during operation and to admit large amounts of air upon impending vacuum during draining.
2. The valve shall be float operated and both the Air & Vacuum and Air Release functions shall be housed in a single body. Body and cover shall be housed in a single body. Body and cover shall

be of cast iron conforming to ASTM A126, Class B. All leverage mechanism parts and the float shall be stainless steel, no plastic or bronze parts shall be permitted. The large and small orifice seats shall be Buna-N and shall be renewable.

3. The Combination Air Valve shall be supplied with “Flushing Attachments” to allow periodic flushing of sediment, grease, and solids. Attachments consist of an inlet isolating valve, bronze blow-off and flushing valves.
4. Approved Manufacturer:
    a. APCO Series 443 SCAV
    b. Golden Anderson Figure 942.
    c. Valmatic

E. Flanged Coupling Adapters (FCA)
1. Flanged coupling adapters shall be provided where indicated. CONTRACTOR may install additional FCA at no additional cost to the Owner as desired for ease of piping installation. FCA and piping shall be secured against movement with fixed supports or tie rods. FCA shall be Dresser Style 127, Rockwell/Smith-Blair Type 912 with anchor studs for 12 inches and under; Type 913 for 14 inches and over. Coupling Adapters shall be of cast iron construction with shop coating.

F. Accessories
1. Handwheel Operators: Cast iron.
    a. Furnish with 2-inch AWWA nut.
    b. Maximum Diameter: 12 inches.
    c. Capable of throttling the valve in any position and holding under all operating conditions.
    d. Worm screw or traveling nut type.
    e. Totally enclosed, operating in a lubricant.
    f. Include exterior position indicator.
2. Floor Boxes
    a. Cast in slab with removable lid to allow access to extension stem.
    b. Removable lid capable of being drilled and tapped.
    c. Neenah R7506-C Series, East Jordan Iron Works equivalent, or equal, unless otherwise noted on plans.
3. Valve Extension Stem
    a. Provide as shown in Drawings for in-plant valves.
    b. Top nut, extension, bottom coupling: ductile iron grade 65-45-12.
    c. Provide 2” square top wrench nut
        1) Pin to extension rod using stainless steel coil pins.
    d. Provide bottom coupling to attach to buried valve operator as recommended by valve manufacturer.
        1) Provide mechanical restraint to attach bottom coupling to valve operator.
    e. Provide 316 stainless steel for extensions stems located:
        1) Outside and unburied,
        2) Partially, fully, or intermittently submerged, or
        3) as shown in Drawings.
4. Adjustable Stem Guides
    a. Provide for in-plant valves as shown in Drawings.
    b. Adjustable range: 2-inch through 36-inch from wall.
    c. Provide 316 stainless steel for stem guides located:
        1) Outside and unburied,
        2) Partially, fully, or intermittently submerged, or
        3) as shown in Drawings.
    d. Provide stem guides for all valve extension stems longer than 6 feet and as required based on length of extension stem.
        1) Maximum allowable spacing between stem guides is 8 feet.
5. Equipment Identification Tags
    a. Permanently attach identification tags to each piece of equipment.
    b. Tags shall display a code number corresponding to the number provided in the Drawings
    c. Tags: Engraved or stamped stainless steel permanently mounted to equipment in high-visibility location.
        1) Lettering: 1/2-inch high.

2.04 ANCHOR BOLTS AND HARDWARE

A. Contractor shall provide anchor bolts, hex nuts, and all other fastener hardware and shall be 304 stainless steel.
   1. Type 304 stainless steel bolts shall conform to:
      a. ASTM F593.
   2. Type 304 Stainless steel nuts shall conform to:
      a. ASTM F594.

B. Concrete anchors shall comply with requirements of Section 03 30 00 - Cast-in-Place Concrete.

C. Locate all anchors and fasteners with templates furnished by equipment manufacturer as applicable.

2.05 SPARE PARTS AND SPECIAL TOOLS

A. Supply all special tools and the following spare parts for each type of pump:
   1. Ten (10) sets of replacement operator O-rings for each type of operator provided.
   2. Five (5) sets of replacement operator retaining pins for each type of operator provided.
   3. Five (5) sets of replacement drive shaft seals for each type of operator provided.
   4. One (1) 5.0 ounce tube of manufacturer recommended gasket sealant.
   5. Three (3) 14.5 ounce tubes of manufacturer recommended lithium based grease for actuator.
   6. 1 year of Manufacturer recommended:
      a. Grease,
      b. Oil,
      c. Coolant, and/or
      d. Any other applicable lubricant or other maintenance related consumable provided for pump operation.
   7. SDS for any applicable products provided with equipment or as spare parts.
   8. Recommended spare parts necessary to maintain each piece of equipment in service for a period of two years.
   9. Provide special tools required for normal repair, parts replacement and maintenance of the equipment that are available only through the manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with Manufacturer's recommendations and as shown on Drawings.

B. All installation of equipment shall be performed by the Contractor. All required installation hardware (such as, but not limited to, support braces, bolts, washers, nuts, and jam nuts) shall be furnished by the Contractor.

C. Manufacturer's authorized representative shall supervise critical installation procedures as necessary, inspect final installation, perform any necessary calibration and adjustment, and start up the equipment. A copy of the startup report shall be included in the O&M manual.

D. Install all anchors in accordance with certified prints supplied by equipment manufacturer.

E. Installation shall include furnishing manufacturer recommended grade(s) of required oil and grease for initial operation.

F. See Specification Section 40 23 00 - Process Piping General Provisions.

3.02 FIELD QUALITY CONTROL

A. Examination

1. See Specification Section 40 23 60 - Process Pipe Testing.

END OF SECTION

SECTION 40 23 30

PROCESS SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes furnishing and installation of:
   1. Process Piping for Utilities located:
      a. Above ground
      b. Below ground
         1) Refer to Specification Section 33 05 20 Process Specialties for Utilities.
   2. Process Specialties items:
      a. Pipe Couplings
      b. Restrained Dismantling Joints
      c. Pressure Gauges
      d. Diaphragm Seal Isolators
      e. Restrained Flange Adaptors
      f. Flange Adaptors
      g. Hydrostatic Seals
      h. Pipe Saddle Taps
   3. Anchor Bolts and Hardware

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
   2. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005
   3. E96 - Standard Test Methods for Water Vapor Transmission of Materials; 2000

1.03 SUBMITTALS

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

1.04 RELATED SECTIONS:

A. Refer to the following specification sections for additional requirements:
   1. Section 01 33 00 - Submittal Procedures
   2. Section 09 91 50 - Shop Painting
   3. Section 09 97 20 - Coating Systems for Industrial Facilities
   4. Section 40 23 00 - Process Piping General Provisions
   5. Section 40 23 10 - Process Water and Waste Piping
   6. Section 40 23 20 - Process Valves and Operators
   7. Section 40 23 60 - Process Pipe Testing
   8. Section 40 91 19 - Instrumentation

1.05 QUALITY ASSURANCE

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

1.06 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

1.07 WARRANTY

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Refer to individual component sections for Approved manufacturers.

B. Reference Section 01 25 13 - Product Substitution for information pertaining to procedures for non-Basis of Bid substitutions or “or equal” items.

C. All equipment called for in this section shall be supplied by a single manufacturer or authorized sales representative to assure uniform quality, ease of maintenance, and minimal parts storage.

D. No equipment shall be supplied by a manufacturer not regularly engaged in the manufacturing and production of equipment detailed in this section. Manufacturers must have installed and had in satisfactory use for a period of not less than 5 years, a minimum of 10 installations of equivalent equipment specified and shall submit evidence of such with the shop drawings.

2.02 PRODUCTS

A. Pipe Couplings
   1. Sleeve type.
   2. Material: ASTM A536 qualified ductile iron.
   3. Conform to AWWA C219
   4. Finish: Provide fusion bonded epoxy per AWWA C153 (ANSI A21.53).
   5. Furnish for suitability to pipe being coupled.
      a. Size.
      b. Material.
         1) Provide stiffeners for HDPE pipe connections where recommended by manufacturer.
      c. Pressure.
      d. Service of pipe.
   6. Acceptable Manufacturers/Models:
      a. Dresser, Style 38,
      b. Smith Blair, Type 411,
      c. or equal.

B. Restrained Dismantling Joint
   1. Provide dismantling joint as all flow meters as shown in Drawings.
   2. Material: ASTM A536 qualified ductile iron.
   3. Dismantling type with integral restraint.
   4. Joint: Flange, conforming to AWWA C207 Class D
   5. Finish: Provide fusion bonded epoxy per AWWA C153 (ANSI A21.53).
   6. Furnish for suitability to pipe being coupled.
      a. Size.
      b. Material.
      c. Pressure.
      d. Service of pipe.
   7. Acceptable Manufacturers/Models:
      a. Dresser, Style 131,
      b. Smith Blair, Type 973,
      c. or equal.

C. Pressure Gages
   1. Provide as shown on the drawing.

2. Provide threaded tee and sample and flushing tap to purge air and flush piping to pressure gauge. Refer to Specification Section 40 23 20 Process Valves and Operators for sample and flushing tap requirements.
    a. Provide 1/4-inch NPT piping and sample and flushing tap connections.
3. Shall be located in piping between pump volute and valves.
4. Provide weatherproof case design.
5. Pressure gage:
    a. Size: 4-1/2 inch dial.
    b. Range: 0-200% of normal operating pressure.
    c. Graduation: as appropriate for range.
    d. Accuracy: 1/2 percent.
    e. Movement: Heavy-duty stainless steel.
    f. Case: Fiberglass Reinforced Polypropylene.
    g. Wetted Materials: Stainless Steel
    h. Mounting: Direct (stem).
    i. Connection: 1/4-inch NPT, bottom.
    j. Glycerin - filled, no exceptions.
6. Acceptable Manufacturers/Models:
    a. Ashcroft,
    b. Weksler,
    c. or equal.

D. Diaphragm Seal Isolators (1/4-inch to 1-inch)
1. Provide on all pressure gauges unless noted otherwise in Drawings.
2. Material:
    a. Top housing: 316L stainless steel.
        1) Bottom housing: 316L stainless steel.
    b. Gasket: PTFE.
    c. Bolt/Clamp rings: carbon steel.
    d. Hardware: Zinc plated alloy steel.
3. Glycerin filled, for pressure applications. Provide manufacturer recommended fill fluid for vacuum applications.
4. Provide flushing port.
5. Designed for continuous duty if instrument is removed.
6. Maximum working pressure: 2,500 psi
7. Joint:
    a. Threaded with flushing port\
    b. Coordinate size with pressure gauge and adjacent piping.
8. Acceptable Manufacturers/Models:
    a. Ashcroft, model 201,
    b. or equal.

E. Restrained Flanged Adapters
1. Material: ASTM A536 qualified ductile iron.
2. Joint: Flange, conforming to AWWA C207 Class D
3. Finish: Provide fusion bonded epoxy per AWWA C153 (ANSI A21.53).
4. Furnish for suitability to pipe being coupled.
    a. Size.
    b. Material.
    c. Pressure.
    d. Service of pipe.
5. Acceptable Manufacturers/Models:
    a. EBBA Iron Series 2100 Megaflange,
        1) Applicable pipe materials: Ductile iron, steel, PVC, HDPE.
    b. Smith Blair, Type 911,
        1) Applicable pipe materials: Ductile iron, steel.
    c. or equal.

F. Hydrostatic Seals

1. Furnish one set of positive hydrostatic pipe link seals at:
    a. All piping penetrations utilizing wall sleeves.
    b. All underground pipe penetrations.
        1) Hardware shall be removable from building interior. Grout exterior of seal.
    c. All penetrations through pre-cast concrete walls, roofs, or floors unless noted otherwise in Drawings.
    d. Hydrostatic seals used on penetrations through tanks which have the potential to leak flammable or explosive gas shall use two sets of hydrostatic seals per penetration.
        1) Applies to the following structures:
            a) Any structure designed for holding of flammable or explosive gas
            b) Any structure classified as Class 1 Division I and adjacent to an occupiable space with a classification rating of Class 1 Division II or Unclassified.
            c) Areas Include but are not limited to:
                (1) Anaerobic digestion structures
                (2) Primary point of settling utility structures
                (3) Preliminary treatment structures
                (4) Biosolids storage and handling structures.
2. Sealing Element: Expanded by tightening hardware.
    a. Air piping: Silicone Rubber
    b. All other pipe: EPDM Rubber
3. Hardware:
    a. At least one face below grade or submerged: 316 Stainless Steel
    b. Both faces above grade or not submerged: Zinc Dichromate Coated Steel
4. Acceptable Manufacturers:
    a. Thunderline Corp.,
    b. or equal.

G. Pipe Saddle Taps
1. Type: Double Bale.
2. Ductile iron body.
3. Bales, nuts and washers shall be 304 stainless steel.
4. Nitrile gasket.
5. Install saddle taps after pipe has been field coated.
6. Acceptable Manufacturers:
    a. Smith Blair,
    b. Romac,
    c. or equal.

2.03 ANCHOR BOLTS AND HARDWARE

A. Contractor shall provide anchor bolts, hex nuts, and all other fastener hardware and shall be 304 stainless steel.
1. Type 304 stainless steel bolts shall conform to:
    a. ASTM F593.
    b. ANSI B18.2.1.
2. Type 304 Stainless steel nuts shall conform to:
    a. ASTM F594.
    b. ANSI B18.2.2.

B. Concrete anchors shall comply with requirements of Section 03 30 00 - Cast-in-Place Concrete.

C. Locate all anchors and fasteners with templates furnished by equipment manufacturer as applicable.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with Manufacturer’s recommendations and as shown on Drawings.

B. All installation of equipment shall be performed by the Contractor. All required installation hardware (such as, but not limited to, support braces, bolts, washers, nuts, and jam nuts) shall be furnished by the Contractor.

C. Manufacturer's authorized representative shall supervise critical installation procedures as necessary, inspect final installation, perform any necessary calibration and adjustment, and start up the equipment. A copy of the startup report shall be included in the O&M manual.

D. General:
   1. Install all items in accordance with manufacturer's recommendations.
   2. Install items only where indicated on the Drawings.
   3. Installation at other location only with prior approved by the Engineer.

E. Provide full force gaskets on all systems.

F. Bolts shall not extend more than 0.5-inch beyond the nut for all applications.

G. Thrust Restraint:
   1. Restrained Joints:
      a. Provide restrained joints for all:
         1) Ductile-Iron Pipe fittings.
      b. Submit method and type to engineer for approval.
      c. Install in accordance with "Thrust Restraint Design for Ductile Iron Pipe" published by the Ductile Iron Pipe Research Association.

H. Examination
   1. See Section 40 23 00 - Process Piping General Provisions

3.02 FIELD QUALITY CONTROL

A. See Specification Section 40 23 60 - Process Pipe Testing.

END OF SECTION

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SECTION 40 23 40

PROCESS PIPING HANGERS & SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes furnishing and installation of:
   1. Process Piping Hanger and Support items.
      a. Hangers for Piping small than 4 Inches.
      b. Hangers for Piping 4 Inches and Larger.
      c. Adjustable Saddle Supports for Piping on Structural Slabs 3 Inches and Larger
      d. Riser Clamps for Piping 2-inch through 24-inch
      e. Hangers for Piping from Reinforced Concrete.
         1) Loadings Under 400 Pounds at new reinforced concrete locations.
         2) Loadings of 400 Pounds to 1,140 Pounds at new reinforced concrete locations.
      f. Continuous Slot Inserts.
   2. Hangers for Piping from existing Cast-In-Place Concrete and Plant-Precast Structural Concrete Locations.
   3. Field-fabricated hangers and supports.
   4. Anchor Bolts and Hardware.

1.02 REFERENCES

A. Manufacturer's Standardization Society (MSS):
   1. SP-58 - Pipe Hangers and Supports - Materials, Design, and Manufacture
   2. SP-69 - Pipe Hangers and Supports - Selection and Application
   3. SP-89 - Pipe Hangers and Supports - Fabrication and Installation

B. American National Standards Institute (ANSI):
   1. Code for Pressure Piping B31.1.0.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Support piping systems in all conditions of testing and operation.
   2. Provide supports that will not become disengaged by movement of the supported pipes.
   3. Support System Factor of Safety: 3 based on supported pipe filled with water.
   4. Provide means of vertical adjustment after installation.
   5. Provide suitable linkage to permit swing at hanger locations where lateral or axial movement is anticipated.
   6. Do not support piping from wood or metal truss roof systems unless systems have been specifically designed for such loading.
   7. Size hangers to accommodate pipe covering and jacketing on insulated pipe.
   8. Provide support to resist flotation of empty pipe when located in submerged areas.

B. Performance Requirements:
   1. Support systems shall prevent movement of the piping in any direction due to pressure, temperature, flow, or water hammer except at properly located expansion joints and fittings.
   2. Support piping in a manner to prevent undue strain on equipment, valves, and fittings.

1.04 SUBMITTALS

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

B. Additional Requirements as applicable:

1. Provide Shop Drawings for all specially designed hanger assemblies and fabrications.
2. Provide calculations indicating the load at each support location.
   a. Submitted load data used to determine location suitability for attachment of supports to new and existing structures.
3. Provide Shop Drawings indicating the location of each proposed device at each support location.
4. Provide calculations for sizing of field-fabricated support members.
5. Shop Drawings shall be prepared by a professional engineer registered in the State of Minnesota.

C. Attachment to Proposed Plant-Precast Structural Concrete.
1. Coordinate proposed attachment method with Plant-Precast Structural Concrete manufacturer. Refer to Part 2.03.A.c.
2. Indicate items in Part 1.04.B in Process Piping Hangers and Support submittal as well as Plant-Precast Structural Concrete submittal.

D. Attachment to existing Plant-Precast Structural Concrete or Cast-In-Place Concrete.
1. Coordinate proposed attachment method with Engineer. Refer to Part 2.03.A.c.
2. Indicate items in Part 1.04.B in Process Piping Hangers and Support submittal.

1.05 RELATED SECTIONS:

A. Refer to the following specification sections for additional requirements:
1. Section 01 33 00 - Submittal Procedures
2. Section 01 60 00 - Product Requirements
3. Section 09 91 50 - Shop Painting
4. Section 09 97 20 - Coating Systems for Industrial Facilities
5. Section 40 23 00 - Process Piping General Provisions
6. Section 40 23 10 - Process Water and Waste Piping and Fittings
7. Section 40 23 30 - Process Specialties
8. Section 40 23 20 - Process Valves and Operators

1.06 QUALITY ASSURANCE

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

1.07 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

1.08 WARRANTY

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

1.09 MEASUREMENT AND PAYMENT

A. The work performed in accordance with this item is considered incidental to the work in lump sum bid items. No separate consideration or payment will be made for work hereunder.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Refer to individual component sections for Approved manufacturers.

B. Reference Section 01 25 13 - Product Substitution for information pertaining to procedures for non-Basis of Bid substitutions or “or equal” items.

C. All equipment called for in this section shall be supplied by a single manufacturer or authorized sales representative to assure uniform quality, ease of maintenance, and minimal parts storage.

D. No equipment shall be supplied by a manufacturer not regularly engaged in the manufacturing and production of equipment detailed in this section. Manufacturers must have installed and had in satisfactory use for a period of not less than 5 years, a minimum of 10 installations of equivalent equipment specified and shall submit evidence of such with the shop drawings.

2.02 GENERAL

A. Hangers
   1. Support process piping from structural elements with adjustable hangers.
   2. Hanger Rods and Threaded Rods: Subject to tensile loading only.

B. Materials of Construction:
   1. Minimum grade 304 stainless steel shall be used.

C. Coordinate installation of pipe hanger and support with insulation. Refer to Specification Section 40 42 13 - Process Pipe Insulation

2.03 PRODUCTS

A. Provide the units indicated for the following applications:
   1. Hangers for Piping small than 4 Inches:
      a. Threaded-rod-mount split-ring clamping hanger.
      b. 304 stainless steel threaded hanger rod
      c. Approved Manufacturers:
         1) McMaster-Carr,
         2) or equal.
   2. Hangers for Piping 4 Inches and Larger:
      a. Anvil Figures 45, 104, 171, and 260.
      b. Approved Manufacturers:
         1) Cooper,
         2) PHD,
         3) or equal.
   3. Adjustable Saddle Supports for Piping on Structural Slabs 3 Inches and Larger:
      a. Anvil Figures 259, 264, and 265.
      b. Approved Manufacturers:
         1) Cooper,
         2) PHD,
         3) or equal.
   4. Riser Clamps for Piping 2-inch through 24-inch:
      a. Riser clamps are used for the support of vertical piping. Load is carried by shear lugs, which are welded to the pipe.
      b. Provide riser clamp at all pipe penetrations through floors unless otherwise noted.
      c. Conform to Federal Specification A-A-1192A (Type 42), ANSI/MSS SP-69 and MSS SP-58 (Type 42)
      d. Approved Manufacturers/Models:
         1) Anvil Figure 40,
         2) or equal.
   5. Hangers for Piping from Reinforced Concrete:
      a. Loadings Under 400 Pounds at <u>new</u> reinforced concrete locations:
         1) Approved Manufacturers/Models:
            a) Anvil Figure 285.
            b) Cooper,
            c) PHD,
            d) or equal.
      b. Loadings of 400 Pounds to 1,140 Pounds at <u>new</u> reinforced concrete locations:
         1) Universal concrete inserts.
         2) Approved Manufacturers/Models:
            a) Anvil Figure 282.

b) Cooper,
c) PHD,
d) or equal.

