

**SPECIFICATIONS FOR
W2E WATER TREATMENT PLANT
ALBION/GRAYVILLE
EDWARDS/WHITE COUNTY
ILLINOIS**

Prepared by:



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**April 4, 2026
Job #22228**



A stylized, handwritten signature in black ink, appearing to read "Rex A. Gower".

04/24/2026

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W2E WTP

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PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Description of work regarding the construction of the proposed lime softening municipal drinking water treatment plant as described in the following technical specifications and as shown in the drawings titled W2E WATER TREATMENT PLANT.

B. Project Information:

1. W2E, Inc is a privately owned, tax-exempt, non-profit organization created in joint effort by the cities of Albion, Illinois and Grayville, Illinois. Both entities have elected representatives to serve as a Board of Directors (henceforth referred to as “The Board”) responsible for the oversight of the construction, financial, and operational aspects of the organization. All decisions arising during construction shall be directed to the board or their designee.
2. Project Location:
 - a. W2E, Inc
150 Co Rd 950 E
Grayville, IL 62844
 - b. Plant location is currently undeveloped land located on the east side of Broster Road, directly across from Fisk Ave.
3. Project Engineer:
 - a. Milano and Grunloh Engineers, LLC
114 West Washington Ave
Effingham, IL 62401
(217) 347-7262

1.02 DIVISION OF WORK

A. Contract 1:

1. Contract 1 shall be responsible for completion of all portions of the work required for a complete and operational Water Treatment Plant (WTP) with the exception of:
 - a. Distribution and Raw Water Piping occurring in the well field.

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 11 00 – Summary of Work

- 1) All exterior piping, connections to existing, connections to other contracts, cut and caps, valves, fittings, etc. located at and connected to the proposed water treatment plant, ground storage tank, and lime beds are the responsibility of Contract 1.
- b. Provide and Install Filters and Media
 - 1) All connections to filters for process piping, air scour, SCADA, etc. are the responsibility of Contract 1.
- B. Contract 2:
 1. Contract 2 shall be responsible for providing, installing, and disinfection of Filters, Underdrains, Support Media, and filter media.
 2. Everything outside of filter connection flanges shall be the responsibility of Contract 1.
- C. Contract 3: (This contract will be bid at a later date)
 1. Contract 3 shall be responsible for the construction of the 1 MG Ground storage tank. Base bid shall be welded steel.
 2. Alternate bid shall be prestressed concrete.
 3. Contractor responsible for all piping to a point 10' outside the tank foundation.
- D. Contract 4: (This contract will be bid at a later date)
 1. Contract 4 shall be responsible for construction of Lime drying beds, valves, piping, effluent metering structure, manholes, and effluent discharge piping.
 2. All excavation, earthwork, dewatering and rough grading required for the construction of the lime drying beds shall be the responsibility of Contract 4.
 3. Effluent metering station shall include v-notch weir and level indicator under Contract 4. Connection to SCADA shall be the responsibility of Contract 1.
 4. Contract 4 piping responsibility begins with the effluent pipe division as shown on plans. All piping, valves, gates, manholes, etc. from this point to point of discharge to ditch shall be included in the contract.

- E. Contract 5: (This contract will be bid at a later date)
1. Contract 5 shall be responsible for all watermain connections located near the well field to make complete connections to provide well connections to the proposed WTP and connections to provide an operational distribution system for the City of Grayville.
 2. Contract 5 shall provide all telemetry and SCADA required at all remote locations of the project to include wells, towers and pump stations to provide a complete and operational system.
 3. Telemetry and SCADA shall be defined to include new radios, towers, pressure transducers, VFD's, etc. All installed equipment shall be fully compatible with equipment installed by Contract 1.
 4. VFDs shall be provided for all wells but is not required at pumping stations.

1.03 SPECIFICATION AND DRAWING SECTIONS

- A. Specifications and/or Drawings may be separated into discipline sections for convenience or reference only. Contractor shall be responsible for Complete Work, implemented by his/her own forces and his/her various subcontractors. Contractor is responsible for coordination between subcontractors.
- B. Further, it is not the intent that any work called out in a titled section be allocated to any specific trade. Allocation of this work to trades is considered a function of the Contractor.
- C. Contractor shall also be responsible for work as specifically cross-referenced in other Sections of Specifications though not specifically mentioned herein and for all information shown on drawings as applicable to their portions of work.

1.04 CONTRACTOR

- A. Contractor:
1. Contractor shall be fully responsible for Complete Work of all Contract Documents including, but not limited to, providing labor, materials and equipment necessary to furnish and install complete work required for a complete and operational plant as described by the contract documents, and as shown on plans.
 2. Plans and Specifications indicate all major construction required for an operational plant. Certain items required for all construction jobs may not be explicitly indicated. These items are to be considered incidental to the

job as necessary for construction and shall not be paid for individually. (i.e. screws, small plumbing valves, unions, support brackets, etc.)

3. Contractor may fulfill certain parts of above obligation through several prime subcontractors and other subcontractors. Contractor shall be responsible for letting of subcontracts in such a manner as to produce Complete Work required by Contract Documents.
4. Contractor shall employ, establish and identify all required administrative, supervisory and operational personnel; including personnel responsible for coordination of mechanical and electrical work, necessary for adequate performance of work. Do not change or replace established key personnel, during conduct of work. Furnish to Owner's representative, in writing, the names, addresses and telephone numbers of responsible persons employed by Contractors who are to be contacted in event of an out-of-hours emergency at construction site. Contractor shall provide a coordinator, in his employ, who shall coordinate all subcontracted work.

1.05 SPECIAL SEQUENCES

- A. General - Contractor shall coordinate with the special sequences described herein in performing the work and establishing a schedule.
 1. It shall be the Contractor's responsibility to apply, obtain, and pay for all applicable township, county, NPDES, railroad and state permits (except IEPA construction permits) prior to commencing work. It shall be the CONTRACTOR's responsibility to conduct his operations in such a manner so as to comply with all provisions and conditions of the permits.
 2. Contractor shall submit in a timely manner all Change Order Requests and Applications for Payment by the date set forth at the preconstruction meeting, to allow for inclusion in the agenda prior to monthly board meetings. Failure to submit in a timely manner will result in a continuance to the next month's meeting.
- B. The Owner shall have the following responsibilities prior to or during this contract:
 1. The Owner will, prior to the start of construction, obtain necessary IEPA construction permits, as required to perform the work obtained under this contract.
 2. The Owner shall, in a timely manner, approve or deny all Change Order Requests and Applications for Payment submitted by the Contractor at the next monthly meeting of the board.

3. Owner shall make payment to Contractor within 10 calendar days of receipt of funds from the funding agency.

1.06 COORDINATION WITH OTHER GENERAL CONTRACTORS

- A. This project is divided into multiple contracts requiring coordination with other General Contractors.
- B. Each General Contractor is responsible for the work contained in their own contract, as well as coordination with General Contractors of other contracts.
- C. Each Contractor shall make provisions for other contracts to complete their work without undue hardship or cost. Under no circumstance shall a Contractor install work that precludes another Contractor from completing the work required under their contract.
- D. Any cost incurred by a Contractor due to the actions of another Contractor shall be borne by the party causing the hardship and no additional funds shall be requested from the Owner.