6. Continuous Slot Inserts:
   a. Inserts shall have working load capacities greater than the pipe hanger loadings.
   b. Approved Manufacturers/Models:
      1) Unistrut P3200 Series,
      2) Power-strut PS-349 Series,
      3) Halfen Channels 4122 or 4141 Series,
      4) or equal.

B. Hangers for Piping from existing Cast-In-Place Concrete and Plant-Precast Structural Concrete Locations:
   1. Contractor to provide calculations indicating the load at each support location to be used in determining suitability of proposed support system at existing locations.
   2. Hanger support spacing be less than those indicated in part 3.01.F of this section based on loading requirements.
   3. Refer to Part 2.03.A.5 for piping hangers.

C. Field-fabricated hangers and supports.
   1. Contractor may proposed field-fabricated piping hangers and supports.
   2. Fabricated
   3. from 304 stainless steel regardless of location.
   4. Field-fabricated hangers and supports shall be manufactured in accordance with Specification Section 05 50 00 Metal Fabrications
      a. Refer to Specification Section 05 50 00 Metal Fabrications for additional requirements pertaining to field-fabricated hangers and supports.
   5. Provide information pertaining to proposed field-fabricated piping hanger and supports with submittal.
   6. Clearly identify field-fabricated supports in submittal and indicate items in Part 1.04.B in Process Piping Hangers and Support submittal.

2.04 ANCHOR BOLTS AND HARDWARE

A. Contractor shall provide anchor bolts, hex nuts, and all other fastener hardware and shall be 304 stainless steel.
   1. Type 304 stainless steel bolts shall conform to:
      a. ASTM F593.
      b. ANSI B18.2.1.
   2. Type 304 Stainless steel nuts shall conform to:
      a. ASTM F594.
      b. ANSI B18.2.2.

B. Concrete anchors shall comply with requirements of Section 03 30 00 - Cast-in-Place Concrete.

C. Locate all anchors and fasteners with templates furnished by equipment manufacturer as applicable.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with Manufacturer's recommendations and as shown on Drawings.

B. All installation of equipment shall be performed by the Contractor. All required installation hardware (such as, but not limited to, support braces, bolts, washers, nuts, and jam nuts) shall be furnished by the Contractor.

C. General

1. Install all units in accordance with manufacturer's instructions.
2. Locate units so that finished piping will not interfere with:
    a. Open accesses.
    b. Walkways and platforms.
    c. Future maintenance of equipment.
3. Group parallel runs of horizontal piping together on trapeze-type hangers where possible.
4. Install supports to provide specified slope when indicated.
5. Provide units of the same type and style for adjacent similar piping.
6. Installation in steel framed structures.
    a. Support piping from beam clamps, attachments, or brackets bolted to steel joists or beams.
    b. Verify with Engineer that structural components are capable of carrying the intended load and stresses.
    c. Not permitted.
        1) Holes drilled in building steel for hanger support rods.
        2) Bolting to decking or walkways.
7. Install supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors.
8. Install supports to facilitate the movement of expansion joints, loops, bends, and similar items.

D. Pipe Support Spacing:
1. Locate units and accessories in accordance with minimum defined in MSS SP-58 and 69.
2. Provide a minimum of 1 support for each length of pipe and at each change of direction or elevation.
3. Provide additional supports within 3 feet of each joint for every valve, fitting, flow meter, flexible coupling, and all non-rigid joints.
4. Locate supports in accordance with maximum allowable spacing shown on the schedules at the end of this section.

E. Building Attachments:
1. Support pipe hangers from concrete inserts in reinforced concrete structures as follows:
    a. Where support rod sizes exceed 7/8-inch in diameter, or where the pipe load exceeds the recommended load for the insert, use 2 inserts with a trapeze-type connecting member below the concrete.
    b. Submit proposed insert locations to Engineer for approval in a timely manner to provide for placement of concrete.
    c. Provide reinforcing rods for pipe sizes over 3 inches.
    d. In areas where the concrete slab will form the finished ceiling, ensure that inserts finish flush with slab surface to make a neat appearance.
    e. Locate concrete inserts so that total load on insert does not exceed manufacturer's recommended maximum load.
2. Locate attachments to ensure that the total and point loads from the supports do not exceed the design capacity of the supporting structure.
3. Where it is necessary to anchor supports to hardened concrete or completed masonry, use either:
    a. Epoxy type adhesive anchors.
    b. Expansion type anchors.
4. For precast concrete plank, drill through concrete plank from below and provide through bolts with square steel plate & nuts.
    a. Plate shall bear directly upon the top surface of the precast concrete plank.
    b. Apply all toppings and insulations after installation of support plate assembly.
    c. Coordinate loading with precast manufacturer for new planks.
5. Attach to structural steel members with beam clamps.
6. Do not support piping from other piping.
7. Prevent contact between dissimilar metals.
    a. Where a concrete or metal pipe support is used, place a 1/8-inch thick Teflon, neoprene rubber, or plastic strip under piping at point of bearing.
    b. Cut to fit entire area of contact between pipe and support.
8. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, plastic coated, or by other recognized industry methods.

a. Electrician's tape is **not** an acceptable isolation method.

F. Hanger Supports:
1. Adequate to maintain pipe, apparatus, and equipment in proper position and alignment under all operating conditions.
2. Screw adjustable after installation is complete.
3. Provide piping supported from the ceiling with adjustable wrought clevis hangers.
4. All steel work, bolts, nuts, washers, and welding shall conform to the applicable provisions of Division 5.
5. Hanger rods shall be attached to inserts in new concrete slabs.
6. Install individual or continuous slot concrete inserts for use with hangers for piping in the formwork before concrete slabs are poured.
   a. Furnish inserts with end caps and cardboard closure strips or filled with foam to prevent concrete intrusion.
   b. Provide all clamping nuts with springs, additional supporting steel and hanger rods required to make the complete installation.
   c. Concrete inserts shall be hot-dip galvanized after being cut to the necessary lengths and installation of end plates.
   d. Clamping nuts shall be given an electro-galvanized finish.
7. Where 2 or more horizontal pipes 3-inches or smaller are run on close centers, support on trapeze-type hangers.
   a. Use Unistrut P1000, Power-Strut, or equal.
   b. The maximum load per trapeze shall be 200 pound calculated with all pipes full of water and the maximum length shall be 36 inches.
   c. Minimum rod size shall be 3/8-inch.
8. Use wall brackets for wall-mounted pipe 2 inches and smaller.
9. Provide pipe guides for hanger supported pipe.
   a. Install guide on each hanger.
   b. Install at 60 foot centers and no more than 60 feet from an anchor.

G. Thrust Anchors and Guides:
1. Suspended Piping:
   a. Center thrust anchors between expansion joints and/or elbows.
   b. Anchors shall hold pipe securely.
      1) Allow for movement at expansion joints.
      2) Prevent separation of joints.
2. Provide thrust anchors as follows:
   a. Changes in pipe diameter.
   b. Changes in pipe direction.
   c. Pipe dead ends.
3. Provide anchorage whenever bending stress exceed the allowable stress of the pipe.
4. Wall pipes may be used as thrust anchors.
5. Provide pipe guides adjacent to sliding expansion joints in accordance with the National Association of Expansion Joint Manufacturers.

H. Maximum allowable spacing of pipe supports:
1. Ductile Iron Pipe:

Pipe Size, Inches	Maximum Span, Feet
4 and less	6
6 thru 12	8
14 and greater	16

2. Steel and Stainless Steel Pipe:

Pipe Size, Inches	Maximum Span, Feet
2 thru 4	6
5 thru 10	8
12 and greater	16

3. PVC Pipe, Schedule 40 and 80:

Pipe Size, Inches	Maximum Span, Feet

1-1/4 and less	4
1-1/2 thru 3	5
4 and greater	6

4. Copper Pipe:

Pipe Size, Inches	Maximum Span, Feet
2-1/2 and less	4
3 thru 6	8

I. Sequencing and Scheduling
   1. Proceed with the installation of support equipment only after the respective building structural work has been completed and approved and any associated concrete support structure has reached its 28-day compressive strength.

J. Examination
   1. See Section 40 23 00 - Process Piping General Provisions

END OF SECTION

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SECTION 40 23 60

PROCESS PIPE TESTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes furnishing and installation of:
   1. Leak testing for:
      a. Process Water and Waste Piping, Fittings, Valves, and Specialties for Utilities.
      b. Process Water and Waste Piping, Fittings, Valves, and Specialties.
   2. Process Pipe Testing items:
      a. Gravity Rated Process Water and Waste Piping, Fittings, Valves, and Specialties.
      b. Pressure Rated Process Water and Waste Piping, Valves, Fittings, and Specialties.
      c. Coordinate with Engineer during testing for pipe service prior to testing.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C600 - Installation of Ductile-Iron Mains and Their Appurtenances

1.03 SUBMITTALS

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

B. Test Results
   1. For each tested pipe segment, record the following for submittal to the Engineer.
      a. Date and time of test.
      b. Ambient air temperature at beginning and end of test.
      c. Identification of pipe segment by process name and pipe location.
      d. Pressure readings every 5 minutes for the duration of air test.
      e. Identify corrective measures taken to remediate non-passing test results.

1.04 RELATED SECTIONS:

A. Refer to the following specification sections for additional requirements:
   1. Section 01 33 00 - Submittal Procedures
   2. Section 09 91 50 - Shop Painting
   3. Section 09 97 20 - Coating Systems for Industrial Facilities
   4. Section 40 23 00 - Process Piping General Provisions
   5. Section 40 23 10 - Process Water and Waste Piping and Fittings
   6. Section 40 23 20 - Process Valves and Operators
   7. Section 40 23 30 - Process Specialties

1.05 QUALITY ASSURANCE

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

1.06 WARRANTY

A. Refer to Section 40 23 00 Process Piping General Provisions for requirements.

1.07 MEASUREMENT AND PAYMENT

A. The work performed in accordance with this item is considered incidental to the work in lump sum bid items. No separate consideration or payment will be made for work hereunder.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 INSTALLATION

A. Preparation
   1. Isolate all piping and equipment to be tested from other systems.
   2. Pressure gages shall be readable by the Engineer without the use of a ladder or accessing the excavation.
   3. Remove foreign materials from the piping and equipment by means of flushing or other appropriate methods.
   4. Install taps in pipe as required to expel air prior to hydrostatic testing.
   5. Contractor to provide fittings and accessories as needed for testing and isolation of piping.

B. Sequencing and Scheduling
   1. Perform leakage testing prior to:
      a. Application of coatings,
      b. Insulation on the piping,
      c. Encasement of piping joints, fittings, valves, or specialties in concrete or other materials.

3.02 FIELD QUALITY CONTROL

A. General Requirements
   1. Expel all air from pipe before beginning hydrostatic test. Install taps necessary to accomplish this and plug as approved by engineer.
   2. For each tested pipe segment, record the following for submittal to the Engineer.
      a. Date and time of test.
      b. Ambient air temperature at beginning and end of test.
      c. Identification of pipe segment by process name and pipe location.
      d. Pressure readings every 5 minutes for the duration of air test.
      e. Identify corrective measures taken to remediate non-passing test results.
   3. Engineer will review pressure data, and examine exposed piping, fittings, valves, etc. Contractor shall repair any leaks.
   4. Provide corrective measures for any line exceeding allowable leakage.

B. Gravity Rated Process Piping, Fittings, Valves, and Specialties:
   1. Remove all dirt and foreign material from pipe interior prior to testing.
   2. Pipe Diameter 27 inches and smaller: Air test.
   3. Pipe Diameter Larger Than 27 inches: Infiltration test.
   4. The following piping schedules shall include deflection testing in addition to air or infiltration testing if requested by Engineer.
      a. PVC-P and PVC-G: all sizes.
      b. PVC-40, PVC-80: greater than 4-inches.
   5. Perform the following tests upon completion of construction and prior to any external connections:
      a. Air Test:
         1) Place inflatable plugs in piping at each end of reach to be tested.
         2) Connect end of an air hose to plug used for air inlet.
         3) Connect other end of hose to portable air control equipment.
         4) This equipment consists of valves and pressure gages used to control the rate air flows to the test section and to monitor air pressure inside the pipe.
         5) Connect an air hose between compressor (or other source of compressed air) and control equipment.

6) Add air to pipe section. Monitor air pressure so pressure inside pipe does not exceed 5.0 psig.
7) When pressure reaches 4.0 psig, stop air supply so internal pressure is maintained for 2 minutes.
8) These 2 minutes allow time for air temperature to come to equilibrium with the pipe walls.
9) During this time check plugs with soap solution to detect any plug leakage. If plugs are found to leak, bleed off air, tighten plugs, and begin again by supplying air.
10) After temperature has been allowed to stabilize for 2 minutes, disconnect air supply and allow pressure to decrease to 3.5 psig.
11) At 3.5 psig, start stopwatch to determine time required for pressure to drop to 2.5 psig.
12) Provide corrective measures for any line not meeting requirements.
13) Test results are usually better if pipe walls are damp at time of testing.
14) Time shall be equal to or greater than the allowable time shown in table at end of this Section.

b. Infiltration Test:
1) Manholes or other access structures shall be watertight, with no leakage permitted. Structures shall have passed leak testing prior to infiltration testing of piping as applicable.
2) Place 90-degree V-notch weirs in locations directed by Engineer to measure leakage in process piping.
3) Allowable leakage rate shall be 100 gallons/day/inch diameter/mile of sewer between any adjacent manholes or structures.
4) Provide corrective measures for lines exceeding the allowable leakage rate.

c. Deflection Test.
1) Deflection Test:
a) Perform on pipe at least 30 days after trench backfill has been placed.
b) Perform test by pulling a mandrel through each line between manholes without aid of mechanical pulling devices.
c) Mandrel diameter: Minimum 95 percent of the base inside diameter of the pipe as follows:

Nominal Size (in.)	Base I.D.	5% Deflection Mandrel
4	3.874	3.68
6	5.742	5.46
8	7.665	7.28
10	9.563	9.08
12	11.360	10.79
15	13.897	13.20
18	16.975	16.13
21	20.004	19.01
24	22.481	21.36
27	25.326	24.06
30	28.639	27.21
33	32.224	30.61
36	35.808	34.02
42	40.401	38.38
48	46.094	43.79

d) The line will be considered acceptable if mandrel can progress through line without binding.
e) Provide corrective measures for lines not meeting these requirements.

C. Pressure Rated Process Piping, Fittings, Valves, and Specialties:
1. Remove all dirt and foreign material from pipe interior prior to testing.
2. Pipe Diameter all sizes: Hydraulic
3. Perform the following tests upon completion of the system and prior to being placed into service:
a. Hydraulic Test:
1) Perform pressure and leakage test in accordance with AWWA C600.
2) Test Pressure: 150 psi.
3) Test Duration: 2 hours.

4) Gage Requirements:
   a) Size: 4-1/2-inch dial.
   b) Range: 0 to 200 psi.
   c) Gradation: 2 psi.
   d) Accuracy: 1/2 percent.
5) Do not allow pressure to vary more than 3.0 percent during the test.
6) Do not allow pressure to vary more than 1.0 percent or 1.0 psig, whichever is greater, during the last hour of the test.
7) Allowable Leakage: One-half of the volume allowed by AWWA C600 in accordance with the following:

$$L = \frac{SD\sqrt{P}}{266{,}400}$$

L = Allowable Leakage in Gallons Per Hour

S = Length of Pipe Tested in Feet

D = Nominal Diameter of Pipe in Inches

P = Average Test Pressure During Test in Pounds/ Square Inch (Gage)

END OF SECTION

SECTION 40 90 10

LIFT STATION CONTROLS AND DEVICES

PART 1 GENERAL

1.01 GENERAL

A. This Section describes the requirements for lift station controls and devices.

1.02 REFERENCES

A. National Fire Protection Association (NFPA), latest adopted version.

B. National Electrical Manufactures Association (NEMA)
   1. NEMA ICS-2 Industrial Control Devices, Controllers, and Assemblies.
   2. NEMA 250 Enclosures for Electrical Equipment.

C. Underwriters Laboratories (UL)
   1. UL 83 Thermoplastic Insulated Wires and Cables.
   2. UL 508 Industrial Control Equipment.
   3. UL 698A Industrial Control Panels relating to Hazardous (Classified) Locations.
   4. UL 913 Intrinsically Safe Apparatus and Associated Apparatus for use in Class I, Class II and III, Division 1, Hazardous (Classified) Locations.

1.03 SUMMARY OF WORK

A. A complete control system shall be provided to operate the 32nd Street Lift Station as specified in this section. The Work includes labor, material, equipment (control devices, instrumentation, control panel, etc.), software, programming, wiring, and supervision necessary to fabricate, install, start-up, and test a complete and operable control system.

B. A new lift station control panel shall be provided at the location indicated on the plan sheets. The Lift Station Control Panel shall include:
   1. Pad mounted enclosure, as shown on the drawings.
   2. PLC, Operator interface, software and programming.
   3. Radio, antenna, cabling and communication with SCADA master, to include modifications to the main SCADA software.
   4. Backup generator and Automatic Transfer Switch.
   5. Control cabling and field wiring.

C. The intent of the control panel is to operate the PLC as the primary pump controller and monitor the wet well level. The backup controller shall operate in the event of PLC failure.

D. Provide Operation and Maintenance Manuals (O&Ms). Include electronic and hard copies of the programs and program changes as specified herein.

E. It is the intent of the Contract Documents that all equipment specified in this Section of the specifications be supplied by a single-source supplier (“Systems Integrator”). The supplier shall assume full responsibility along with the Contractor for furnishing, installing and start-up procedures to make the system operate per the intent of the Contract Documents.

F. It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The Contractor shall be responsible for all details which may be necessary to properly install, adjust and place in operation the complete installation.

G. It shall be the responsibility of the Contractor and supplier to examine all new and existing equipment that is transmitting a signal to, or receiving a signal from, equipment specified in this Section. The Contractor shall be responsible for providing signal converters, buffer amplifiers, and isolation devices to make signal levels, reference to ground, etc. compatible between devices specified in this Section and existing equipment or equipment specified in other Sections.

H. The labor specified herein includes but is not limited to engineering software development, panel fabrication and installation, equipment calibration and adjustment, testing, training, and documentation.

I. This section includes coordination with electrical contractor to ensure that the proper number and type of conductors are installed. It shall be the responsibility of the Systems Integrator to coordinate this work with the installing electrician.

1.04 SUBMITTALS

A. Technical data in conformance with Division 1 and including:
   1. All equipment and components indicated on the Drawings and specified in Part 2 of this Section.
   2. Software packages including complete description of features and capabilities.

B. Shop Drawings in conformance with Division 1 and including:
   1. Panel Drawings including system schematic drawings, terminal numbering, wire numbering, component schematic drawings, dimension drawings, layout drawing sand nameplate schedule.
   2. Overall system diagram showing all components, converters, cables, and connectors.

C. Operational and Maintenance data in conformance with Division 1 and including:
   1. Panel equipment, field devices and instruments, including “as-built” system schematics.
   2. Electronic files on removable media containing final system record drawings, wiring diagrams and panel details. The drawings files shall be in AutoCAD format (.DWG files).
   3. Complete software documentation including programming information and operator’s guides. Include hard copies of all operator interface unit.
   4. All applicable software licenses registered to the Owner.

D. All submittals shall be bound in 3-ring binders with labeled tabs separating sections.

1.05 FACTORY TESTING

A. The Control System shall be assembled at the manufacture’s facility and tested to the greatest extend possible. This test shall include simulation of all I/O points and demonstration of proper system operation. Document the results of this test in writing and submit to Engineer.

B. The Engineer and Owner may witness the factory acceptance test. Schedule test date a minimum of two weeks in advance to allow attendance by the Engineer and the Owner.

C. Correct any deficiencies identified during the test prior to shipping the control system to the job site.

1.06 QUALITY ASSURANCE

A. All materials, equipment, and parts shall be new and unused of current manufacture.

B. System Integrator shall be responsible for providing all necessary accessories required for a complete and operational system.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

D. Products: Listed and classified by UL or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicted.

E. Control panels shall be meet the requirements of UL-508A and shall be UL labeled or third party certified. Control panels with intrinsically safe circuits shall meet the requirements of UL-698A and shall be labeled as such. Panels shall be listed, or third party certified when delivered to the job site. When the Owner accepts the panel(s), the Contractor certifies that the panels have retained their UL listing or third-party Certification.