1.07 GENERAL SEQUENCE OF CONSTRUCTION

- A. The general sequence listed below is for basic reference only and does not constitute a required order. Sequence of construction is at the discretion of the Contractor, with the understanding that operational needs take priority.
 1. Preliminary Sitework
 2. Construct Major Equipment
 3. Construct Building
 4. Complete all Underground and Interior Piping
 5. Complete electrical, SCADA, telemetry (Plant, Wells, Towers, etc.)
 6. Construct Foundations and Lime Beds
 7. Final Painting
 8. Finalize sitework

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 PAYMENT

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 11 00 – Summary of Work

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 11 00

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.03 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount, or in lieu of a bid item amount, if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.
 - 3. Alternates indicating in lieu of will replace the specified line item bid amount for calculation of Contract Sum.

1.04 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
 - 2. Alternate bid amounts shall consider all costs related to the implementation of the alternate to include additional foundations, materials, electrical, telemetry, engineering, programming, labor, etc.

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 23 00 – Alternates

- B. Notification: Immediately following award of the Contract, each party involved shall be notified in writing of the status of each alternate, in particular whether alternates have been accepted, rejected, or deferred for later consideration. Notification shall include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.01 SCHEDULE OF ALTERNATES

- A. Alternate No. 3A: PRESTRESSED CONCRETE 1MG GST.
 - 1. Base Bid: Provide and Install (1) 1 MG Welded Steel Ground Storage Tank as described in Section 33 16 23.
 - 2. Alternate: Provide and Install (1) Prestressed Concrete Ground Storage Tank as described in Section 33 16 33. Contract unit price for this alternate will be in lieu of the contract unit price for the base bid.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for PRESTRESSED CONCRETE 1MG GST related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 23 00

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Materials, equipment, methods of construction, processes or products, not specifically indicated, may be acceptable to Owner and Engineer, but shall be approved in writing by Engineer and Owner prior to implementation or inclusion in the project.

1.02 REQUESTS FOR SUBSTITUTION PRIOR TO BID

- A. Where a bidder intends to provide other than the listed equipment, the alternate material or equipment must be approved by the engineer prior to the bid. In order for the alternate equipment to be considered an “approved equal”, prospective suppliers must make a pre-bid submittal as detailed in the following paragraph and make it available to the design engineer fifteen (15) days prior to the time of the bidding. A list of approved equal material or alternate suppliers will be forthcoming from the engineer five (5) days before bids are taken.
- B. Two copies of project specific pre-bid submittals shall be provided in bound form, and shall contain full-size drawings of the proposed equipment with catalog cuts of sufficient detail to allow assessment of the suitability of the equipment and the impact of the alternate equipment to the job, contractor, engineer, and owner. The pre-bid submittal shall also include written evidence that such product conforms in all respects to the specified requirements and that it has been used successfully elsewhere under similar conditions and shall include any calculations required as proof of adequacy. Should any product require a re-design from these plans and specifications, the Contractor shall be liable for those costs. Re-design includes electrical, mechanical, and/or civil engineering aspects for the installation and operation of the proposed product.
- C. The submittals for approval must contain only like equipment and only the specific equipment being submitted for approval. The submittal shall be complete with the equipment proposed for submittal, equipment proposed to be replaced, ID tags per plans and specifications if applicable, location, and plan sheet number. All variances from specified equipment must be explicitly noted. Approval requests made after the appointed time, fail to provide enough information, or fail to meet the given specifications will not be considered.

1.03 REQUESTS FOR SUBSTITUTION AFTER NOTICE TO PROCEED

A. Procedure:

1. After the NOTICE TO PROCEED has been issued, Owner and/or Engineer shall consider written requests for substitutions of materials, equipment, methods of construction, processes, products, or other items.
2. Contractor shall submit requests sufficiently in advance to avoid delay of the Work and shall process requests for material substitutions in a timely manner.
3. Contractor shall submit six (6) copies of the request for substitution which shall include the following:
 - a. Complete data substantiating compliance of the proposed substitute with the Drawings and Specifications.
 - b. Proposed product substitution information including:
 - 1) Specified item proposed for substitution; include product name, identification tag numbers, plan sheet number, and applicable specification.
 - 2) Proposed product identification; include manufacturer's name.
 - 3) Manufacturer's literature, including but not limited to product description, marked to indicate specific model, type, size, and options to be considered; performance and test data; reference standards; difference in power demand; and dimensional differences for specified unit.
 - 4) Names and addresses of similar projects in which product was used, including date of installation and field performance data.
 - 5) Where substitutions include modifications to other elements of the Work, Contractor shall provide revised design drawings stamped by a Professional Engineer for Engineer and/or Owner review.
 - c. Proposed methods of construction substitution information including:
 - 1) Detailed description of proposed method.

- 2) Drawings illustrating method.
 - d. Itemized comparison of proposed substitution with product or method specified.
 - e. Data relating to changes in construction schedule.
 - f. Relation to separate contracts.
 - g. Accurate cost data on proposed substitution in comparison with product or method specified.
4. In making a request for substitution, or in using an approved substitute item, Contractor represents:
- a. Contractor has personally investigated proposed product or method and has determined that it is equal or superior in all respects to that specified and that it shall perform the function for which it is intended.
 - b. Contractor shall provide the same guarantee for the substitute item as for the product or method specified.
 - c. Contractor shall coordinate installation of the approved substitution into the Work, to include building modifications if necessary, making such changes as may be required for the WORK to be complete in all aspects.
 - d. Contractor waives all claims for additional costs related to the substitution which subsequently become apparent

1.04 CONTRACTOR'S OPTION

- A. For products specified only by reference standards, Contractor may select any product meeting standards by any manufacturer and indicate the selected type in the submission.
- B. For products specified by naming several products or manufacturers, Contractor may select any product and manufacturer named and indicate the selected type in the submission.
- C. For products specified by naming one or more products, but indicating the option of selecting equivalent products by stating "or equivalent" after specified product, Contractor must submit request, as required for substitution, for any product not specifically named

1.05 ENGINEER'S APPROVAL

- A. Substitutions and/or options will not be considered if they are indicated or implied on SHOP DRAWINGS or project data submittals without a formal request submitted in accordance with this section.
- B. Engineer shall indicate approval or disapproval of the requested substitution(s) either by separate letter or by endorsement on Contractor's letter of request.
- C. Any additional cost incurred by an approved substitution (including engineering costs of redesign) will be at Contractor's expense.
- D. Contractor shall obtain Engineer's written approval of substitutions prior to ordering materials, equipment, or products for the WORK. Should Contractor order such materials, equipment, or products before Engineer approves of same, and if they are disapproved by the Engineer, all return, reordering and repurchasing costs will be at Contractor's expense.
- E. Engineer, with timely notice being given by Contractor, shall inspect all substituted materials, equipment or products for conformance with substitution approvals, prior to installation.
- F. Engineer reserves the right to require substitute items to comply in color and pattern with specified items, if necessary to secure "design intent"

1.06 TRADEMARKS, COPYRIGHTS AND PATENTED DEVICES, MATERIALS, AND PROCESSES

- A. It shall be the burden and responsibility of Contractor to determine, before bidding, the existence of any patents, trademarks, or copyrights which are in any way infringed upon by the DRAWINGS and SPECIFICATIONS.
- B. Contractor shall include, or be considered as having included in the price or prices in the BID, which becomes a part of the CONTRACT, a sufficient sum to cover all fees, royalties and claims for any material, patent rights, machine, appliance, copyright, trademark, or any arrangement that may be used upon or in any manner connected with or appurtenant to the WORK.
- C. If Contractor is required or desires to use any design, device, material, or process covered by letters, patents, copyrights, or trademarks, Contractor shall provide for such use by suitable written agreement with the patentee or patent owner, copyright owner, or trademark owner, which agreement shall provide that there will be no future or continuing royalties or payments by Contractor or by Owner. Contractor and the surety shall, at all times, defend, save harmless, and indemnify Owner, LOCAL GOVERNMENT, Engineer, and each of their officers, agents, and employees from and against all such fees, royalties, and claims or

suits in connection therewith by reason of any infringement or alleged infringement of such patent rights, copyrights, or trademark rights.

- D. Contractor shall pay all applicable royalties and license fees.
- E. Contractor shall defend all suits or claims for infringement of any patent rights and save Owner, LOCAL GOVERNMENT and Engineer harmless from loss on account thereof, except that Owner shall be responsible for any such loss when a particular process, design, or the product of a particular manufacturer or manufacturers is specified. However, if Contractor has reason to believe that the design, process or product specified is an infringement of a patent, Contractor shall be responsible for such loss unless Contractor promptly gives such information to Engineer or Owner

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 25 00

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for Preconstruction, Progress, and Coordination Meetings.

1.02 PRE-CONSTRUCTION MEETING

A. The Owner will schedule within five (5) business days after Notice of Award.

B. Attendance:

1. Owner.
2. Engineer.
3. General Contractor.
4. Subcontractors.
5. Large Suppliers
6. Funding Agency

C. Distribute and Discuss:

1. Project Directory:
 - a. List of Subcontractors.
 - b. Tentative Construction Schedule
 - c. Permit and Easement review.
2. Designation of responsible personnel.
3. Establish chain of authority.
4. Interrelation and coordination of subcontractors.
5. Critical work sequencing, scheduling.
6. Processing of field decisions and change orders.
7. Adequacy of distribution of contract documents.

8. Submittals:
 - a. Schedules.
 - b. Shop drawings, product data and samples.
 - c. Test reports.
 - d. Manufacturer's certification of products.
 - e. Schedule of values.
 - f. Copies of all permits.
9. Major equipment deliveries and priorities.
10. Procedures for maintaining record documents.
11. Use of premises:
 - a. Office and storage areas.
 - b. Access.
 - c. Owner's requirements.
12. Safety and first aid procedures.
13. Security procedures.
14. Housekeeping procedures.
15. Engineer Observation.
16. Barriers.
17. Temporary Utilities.

1.03 PROGRESS MEETINGS

- A. The Engineer shall schedule and administer monthly progress meetings including the following items.
 1. Prepare agenda.
 2. Distribute written notice and agenda of regular and called meetings five (5) business days in advance of meeting date.

3. Make physical arrangements for meetings.
 4. Preside at meetings,
 5. Record minutes; include significant proceedings and decision.
 6. Distribute copies of minutes to participants within five (5) business days after meetings.
- B. Attendance:
1. Owner.
 2. Engineer.
 3. Contractor.
 4. Subcontractors and suppliers as requested by Engineer.
 5. Funding Agency.
- C. Minimum agenda.
1. Review and approve minutes of previous meeting.
 2. Review work progress since last meeting; review schedule.
 3. Review applications for payment.

1.04 COORDINATION MEETINGS

- A. The Engineer shall schedule and administer coordination meetings as required.
1. Prepare agenda.
 2. Distribute written notice and agenda of meetings five (5) business days in advance of meeting date.
 3. Make physical arrangements for meetings.
 4. Preside at meetings.
 5. Record minutes; include significant proceedings and decisions.
 6. Distribute copies of minutes of meetings to participants, Engineer and Owner within five (5) business days after meetings.

B. Attendance:

1. Engineer.
2. Contractor.
3. Subcontractors and suppliers as pertinent to agenda.
4. Funding Agency.

C. Minimum Agenda:

1. Review and approve minutes of previous meeting.
2. Review work progress since last meeting.
3. Note field observations, problems and decisions.
4. Identify problems which impede planned progress.
5. Discuss maintenance of construction schedule.
6. Discuss plan progress during next work period.
7. Coordinate projected progress with all contractors.
8. Review submittal schedules, expedite as required to maintain schedule.
9. Maintaining of quality and work standards.
10. Review changes proposed by Owner for:
 - a. Effect on construction schedule.
 - b. Effect on completion date.
11. Complete other current business.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 PAYMENT

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 31 13 – Project Meetings

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 31 13

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Construction schedule requirements and procedures.

1.02 RELATED SECTIONS

A. Section 01 31 13 – Project Meetings.

B. Section 01 33 00 – Submittal Procedures.

1.03 FORM OF SCHEDULES

A. Prepare a standard horizontal bar chart.

1. Provide separate horizontal bar column for each class of work, activity or long-lead equipment item.
2. Columns should follow table of contents of the specifications.
3. Critical path work items shall be highlighted in some manner.

1.04 CONTENT OF SCHEDULES

A. Indicate complete sequence of construction by activity.

1. Submittals: In accordance with Section 01 33 00 - Submittal Procedures.
 - a. Submittal dates.
 - b. Dates when reviewed copies will be required.
2. Product procurement date, fabrication time and delivery dates.
3. Dates for beginning, and completion of, each element of construction.

B. Indicate cumulative percentage of work completed as of first day of each month.

C. Furnish separate schedule, showing submittals, review item, procurement schedules and delivery dates as required.

D. Define critical portions of entire schedule.

1.05 UPDATING

A. Update monthly. Indicate:

1. Progress of each activity since previous submission.
2. Projected completion dates for all activities.
3. Activities modified since previous submission.

1.06 SUBMITTALS

A. Submit initial schedule at the preconstruction meeting.

1. The Engineer and Owner shall review schedules and return reviewed copy within ten business days after receipt.
2. When directed, resubmit within ten business days after return of reviewed copy.

B. Submit monthly updated schedules accurately depicting progress to first day of each month.

1.07 DISTRIBUTION

A. The Contractor shall distribute copies of approved schedules to:

1. Job site file.
2. Subcontractors and suppliers on as-needed basis.
3. Engineer.
4. Owner.

B. Instruct recipients to report any inability to comply with projected completion dates, and to furnish a detailed explanation together with suggested remedies.

1.08 ACCELERATION

A. If at any time during the project Contractor fails to complete an activity by its latest scheduled completion date, which late completion will impact the end date of the work past the Contract completion date, submit within five

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Section 01 32 16 – Construction Progress Schedules

(5) calendar days plans to reorganize the work force to return to the current schedule.