F. The supervisory control system supplier, (Systems Integrator), shall be:

Telemetry and Process Controls, Inc.
7250 Hudson Blvd, Suite 160
Oakdale, MN 55128
Attn: Mr. Brad Winkels
bwinkels@tpcusa.com
(651) 430-0435

1.07 FUNCTIONAL DESCRIPTIONS LIFT STATION CONTROL PANEL

A. Lift Station:
1. Control shall be provided for two wet well pumps.
2. An analog level sensor and two float switches shall be provided in the wet well.
3. Normal control shall be provided by a primary controller, and a submersible level transducer. A Hand-off-Auto switch shall be mounted on the inner door.
   a. Auto Mode(H-O-A selector switch in Auto position):
      1) The pumps shall be controlled based on the level in the wet well. On a rising level, the lead pump shall be started followed by the lag pump. Once started, pump shall be stopped at separate low levels. Four (4) setpoints shall be provided based on wet well configuration and shall be coordinated with the Owner, Integrator and Engineer during shop drawing submittals:
         a) Lag Pump Start
         b) Lead Pump Start
         c) Lead Pump Stop
         d) Lag Pump Stop.
      2) The pumps shall automatically alternate lead duty every cycle. Manual alternation shall be selectable via the operator interface.
      3) An adjustable 0 to 3 minute timer in the PLC shall delay the starting of the lag pump.
      4) A time delay of 0-60 seconds, initially set at 5 seconds, shall be included for each setpoint.
   b. Hand Mode (H-O-A selector switch in Hand position): The pump will run. The Hand position shall be wired directly to the motor starter, bypassing all interlocks with the exception of motor overload or any other alarm that would void the pump manufacturer's warranty.
   c. Off Mode (H-O-A selector switch in Off position): The pump will not run.
   d. If the lead pump fails, the lag pump shall be started automatically.
4. In addition to high- and low-level alarms, the float switches shall also be utilized to provide backup control. Controls relays and timers independent of the PLC shall provide control logic:
   a. A High wet well alarm shall be initiated and the lead and lag pumps shall be started based on float LSH-1. The lag pump shall start after adjustable 0-60 second time delay, initially set for 30 seconds. (An adjustable 0-60 second time delay, initially set for 10 seconds, shall delay the initiation of the High-level alarm and backup float mode).
   b. Pumps shall operate until the low-level alarm float LSL-1 is reached and both pumps shall stop. When the pump station is under primary control (not backup), the LSL-1 float shall stop the pumps and send a low-level alarm. The LSL-1 float shall not initiate a low-level alarm when under backup control.
   c. Once initiated, pumps shall remain under backup control mode until the alarm is reset either via telemetry or via a reset pushbutton mounted on the inner door.
5. A thermostat inside the enclosure shall provide a low temperature alarm.
6. Pump Runtime:
   a. In addition to the physical run time meters, record pump runtime separately for each pump within the controller
   b. Record separately the "both" pumps running runtime within the controller.

7. Pump Starts:
    a. Record the total number of starts for each pump in the controller.
    b. Provide accumulated total start cycles, (resettable by administrator), and 24 hour cycles.
    c. Provide an average runtime per start for each pump.
8. Temperature sensors supplied with the pump shall initiate a pump overtemperature alarm and stop the pump upon an over temperature condition. Pump shall be locked out until manually reset. Temperature monitoring units shall be furnished by the pump supplier for installation in the lift station control panel. Provide an auxiliary contact on the associated pump circuit breaker (and slave relays as required) to disconnect the over temperature circuitry when the circuit breaker is in the off position.
9. Seal chamber moisture sensors supplied with the pump shall initiate a pump seal chamber moisture alarm upon detection of moisture in the seal chamber. Moisture monitoring units shall be furnished by the pump supplier for installation in the lift station control panel. A moisture alarm bypass switch shall be provided inside the control panel's inner door to allow disconnecting the moisture alarm from any alarm horn, exterior alarm light, and telemetry. Provide an auxiliary contact on the associated pump circuit breaker (and slave relays as required) to disconnect the moisture sensor circuitry when the circuit breaker is in the off position.
10. Motor chamber moisture sensors (if supplied with the pump) shall initiate a motor chamber moisture alarm and stop the pump upon detection of moisture in the pump motor. Pump shall be locked out until manually reset. Moisture monitoring units shall be furnished by the pump supplier for installation in the lift station control panel. Provide an auxiliary contact on the associated pump circuit breaker (and slave relays as required) to disconnect the moisture sensor circuitry when the circuit breaker is in the off position.
11. A Phase monitoring relay shall initiate an alarm and lockout pumps upon phase failure, phase reversal or undervoltage condition.
12. A Pump Fail alarm shall be initiated upon a VFD fail or circuit breaker trip.
13. Alarm Handling:
    a. The exterior alarm light shall flash until the alarm condition is acknowledged or cleared.
    b. The inner door alarm light(s) shall remain on continuously until the alarm condition is cleared. The alarm acknowledge pushbutton shall shut off the exterior alarm light.
    c. Alarm delays shall be adjustable and coordinated with the Owner and Engineer. All alarm delays shall be initially set to zero.
    d. The following alarm points shall be telemetered to the SCADA Master"
        1) High Level Alarm
        2) Low Level Alarm
        3) Motor Seal Failure (Each Pump)
        4) Overtemperature Alarm (Each Pump)
        5) Motor Fail Alarm (Each Pump)
        6) Motor Trouble Alarm (from seal fail/overtemp motor manager unit)
        7) Low Temperature Alarm
        8) UPS/Control Power Fail
        9) Phase/Power Fail
        10) Intrusion Alarm
14. The following status points shall be telemetered to the SCADA master telemetry unit:
    a. Wet Well Level
    b. HOA in "Hand" or "Off" position
    c. Alarm and Operating set points
    d. Alarm Acknowledge
    e. Float switch status
    f. Backup mode reset command.
    g. Pump Status for each pump:
        1) Running
        2) Accumulated Runtime
        3) Accumulated Cycles
        4) Normal/Fail status
        5) Fail delay status
    h. Generator status:
        1) Generator Running
        2) Generator Fail

3) Transfer switch status

15. Power Failure:
    a. Control circuit backup power shall be provided by a UPS.
    b. A UPS fail alarm shall bypass the UPS and initiate an alarm.
    c. Upon restoration of power, time delays shall be provided between starting of lead and lag pumps.
    d. A relay shall be provided ahead of the UPS to indicate control power failure.
16. Operator Interface Screens:
    a. Provide the following graphic displays at the lift station:
        1) HOA switch in “Hand”, “Off”, or “Auto” position.
        2) Real-time wet well level.
        3) Alarm and Operating setpoints.
        4) Binary Float Status: Yellow when normal, Red when in alarm.
        5) Operating mode (Float or Analog Control)
        6) Generator status:
            a) Generator Running
            b) Generator Fail
            c) Transfer switch status
        7) Pump Data:
            a) Running
            b) Accumulated Runtime
            c) Accumulated Cycles
            d) Normal/Fail status
            e) Fail delay time
        8) Alarm Screen

B. Control Devices located on front of inner lift station control panel door:
    1. Hand-Off-Auto selector switch for each pump.
    2. Green Run pilot light for each pump.
    3. Red Fail pilot light (Overtemperature, OL trip) for each pump
    4. Amber Seal Fail pilot light for each pump.
    5. Fail Reset pushbutton for each pump.
    6. Red High Level Alarm pilot light.
    7. Operator Interface.
    8. Float control reset pushbutton.
    9. Pump runtime meters

C. Other Devices accessible with inner door closed:
    1. Main breaker operating handle
    2. Pump breaker operating handle (for each pump)
    3. Breaker operating handles.
    4. Duplex receptacle.
    5. VFD operator interface.
    6. ATS annunciator and control panel.

PART 2 PRODUCTS

2.01 CONDUIT AND FITTINGS

A. Metal Conduit:
    1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    2. GRC (Galvanized Rigid Steel Conduit): Comply with ANSI C80.1 and UL 6.
        a. Metallic zinc applied by hot-dipped galvanizing or electro-galvanizing.
        b. Threads galvanized after cutting.
        c. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

C. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

D. Nonmetallic Conduit:
1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. RNC: Type EPC-40-PVC, Type EPC-80-PVC.
   a. Complying with NEMA TC 2 and UL 651 unless otherwise indicated.
   b. Polyvinyl-chloride (PVC) plastic compound.
   c. Rated for direct sunlight exposure where installed exposed.
   d. Fire retardant and low smoke emission.
   e. Suitable for use with 90 Degree C wire.

E. Nonmetallic Fittings:
1. Fittings, General: Listed and labeled for type of conduit, location, and use.
2. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
3. Solvents and Adhesives: As recommended by conduit manufacturer.

2.02 UNDERGROUND WARNING TAPE

A. 6 inches wide, 4 mil polyethylene film.
B. Vivid, opaque, long-lasting red color with bold, black letters.
C. Lettering:
1. Top line – "...CAUTION..."
2. Bottom line – "...ELECTRIC LINE BURIED BELOW..."

2.03 WIRE AND CABLE

A. Stranded copper conductor with 600 volt insulation.

B. Conductor Size #4 AWG and smaller shall have THWN insulation.

C. Conductor Size #3 AWG and larger shall have THWN or XHHW insulation.

D. Insulation of all wire shall conform to ICEA S-61-402, ICEA S-66-524, NFPA 70, and UL-83.

E. UL listed.

F. Tool-compressed terminals and connectors; Burndy, Ideal, Thomas & Betts, or approved equal.

2.04 GROUNDING MATERIALS

A. Class B stranded copper conductor which is bare or with green insulation.

B. Copperweld ground rod 5/8 inch by 10 feet.

C. Tool-compressed connectors and lugs; Burndy Hyground, Thomas & Betts 53,000 Series, or approved equal.

D. Burndy Type QGFL bar taps.

E. UL listed.

2.05 CONTROL PANEL FABRICATION

A. Enclosure

1. Enclosures for outdoor control panels shall be NEMA 4X Type 304 stainless steel. Hoffman, or equal.
    a. Maximum 60 inches high, width as required. Double sided enclosure if required due to space requirements of devices specified. Detail on drawing is based on single sided enclosure.
    b. Removable back panel.
    c. Inner door mounting HOA selector switches, and other operator-controlled devices.
    d. 12 inch by 12 inch by 1 inch pocket inside exterior door for documentation storage.
    e. Free standing, pad mounted with 18 inch vented skirts.
    f. Exterior gasketed doors with continuous hinge and 3 point handle-operated latching system. Handle with provisions for padlocking.
    g. Internal doors with continuous hinge and quarter turn latches, control devices mounted on inner doors.
    h. Circuit breaker operating handles and overload relay reset pushbuttons accessible with interior doors closed.
    i. Door stop kits to hold exterior doors in desired position, Hoffman ADSTOPK or approved equal.
2. All components labeled per shop drawings.
    a. Engraved labels attached with screws.
3. All wiring terminated on barrier-type terminal strips. Terminal strips shall be labeled with engraved plastic labels.
    a. Labels shall be attached with two-part epoxy adhesive.
    b. 600 volt terminal strips.
    c. Ring or spade type clamp connectors.
    d. Wiring laced using plastic ties and plastic wiring troughs.
    e. Wiring held down with straps attached to enclosure with screws.
    f. Separate power, control and signal conductors.
    g. Power wiring: #14 AWG, stranded, 600V copper minimum.
    h. Control wiring: #18 AWG, stranded, 600V copper minimum.
    i. Signal wiring: shielded, 300V copper minimum.
    j. Provide 15 amp, 10,000 AIC breaker on power circuits using #14 wire.
    k. Connections to instruments via terminal strip or connectors. Soldering wired to terminal strips in not acceptable.
    l. High voltage and low voltage components shall be separated by a barrier.
4. Tag all wires at each end with wire number matching shop drawings.

B. Programmable Logic Controller (PLC):
1. Programmable logic controller capable of performing relay logic, timing, counting, sequencing, mathematical, proportional-integral-derivative (PID) control, and other functions as required by the functional descriptions in this section. Provide complete unit with rack, power supply, modules, cables, and connectors.
2. Auto start-up after power failure. Retain program and setpoints so that system starts automatically when power is restored.
3. Ethernet communications with Operator Interface.
4. Embedded I/O
    a. 12 digital inputs.
    b. 12 digital outputs.
    c. 4 analog inputs.
    d. 4 analog outputs.
5. Expandable with 1762 I/O modules.
6. LED indictor.
7. Programmable in ladder logic using IBM-compatible computer as described in the functional description in this Section. Provide programming software that is standard product of the PLC

manufacture. Software shall allow on-line program editing without interrupting PLC operation. Software shall have an advanced instruction set including timing, sequencing, relay logic, close-loop PID control, mathematical, trigonometric, Boolean, floating-point and integer calculations, and time and event-based interrupts.

8. PLCs shall have Ethernet ports and RD-232 serial ports to allow communications between systems components. Provide all required interface modules and converters.
9. Environmental
    a. Operating temperature: 0 degrees to 50 degrees C.
    b. Humidity: 0 to 95 percent (non-condensing).
    c. Noise immunity: comply with NEMA ICS-2-230.
10. Manufacturer:
    a. Allen-Bradley “MicroLogix” Model 1400, including options specified, and manufacturer’s programming software.
    b. Solid-state type pump controllers such as those manufactured by US Filter, Diversified Electronics, or equal may be furnished so long as the controls proposed meet all functional requirements specified and shown on Drawings.
11. Operator Interface (Touch Screen):
    a. 10.4 inch flat panel color display
    b. 640X480 resolution, 18-bit graphics
    c. Panelview Plus, Maple System, C-More.

C. Service Entrance
1. 480/277V, 100A, 3PH, 4W service from Utility.
    a. Equipment shall be rated for fault current 22kA RMS Symmetrical.
    b. Coordinate with Xcel Energy for electric and gas service.
2. Provide a neutral bus for terminating the service neutral, the ground electrode conductor and the equipment grounding conductors.
3. A grounding electrode system shall be provided at the control panel.
4. Main breaker mechanically interlocked portable generator breaker, (key interlocks not acceptable):
    a. 100A, 3-pole utility breaker (UL Listed for service entrance)
    b. 100A, 3-pole portable generator breaker.
    c. Both breakers shall be molded case, thermal-magnetic with 22,000A interrupting capacity. Output of mechanically interlocked breakers shall be input to the “normal” lugs of the automatic transfer switch (ATS).
    d. Interlock shall permit only one (1) breaker to be closed at any time and shall permit both breakers to be locked open with a single padlock.
    e. Standby generator receptacle shall be 200A, reversed contacts, tool crimped connections, heavy duty, circuit breaking, weather proof with 45 degree angle adapter, mounting box and spring door. Match with Owner’s existing portable generator, Crouse-Hinds or equal.
5. Automatic Transfer Switch (ATS)
    a. Provide ATS inside the power section side of the lift station enclosure.
    b. ATS to have remote annunciator and control panel mounted on the enclosure inner door.
    c. ASCO or GE-Zenith.
6. Surge Protector:
    a. Provide protection from high frequency noise, electrical transients and high energy disturbances.
    b. Maximum surge current: 120kA.
    c. Working Voltage: 480/277V, 3 Phase, 4 Wire.
    d. UL1449 VPR 3rd Edition: 1000V
    e. LED Status Indication.
    f. Cooper Industries MTL ZD16304 or equal.

D. Phase Failure Relay
1. Provide relay voltage sensing for under voltage, phase reversal, phase unbalance and phase loss. Prevent pump motor operation under any abnormal condition.
2. Motor shall restart upon restoration of proper voltage and phase. Normal motor starting voltage dip shall not cause phase failure relay to trip motor.
3. Phase failure relay shall be Symcom Motor Saver, or equal.

E. Circuit Breakers:
   1. Circuit breakers will be UL labeled and shall be of the size shown. Provide breakers with an interrupting rating of not less than 10,000 amperes, symmetrical.
   2. Circuit breakers that are downstream of a control panel step-down transformer may have 10,000 amperes interrupting rating.
   3. Provide –circuit breakers as shown on the plans.

F. Control Panel Transformers:
   1. Provide control panel transformers inside control panel for all require voltages other than service to panel.
   2. Size control panel transformer to handle the 120VAC control power, plus power to the SCADA RTU, and general receptacle.
   3. Minimum size to be 3kVA
   4. Provide two (2) primary fuses and fuse holders.

G. Pump Protection Relays:
   1. Provided by pump manufacturer for installation in the pump control panel.

H. Variable Frequency Drives:
   1. Provide a variable frequency drive (VFD) rated to convert a single phase supply to three phase for the motor horsepower.
   2. Lift station VFDs shall operate a 230 volt, 3 phase motor from incoming 240 volt, 1 phase power source.
   3. Install electronic trip overload sized per actual pump motor nameplate data and suitable for submersible pumps shall be installed.
   4. Contractor will assume responsibility for proper application of motors running protection for all motors in accordance with manufacturer's recommendations and the nameplate rating of the actual motors installed. All motors will be phased to have overload protection.
   5. Provide ABB ACH550 or equivalent form Allen-Bradley, Cutler-Hammer, Square D.

I. Elapsed Time Meters
   1. Operating voltage: 90-264VAC, 60Hz
   2. 6 Digit, non-resettable
   3. UL Recognized
   4. Redington Model 722 or equal.

J. Control switches
   1. Selector, momentary pushbutton, or maintained selector as required. Positions as required for application.
   2. Heavy duty, oil-tight, contacts as required.
   3. Contact rating shall conform to NEMA A-600.
   4. Allen Bradly 800T or equivalent.

K. Control relays and timing relays
   1. Plug-in type with dust cover, socket and locking spring when relay mounted horizontally.
   2. Coil: continuous operation at 120 VAC ±10 percent unless shown otherwise.
   3. Contacts, 3 pole, double throw, minimum.
      a. 10 amps, make-break, 120 VAC, resistive.
      b. Insulation resistance: 1000 megaohms at 500 VDC.
      c. Dielectric: 2000 VAC, 60 Hz.
   4. Operating time
      a. 35 milliseconds (nominal) energization.
      b. 100 milliseconds (nominal) de-energization.
   5. Mechanical life: 10^6 operations.
   6. Timing relays shall be of the same manufacturer and series as control relays. Provide electronic timers with range as indicated.

L. Indicating lights
   1. Sunlight visible, 30.5mm, high visibility LED.

2. A “Push-to-Test” pushbutton shall be mounted on the inner door to illuminate all pilot lights when pushed.
3. Heavy-duty, oil-tight.
4. NEMA 4 rating.
5. Allen Bradley 800T, or equal.
6. Colors.
    a. Running: Green.
    b. Power on: White.
    c. Alarm: Red.
    d. Alert: Amber

M. External Alarm Light
1. Provide NEMA 4X, industrial units.
2. Provide UL labeled alarm beacons suitable for top mounting on panel.
3. Red flashing LED cluster lamps.
4. Edwards 105 series or approved equal.
5. Provide an illuminated toggle switch to allow the external alarm light to be disabled.

N. Uninterruptible power supply (UPS)
1. True on-line with spike, line noise and RFI/EMI filtering.
2. UL Listed.
3. Cord and plug connected. Provide a receptacle in the control panel for connection of the UPS.
4. Battery sized to power 115 percent of panel control power requirements for 10 minutes.
5. Surge protection ANSI/IEEE C62.41
6. Fail alarm circuit internal to UPS which bypasses the UPS and initiates an alarm upon activation.

O. Control Circuit surge protection
1. 120 VAC, 20 Amp rated in-line device. Listed for protection from ANSI/IEEE CG62.41 Category A and B Transients.
2. 300 V peak Clamping voltage.
3. ASCO model 252 or approved equal.

P. Terminals
1. NEMA style, barrier type, 0.4-inch spacing, nominal.
2. 600V RMS, 55 amp rating.
3. UL listed.
4. Allen-Bradley 1492-CA1 series, or equal.
5. Terminals for larger power circuits shall be 600 VAC barrier-type, sized for the conductors.

Q. Enclosure Heaters:
1. Heaters will have a metal housing, integral thermostat, and 0 to 100 degrees F adjustable range. Heaters shall be capable of heating the interior to 50 degrees F with an outside air temperature of -30 degrees F.
2. Provide Hoffman Engineering “Design-Aire” type or equal.
3. Provide a low temperature thermostat for low alarm notification.

R. Ventilation
1. Thermostatically controlled ventilation fan with fixed intake/discharge louvres.
2. Air filters, filter retainer, filter sealing gasket and finger guard.
3. NEMA 3R steel shroud kits with finish to match panel.

S. Receptacle: Provide UL-listed ground fault interrupter type, 20 A specification grade receptacles:
1. One (1) mounted on inner door of panel.

T. Door switches for monitoring the position of the exterior doors.

U. Intrinsically-Safe Barrier:
1. UL labeled unit suitable for using non-rated devices in NEC Class 1, Division 1 explosive area.

2. Non-Zener diode.
3. Terminal strip connections.

V. LED Lighting package for panel interior with manual switch and lamp guard. Lighting shall be provided behind each door on both sides of the control panel, (high and low voltage sections).

W. Enclosure security (both sides of enclosure)

1. Provide security alarm consistent with Owner's other lift stations.

2.06 TELEMETRY EQUIPMENT

A. Cable Surge protection
1. UL497B Listed Gas Tube.
2. Multi Strike
3. 18-8 Stainless Steel hardware
4. 20kA IEC 61000-4-5 8/20 waveform
5. Manufacture: Polyphaser model IS-B50LN-C2 or approved equal.

B. Cable ground Kit
1. Times Microwave Systems ground kit GK-S400TT or equal.

C. Radio
1. Match Owner's existing radios

D. Industrial Ethernet switch
1. 5-port
2. 10/100 Mbps.
3. RJ 45
4. Phoenix Contact SFNT 5TX or equal.

E. Directional.
1. Compatible with existing SCADA system and per radio path study.

F. Antenna cable
1. UV Resistant Polyethylene Jacketed.
2. Flexible outer conductor.
3. 50 dB RF Shielding.
4. Outdoor rated.
5. With required hardware and accessories for a complete system.
6. Manufacture: Avaya, LMR-400, or approved equal.

2.07 SUBMERSIBLE LEVEL TRANSDUCER

A. Type 316 Stainless Steel Body

B. 2-inch minimum diameter Teflon faced pressure-transmitting diaphragm.

C. Solid state type internal transducer.

D. Sealed cable entry.

E. Stainless steel connecting hardware, clamps, cables, etc.

F. Pressure range as required.

G. Waterproof shielded cable.

H. Sufficient length of cable to reach from the bottom of the wet well to the control panel.

I. KPSI Model 750, Sigma Series 6100 or approved equal.

2.08 FLOAT LEVEL SWITCHES

A. Provide level float switches integrally sealed suitable for Class 1, Division 1, Group D environments.

B. Provide Switch Assemblies:
   1. Constructed of molded polyethylene, Teflon coated stainless, or equal.
   2. One normally open switch to close as wet well level rises and reverse as level falls. SPST contact rated minimum 4 amps at 120Vac.
   3. Cable insulation suitable for continuous submergence in water or hydrocarbons. Wire minimum 14 AWG stranded copper. Cable length to suit the installation; See plans.

C. Installation:
   1. Mount float switches as shown on Drawings.
   2. Wire the switch to the control panel using the manufacturer supplied flexible cable. There shall be no splices or junctions between the switches and the control panel.

D. Install in a manner that permits easy removal of the switches for maintenance or cleaning and without the need to empty the tank, wet well, or sump.

E. Provide US Filter, Flygt, Anchor Scientific, or equal.

2.09 FLOAT LEVEL SWITCH MOUNTING CABLE

A. Stainless steel mounting cable for hanging in lift station wet well for mounting of floats.

B. 5 pound cast iron weight to provide tension to cable.

2.10 SPARE PARTS

A. Contractor shall furnish the following spare parts to the Owner. Spares shall be delivered in boxes labeled on the outside with manufacturer and part number identified on the box:
   1. One (1) spare relay for each type of relay used.
   2. Two (2) fuses of each type used.
   3. One (1) spare power supply of each type used,

B. Provide the following special tools:
   1. Mounting ring wrench(s) for pushbuttons, switches, and lights.
   2. Fuse puller.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. All work shall be performed in a neat and workmanlike manner consistent with the high-quality standards of the electrical trade. “A neat and workmanlike manner” shall be as required by NFPA 70, Section 110.12; and shall conform to NECA 1, Standard Practices for Good Workmanship in Electrical Contracting. Each electrician shall be knowledgeable and well-trained in the particular tasks to be performed.

3.02 RADIO PATH STUDY

A. Supplier shall conduct a field study of radio signal strength to determine required radio output power, antenna mounting height and antenna location for reliable communications with the City’s existing radio SCADA system. The field study shall be conducted prior to submitting shop drawings or ordering any equipment.

B. For licensed radio systems, Supplier shall act as the City's agent to modify the City's existing FCC radio license to include the new SCADA site. Supplier shall complete and file all required documents and shall pay all related costs.

3.03 SCADA SYSTEM SOFTWARE DEVELOPMENT

A. Supplier shall modify the existing SCADA system software at all existing locations as required to incorporate the new information from the new SCADA site(s). Graphic and control screens shall be added as well as trending and alarms to match existing sites.

3.04 ELECTRICAL SERVICE

A. Coordination of Work with the Utility:

1. Primary service cost paid by Owner.
2. Contractor responsible for all coordination with the utility with regard to the service connection and exact location of the transformer and gas meter.
3. Provide and install all conduit, pole risers, weatherheads, wiring, grounding, meters, panels, electrical devices, etc. not installed by the power company and required for a complete service.
4. Install items furnished but not installed by the utility.

3.05 CONDUIT INSTALLATION

A. Conduit size shall be as shown on the Project or as required by the NFPA 70 with a minimum size of 3/4 inch. All raceways shall be installed in accordance with NECA Standard of Installation and as specified herein.

B. All conduit shall be schedule 80 PVC, except pole risers which shall be rigid steel.

C. Pull boxes or fittings shall be installed as Site and pulling requirements dictate.

D. All conduits shall be kept dry and free of water or debris with pipe plugs or caps.

E. Underground conduit runs shall have a minimum cover of 2 feet. Contractor shall do all trenching for underground conduit with a minimum size trench. Underground warning tape shall be laid approximately 9 inches below the surface in the trench above the conduit.

F. Conduit containing the float and/or transducer cables shall be identified with permanently affixed labels with the wording "Intrinsic Safe Wiring."

3.06 WIRING INSTALLATION

A. through the system in such a manner as to not exceed the maximum tensile strength of the cable being pulled as allowed by the NFPA 70 and/or cable manufacturer. All handling and installation of wire and cables shall be done by competent and skilled workmen who shall use methods which will prevent damage to the wire and cable. Pulling compound shall dry to a fine lubricating non-conductive powder and shall be approved by the cable manufacturer.

B. Adequate measures shall be employed to determine that the raceways are free of foreign material and moisture before pulling wire or cable.

C. Any conductor used for equipment grounding purposes shall be green in color, unless it is bare. Conductors with white or green covering shall not be used to indicate other than neutral or grounding. This limitation applies to all power and control circuits.

D. Conductors shall be without splice from termination to termination.

E. Every bolt, lug and screw termination shall be tightened with a torque wrench or torque screwdriver to the torqued values specified in UL standards and/or as specified by the device manufacturer.

3.07 LABELING

A. Label all field mounted control devices, instrumentation, switches, etc., with tag number and item description.

B. Labels shall be engraved laminated plastic with 1/4 inch high lettering. Labels shall be attached with stainless steel screws to the device or nearby wall.

3.08 CALIBRATION, ADJUSTING AND TESTING

A. Devices requiring field calibration shall be calibrated in the presence of the Engineer's representative and documented.

3.09 PROJECT MANAGEMENT

A. Supplier shall provide engineering and administrative services necessary to fulfill the requirements of this specification.

B. Supplier shall provide the services of an experienced project manager as the overall coordinator during the course of the project.

3.10 TESTING, START-UP, AND TRAINING

A. Complete panel fabrication and wiring at the control panel supplier's facility to the extent that only field wiring will be needed on Site after the panel has been installed.

B. Test the panel before shipping. Simulate inputs as needed to test both the automatic controls and the backup control circuitry. Be prepared to demonstrate controls operation on site during start-up of the lift station.

C. Supplier shall provide a skilled programmer/instrumentation engineer or technician who shall complete troubleshooting and start-up to place the entire system into satisfactory operation. The engineer or technician shall make the necessary inspection of the completed installation, make the necessary final field adjustments, and make program revisions as required for start-up.

D. Verify motor rotation and proper phase connection prior to operating pump motors.

E. Conduct a 2-hour demonstration of all system features and functions to Owner and Engineer.

F. During start-up, make necessary adjustments, including minor wiring or PLC program changes if needed, to obtain proper operation of the lift station controls.

G. Instruct the Owner's personnel in the proper operation and maintenance of the lift station controls.

H. Record changes to the controls. Revise wiring diagrams and schematic diagrams to show final installation.

I. Insert revised diagrams, final program printouts, and final operator interface screen printouts into each operation and maintenance manual in place of original diagrams.

J. Contractor shall coordinate with the Owner for connection and operation of the Lift Station using a portable generator connection.

1. Verify proper phasing of the generator receptacle.
2. Verify operation of the pumps while connected to the generator.

K. Contractor shall test and demonstrate operation of the lift station under generator power. Utility main breaker shall be used to simulate loss of normal power.
    a. Verify proper phase rotation prior to running the pump motors.
    b. Demonstrate operation of lift station on generator power, including startup and running of both pumps.
    c. Demonstrate return to normal power operation using the utility main breaker.

3.11 TELEMETRY CABLE

A. Comply with TIA/EIA standards.

B. Install ground kit as required per manufacture. Connect to existing ground system.

C. Install surge protection per manufacture.

3.12 ACCEPTANCE TESTING

A. After the installation is complete, and proper operation has been demonstrated, a 60-day acceptance test shall begin. The entire system shall be required to operate for 60 days with no malfunctions, field repairable malfunctions excepted. Any malfunction during the 60-day test which cannot be corrected within 24 hours by the supplier shall be considered a non-field repairable malfunction and after repairs are complete, the test shall be repeated.

B. The acceptance test shall apply to all equipment furnished under this Section.

3.13 SUPPLIES

A. Contractor shall provide all expandable items for equipment installed under this contract. For system startup, checkout, and during the acceptance test.

END OF SECTION

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SECTION 43 24 10

SUBMERSIBLE LIQUID VOLUTE CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Provide non-clog submersible liquid pumps as shown in Drawings at each of the following:
      a. Lift Station.
   2. Components:
      a. Impeller
      b. Pump/Motor Shaft
      c. Pump Shaft Seals
      d. Motors
      e. Motor Protection
      f. Power Cable
   3. Accessories:
      a. Pump Guide Bars and Brackets
      b. Lifting Devices
      c. Cable Holder
      d. Lifting Chain Holder
      e. Discharge Connection
      f. Access Hatches
      g. Safety Grating
      h. Equipment Identification Tags
   4. Anchor Bolts and Hardware
   5. Spare Parts and Special Tools

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A48 - Specification for Grey Cast Iron Castings
   2. ASTM A108-81 - Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
   3. ASTM A532-82 - Specification for Abrasion-Resistant Cast Irons.
   4. ASTM A582-80 - Specifications for Free-Machining Stainless and Heat Resisting Steel Bars, Hot-Rolled or Cold-Finished.

B. Anti-Friction Bearing Manufacturer's Association (AFBMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings

C. Hydraulics Institute Standards (HIS):
   1. Centrifugal Pump Test Code

D. NEC and ICEA standards

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Pump design shall include considerations for clogging.
      a. Capable of handling raw unscreened sewage with soft solids up to 3.1 inch diameter
   2. Each pump/motor assembly shall be designed as a completely submersible unit capable of pumping specified medium.
      a. Maximum allowable number of pump veins for impellers provided shall be 2.
      b. Where possible, suction inlet for submersible pumps shall have a minimum diameter opening of 6-inches. Smaller than 6-inches may be provided with approval of Engineer.

Clearly identify in submittals pumps proposed with suction inlet opening having diameters less than 6-inches.

3. Pump/motor assembly shall be designed to automatically and firmly connect to discharge piping when lowered into place on discharge connection.
4. Pump/motor assembly shall be easily removable for inspection or service requiring no bolts, nuts or other fasteners to be removed for this purpose.
5. Pump/motor assembly and pump motor protection module shall be supplied by one manufacturer.
6. Pump/motor assembly shall not bear directly on sump floor.
7. There shall be no need for personnel to enter pump wetwell for normal inspection or service.
8. Explosion-proof design.

B. Performance Requirements:

1. Lift Station

No. of Pumps	2 (1 duty, 1 standby) Station is capable of operating all 2 pumps simultaneously
Type of Drive	Variable Speed (VFD)
Drive Arrangement	Submersible
Pumped Medium	Unscreened Wastewater
Maximum Allowable Discharge Flange Size	4-inch Contractor shall furnish eccentric reducer if smaller than maximum allowable discharge flange is provided.
Design Flow Capacity (per pump)	400 US gpm at 56 ft TDH at 60 hz frequency
Maximum Motor hp	12.0 hp
Motors	480 volt, 3-phase, 60 hertz,
Motor Ratings	Class 1, Division 1, Groups C and D
Motor Service Factor	1.15
Stator insulation	Class F, rated for 356 degrees F
Continuous duty	Handling of 104 degrees F pumped media

2. Non-overloading motor throughout entire pump performance curve from shut-off to static head condition.
3. Motor and cable capable of continuously submersible to 65-feet without loss of watertight integrity.
4. Verify nameplate full load amps for motor overload sizing.
5. Refer to Drawings for wetwell depths associated with pump accessories and appurtenances.

1.04 SUBMITTALS

A. Vendor and manufacturer information:

1. Name, address, toll-free phone number and email address of manufacturers.
2. Name, address and phone number of local service representative.

B. Shop Drawings:

1. Shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
2. Size, Model Number and Serial Number of each component.
3. Detailed specifications, dimensions and drawings for equipment.
   a. Cut sheets for electric motors and ancillary items manufactured by others.
   b. Detailed specifications, dimensions and weights for total assembly.
   c. Specifications and complete bill of materials showing materials of construction, part numbers, etc.
   d. Motor performance including but not limited to: performance curves for torque, current, power factor, input/output kilowatts and efficiency (as applicable). Include data on starting and no-load characteristics.
4. Typical installation guides.
5. Installation, inspection and start-up report in accordance with Section 01 75 00 - Starting and Adjusting.

C. Test Reports:
   1. At time of startup, Manufacturer or Manufacturer Representative shall provide a minimum of 3 drawdown tests for each pump provided. Results of drawdown testing shall be provided with startup reports to Engineer.

D. Operation and Maintenance Manuals
   1. Operation and maintenance data in accordance with Section 01 78 23 - Operation and Maintenance Data
   2. Parts list and list of recommended spare parts
   3. Printed warranty shall be provided within 10 days of commencement of the warranty period.

E. Evidence of experience and installations as described in Section 2.01.

1.05 RELATED SECTIONS:

A. Refer to the following specification sections for additional requirements:
   1. Section 01 33 00 - Submittal Procedures
   2. Section 09 91 50 - Shop Painting
   3. Section 26 00 00 - General Provisions for Electrical Systems
   4. Section 26 05 10 - Electric Motors
   5. Section 40 90 00 - Control System Functional Description
   6. Section 40 91 19 - Instrumentation
   7. Section 40 92 13 - Control System Panels and Hardware

1.06 QUALITY ASSURANCE

A. The physical and chemical properties of all materials, design, performance characteristics and methods of construction and installation of all process items shall be in accordance with applicable current editions of the following standards, references, and guidelines.
   1. American Water Works Association (AWWA)
   2. American Society for Testing and Materials (ASTM)
   3. American Society of Mechanical Engineers (ASME)
   4. American National Standards Institute (ANSI)
   5. Occupational Safety and Health Act (OSHA)
   6. National Electrical Manufacturers Association (NEMA)
   7. Institute of Electrical and Electronic Engineers (IEEE)
   8. Underwriters Laboratories, Inc. (UL)
   9. The Chlorine Institute
   10. Pipe Fabrication Institute

B. All materials, equipment and their installation shall comply with the applicable sections of the following current codes:
   1. Minnesota Rules, Chapter 4720.
   2. Recommended Standards for Water Works (“10 State Standards”), Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers.

C. All welding shall be performed by ASME certified welders. Submit copies of the welder’s certification to the Engineer prior to any welds made.

D. Certified pump performance curves including:
   1. Head capacity curves.
   2. Horsepower curve.
   3. Wire-to-water efficiency (including all friction and shaft losses).
   4. Shut-off head.
   5. Recommended operating range.

E. Each pump furnished under these specifications shall be tested at the factory in accordance with the latest edition of the Hydraulics Institute Standards for both hydrostatic pressure & performance. Certified copies of all test reports shall be submitted to Engineer for approval prior to shipment.

F. Each pump shall be tested at the full load speed of the respective driver for head, capacity, brake horsepower and efficiency from shutoff to 150 percent of design capacity. In addition, for variable speed units, one (1) pump of each service shall be tested at the minimum design conditions plus three (3) equally spaced speeds between the minimum and maximum conditions.

G. Tests on all motors shall be conducted in accordance with IEEE Standards. All test results shall be submitted to the Engineer for approval prior to shipment.
   1. Each motor shall be given a short commercial test which includes the following:
      a. No load running current
      b. High potential
      c. Winding resistance

H. Replace pumping equipment that fails to meet test requirements with equipment that does meet test requirements.

I. Test results to be approved by Engineer before shipment.

1.07 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage, and handling in accordance with Section 01 60 00 – Product Requirements.

B. Inspection:
   1. Inspect all pipe and products as it is received to determine damage and/or missing parts.
   2. Notify Engineer of any missing, damaged, or defective products.
   3. Remove all products found to be defective by the Engineer from the site.
   4. Repair or replace damaged items in accordance with the manufacturer's instructions.

C. Handling and Storage:
   1. Handling and storage of products shall be in accordance with Section 22 of AWWA C600.

D. Scheduling
   1. Schedule all process work in phases to accommodate the Owner's occupancy and treatment requirements.
   2. Refer to Specification Section 01 51 00 Temporary Utilities in advance of any service interruption, disruption to construction activities, or to the existing process system operation. Do not proceed until the Owner has granted approval.

E. Provide storage and handling requirements for materials as recommended by equipment manufacturer and supplier is accordance with Section 01 78 23 Operation and Maintenance Data.

1.08 WARRANTY

A. Provide written guarantee of operation for pumping units and appurtenant equipment for a period of 1 years from date of initial service. Provider is to provide an additional guarantee of up to one-year of storage following delivery of the pumps to OWNER for storage – before the installation guarantee starts.

B. Provide written guarantee of operation for above grade control station for a period of 1 years from date of initial service. Guarantee excludes normal use items.

C. Include list of parts and services under warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products specified in this section shall be manufactured by:
   1. ITT Flygt,

B. Plan layouts, weights, and pertinent specification language used in the design have been based upon ITT Flygt equipment.

C. All equipment called for in this section shall be supplied by a single manufacturer or authorized sales representative to assure uniform quality, ease of maintenance, and minimal parts storage.

D. No equipment shall be supplied by a manufacturer not regularly engaged in the manufacturing and production of equipment detailed in this section. Manufacturers must have installed and had in satisfactory use for a period of not less than 5 years, a minimum of 10 installations of equivalent equipment specified and shall submit evidence of such with the shop drawings.

2.02 GENERAL

A. These specifications shall be considered as minimum requirements. The Contractor or Equipment Supplier shall add such additional features as are necessary for satisfactory operation and functioning of equipment.

B. Performance:
   1. Designed for continuous operation.
   2. Operation without overloading motor throughout performance curve.
   3. All pumps shall be capable of passing 3 inch solids.

2.03 PRODUCTS

A. Materials of Construction
   1. Major Pump Components: Grey cast iron, ASTM A-48, minimum Class 30, smooth surfaces devoid of blowholes or other irregularities.
   2. Pump/Motor shaft and sleeve: ASTM A276 Type 420 stainless steel.
   3. Wear Ring, case: Cast Iron, ASTM A48, minimum 200 Brinell.
   4. Wear Ring, impeller Stainless Steel, AISI329, 350 Brinell.
   5. O-Rings: Nitrile Rubber (NBR).
   6. Fasteners (including impeller fastener): Stainless Steel, ASTM A276 Type 316Ti.
   7. Lower Seal Faces: Silicon Carbide/Silicon Carbide or Tungsten Carbide/ Tungsten Carbide
   8. Upper Seal Faces: Silicon Carbide stationary/Carbon rotating or Tungsten Carbide stationary/ Tungsten Carbide rotating.

B. General Pump/Motor Construction:
   1. Explosion-proof pump, motor and cable entry assembly approved for use in areas classified as hazardous in accordance with NEC Class I, Division 1, Group C and D service.
   2. Body seal design:
      a. Metal-to-metal contact between machined surfaces.
      b. Fit critical mating surfaces requiring watertight seal with Nitrile or Viton rubber O-rings without specific torque limit required.

C. Components
   1. Impeller:
      a. Dynamically balanced.
      b. Ceramic coated.
      c. Manufacturer to match impeller with pump application.
      d. Furnish bottom plate or wear ring(s) to provide efficient sealing between impeller and volute.
   2. Pump/motor Shaft:
      a. Continuous, one-piece, pump and motor shaft without couplings.

b. Maximum deflection: 0.002-inches at full driver output measured at lower mechanical seal.