- B. Addition of equipment or construction forces, increasing working hours, or other method, manner, or procedure to return to the contractually required completion date will not be justification for Contract modification.
- C. Contractor shall plan, schedule, and coordinate construction operations and activities in a manner that will facilitate simultaneous progress of work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 32 16

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Construction Submittal procedures and general requirements for submittals during the progress of the work.
 - a. Administrative Submittals
 - b. Shop Drawings
 - c. Product Data
 - d. Samples
 - e. Test Specimens
 - f. Certificates of Compliance
 - g. O & M Manuals
 - h. Record Documents

- B. The Owner and Engineer each reserve the right to direct and modify the procedures and requirements for submittals as necessary to accomplish the specific purpose of each submittal.

1.02 RELATED SECTIONS

- A. Section 01 78 23 – Operation and Maintenance Data: Preparation and assembly of O & M Manuals
- B. Section 01 78 39 – Project Record Documents: Preparation and maintenance of Project Record Documents.
- C. Section 01 45 00 - Quality Control and Testing Services

1.03 ADMINISTRATIVE SUBMITTALS

- A. Provide all submittals as may be specifically required in other parts of the Contract Documents.
- B. Failure to comply promptly with requirements for submittals, as required by law, to applicable federal, state, or local agencies may result in the

withholding of progress payments and make the Contractor liable for other prescribed action and sanctions.

- C. Submit to the Owner and Engineer a copy of all letters relative to the Contract, transmitting notifications, reports, certifications, payrolls, and the like, that are submitted directly to a federal, state, or other governing agency.
- D. On a daily basis during the progress of the Work, maintain, and submit to the Engineer, full and correct information as to:
 - 1. The number of persons employed in connection with each subdivision of the Work.
 - 2. The classification, rate of pay and address of each of these persons.
 - 3. The cost, source, and amount of each class of materials delivered, equipment received, and major construction equipment used in each subdivision of the Work.
- E. When requested by the Engineer, submit to the Engineer two copies of each purchase order for all materials and equipment furnished under this Contract for incorporation in the Work. Each purchase order shall show:
 - 1. Supplier's name.
 - 2. Manufacturer's name.
 - 3. Materials, type, model number, size, quantity, accessory list of the material and equipment ordered.
 - 4. Requested delivery date of the material and equipment ordered.

1.04 TECHNICAL SUBMITTALS

- A. General:
 - 1. Requirements in this section are in addition to any specific requirements for submittals specified in other Divisions and Sections of the Specifications. The Contractor shall be responsible for the accuracy and completeness of all information contained in each submittal.
 - 2. Address all submittals and correspondence to:

Milano & Grunloh Engineers, LLC

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114 W. Washington Avenue
P.O. Box 897
Effingham, Illinois 62401

3. Submit descriptive information, which will enable the Engineer to advise the Owner whether the Contractor's proposed materials, equipment, or methods of work are in general conformance to the design concept and in compliance with the Drawings and Specifications.

B. Record Documents

1. Record documents shall be prepared and maintained in accordance with Section 01 78 39 - Project Record Documents.
2. Upon satisfactory completion of the Contract, submit record documents to the Engineer. Accompany submittal with transmittal containing submittal date, Contract title and number, the Contractor's name and address, title and number of each record document, certification that each document as submitted is complete and accurate, and the Contractor's signature.
3. The contract closeout and final payment under this contract **will not** be finalized and approved until a complete and accurate set of record documents, as described in Section 01 78 39 - Project Record Documents, have been submitted to the Engineer, reviewed for accuracy and accepted.

C. Operation and Maintenance Manual (O&M)

1. O&M Manuals shall be prepared and submitted to the Engineer in accordance with Section 01 78 23 – Operation and Maintenance Manuals.
2. The contract closeout and final payment under this contract **will not** be finalized and approved until O&M Manuals have been submitted to the Engineer, reviewed for accuracy and accepted.

D. Professional Seals

1. Provide seal on drawings of structural components and assemblies that are submitted for review and where required by the Specifications.
2. Each copy of a submittal requiring a Professional Seal shall bear an original seal. Reproductions of Professional Seals will not be accepted.

E. Samples and Test Specimens

1. Where required in the Specifications, and as determined necessary by the Engineer, test specimens or samples of materials, appliances, and fittings to be used or offered for use in connection with the Work shall be submitted to the Engineer at the Contractor's expense, with information as to their sources, with all cartage charges prepaid, and in such quantities and sizes as may be required for proper examination and tests to establish the quality or equality thereof, as applicable.
2. All samples and test specimens shall be submitted in ample time to enable the Engineer to make any tests or examinations necessary, without delay to the Work. The Contractor will be held responsible for any loss of time due to his neglect or failure to deliver the required samples to the Engineer, as specified.
3. The Contractor shall submit additional samples as required by the Engineer to ensure equality with the original approved sample and/or for determination of Specification compliance.
4. Laboratory tests and examinations that are not required by the Specifications and that the Owner elects to make will be made at no cost to the Contractor, except that, if a sample of any material or equipment proposed for use by the Contractor fails to meet the Specifications, the cost of testing subsequent samples shall be borne by the Contractor.
5. Submit, in duplicate, to the Engineer test results that are certified by laboratory as specified in Section 01 45 00 - Quality Control and Testing Services. The samples furnished and the cost for the laboratory services shall be at the expense of the Contractor and included in the prices bid for the associated work.

F. Certificates of Compliance:

1. Furnish a Certificate of Compliance for materials specified to a recognized standard or code prior to the use of any such materials in the work. The Engineer may permit the use of certain materials or assemblies prior to sampling and testing if accompanied by a Certificate of Compliance. The certificate shall be signed by the manufacturer of the material or the manufacturer of assembled materials and shall state that the materials involved comply in all respects with the requirements of the Specifications. A Certificate of Compliance shall be furnished with each lot of material

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Section 01 33 00 – Submittal Procedures

delivered to the work and the lot so certified shall be clearly identified in the certificate.

2. All materials used on the basis of a Certificate of Compliance may be sampled and tested at any time. The fact that material is used on the basis of a Certificate of Compliance shall not relieve the Contractor of responsibility for incorporating material in the Work which conforms to the requirements of the Contract Documents and any such material not conforming to such requirements will be subject to rejection whether in place or not.
3. The Engineer reserves the right to refuse permission for use of material on the basis of a Certificate of Compliance.
4. The form of the Certificate of Compliance and its disposition shall be as directed by the Engineer.

PART 2 PAYMENT

- 2.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 33 00

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. General procedures for submittal of Shop Drawings, Product Data and Samples.
2. The Owner and Engineer each reserve the right to direct and modify the procedures and requirements for submittals as necessary to accomplish the specific purpose of each submittal.

1.02 RELATED SECTIONS

A. None

1.03 GENERAL

- A. Submit Shop Drawings, Product Data and Samples required by the Contract Documents.

1.04 SHOP DRAWINGS

A. Drawings shall be presented in a clear and thorough manner.

1. Details shall be identified by reference to sheet, detail, and specific name of equipment shown on Contract Drawings.

B. Review of the shop drawings is rendered as a service only and shall not be considered as a guarantee of measurements or of building conditions; nor shall it be construed as relieving the contractor of basic responsibilities under their contract. Engineer shall review shop drawings only for conformance with design concept of the project. Review by the engineer shall not be construed:

1. As permitting any departure from the contract requirements.
2. As relieving the contractor of the responsibility for any error in details, dimensions or otherwise that may exist.
3. As approved departures from additional details or instructions previously furnished by the engineer.