3. Pump Shaft Seals:
   a. Tandem, mechanical-shaft seal system assemblies with two totally independent seal units.
   b. Operate lapped seal faces at constant rate in an oil reservoir that hydrodynamically lubricates seal faces.
   c. Lower primary seal unit, located between pump and seal chamber, shall contain one stationary and one positively driven rotating tungsten-carbide ring or silicon carbide.
   d. Upper secondary seal unit, located between seal chamber and motor, shall contain one stationary and one positively driven rotating tungsten-carbide ring or silicon carbide.
   e. No adjustment or maintenance required.
   f. Seal effectiveness not dependent upon direction of rotation.
   g. Dry motor operation without damage while pumping under load.
   h. Seal oil chamber designed to prevent overfilling and provide oil expansion capacity. Easily accessible drain and inspection plug.
   i. Pumped media not used for lubrication.
4. Motors:
   a. Refer to Section 26 05 10 - Electric Motors
   b. Capable of 15 evenly spaced starts per hour.
5. Motor Protection:
   a. Motor Thermal Protection
      1) Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor.
      2) Should the thermal switches open, the motor shall stop and activate an alarm.
   b. Motor Moisture Protection
      1) A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, activate alarm to signal the need to schedule an inspection.
   c. Motor Protection Module
      1) The thermal switches and float switch shall be connected to a Motor Protection Module. The Motor Protection Module shall be designed to be mounted in the pump control panel.
      2) Module shall be powered by 120 volt input.
      3) Accept leads from thermal switch and moisture detection sensor.
      4) Motor Protection Module provides dry output to be used for control system alarm and lockout features for thermal and motor moisture protection.
   d. Refer to Section 40 90 00 - Instrumentation and Control for Process Systems.
6. Power Cables:
   a. Size according to NEC and ICEA standards.
   b. Length sufficient to reach junction box without the need of any splices.
      1) Refer to Drawings for wetwell depths and location of junction box for determining cable length.
   c. Four (4) wire connectors with labeling.
   d. Label wires A, B, C, Neutral and Ground
   e. Oil resistant outer jacket of chloroprene rubber.
   f. Entry seal at motor:
      1) Single or dual cylindrical elastomer grommet, flanked by washers, all having a close tolerance fit against cable outside diameter and entry inside diameter and compressed by body containing a strain relief function separate from the function of sealing the cable.
      2) Entry seal may be reused to change out cable.

D. Accessories
   1. Pump Guide Bars and Brackets:
      a. Guide rail and lift out system provided for each pump.
      b. Guide bars, supports and fasteners:
         1) 316 stainless steel.
         2) Two (2) Schedule 40 pipe guide bars per pump with supports at bottom, top and midpoint.
         3) Attach intermediate support brackets to discharge piping at minimum 10-foot intervals.

c. Diameter: As recommended by pump manufacturer.
d. Length: As required to extend from lower guide holder or discharge connection to upper guide holder mounted on the access frame.

2. Lifting Devices:
   a. Provide each pump with oversized 316 stainless steel center lifting bale.
   b. Provide 316 stainless steel chain to facilitate inspection and removal for each pumping unit in a single lift.
   c. Provide connection for stainless steel lifting chain to oversized bale on submerged pumping units by means of a 316 stainless steel clevis without entering the wet well.
   d. Bale, chain, and clevis assembly shall be rated for a minimum of 150 percent of the pumping unit weight.
   e. Provide lifting device system for each pump.
3. Cable Holder:
   a. Cable holder: fabricate from 316 stainless steel and attach below pump access cover.
   b. Each pump power cable shall be supported on a separate minimum thickness 3/8-inch Type 316 stainless steel hook located within 6-inches of guide rail bracket for each pump. Each pump power cable shall be run as not to restrict removal of pumps.
   c. Cable holder may be used to support instrumentation. Each instrumentation cable shall be run as not to restrict removal of pumps.
4. Lifting Chain Holder:
   a. Provide a lifting chain holder for each pump.
   b. Lifting Chain Holder: fabricate from 316 stainless steel and attach below pump access cover.
   c. Each pump lifting chain shall be supported on a separate minimum thickness 1/2-inch Type 316 stainless steel hook located within 6-inches of guide rail bracket for each pump. Each pump lifting chain shall be run as not to restrict removal of pumps.
   d. One pump lifting chain and only one pump lifting chain may be supported by each Lifting Chain Holder assembly. Provide minimum two anchors per lifting chain holder.
5. Discharge Connections:
   a. Provide discharge connection for each pump.
   b. Grey cast iron, ASTM A-48, Class 30.
   c. 90 degree elbow with base-mounting shoe for bolting to concrete floor of wet well or scum box.
   d. Provide guide bar support brackets and pump slide-on connection at one end.
   e. Pipe-flange connection faced and drilled in accordance with ANSI B16.1, Class 125 flanges.
6. Equipment Identification Tags
   a. Permanently attach identification tags to each piece of equipment.
   b. Tags shall display a code number corresponding to the number provided in the Drawings
   c. Tags: Engraved or stamped stainless steel permanently mounted to equipment in high-visibility location.
      1) Lettering: 1/2-inch high.
7. Access Hatches:
   a. Provide safety grating for <u>all</u> access hatches provided.
   b. Single leaf or double leaf as shown on Drawings.
   c. Doors: 1/4-inch aluminum diamond pattern plate designed to withstand a live load of 300 pounds per square foot except:
   d. Channel Frame: 1/4-inch aluminum with an anchor flange around the perimeter.
      1) Drainable frame shall discharge moisture from frame channel, to a single 1-1/2 inch drain connection on underside of hatch frame.
      2) Route drain discharge using SCH40 PVC of same diameter as hatch drain to appropriate location, determine in field.
      3) Drain shall not interfere with operation of hatch or removal and installation of any process equipment via hatch opening.
   e. Hinges: 316 Stainless steel with stainless steel pins.
   f. Hardware: 316 stainless steel, including all parts of latch and lifting mechanism assemblies, hold open arms and guides and all brackets and fasteners.
   g. Covers shall be counterbalanced.
   h. Equip each hatch with a recessed hinged hasp for padlocking. All hasps and padlocking parts shall be 1/4-inch type 316 stainless steel.
   i. Finish: Mill finish with bituminous coating applied to surface in contact with concrete.

j. Seal: Shall have built in neoprene gasket.
k. Maximum allowable deflection shall be 1/150 of the span.

8. Safety Grate:
   a. Secondary protective grating panel shall be 1-inch thick aluminum “I” bar grating, no exceptions.
   b. Grating panel color and finish shall be Safety Yellow powder- coating.
   c. Grating panel shall be hinged with tamper proof stainless steel bolts, and shall be supplied with positive latch to maintain unit in an upright position.
   d. A 6-inch viewing area shall be provided on each lateral unhinged side of grating panel, for visual observation and limited maintenance procedures.
   e. A padlock hasp for owner-supplied padlock shall be provided.

2.04 ANCHOR BOLTS AND HARDWARE

A. Contractor shall provide anchor bolts, hex nuts, and all other fastener hardware and shall be 304 stainless steel.
   1. Type 304 stainless steel bolts shall conform to:
      a. ASTM F593.
   2. Type 304 Stainless steel nuts shall conform to:
      a. ASTM F594.

B. Concrete anchors shall comply with requirements of Section 03 30 00 - Cast-in-Place Concrete.

C. Locate all anchors and fasteners with templates furnished by equipment manufacturer as applicable.

2.05 SPARE PARTS AND SPECIAL TOOLS

A. Supply all special tools and the following spare parts for each type of pump:
   1. Two (2) complete sets of gaskets, O-rings, and lipseals
   2. One (1) impeller
   3. Two (2) sets of casing wearing rings including nuts and screws (if required by enclosed impeller design)
   4. Two (2) sets of impeller wearing rings including nuts and screws (if required by enclosed impeller design)
   5. One (1) complete set of bearings
   6. One (1) complete set of adjusting shims (if required)
   7. Two (2) sets of mechanical seals
   8. 1 year of Manufacturer recommended:
      a. Grease,
      b. Oil,
      c. Coolant, and/or
      d. Any other applicable lubricant or other maintenance related consumable provided for pump operation.
   9. SDS for any applicable products provided with equipment or as spare parts.
   10. Recommended spare parts necessary to maintain each piece of equipment in service for a period of two years.
   11. Provide special tools required for normal repair, parts replacement and maintenance of the equipment that are available only through the manufacturer.

B. All spare parts must be properly protected for long term storage and packed in waterproof containers, such as plastic totes, which are clearly identified with indelible markings on outside contents.

C. Contractor shall prepare transmittal for each transfer of spare parts to Owner. A copy of the transmittal shall be given to the Owner at the time of the transfer. The transmittal shall include the following:
   1. Date of transfer
   2. Detailed list of spare parts transferred

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with Manufacturer's recommendations and as shown on Drawings.

B. All installation of equipment shall be performed by the Contractor. All required installation hardware (such as, but not limited to, support braces, bolts, washers, nuts, and jam nuts) shall be furnished by the Contractor.

C. Manufacturer's authorized representative shall supervise critical installation procedures as necessary, inspect final installation, perform any necessary calibration and adjustment, and start up the equipment. A copy of the startup report shall be included in the O&M manual.

D. Install all anchors in accordance with certified prints supplied by equipment manufacturer.

E. Installation shall include furnishing manufacturer recommended grade(s) of required oil and grease for initial operation.

3.02 FIELD SERVICE AND START UP

A. Field Testing:
   1. Conduct test of the pumping equipment in the presence of the Engineer and in accordance with the Test Code of the Standards of the Hydraulic Institute for Centrifugal Pumps.
   2. Testing Period: One hour minimum, or longer as may be required to determine compliance with the specifications.
   3. Provide all power, gages, measurement devices, and other apparatus required for the testing.
   4. Remove all testing equipment upon completion of testing.
   5. Provide copies of all test data and results to Owner and Engineer.
   6. Resulting pump capacities shall be within 5 percent of the previously supplied certified curves.
   7. Replace pumping equipment which fails to meet the specified requirements.

B. Manufacturer's Field Services: Check pumps and motors for alignment after installation and prior to field testing.

C. Coordinate startup with installation of related equipment.

D. Refer to Section 01 75 00 - Starting and Adjusting for additional requirements.

E. Demonstration
   1. Provide a minimum of two (2) hours of operator training for each pump installation location identified in Part 1.03.B at Owner's convenience after pumps are operational.
   2. Owner may videotape training.

END OF SECTION

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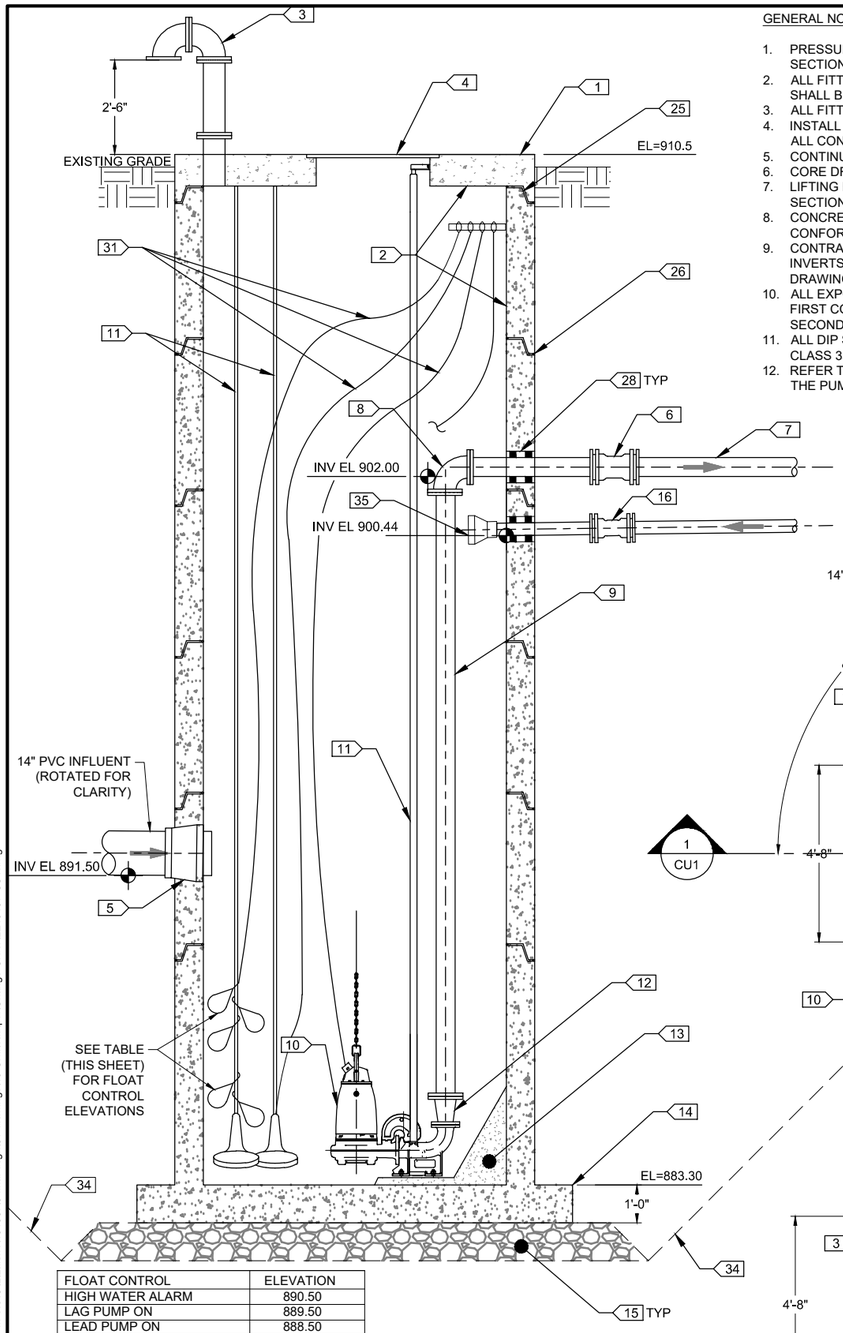
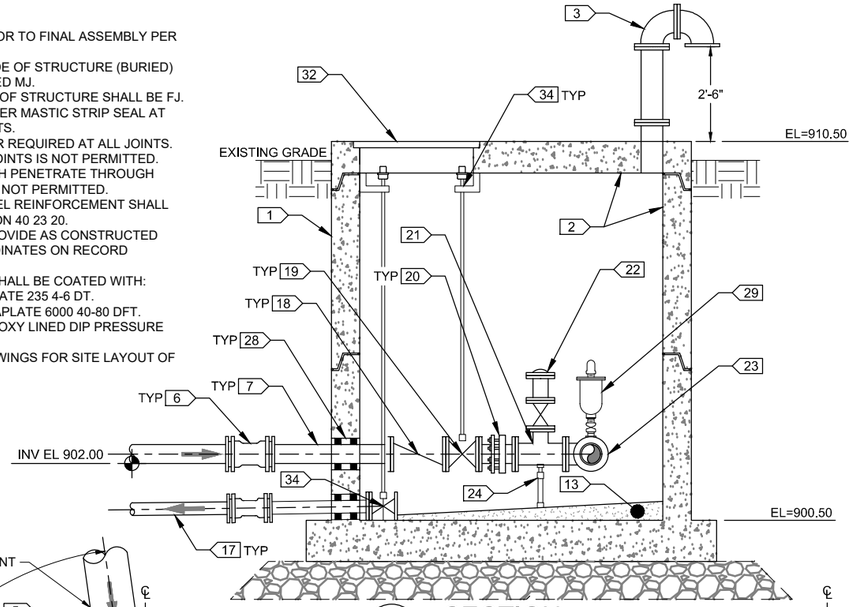
GENERAL NOTES:

1. PRESSURE TEST PRIOR TO FINAL ASSEMBLY PER SECTION 40 23 60.
2. ALL FITTINGS OUTSIDE OF STRUCTURE (BURIED) SHALL BE RESTRAINED MJ.
3. ALL FITTINGS INSIDE OF STRUCTURE SHALL BE FJ.
4. INSTALL BUTYL RUBBER MASTIC STRIP SEAL AT ALL CONCRETE JOINTS.
5. CONTINUOUS SEALER REQUIRED AT ALL JOINTS.
6. CORE DRILLING AT JOINTS IS NOT PERMITTED.
7. LIFTING HOLES WHICH PENETRATE THROUGH SECTION WALLS ARE NOT PERMITTED.
8. CONCRETE AND STEEL REINFORCEMENT SHALL CONFORM TO SECTION 40 23 20.
9. CONTRACTOR TO PROVIDE AS CONSTRUCTED INVERTS AND COORDINATES ON RECORD DRAWINGS.
10. ALL EXPOSED PIPE SHALL BE COATED WITH: FIRST COAT: DURAPLATE 235 4-6 DT. SECOND COAT: DURAPLATE 6000 40-80 DFT.
11. ALL DIP SHALL BE EPOXY LINED DIP PRESSURE CLASS 350.
12. REFER TO CIVIL DRAWINGS FOR SITE LAYOUT OF THE PUMP STATION.



FLOAT CONTROL	ELEVATION
HIGH WATER ALARM	890.50
LAG PUMP ON	889.50
LEAD PUMP ON	888.50
ALL PUMPS OFF	886.00
LOW WATER ALARM	885.30

1 CU1 SECTION
0 2 4
SCALE IN FEET



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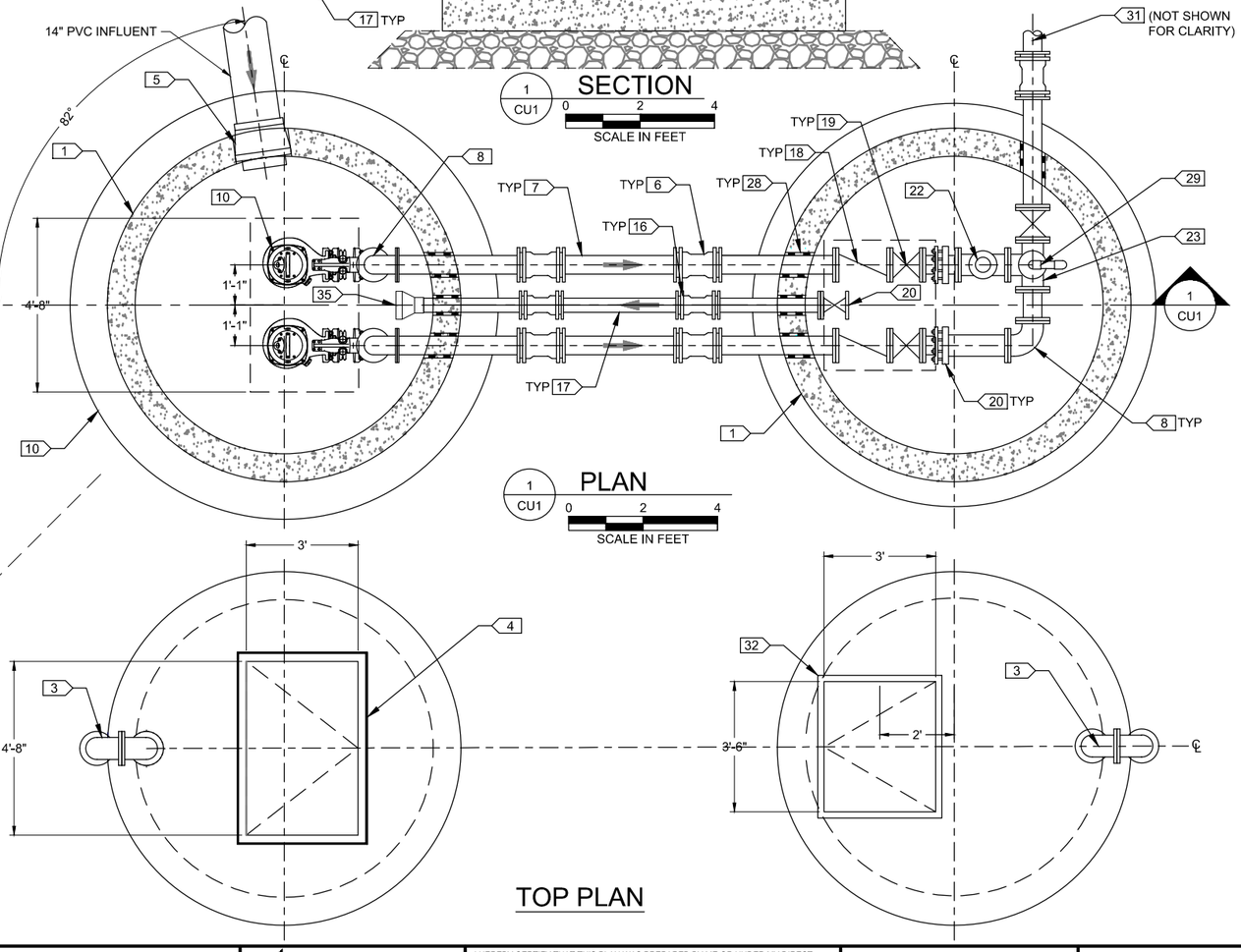
SCALE IN FEET



1 CU1 PLAN
0 2 4
SCALE IN FEET

TOP PLAN

KEYNOTES:

1. INSTALL 96" DIA. PRECAST CONCRETE MANHOLE SECTIONS WITH R4 JOINTS.
2. COAT UNDERSIDE OF MANHOLE COVER AND FULL HEIGHT OF INTERIOR WALLS WITH 100% SOLIDS AMINE CURED EPOXY.
   FIRST COAT - DURAPLATE 235 4-6 DFT
   SECOND COAT - DURAPLATE 6000 40-80 DFT
3. INSTALL 4" DIP FLG VENT WITH SEEPAGE COLLAR AND BIRD SCREEN CASE. (3 / CU2)
4. INSTALL 56" X 36" HATCH COVER
5. PROVIDE INTEGRAL CAST BOOT. (2 / CU2)
6. INSTALL 6" DIP MJ SLEEVE.
7. INSTALL 6" DIP PIPE.
8. INSTALL 6" FLG 90° DIP BEND.
9. INSTALL 6" DIP RISER PIPE.
10. INSTALL SUBMERSIBLE PUMP WITH LIFTING CHAIN.
11. INSTALL DUAL S.S. PUMP GUIDES WITH INTERMEDIATE S.S. RAIL. GUIDE SUPPORTS AT 10'-0" MAX. INTERVALS.
12. INSTALL 6" X 4" DIP FLG REDUCER.
13. GROUT UNDERNEATH PUMP PER MANUFACTURER'S RECOMMENDATIONS.
14. CAST 12'-0" X 12'-0" SQUARE OR 12'-0" DIAMETER CONCRETE BASE. 1'-0" THICK MIN.
15. INSTALL MIN. 12" COMPACTED BACKFILL.
16. INSTALL 4" DIP MJ SLEEVE.
17. INSTALL 4" DRAIN PIPE AT 2% SLOPE.
18. INSTALL 6" DIP FLG CHECK VALVE.
19. INSTALL 6" DIP FLG GATE VALVE WITH HAND WHEEL ACTUATOR.
20. INSTALL 6" DIP FLG ADAPTER.
21. INSTALL 6" x 4" DIP FLG TEE.
22. INSTALL 4" GATE VALVE WITH 4" RISER DIP FLG PIPE & 4' BLIND FLANGE.
23. INSTALL 6" X 6" DIP FLG TEE.
24. INSTALL SUPPORT UNDER EACH TEE AND AS SHOWN. TYP. OF 3 (1 / CU2)
25. PROVIDE HYDROPHOLIC WATERSTOP.
26. PROVIDE GATOR WRAP OR APPROVED EQUAL AT ALL JOINTS AND BETWEEN MH CASTING, RINGS AND MH RISER.
27. CORE AND DRILL PENETRATIONS WITH MECHANICAL SEAL. (5 / CU2)
28. INSTALL 2" NPT AIR RELEASE VALVE.
29. PROVIDE 25 POUND COATED PEDESTAL CAST IRON WEIGHT WITH 1/8" MIN. DIA. S.S. CABLE FOR MOUNTING FLOATS & MOUNTING SUBMERSIBLE PRESSURE TRANSDUCER.
30. PROVIDE S.S. BRAIDED WIRE SHEATHING FOR ALL ELECTRICAL WIRING/CORDS. LEAVE A 5' LOOP IN CABLE FOR MAINTENANCE PURPOSES.
31. PROVIDE RESTRAINED FLANGED COUPLING ADAPTER FOR CONNECTION TO 6" PVC PIPE. (NOT SHOWN FOR CLARITY).
32. INSTALL 3'-6" X 3'-0" HATCH COVER.
33. INSTALL STEM SUPPORT FOR GATE VALVE ACTUATOR EXTENSION.
34. BACKFILL ADJACENT TO STRUCTURE CAN CONSIST OF ON-SITE GRANULAR SOILS WHICH ARE FREE OF DEBRIS AND ORGANIC MATERIAL OR IMPORTED SELECT GRANULAR BORROW MEETING MNDOT 3149.2B. COMPACTED TO 95% OF STANDARD PROCTOR.
35. INSTALL 4" TIDEFLEX CHECK VALVE.

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DRAWN BY:	WSW
DESIGNER:	FSB
CHECKED BY:	WFL
DESIGN TEAM	

NO.	BY	DATE	REVISIONS

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3535 VADNAIS CENTER DRIVE
ST. PAUL, MN 55110-5196
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I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Fasil Yitbarek

Date: 07/30/2021

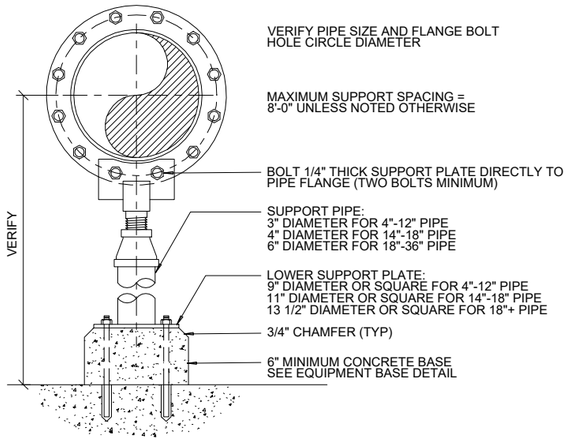
FASIL B. YITBAREK, PE
Lic. No. 544107

LAKE ELMO, MINNESOTA

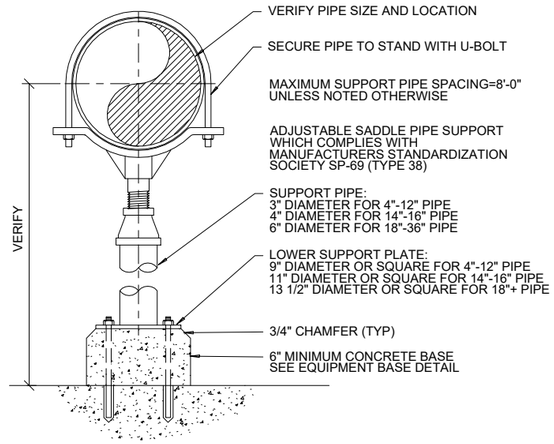
WET WELL & VALVE MANHOLE - CHANGE ORDER

FILE NO. LAKMO 151537

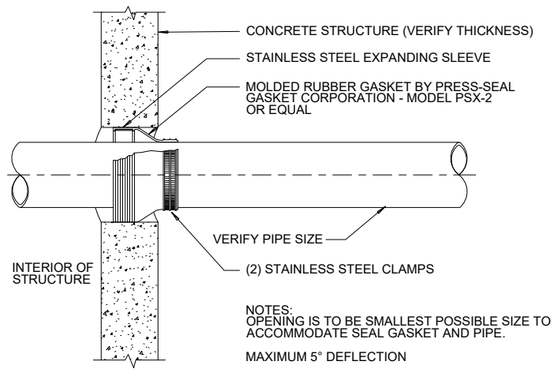
1 / 2



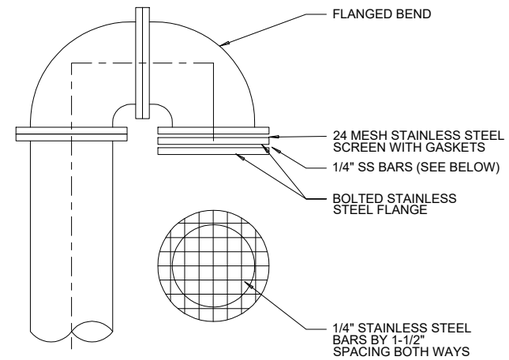
1 CU2 PIPE SUPPORT FROM FLOOR - TYPE 1 DETAIL
NO SCALE



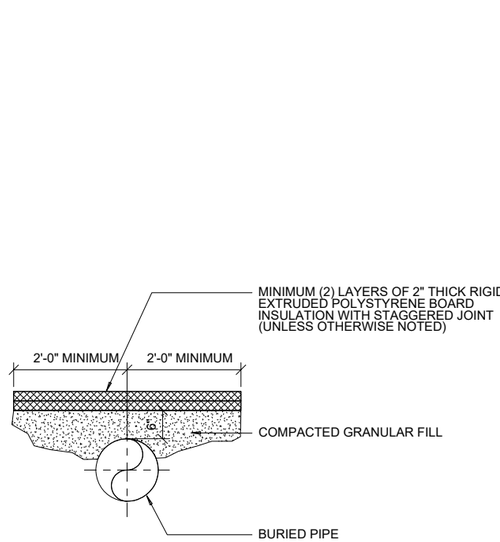
1 CU2 PIPE SUPPORT FROM FLOOR - TYPE 2 DETAIL
NO SCALE



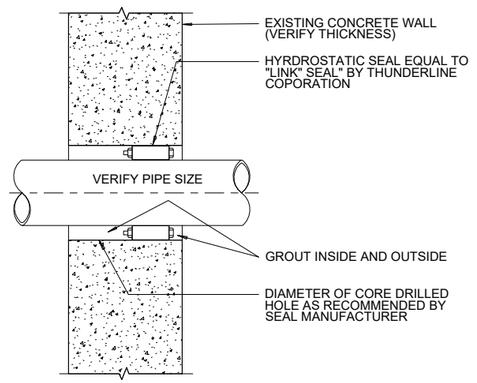
2 CU2 PIPE SEAL GASKET
NO SCALE



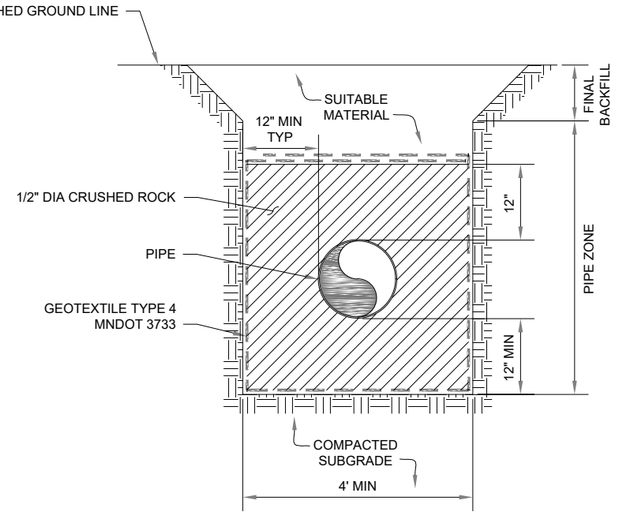
3 CU2 VENT SCREEN/BAR
NO SCALE



4 CU2 PIPE INSULATION DETAIL
NO SCALE



5 CU2 CORE DRILLED PIPE PENETRATION DETAIL
NO SCALE



NOTES:

1. CONTRACTOR SHALL CONSTRUCT TRENCH AND PROVIDE PROTECTIVE MEASURES AS REQUIRED TO COMPLY WITH OSHA REGULATIONS.

6 CU2 PIPE BEDDING & TRENCH BACKFILL
NO SCALE

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FASIL B. YITBAREK, PE
Date: 07/30/2021 Lic. No. 544107

LAKE ELMO, MINNESOTA

WET WELL & VALVE MANHOLE - CHANGE ORDER

FILE NO. LAKMO 151537

2 / 2

BRANCH CIRCUIT HOME RUN TO PANELBOARD, PANEL NAME SHOWN ABOVE CIRCUIT NUMBER(S) AND TAGGED TO INDICATE CONDUIT AND CONDUCTOR SIZES. CIRCUITING SIZES NOT SHOWN SHALL BE MINIMUM 3/4"C. WITH #12 AWG. CONDUCTORS AND SIZED PER NEC REQUIREMENTS.

CONDUIT EXPOSED

CONDUIT CONCEALED

CONDUIT CONTINUED

CONDUIT TURNING UP

CONDUIT CAPPED

OVERHEAD ELECTRICAL LINE

UNDERGROUND CONCRETE ENCASED ELECTRICAL DUCT BANK

UNDERGROUND CONCRETE ENCASED ELECTRICAL BANK ROUTED BENEATH SLAB-ON-GRADE

DIRECT BURIED CONDUIT

GROUND CONDUCTOR

INDICATES THAT ALL OR PART OF CIRCUIT MAY BE ROUTED IN DUCT BANK OR UNDERGROUND. CONDUIT SIZE SHOWN ON ONE-LINE IS ABOVE GROUND AND/OR INSIDE OF STRUCTURE. SEE DUCT BANK SCHEDULE AND SECTIONS FOR CONDUIT SIZE OF UNDERGROUND PORTION OF CIRCUIT.

2X4 LIGHT FIXTURE
UPPER CASE INDICATES FIXTURE TYPE
NUMBER INDICATES CIRCUIT LOWER CASE
INDICATES SWITCH DESIGNATION

1X4 LIGHT FIXTURE

4' INDUSTRIAL LIGHT FIXTURE

2X2 LIGHT FIXTURE

WALL MOUNTED LIGHT FIXTURE

SURFACE MOUNTED LIGHT FIXTURE

RECESSED LIGHT FIXTURE

EXIT LIGHT (WITH FACES & DIRECTION ARROWS INDICATED)

WALL MOUNTED EXIT LIGHT (WITH FACES & DIRECTION ARROWS INDICATED)

WALL MOUNTED BATTERY PACK EMERGENCY LIGHT

SHADED FIXTURE = EMERGENCY LIGHT

POLE MOUNTED LUMINAIRE

HANDRAIL MOUNTED LUMINAIRE

SWITCH SYMBOL:
SINGLE POLE (IF BLANK)
2 = DOUBLE POLE
3 = THREE-WAY
4 = FOUR-WAY
D = DIMMER
K = KEY OPERATED
LV = LOW VOLTAGE
MS = MANUAL MOTOR STARTER
OS = OCCUPANCY SENSOR
P = WITH PILOT LIGHT
WP = WEATHERPROOF
x = SMALL LETTER INDICATES LUMINARIES CONTROLLED
XP = EXPLOSION PROOF

POWER OR DISTRIBUTION CABINET

POWER OR LIGHTING PANELBOARD

MOTOR AND MOTOR SWITCH

METER

DISCONNECT

MOTOR STARTER

COMBINATION STARTER/DISCONNECT

TRANSFORMER

RELAY

SINGLE WALL RECEPTACLE

DUPLEX WALL RECEPTACLE

DUPLEX CEILING RECEPTACLE

EMERGENCY RECEPTACLE

SPECIAL PURPOSE RECEPTACLE

DOUBLE DUPLEX RECEPTACLE

FLOOR BOX, POKE-THROUGH OR GROUND ROD AS NOTED

JUNCTION BOX

WALL MOUNTED JUNCTION BOX

THERMOSTAT

PHOTOCELL

TELEPHONE OUTLET

COMBINATION VOICE/DATA OUTLET

DATA OUTLET

CCTV (CLOSED CIRCUIT TV CAMERA)

BUZZER

PUSHBUTTON STATION

FACP - FIRE ALARM CONTROL PANEL

FAAP - FIRE ALARM ANNUNCIATOR PANEL

FIRE ALARM MANUAL PULL STATION

FIRE ALARM HORN/STROBE

FIRE ALARM STROBE

FIRE ALARM SMOKE DETECTOR:
D = DUCT, I = IONIZATION, PH = PHOTOELECTRIC

FIRE ALARM HEAT DETECTOR

FIRE ALARM FLOW SWITCH

FIRE ALARM TAMPER SWITCH

FIRE SMOKE DAMPER

SMOKE DAMPER

OCCUPANCY SENSOR, CEIL MOUNT

OCCUPANCY SENSOR, WALL MOUNT

ANTENNA

AT MOTOR (SCHEMATIC DEVICE LOCATION)

AT PLC (SCHEMATIC DEVICE LOCATION)

AT MFR CP (SCHEMATIC DEVICE LOCATION)

CONNECTION POINT

EXTERNAL CONNECTION POINT

GROUND

CIRCUIT BREAKER

DRAWOUT CIRCUIT BREAKER

SWITCH

FUSE

NORMALLY OPEN PUSH-BUTTON

NORMALLY CLOSED PUSH-BUTTON

SELECTOR SWITCH

POTENTIOMETER

NORMALLY CLOSED CONTACTS

NORMALLY OPEN CONTACTS

FIXED CAPACITOR

MUSHROOM HEAD PUSH-BUTTON

NORMALLY CLOSED LIMIT SWITCH

NORMALLY OPEN LIMIT SWITCH

SOLENOID

FLOAT SWITCH (OPENING ON RISING LEVEL)

FLOAT SWITCH (CLOSING ON RISING LEVEL)

SWITCH (OPENING ON INCREASE) P=PRESSURE, V=VACCUM, DP=DIFFERENTIAL PRESSURE

SWITCH (CLOSING ON INCREASE) P=PRESSURE, V=VACCUM, DP=DIFFERENTIAL PRESSURE

TEMPERATURE SWITCH (OPENING ON RISING LEVEL)

TEMPERATURE SWITCH (CLOSING ON RISING LEVEL)

ON TIME DELAY SWITCH (TIME DELAY AFTER COIL IS ENERGIZED)

OFF TIME DELAY SWITCH (TIME DELAY BEFORE COIL IS ENERGIZED)

FLOW SWITCH (OPENING ON INCREASE IN FLOW)

FLOW SWITCH (CLOSING ON INCREASE IN FLOW)

TORQUE SWITCH (NORMALLY CLOSED)

TORQUE SWITCH (NORMALLY OPEN)

ENGINE DRIVEN GENERATOR

MOTOR- NUMBER DENOTES HORSEPOWER

CURRENT TRANSFORMER

POTENTIAL TRANSFORMER

METERING DEVICE

FUSED DISCONNECT

MAGNETIC STARTER

THERMAL OVERLOAD RELAY

SURGE SUPPRESSION

TRANSFORMER

ALARM HORN

KEY INTERLOCK

PILOT LIGHT

STARTER, CONTACTOR OR RELAY COIL

XX XXX (XX) MISC. SYSTEM COMPONENT, SEE ABBREVIATIONS FOR LETTER DESIGNATIONS NOT LISTED BELOW.

LE = LEVEL ELEMENT
LIT = LEVEL INDICATING TRANSMITTER
FE = FLOW ELEMENT
FIT = FLOW INDICATING TRANSMITTER
FS = FLOW SWITCH
HS = HAND SWITCH
PB = PULLBOX
SS = SOFT STARTER
TS = TAMPER SWITCH
ATS = AUTOMATIC TRANSFER SWITCH
HOA = HAND OFF AUTO SELECTOR SWITCH
TIT = TEMPERATURE INDICATING TRANSMITTER
TSH = TEMPERATURE SWITCH HIGH
TVSS = TRANSIENT VOLTAGE SURGE SUPPRESSER
VFD = VARIABLE FREQUENCY DRIVE
SV = SOLENOID VALVE
XS = MOISTURE SWITCH
XSH = MOISTURE SWITCH HIGH
ZS = POSITION SWITCH

NOTES

GENERAL WIRING METHODS:

1. USE NO. 10 AWG CONDUCTOR FOR 20 AMPERE, 120-VOLT BRANCH CIRCUIT HOME RUNS LONGER THAN 75 FEET AND FOR 20 AMPERE, 277-VOLT BRANCH CIRCUIT HOME RUNS LONGER THAN 150 FEET.