1.05 PRODUCT DATA

- A. Preparation:
 - 1. Clearly mark each copy to identify pertinent products or models.
 - 2. Show performance characteristics and capacities.
 - 3. Show dimensions and clearances required.
 - 4. Show wiring or piping diagrams and controls.
- B. Manufacturer's standard schematic drawings and diagrams:
 - 1. Modify drawings and diagrams to delete information which is not applicable to the Work.
 - 2. Supplement standard information to provide information specifically applicable to the Work.

1.06 CONTRACTOR RESPONSIBILITIES

- A. See General Conditions and Supplemental General Conditions.

1.07 SUBMISSION REQUIREMENTS

- A. Make submittals promptly and in such sequence as to cause no delay in the Work.
- B. Number of submittals required:
 - 1. Shop Drawings: Submit the number of opaque reproductions which the Contractor requires, plus three copies which will be retained by the Engineer. Alternately, electronic Portable Document Format (PDF) submittals are acceptable provided all parties agree.
- C. Submittals shall contain:
 - 1. The date of submission and the dates of any previous submissions.
 - 2. The Project title and number.
 - 3. Contract identification.

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Section 01 33 23 – Shop Drawings, Product
Data & Samples

4. The names of:
 - a. Contractor.
 - b. Supplier.
 - c. Manufacturer.
5. Identification of the product, with the specification section number.
6. Field dimensions clearly identified as such.
7. Relation to adjacent or critical features of the Work or materials.
8. Applicable standards, such as ASTM, ANSI, or AWWA numbers.
9. Identification of deviations from Contract Documents.
10. Identification of revisions on resubmittals.
11. An 8 in. x 3 in. blank space for Contractor and Engineer stamps.
12. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

End of Section 01 33 23

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for Manufacturer’s Services during construction and start-up.

1.02 RELATED SECTIONS

- A. Section 01 75 00 – Starting and Adjusting
- B. Section 01 75 16 – Startup Procedures
- C. Section 01 79 00 – Demonstration and Training

1.03 SUBMITTALS

A. Submit written authorization from each manufacturer for each manufacturer’s authorized representative to include:

1. Name of manufacturer represented.
2. Name of authorized representative.
3. Name of equipment or system for service.
4. Specification section name and number of equipment or system for service.
5. Authorization of named representative by manufacturer.

B. Submit a written report prepared by the manufacturer’s authorized representative for each manufacturer for each trip to the site that includes:

1. Detailed description of Representative’s findings.
2. Installation certification.
3. Detailed record of all inspections.
4. Outline in detail of any and all deficiencies noted.

1.04 MANUFACTURER'S AUTHORIZED REPRESENTATIVE

- A. Provide competent and experienced technical, process and construction representatives to represent the manufacturers of the equipment and systems with manufacturer's written authorization as manufacturer's authorized representative.

1.05 SERVICES DURING CONSTRUCTION

- A. Manufacturer's authorized representative shall be present on site for as many days as may be necessary to resolve assembly, installation and start-up problems at the worksite which are attributable to, or associated with, the equipment furnished, whether or not specifically set forth in the Technical Specifications.

1.06 STARTUP SERVICES

- A. Where Startup services are called for in the Technical Specifications, or when technical assistance is necessary due to any malfunction of the equipment or system furnished, the manufacturer's authorized representative shall provide such services. He shall also conduct and/or assist with final performance and demonstration testing, as required by Section 01 75 16 – Startup Procedures, Section 01 79 00 - Demonstration and Training, and elsewhere in the Specifications. These services shall continue until such times as the applicable equipment or system has been successfully tested for performance and has been accepted by the Owner for full-time operation.
- B. Contractor shall provide and coordinate any and all manufacturer services specified and services in addition to those listed in the contract documents that are required for complete and satisfactory start-up, commissioning and training.

1.07 MANUFACTURERS' SERVICE FOR EQUIPMENT

- A. Provide all manufacturers' service recommended by each manufacturer for all equipment furnished under all contracts pertaining to this project, whether specifically set forth or not in the technical specifications.
- B. Submit, to the Engineer, a written report covering the technician's findings and installation certification by each manufacturer for each trip covering all inspections and outlining in detail any deficiencies noted. The Engineer will forward a copy of each report to the Contractor indicating which items are to be acted upon by the Contractor.

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Section 01 43 33 – Manufacturer's Field Services

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

PART 4 PAYMENT

4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 43 33

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. General requirements for Quality Control and Testing Services for materials testing related to all contracts.

1.02 RELATED SECTIONS

- A. General Conditions – Inspections and testing required by laws, ordinances, rules, regulations, or orders of public authorities.
- B. Respective Specification Sections – Certification of products.
- C. Respective Specification Sections – Test, adjust and balance equipment.
- D. Each Specification Section listed – tests and standards.

1.03 REFERENCES

- A. IDOT Standard Specifications for Road and Bridge Construction
- B. Recommended Requirements for Independent Laboratory Qualification

1.04 SUBMITTALS

- A. Results of all testing completed shall be submitted to engineer for review. Testing results will be and approval or recommendations will be disseminated to all concerned parties.

1.05 INSPECTION AND TESTING

- A. The OWNER shall employ and pay for a materials testing firm for testing as required in Division 31 – Earthwork and Division 3 – Concrete and in accordance with the IDOT Standard Specifications for Road and Bridge Construction, adopted January 1, 2022. The CONTRACTOR may complete independent testing at his own cost.
- B. It is the intent of the OWNER that the CONTRACTOR shall employ the services of a Testing Laboratory to perform some of the specified tests and inspections except for materials testing as required in Division 31 – Earthwork and Division 3 – Concrete. The OWNER may also, at its option, obtain additional inspections and tests in accordance with General Conditions.

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Section 01 45 00 – Quality Control
and Testing Services

- C. Inspection, Sampling and Testing shall be paid for by the CONTRACTOR and performed for all Divisions except for materials testing as required in Division 31 – Earthwork and Division 3 – Concrete. CONTRACTOR shall provide any additional testing as indicated in each section.
- D. Employment of Testing Laboratory shall in no way relieve the CONTRACTOR of his obligation to perform work in accordance with Contract.

1.06 QUALIFICATIONS TESTING SERVICE EMPLOYED BY CONTRACTOR

- A. Meet "Recommended Requirements for Independent Laboratory Qualification", latest edition, published by American Council of Independent Laboratories.
- B. Meet all other standards as required and recognized by the industry.

1.07 RESPONSIBILITIES OF TESTING SERVICE EMPLOYED BY CONTRACTOR

- A. Perform specified inspections, sampling and testing of materials and construction methods:
 - 1. Comply with specified Standards, ASTM, other recognized authorities and as specified.
 - 2. Ascertain compliance with contract requirements.
- B. Promptly notify Contractor and Engineer of irregularities or deficiencies of work, which are observed during performance of services.
- C. Promptly submit 3 copies of reports of inspections and tests to Engineer including:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Testing Laboratory name and address.
 - 4. Name and signature of inspector.
 - 5. Date of inspection and sampling.
 - 6. Record of temperature and weather.
 - 7. Date of test.