ELECTRICAL SHEET INDEX	
E0	LIFT STATION ELECTRICAL - SYMBOLS, ABBREVIATIONS & NOTES
E1	LIFT STATION ELECTRICAL - ONE-LINE DIAGRAM & DETAILS
E2	LIFT STATION ELECTRICAL - LIGHTING DIAGRAM & DETAILS
E3	LIFT STATION ELECTRICAL - GENERATOR DIAGRAM & DETAILS

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A	AMBER, AMPERE, ALARM	LIT	LEVEL INDICATING TRANSMITTER
AC	ALTERNATING CURRENT	LP	LIGHTING PANEL
AFF	ABOVE FINISHED FLOOR	LS	LIMIT OR LEVEL SWITCH
AFG	ABOVE FINISHED GRADE	LTG	LIGHTING
AM	AMMETER	LWCO	LOW WATER CUTOFF
ANN	ANNUNCIATOR	M	MAGNETIC MOTOR STARTER
AR	ALARM RELAY	MA	MILLIAMPERE
AS	AMMETER SWITCH	MCB	MAIN CIRCUIT BREAKER
ATS	AUTOMATIC TRANSFER SWITCH	MCC	MOTOR CONTROL CENTER
AWG	AMERICAN WIRE GAUGE	MD	MOISTURE DETECTOR
BC	BATTERY CHARGER	MFR	MANUFACTURER
BLDG	BUILDING	MH	MANHOLE OR MOUNTING HEIGHT
C	CLOSE, COUNTER OR CONTACTOR	MOV	MOTOR OPERATED VALVE
CAP	CAPACITOR	MS	MANUAL MOTOR STARTER
CB	CIRCUIT BREAKER	MSH	MOTOR SPACE HEATER
CD	CONTROL DAMPER	MTR	MOTOR
CGD	COMBUSTIBLE GAS DETECTOR	MTS	MANUAL TRANSFER SWITCH
CKT	CIRCUIT	MV	MILLIVOLT, MEDIUM VOLTAGE
CL2	CHLORINE	MVA	MEGA VOLT AMPERE
CP	CONTROL PANEL	N	NEUTRAL
CPT	CONTROL POWER TRANSFORMER	NC	NORMALLY CLOSED
CR	CURRENT OR CONTROL RELAY	NMC	NON-METALLIC CONDUIT
CS	CONTROL STATION	NO	NORMALLY OPEN
CT	CYCLE TIMER OR CURRENT TRANSFORMER	O	OPEN
		OL	OVERLOAD
CV	CONTROL VALVE	OOA	ON-OFF-AUTO
2/C	2 CONDUCTOR	OOR	ON-OFF-REMOTE
4"C	4" CONDUIT	OH	OVERHEAD
DC	DIRECT CURRENT	P	PRIMARY
DI	DOOR INTERLOCK	PB	PUSHBUTTON OR PULL BOX
DM	DAMPER MOTOR OR DEMAND METER	PLC	PROGRAMMABLE LOGIC CONTROLLER
DPDT	DOUBLE POLE DOUBLE THROW	PF	POWER FACTOR
DPST	DOUBLE POLE SINGLE THROW	PFCC	POWER FACTOR CORRECTION CAPACITOR
DP	DIFFERENTIAL PRESSURE		
DPS	DIFFERENTIAL PRESSURE SWITCH	PH	PHASE, CHEMICAL TERM
DS,DISC	DISCONNECT SWITCH	PRS	PROXIMITY SWITCH
DWG	DRAWING	PRV	POWER ROOF VENTILATOR
E	EMERGENCY OR DAMPER OPERATOR	PS	PRESSURE SWITCH OR PUMP STATION
EC	EMPTY CONDUIT	PT	POTENTIAL TRANSFORMER OR PROGRAM TIMER
ECP	EQUIPMENT CONTROL PANEL		
EG	ENGINE GENERATOR	PVC	POLYVINYL CONDUIT
EL	ELEVATION OR EMERGENCY LIGHT	2P	2 POLE
EMH	ELECTRICAL MANHOLE	R	RED, RAISE RELAY OR REVERSE
ES	END SWITCH	RECP	RECEPTACLE
ETM	ELAPSED TIME METER	RGS	RIGID GALVANIZED STEEL
EUH	ELECTRICAL UNIT HEATER	RMC	RIGID METALLIC CONDUIT
EVS	EMERGENCY VENTILATION SHUTOFF	RTD	RESISTANCE TYPE TEMP DETECTOR
EXIST	EXISTING	RTU	REMOTE TERMINAL UNIT
F	FORWARD	SA	SURGE SUPPRESSOR
FA	FIRE ALARM	SCC	SHORT CIRCUIT CURRENT
FACP	FIRE ALARM CONTROL PANEL	SCADA	SUPERVISORY CONTROL AND DATA ACQUISITION
FDR	FEEDER		
FE	FLOW ELEMENT	S2	SIZE 2 STARTER
FIT	FLOW INDICATING TRANSMITTER	SP	SINGLE POLE
FO	FIBER OPTIC	SPD	SURGE PROTECTOR
FS	FLOW SWITCH	SPDT	SINGLE POLE DOUBLE THROW
FPSP	FIRE PROTECTION SIGNALING PANEL	SPST	SINGLE POLE SINGLE THROW
FVNR	FULL VOLTAGE NON-REVERSING	SS	SELECTOR SWITCH OR SOFT STARTER
G	GREEN OR GROUND OR GENERATOR	S.S., SST	STAINLESS STEEL
GD	GROUND DETECTOR OR GAS DETECTOR	SSRV	SOLID STATE REDUCED VOLTAGE STARTER
GEN	GENERATOR	STR	STARTER
GFI	GROUND FAULT INTERRUPTER	SV	SOLENOID VALVE
GFCI	GROUND FAULT CKT INTERRUPTER	SWBD	SWITCHBOARD
GND	GROUND	SWGR	SWITCHGEAR
GUH	GAS UNIT HEATER	T	THERMOSTAT, TIMER OR TOTALIZER
H	HIGH OR HUMIDISTAT	TB	TERMINAL BLOCK
HH	HANDHOLE	TCP	TEMPERATURE CONTROL PANEL
HOA	HAND-OFF-AUTO	TD	TIME DELAY RELAY
HP	HORSEPOWER	TEMP	TEMPERATURE
HTR	HEATER	TQ	TORQUE
HVMH	HIGH VOLTAGE ELECTRIC MANHOLE	TTB	TELEPHONE TERMINAL BOX
HZ	HERTZ (CYLES PER SECOND)	TVSS	TRANSIENT VOLTAGE SURGE SUPPRESSOR
I/O	INPUT/OUTPUT		
INST	INSTANTANEOUS	UG	UNDERGROUND
IS	INTRINSICALLY SAFE	UPS	UNINTERRUPTIBLE POWER SUPPLY
ISO	ISOLATION	UV	UNDER VOLTAGE OR ULTRAVIOLET
J	JUNCTION BOX	V	VOLTS
K	KEY INTERLOCK	VA	VOLT AMPERE
KAIC	KILOAMPERE	VAR	VOLTAMPERE REACTIVE
KCMIL	THOUSAND CIRCULAR MILS	VFD	VARIABLE FREQUENCY DRIVE
KV	KILIVOLT	VM	VOLTMETER
KVA	KILIVOLT AMPERE	VS	VOLTMETER SWITCH
KVAR	KILOVAR	W	WHITE OR WATTS
KW	KILOWATT	WE	WEIGHT ELEMENT
KWH	KILOWATT HOUR	WIT	WEIGHT INDICATING TRANSMITTER
L	LOW, LEVEL	WP	WEATHERPROOF
LA	LIGHTNING ARRESTER	WPI	WEATHERPROOF IN-USE RECEPTACLE COVER
LAN	LOCAL AREA NETWORK		
LC	LIGHTING CONTACTOR	XFMR	TRANSFORMER
LE	LEVEL ELEMENT	XP	EXPLOSION-PROOF

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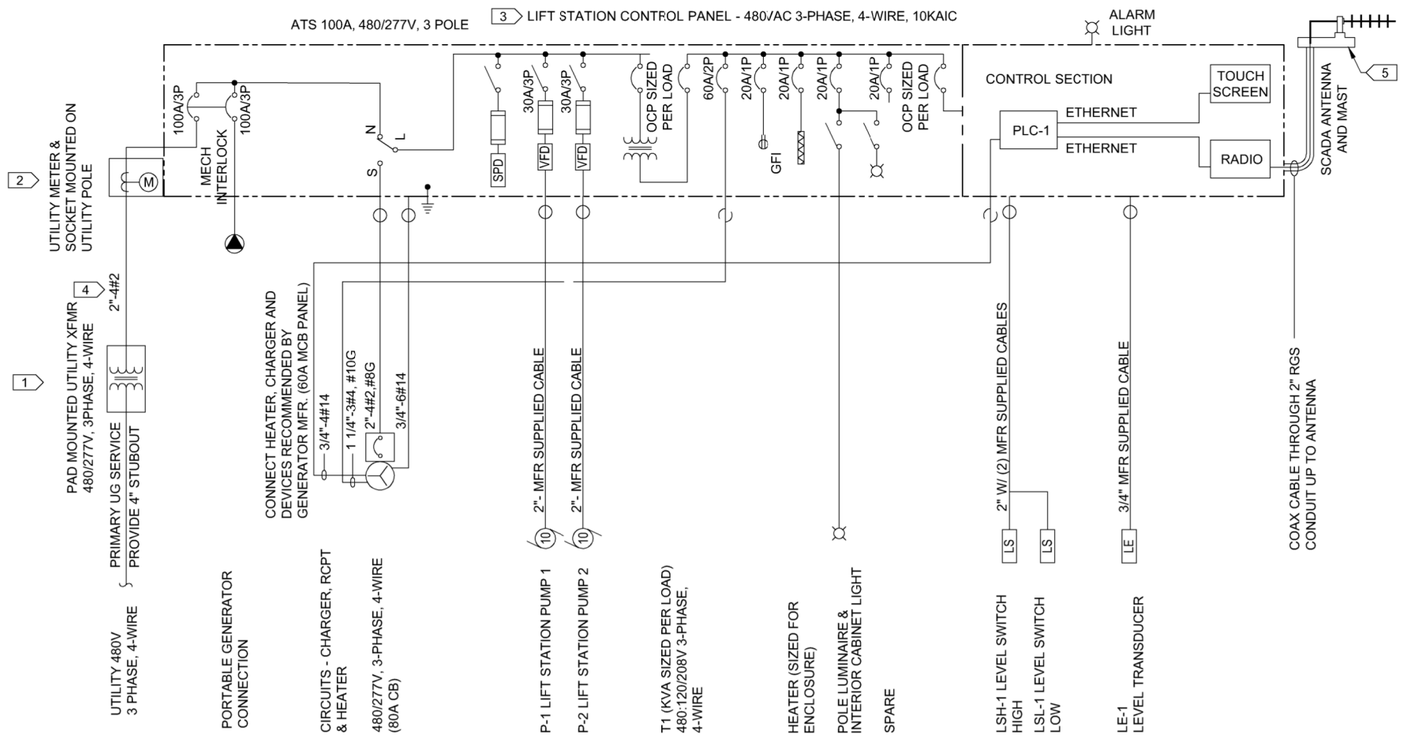
Date: 07/30/2021 JOHN P. CARLSON, PE Lic. No. 24001

LAKE ELMO, MINNESOTA

LIFT STATION ELECTRICAL-SYMBOLS,ABBREVIATIONS & NOTES

FILE NO. LAKMO 151537

E0

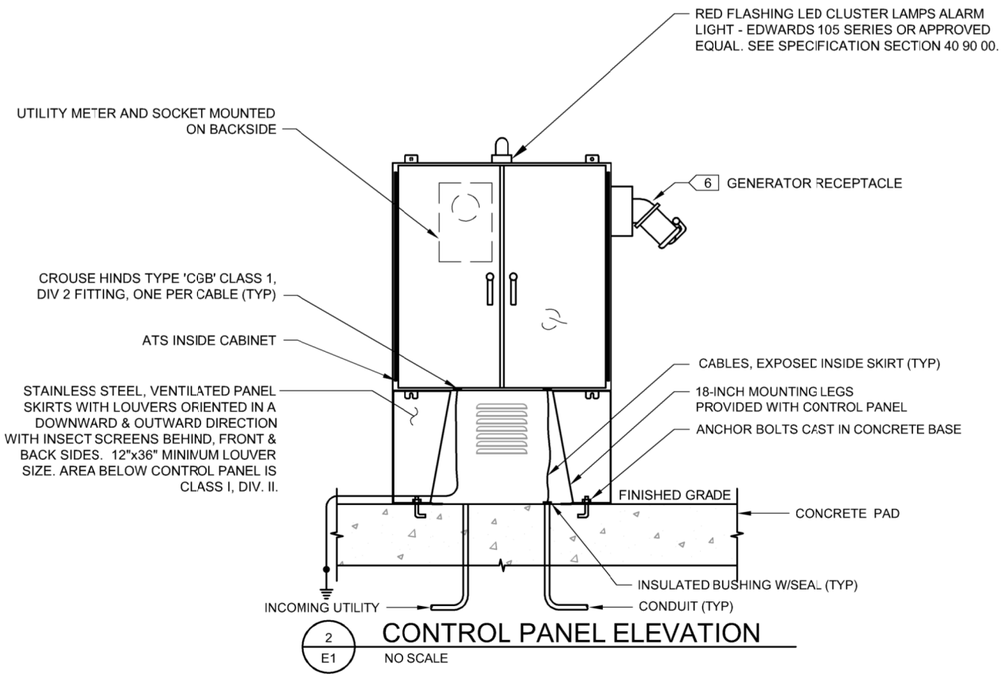


1 / E1 CONTROL PANEL ONE-LINE DIAGRAM

NO SCALE

KEY NOTES:

1. UTILITY PROVIDED PRIMARY SERVICE AND TRANSFORMER. ELECTRICAL CONTRACTOR SHALL COORDINATE UTILITY WORK.
2. PROVIDE METERING CABINET, METER SOCKET AND INSTALL UTILITY FURNISHED METER.
3. CONTRACTOR SHALL CONTACT UTILITY AND PROVIDE ARC FLASH AND AVAILABLE FAULT CURRENT LABELING ON EQUIPMENT PER NEC 110.16 AND 110.24.
4. PROVIDE SECONDARY CIRCUITRY.
5. PROVIDE ANTENNA WITH WEATHERHEAD, CONDUIT, CABLE AND MOUNTING BRACKETS AND CONNECT TO RADIO. VERIFY HEIGHT REQUIREMENTS WITH OWNER.
6. PROVIDE GENERATOR RECEPTACLE-200 AMP, 4 POLE, 5-WIRE CROUSE-HINDS ARKTITE SERIES OR EQUAL. VERIFY RECEPTACLE WITH OWNER.



5

2 / E1 CONTROL PANEL ELEVATION

NO SCALE

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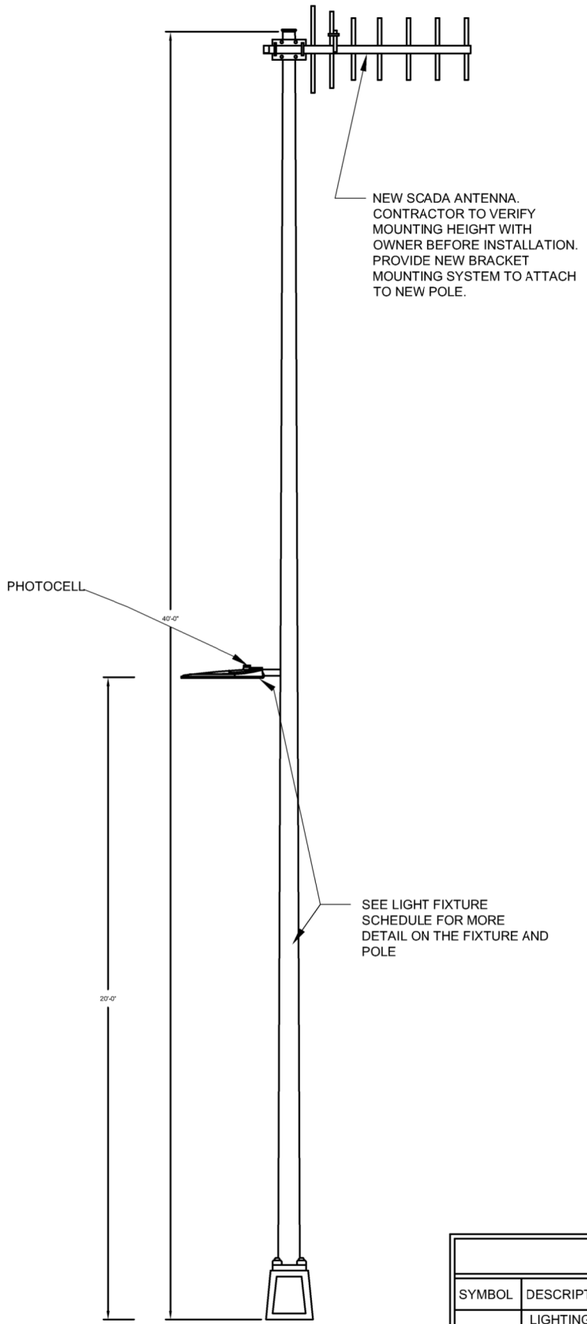
LAKE ELMO, MINNESOTA

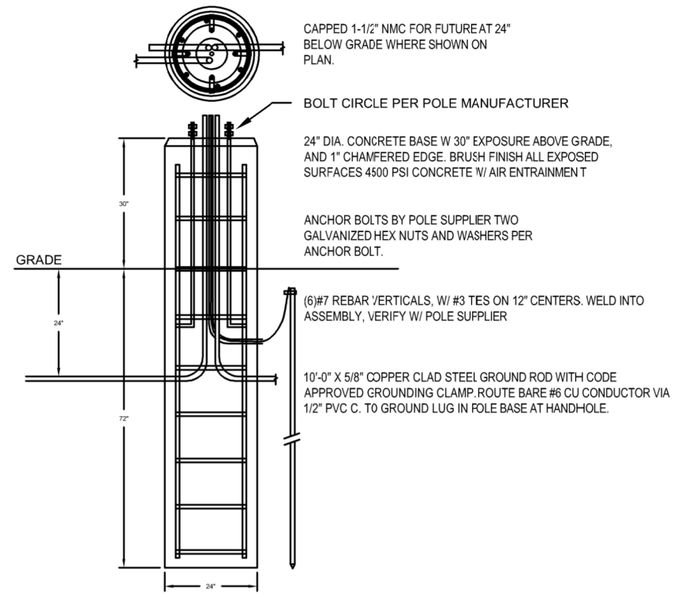
LIFT STATION ELECTRICAL - ONE-LINE DIAGRAM & DETAILS

FILE NO. LAKMO 151537

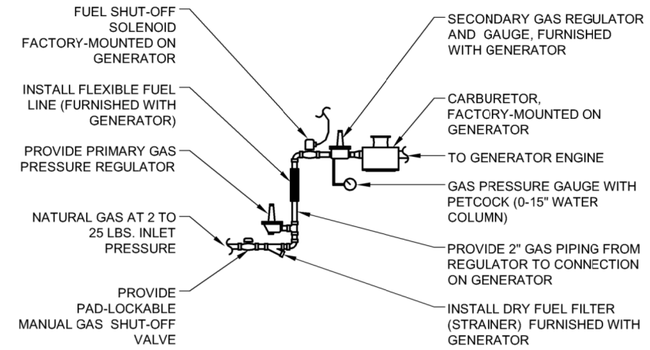
E1



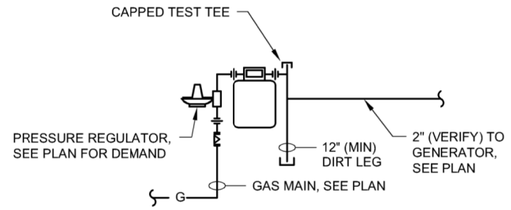
1 E2 **LIGHTING UNIT DETAIL**
SCALE: NONE



2 E2 **LIGHTING UNIT FOUNDATION DETAIL**
SCALE: NONE



3 E2 **GEN GAS PIPING**
SCALE: NONE



NOTE:
GAS METER & REGULATOR SHALL BE BY THE LOCAL GAS COMPANY. ALL COSTS WILL BE INCURRED BY THE CONTRACTOR.

4 E2 **GAS METER**
SCALE: NONE

EQUIPMENT SCHEDULE

SYMBOL	DESCRIPTION	LAMP SOURCE	MOUNTING	OPTICS	MANUFACTURER & SERIES #
✷	LIGHTING UNIT TYPE SPECIAL LED LUMINAIRE WITH SHORTING CAP ON ROUND ALUMINUM POLE	183 WATT 40 LED 4000K	40' POLE ON LIGHT FOUNDATION DESIGN E MOD.	TYPE III	LITHONIA LIGHTING - LUMINAIRE: DSX1 LED-P7-40K-T3M-MVOLT-RPA-PER7-DMG-DDBXD-DSHORT-SBK-U HAPCO - POLE: RTA40D8BF-GFI-ANODIZED DARK BRONZE

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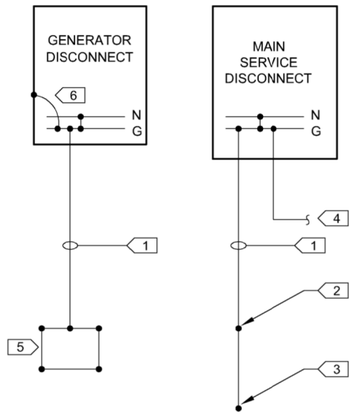
LAKE ELMO, MINNESOTA

LIFT STATION ELECTRICAL-LIGHTING UNIT DRAWING AND DETAIL

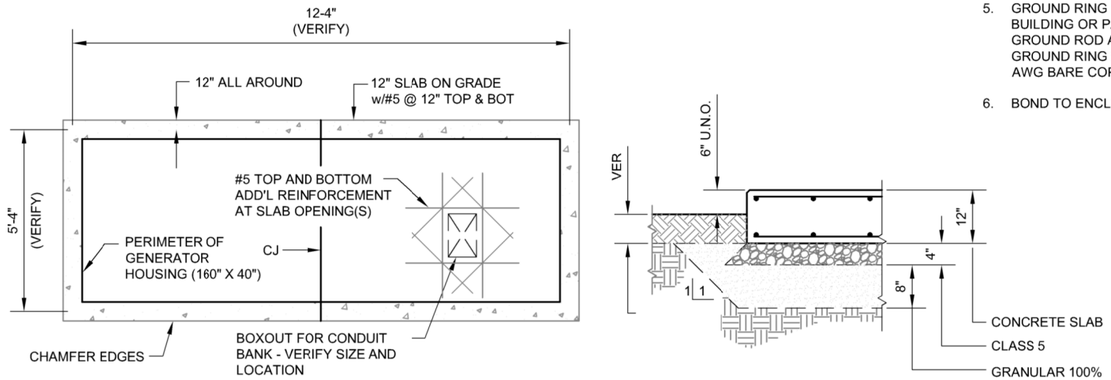
FILE NO. LAKMO 151537

E2



1 / E3 BONDING AND GROUNDING DETAIL

SCALE: NONE



NOTES

- CJ = PROVIDE SLAB CONTROL JOINT: TOOLED JOINT, 1/2" DEEP, 1/8"W (MAX), MAKE SAW CUT AS SOON AS CUTTING CAN BE DONE WITHOUT RAVELING THE CONCRETE. FILL JOINTS WITH JOINT SEALER (UNO).
- COORDINATE SLAB LOCATION AND ORIENTATION WITH CIVIL.
- REFER TO ELECTRICAL PLANS AND SPECIFICATIONS FOR ADD'L NOTES & DETAILS.
- CONTRACTOR SHALL VERIFY DIMENSIONS AND ALL OTHER REQUIREMENTS.