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and Testing Services

8. Identification of product and Specification Section.
9. Location in project.
10. Type of inspection or test.
11. Observations regarding compliance with Contract Documents.

1.08 LIMITS OF AUTHORITY OF TESTING SERVICE

- A. The testing service employed by the contractor is not authorized to:
 1. Release, revoke, alter or enlarge on, Contract requirements.
 2. Approve or accept any portion of work.
 3. Perform any duties of the Contractor.

1.09 CONTRACTOR'S RESPONSIBILITIES

- A. Provide the services of an independent Testing Service that meets the requirements specified above, to perform the tests and inspections specified in the Contract Documents.
- B. Employment of Testing Laboratory shall in no way relieve Contractor of his obligation to perform work in accordance with Contract.
- C. Cooperate with Laboratory personnel (employed by Owner or Contractor), provide access to work and to manufacturer's operations.
- D. Provide Laboratory with preliminary representatives' samples of materials to be tested, in required quantities.
- E. Furnish copies of mill test reports.
- F. Furnish verification of compliance with Contract requirements for all materials and equipment.
- G. Furnish casual labor and facilities:
 1. To provide access to work to be tested.
 2. To obtain and handle samples at site.
 3. To facilitate inspections and tests.

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Section 01 45 00 – Quality Control and Testing Services

- 4. For laboratory's exclusive use for storage and curing of test samples.
- H. Notify laboratory sufficiently in advance of operations to allow for its assignment of personnel and scheduling of tests.
- I. Correct work which is defective, or which fails to conform to Contract Documents in accordance with General Conditions. Corrective work shall not delay project schedule or work of other contractors, nor shall it be at any additional cost to the OWNER.
- J. When test results indicate non-conformance with Contract requirements, pay all costs for additional inspections, sampling and testing required, including, but not be limited to, additional services of Engineer, and/or Testing Laboratory.
- K. Patch all surfaces and areas disturbed by testing operations.

1.10 ADDITIONAL TESTING BY OWNER

- A. Owner may also at his option, obtain additional inspections and tests in accordance with General Conditions.

1.11 REINSPECTION

- A. If the accuracy or adequacy of any inspection or test is challenged by any parties, and reinspection or retesting is required, all costs for reinspection or retesting shall be paid by the party challenging the original report unless the reinspection, or retesting results in taking actions differing from that based on the original report, in which case the party paying for the original tests shall pay for the additional inspection and tests.
- B. Such inspections or tests will be considered only when performed by a Testing Laboratory or Consultant employed by the OWNER or approved by the OWNER in writing.

1.12 SCHEDULE OF TESTS

- A. Tests and inspections are listed in the specification section for the products or work requiring the test or inspection.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

PART 4 PAYMENT

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Section 01 45 00 – Quality Control
and Testing Services

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 45 00

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for provision and maintenance of temporary utilities during construction period to include:
 - a. Portable toilets as needed.
 - b. Payment of all utility, field office telephone, and fuel bills, service charges, and installation charges as needed.
 - c. Drinking water for Contractor's forces.
 - d. Non-potable water required by Contractor's work.
 - e. Work area lighting as required.
 - f. Safety lighting for barriers and other safety obstacles for work activities under the responsibility or control of Contractor.
 - g. 480 volt 3-Phase power is available on site. It will be the contractor's responsibility to coordinate any and all power requirements for the site.
 - h. The contractor shall supply an Engineers/ Owners job trailer for the duration of the project. The trailer shall be approximately 12' X 20' and shall have electric service. The trailer shall be equipped with a table large enough to seat 8 people and approximately 10 chairs to be utilized for weekly construction meetings, along with telephone and internet services. This trailer can be shared with the General Contractor's trailer

1.02 RELATED SECTIONS

- A. None

1.03 DESCRIPTION OF UTILITY SYSTEMS

- A. Electrical service as required for Contractor's field office.
- B. Cost of electricity (monthly service charge) shall be borne by the Contractor. Permanent utilities may be used once installed until such time

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Section 01 51 00 – Temporary Utilities

possession has been passed to the Owner. The temporary electric service supplied by the contractor shall comply with all NEC and OSHA requirements for temporary service.

- C. Telephone Service – Coordinate installation with local phone company. For construction purposes, cell phones will be acceptable.
- D. Toilets:
 - 1. Provide temporary toilet facilities for use of all workmen and authorized parties throughout construction period.
 - 2. Provide a minimum number of approved enclosed combination toilet and urinal units for construction personnel.
 - 3. Location:
 - a. Obtain Owner's approval.
 - 4. Enclosures for toilet facilities:
 - a. Weatherproof, sight proof, sturdy temporary enclosures.
 - b. Ventilated to meet applicable Federal and State requirements.
 - c. For enclosures accommodating two or more persons, provide privacy screens for each toilet fixture.
 - 5. The Contractor shall have the toilet facilities cleaned and emptied a minimum of once per week or suitable facilities complying with all County Health Department regulations shall be installed.

1.04 COSTS OF INSTALLATION, OPERATION, MAINTENANCE AND CONSUMABLES

- A. Installation, Operation and Maintenance:
 - 1. The General Contractor shall make all arrangements necessary and pay all costs associated with the installation, operation, maintenance, restoration, and warranty extension of temporary utilities until substantial completion.
- B. Consumables:
 - 1. The General Contractor for each contract shall pay all costs of consumables for temporary utilities until substantial completion.

- a. Telephone charges.
- b. Drinking water.
- c. Etc.

1.05 MONITOR TEMPORARY UTILITIES

- A. The General Contractor for each contract shall be responsible for all damage to his work or to that of other contractors caused by a defect in any temporary utility.
 - 1. Enforce compliance with applicable codes and standards.
 - 2. Enforce safe practices.
 - 3. Prevent abuse of services and utilities.
 - 4. Prevent damage to finishes.

1.06 REQUIREMENTS OF REGULATORY AGENCIES

- A. Request and obtain Owner's prior written authorization for Contractor to obtain and pay for:
 - 1. Permits and inspections required by governing authorities.
- B. Comply with specified codes and regulations:
 - 1. National Electric Code (ANSI C1).
 - 2. National Electrical Safety Code.
 - 3. National Fire Protection Association Pamphlet.
 - 4. Federal and State requirements.
 - 5. Utility company regulations.

PART 2 PRODUCTS

2.01 MATERIALS.

- A. General:

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1. Materials may be new or used, but shall be adequate for purposes used, shall not create unsafe or unsanitary conditions, nor violate specified codes. Comply with Federal and State regulations. Any utilities that may be incorporated into a permanent utility must be new.
- B. Electrical Power System:
1. Provide and maintain all required facilities, including transformers, poles, conductors, raceways, breakers, fuses and switches.
 2. Receptacles, fixtures:
 - a. Standard products, meeting UL requirements.
 - b. Provide heavy-duty guards on fixtures.
 - c. Provide appropriate types of fixtures and receptacles for the environment in which used, in accordance with NEC and NEMA standards.
 3. The Owner will work with Wayne-White Electric Cooperative on the temporary service as shown in the drawings. The Contractor shall coordinate with the Owner and Wayne-White Electric Cooperative if any other electrical work is desired by the Contractor. Any additional work will be at the Contractors expense.
- C. Telephone:
1. Coordinate installation with local phone company.
- D. Toilets:
1. Equipment: Standard products, meeting code requirements.
 2. Toilet Facilities: Self ventilated portable toilets, Either:
 - a. Chemical toilets.
 - b. Recirculating toilets.
 - c. Combustion toilets.

PART 3 EXECUTION

3.01 ALL TEMPORARY UTILITIES

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Section 01 51 00 – Temporary Utilities

- A. Comply with Federal and State regulations.
- B. Install work in a neat and orderly manner.
- C. Make structurally, mechanically, and electrically sound throughout.
- D. Maintain to give safe, continuous service, and to provide safe working conditions.
- E. Modify and extend systems as work progress requires.

3.02 INSTALLATION

- A. Electrical:
 - 1. Do not run branch circuits on the ground.
 - 2. Wire all safety devices specified for operation of equipment.
 - 3. Check the operation of all safety devices.
- B. Telephone and Internet:
 - 1. Coordinate installation with local phone company and internet supplier.
- C. Toilets:
 - 1. Erect securely, anchor to prevent dislocation.
 - 2. Service as often as necessary to prevent accumulation of waste, and creation of unsanitary conditions.

3.03 REMOVAL

- A. Upon Owner's prior written authorization, completely remove temporary materials and equipment.
- B. Repair all damage caused by installation. Restore to original condition.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

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Section 01 51 00 – Temporary Utilities

END OF SECTION 01 51 00

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Provide all labor, materials, equipment, supervision, and incidentals necessary to implement and maintain temporary environmental controls during construction, including but not limited to:
 - a. Noise Control
 - b. Air Quality Control
 - c. Water Control
 - d. Debris Control
 - e. Pollution Control
 - f. Erosion and Sediment Control
 - g. Traffic Control
2. Temporary environmental controls shall be implemented to protect the Project, adjacent properties, public rights-of-way, natural resources, and the health and safety of workers and the public.

1.02 RELATED SECTIONS

A. Related Requirements:

1. Storm Water Permit
2. Division 31– Earthwork.
3. *Illinois Urban Manual, A Technical Manual Designed for Urban Ecosystem Protection and Enhancement by the Natural Resources Conservation Service and Illinois Environmental Protection Agency, January 2010 or latest edition.*

B. Attached documents:

1. Storm Water Pollution Prevention Plan (SWPPP) attached in Appendix B

1.03 REFERENCES

- A. Manual on Uniform Traffic Control Devices (MUTCD), latest edition, published by the Federal Highway Administration.
- B. Illinois Environmental Protection Agency (IEPA) NPDES General Permit for Storm Water Discharges from Construction Site Activities.

1.04 SUBMITTALS

- A. Storm Water Pollution Prevention Plan (SWPPP) acknowledgment and Contractor Certification Statement.
- B. Copy of IEPA Notice of Intent (NOI) confirmation and proof of fee payment.
- C. Traffic Control Plan (TCP) when work impacts public roadways, access drives, or pedestrian facilities.
- D. Documentation of required permits for lane closures, right-of-way work, or nighttime operations.

PART 2 PRODUCTS – Not used

PART 3 EXECUTION

3.01 TEMPORARY ENVIRONMENTAL CONTROLS

- A. Provide controls over environmental conditions at the construction site and related areas under Contractor's control.
- B. Comply with all federal, state, and local environmental regulations and permit requirements.
- C. Remove physical evidence of temporary controls upon completion of the Work or as directed by the Owner.

3.02 NOISE CONTROL

- A. Equip all engines and engine-driven equipment with adequate mufflers in constant operation and properly maintain to prevent excessive or unusual noise.
- B. Conduct operations to minimize noise impact to adjacent properties.
- C. Nighttime Work:

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Section 01 57 19 – Temporary Environmental
Controls

1. Work between 8:00 p.m. and 7:00 a.m., Monday through Saturday, or at any time on Sundays or legal holidays, shall require prior written permission from the Owner.
2. Obtain all necessary permits and approvals from governing agencies before commencing such work.

3.03 AIR QUALITY CONTROL

- A. Provide dust control measures to minimize airborne dust from construction operations.
 1. Use water spraying, approved dust palliatives, or other suitable means.
 2. Prevent dust from migrating beyond the project limits.
- B. Temporary heating devices, when required, shall be of an approved type that will not cause air pollution.
- C. Coordinate placement of construction equipment to prevent intake of exhaust gases into building air systems.

3.04 WATER CONTROL

- A. Provide methods to control surface and rainwater to prevent damage to the Project, site, and adjoining properties.
- B. Provide, operate, and maintain pumps and hydraulic equipment of adequate capacity to control surface water.
- C. Dispose of drainage water in a manner that prevents flooding, erosion, silting, or runoff of sediment to adjacent areas.
- D. Prevent water from entering open excavations.

3.05 DEBRIS CONTROL

- A. Maintain all areas under Contractor's control free of extraneous debris.
- B. Implement a debris management program to prevent accumulation at construction sites, storage areas, parking areas, and along access or haul routes.
 1. Provide suitable containers for debris collection.
 2. Prohibit overloading of trucks to prevent spillage.

3. Inspect traffic areas daily to enforce compliance.
- C. Do not allow debris, waste materials, equipment, or stored materials to block or restrict adjacent properties, driveways, sidewalks, fire lanes, public roadways, or site access routes.
1. Maintain clear and unobstructed access at all times unless otherwise approved in writing by the Owner.
 2. Immediately remove any material or equipment causing obstruction.
 3. Costs associated with corrective action due to obstruction shall be borne by the Contractor.
- D. Schedule regular collection and lawful disposal of debris.
- E. Provide additional collection as required to prevent accumulation.

3.06 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, or atmosphere from construction operations.
- B. Provide equipment and personnel for emergency response to contain and remove spills and contaminated materials.
- C. Prevent harmful substances from entering public waters.
- D. Prohibit disposal of wastes, effluents, chemicals, or similar substances into streams, drainage ditches, sanitary sewers, or storm sewers.
- E. Provide systems to control atmospheric pollutants.
 1. Prevent toxic concentrations of chemicals.
 2. Prevent harmful dispersal of pollutants into the atmosphere.

3.07 EROSION AND SEDIMENT CONTROL

- A. Erosion control is the responsibility of the General Contractor. Provide all labor, equipment, and materials necessary to comply with the SWPPP and contract drawings.
- B. Estimated quantities for erosion control items are included in the Contract Documents.

- C. Contractor Responsibilities:
 - 1. Review SWPPP and sign Contractor Certification Statement.
 - 2. Submit IEPA Notice of Intent (NOI) at least 30 days prior to construction start.
 - 3. Submit SWPPP electronically to IEPA as required.
 - 4. Pay required permit fees (\$250 for disturbances less than 5 acres; \$750 for 5 acres or more).
- D. Comply fully with all aspects of the SWPPP.
- E. Inspections, documentation, and compliance activities required by the SWPPP shall be incidental to the Work and not paid separately.
- F. Maintain all erosion control items in proper working condition.
- G. Upon completion:
 - 1. Submit Notice of Termination (NOT) to IEPA.
 - 2. Remove temporary erosion control materials. Materials shall become the property of the Owner unless otherwise directed.
- H. Failure to comply with SWPPP requirements may result in notification to the Illinois Environmental Protection Agency.