2 / E3 GENERATOR FOUNDATION DETAIL

SCALE: NONE

KEYNOTES:

1. SIZE GROUNDING CONDUCTORS PER NEC. #2 AWG BARE COPPER MINIMUM.
2. PROVIDE $\frac{3}{4}$" X 10' COPER GROUND ROD. EXOTHERMIC WELD ALL CONNECTIONS TO GROUND RODS.
3. GROUND RODS SHALL BE SPACED A MINIMUM OF 6 FEET APART.
4. BONDING CONDUCTOR PER NEC FOR CONNECTION TO CONTROL PANEL, EXPOSED ABOVE GROUND PIPE/VENT AND ALL OTHER AREAS REQUIRED TO BE BONDED TO THE GROUNDING ELECTRODE SYSTEM.
5. GROUND RING ENCIRCLING THE BUILDING OR PAD WITH A 3/4" X 10' GROUND ROD AT EACH CORNER. GROUND RING SHALL BE AT LEAST #2 AWG BARE COPPER CONDUCTOR.
6. BOND TO ENCLOSURE.

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JOHN P. CARLSON, PE
Date: 07/30/2021 Lic. No. 24001

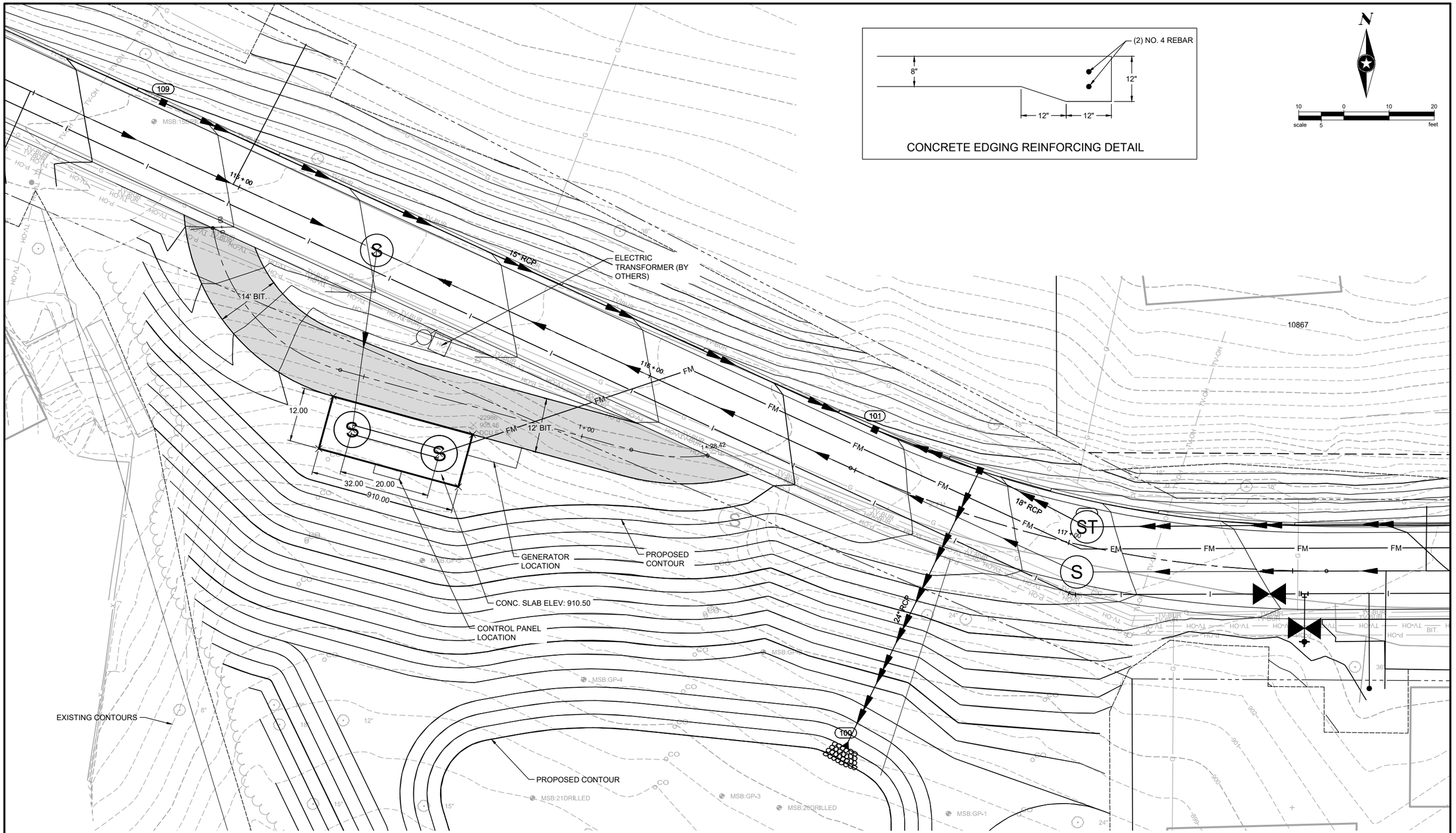
LAKE ELMO, MINNESOTA

LIFT STATION ELECTRICAL-GENERATOR DIAGRAM & DETAIL

FILE NO. LAKMO 151537

E3

CONCRETE EDGING REINFORCING DETAIL



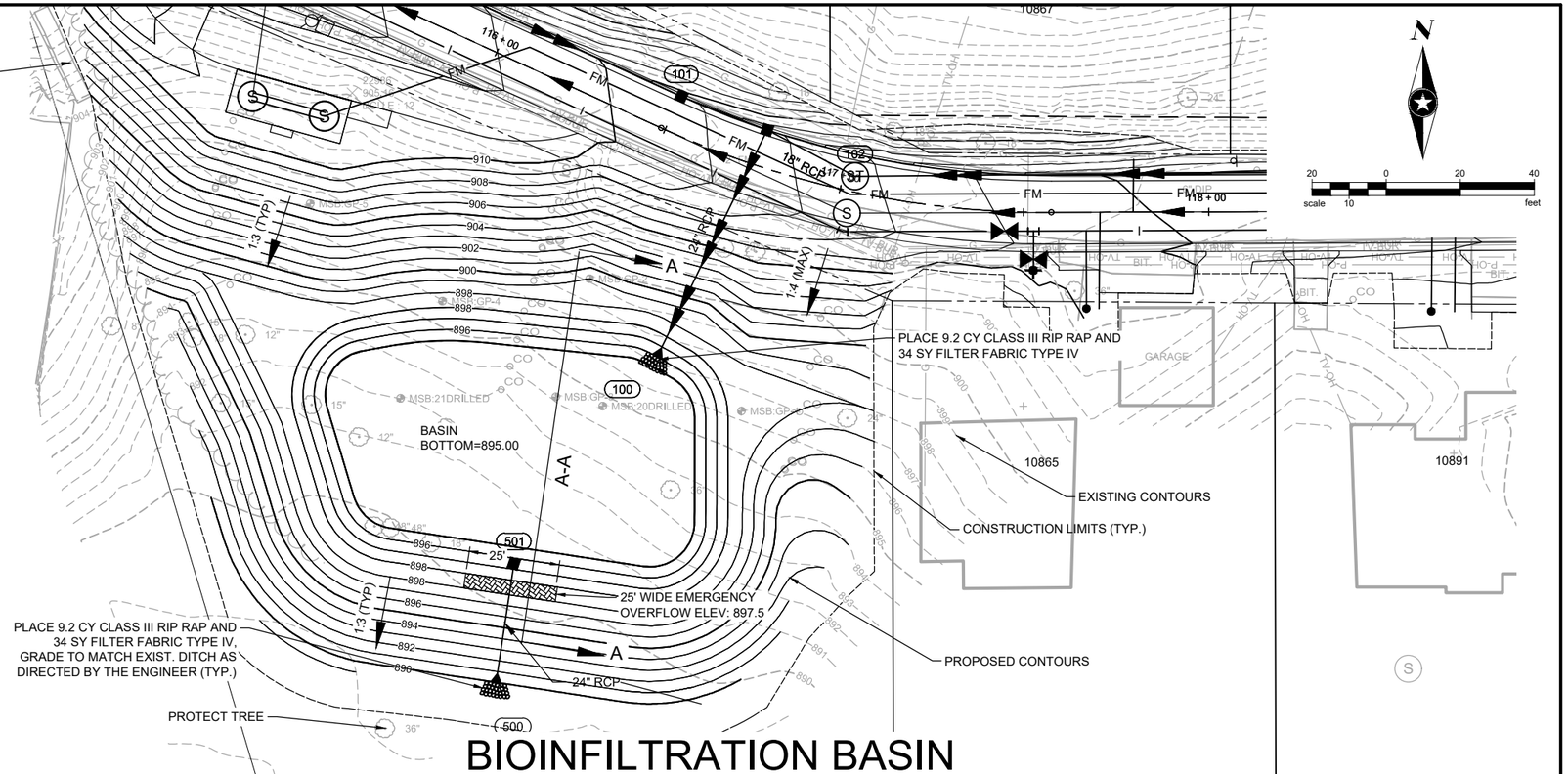
DRAWN BY: ZTS DESIGNER: ZTS/JRT CHECKED BY: SDH DESIGN TEAM	NO.	BY	DATE	REVISIONS	SEH PHONE: 651.490.2000 3535 VADNAIS CENTER DRIVE ST. PAUL, MN 55110-5196 www.sehinc.com	I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA. Zachary T Stafslien Date: 07/30/2021 ZACHARY STAFSLIEN, PE Lic. No. 56679	LAKE ELMO, MINNESOTA	**LIFT STATION SITE PLAN** **OLD VILLAGE PHASE 5 & 6 IMPROVEMENTS**	FILE NO. LAKMO 151537	66A 137

SUGGESTED CONSTRUCTION SEQUENCING:

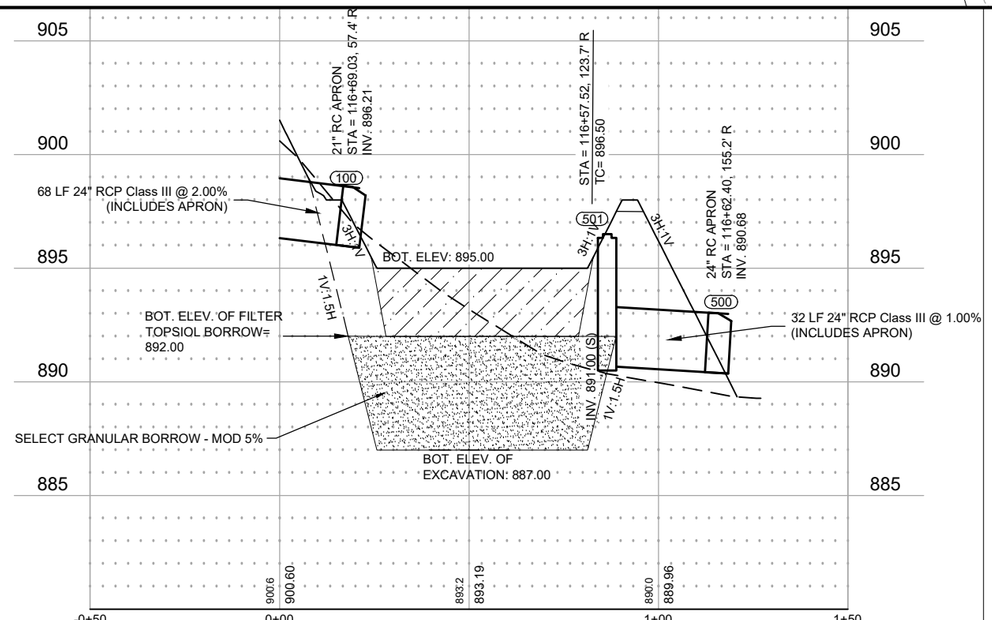
1. REVIEW SWPPP AND ITS REQUIREMENTS PRIOR TO ANY SITE WORK.
2. INSTALL APPROPRIATE TEMPORARY EROSION CONTROL DEVICES TO PREVENT SEDIMENT FROM LEAVING OR ENTERING THE PRACTICE DURING CONSTRUCTION.
3. ALL DOWN-GRADIENT PERIMETER SEDIMENT CONTROL BMPS MUST BE IN PLACE BEFORE ANY UP GRADIENT LAND DISTURBING ACTIVITY BEGINS.
4. PERFORM CONTINUOUS INSPECTIONS OF EROSION CONTROL PRACTICES, ESPECIALLY AFTER EACH RAINFALL EVENT.
5. INSTALL ALL UTILITIES (WATER, SANITARY SEWER, ELECTRIC, GAS, PHONE, FIBER, ETC.) PRIOR TO SETTING FINAL GRADE OF BIOINFILTRATION DEVICE.
6. ROUGH GRADE THE SITE, IF BIOINFILTRATION AREAS ARE BEING USED AS TEMPORARY SEDIMENT BASINS DURING CONSTRUCTION. LEAVE A MINIMUM OF 1 FT OF COVER OVER THE PRACTICE TO PROTECT THE UNDERLYING SOILS FROM ACCUMULATING SEDIMENT.
7. COMPLETE, STABILIZE, AND VEGETATE ALL OTHER SITE IMPROVEMENTS.
8. COORDINATE INFILTRATION TESTING, INCIDENTAL TO BIOINFILTRATION SYSTEM.
9. CONSTRUCT AND VEGETATE BIOINFILTRATION DEVICE FOLLOWING STABILIZATION OF CONTRIBUTING DRAINAGE AREA. ENSURE THAT CRITICAL ELEVATIONS, TOP OF MEDIA AND EMERGENCY OVERFLOW, ARE CORRECT.
10. REMOVE TEMPORARY EROSION CONTROL DEVICES AFTER THE CONTRIBUTING DRAINAGE AREA IS ADEQUATELY VEGETATED.

GENERAL NOTES

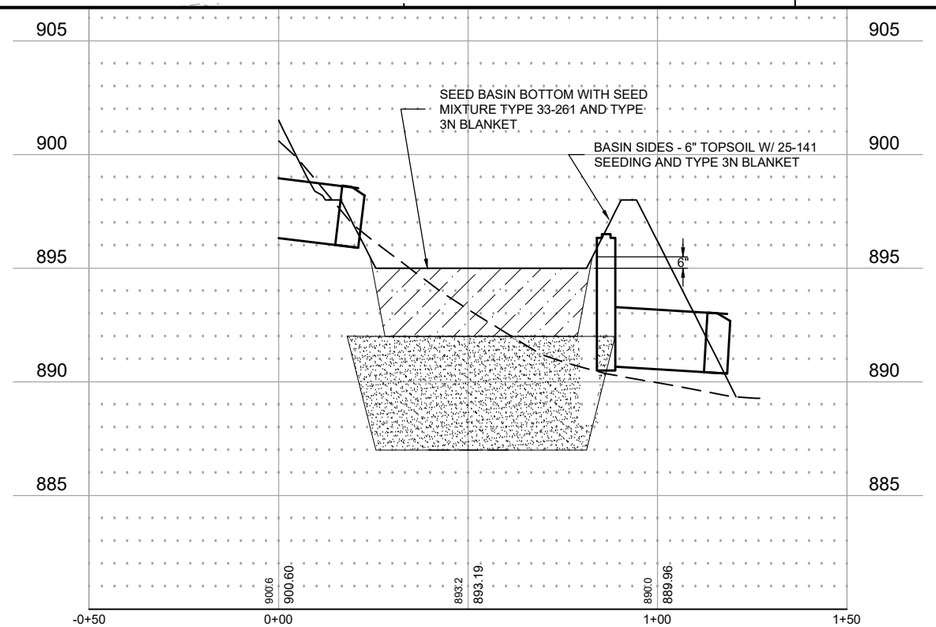
1. IN THE EVENT SEDIMENT IS INTRODUCED INTO THE BMP DURING OR IMMEDIATELY FOLLOWING EXCAVATION, THIS MATERIAL SHALL BE REMOVED PRIOR TO CONTINUING CONSTRUCTION
2. CONTRACTOR SHALL USE ONSITE CLAY MATERIAL TO CONSTRUCT THE BERM AROUND THE STORM POND, AS DIRECTED BY THE ENGINEER.
3. STRIP TOPSOIL, AS DIRECTED BY THE ENGINEER, WITHIN BIOINFILTRATION BASIN AND BERM AREA, PAID FOR AS COMMON EXCAVATION.
4. CONTRACTOR SHALL EXCAVATE CLAY LAYER TO ELEVATION 887.00, AS DIRECTED BY THE ENGINEER.
5. BACKFILL EXCAVATION WITH SELECT GRANULAR MATERIAL (PAID FOR AS SELECT GRANULAR BORROW - MOD 5%) TO ELEV. 892.00.
6. BACKFILL EXCAVATION WITH MNDOT TYPE E TOPSOIL ROOTING BORROW (PAID FOR AS FILTER TOPSOIL BORROW) FROM ELEVATION 892.00 TO 895,00.
7. NO EQUIPMENT WILL BE ALLOWED TO SIT IN OR DRIVE ON BOTTOM OF POND DURING POND CONSTRUCTION SCARIFICATION AND EXCAVATION TO HAPPEN FROM TOP OF BANKS.
8. SEE MINNESOTA STORMWATER MANUAL FOR SUBGRADE PREPARATION.



BIOINFILTRATION BASIN



BIOINFILTRATION BASIN SECTION A-A (NOT TO SCALE)



BIOINFILTRATION BASIN RESTORATION

DRAWN BY: ZTS					
DESIGNER: ZTS/JRT					
CHECKED BY: SDH					
DESIGN TEAM	NO.	BY	DATE	REVISIONS	

SEH
PHONE: 651.490.2000
3535 VADNAIS CENTER DRIVE
ST. PAUL, MN 55110-5196
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ZACHARY STAFSLIEN, PE
Date: 07/30/2021 Lic. No. 56679

LAKE ELMO, MINNESOTA

BIOINFILTRATION BASIN OLD VILLAGE PHASE 5 & 6 IMPROVEMENTS

FILE NO. LAKMO 151537

OPTION 2: LIFT STATION OPTION
AND RAISE GRAVITY SEWER

FUTURE SEWER
EXTENSION FOR
NORTH OF UPRR

DEVELOPER CONNECTS
AT 910 INVERT

CSAH 14

KLONDIKE AVE N

33RD ST N

34TH ST N

UPPER 33RD ST N

UPRR

33RD ST LN N

KRAFT CIR

LAMPERT AVE

LANGLY CT

32ND ST N

KLONDIKE AVE N

LAKE ELMO AVE

36TH ST N

8" PVC

14" C-900 PVC

8" C-900 PVC

15" PVC

LS

GP

LEGEND

PROPOSED SANITARY SEWER

PROPOSED 8" WATER MAIN

N

100 0 100 200

scale 50 feet

LS = CITY OWNED LIFT STATION

GP = GRINDER PUMP STATION

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FILE NO. 151537

DATE: 2/9/2021

OLD VILLAGE PHASE 5 & 6
SANITARY SEWER & WATER MAIN
OVERVIEW MAP

FIGURE NO. 2

Save: 2/9/2021 3:05 PM zsfafslien Plot: 2/9/2021 3:54 PM S:\KOI\LLakmo\151537\5-final-dsgn\51-drawings\10-Civil\cad\dwg_oldStreet Alignment Exhibit.dwg