3.08 TRAFFIC CONTROL

- A. General
 - 1. Provide, install, maintain, and remove all traffic control devices required to perform the Work safely.
 - 2. Comply with the Manual on Uniform Traffic Control Devices (MUTCD) and all applicable state and local requirements.
 - 3. Maintain access to adjacent properties, emergency services, and existing facilities at all times.
 - 4. Conduct operations to minimize interference with public and private roadways.

B. Protection of Adjacent Access

1. Do not block, restrict, or otherwise interfere with access to adjacent properties, driveways, sidewalks, fire lanes, alleys, or public roadways with delivery trucks, construction equipment, materials, or debris.
2. Schedule deliveries and equipment staging to prevent congestion or obstruction of traffic.
3. When temporary interruption of access is unavoidable, obtain prior approval from the Owner and provide advance written notice to affected property owners and occupants.
4. Provide flaggers or other approved traffic control measures when required to safely manage temporary delivery operations.
5. Immediately relocate any vehicle, equipment, or material causing an unauthorized obstruction.
6. Costs associated with delays, towing, relocation, or corrective measures required due to obstruction of access shall be borne solely by the Contractor.

C. Traffic Control Plan (TCP)

1. Submit a site-specific Traffic Control Plan when required by permitting agencies.
2. Include phasing, lane closures, detours, signage, flagging operations, and pedestrian routing.

D. Installation and Maintenance

1. Install advance warning signs, barricades, cones, drums, and channelizing devices prior to commencing affected work.
2. Provide certified flaggers when required.
3. Inspect traffic control devices daily and after severe weather.
4. Immediately repair or replace damaged or displaced devices.

E. Lane Closures and Detours

1. Schedule closures to minimize public disruption.

DIVISION 01 – GENERAL REQUIREMENTS
Section 01 57 19 – Temporary Environmental
Controls

2. Provide clearly marked detour routes where required.
3. Remove or cover conflicting existing signs and pavement markings.

F. Removal

1. Remove temporary traffic control devices when no longer required.
2. Restore affected areas to original or better condition.

PART 4 PAYMENT

- 4.01 This work shall include all equipment, materials and labor to supply, install, and remove all erosion control items and maintain these items throughout construction and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 57 19

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Administrative and quality requirements for products incorporated into the Work.
2. General requirements for product quality, certification, delivery, storage, handling, maintenance, and inventory control.

1.02 REFERENCES

A. NSF 61 – Drinking Water System Components – Health Effects.

B. Certification by the following ANSI-accredited organizations:

1. Underwriters Laboratories (UL).
2. NSF International.

1.03 RELATED SECTIONS

1. 01 33 00 – Submittal Procedures

1.04 BASIC PRODUCT REQUIREMENTS

- A. Products provided under this Contract shall be new and of suitable grade for the intended purpose unless explicitly stated otherwise in the Contract Documents.
- B. Products in contact with potable water during normal operation shall be tested and certified in accordance with NSF 61 by an ANSI-accredited certifier.
- C. No products shall contain asbestos materials or lead-based paint.
- D. Submit product data in accordance with Section 01 33 00 – Submittal Procedures. Product data shall clearly demonstrate conformance with the Contract Documents.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.01 PREPARATION FOR SHIPMENT

- A. When practical, equipment shall be factory assembled.
- B. Equipment parts and assemblies shipped unassembled shall be furnished with assembly plans and instructions.
- C. Individual parts and components shall be tagged or piece-marked and keyed to the assembly plans. Separate parts and assemblies shall be match-marked to facilitate field assembly.
- D. Machined and unpainted parts subject to damage shall be protected with a strippable protective coating.
- E. Equipment shall be packaged or crated to prevent damage during shipping, handling, and storage.
- F. Each package or crate shall be clearly marked to indicate:
 - 1. Contents by name and equipment number (if applicable).
 - 2. Approximate weight.
 - 3. Special handling precautions.
 - 4. Recommended storage requirements prior to installation.

3.02 RECEIVING

- A. Unload and record receipt of equipment and materials at the jobsite. Submit daily written receipt reports to the Engineer.
- B. Inspect and accept responsibility for all Owner supplied equipment and materials to the jobsite.

3.03 INSPECTION

- A. Immediately inspect equipment and materials upon receipt for completeness and shipping damage.
- B. If damage is identified:
 - 1. Notify the Engineer immediately.
 - 2. Notify the manufacturer and transportation company.

3. Expedite replacement, if required by the Engineer and Owner, at no additional cost to the Contract.

- C. Inspect materials and equipment for conformance with Contract Documents and approved Shop Drawings prior to incorporation into the Work. Notify the Engineer of deviations.

3.04 HANDLING

- A. Handle equipment and materials in accordance with manufacturer's written recommendations and in a manner that prevents damage.

3.05 STORAGE AND LAYDOWN

- A. Store equipment and materials in accordance with manufacturer's recommendations.
- B. Store materials off the ground and out of mud or standing water.
- C. Protect stored items from weather, vandalism, and theft.
- D. Do not store materials on private property without written permission from the property owner or lessee.
- E. Use only designated laydown/construction areas shown on the Contract Drawings. Rough grade as required to accommodate laydown on proposed parking, driveways, or grassed areas.

3.06 INSURANCE

- A. Comply with General Conditions regarding insurance coverage for materials delivered but not yet incorporated into the Work.

3.07 INVENTORY CONTROL

- A. Store equipment and materials to allow access for inspection and inventory control.
- B. Maintain a current inventory of stored materials to:
 1. Facilitate inspection.
 2. Support progress payment applications for materials delivered but not yet installed.

3.08 EQUIPMENT MAINTENANCE PRIOR TO OWNER'S ACCEPTANCE

- A. Provide the required or manufacturer's recommended equipment maintenance during storage, during installation, and until such time as the Owner accepts the equipment for full-time operation.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 62 00

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Survey and field engineering.
2. Submittals.
3. Records.

B. Unless otherwise specified in the specific sections, Owner shall provide initial engineering surveys to establish reference points for the project including:

1. A minimum of two permanent benchmarks with an adequate number of survey control points shall be established in a protected located on site. Record locations on Project Record Documents.
2. Establishment of lines and levels, located and laid out, by instrumentation:
 - a. Site improvements:
 - 1) Stakes for grading, fill, and topsoil placement.
 - 2) Utility slopes and invert elevations.
3. Additional engineering surveys and staking shall be conducted after rough grading and clearing has been completed to include:
 - a. Building foundation and column locations, floor elevations, and other controlling dimensions.
 - b. Directional boring end points

C. Contractor shall carefully preserve all reference points and benchmarks.

1. In case of loss or disturbance of reference points and benchmarks, Contractor shall be responsible for the cost of replacement by Engineer.
 - a. Such cost will be deducted from the next progress payment to Contractor.
 - b. Such cost will be reimbursed to Engineer by Owner.

1.02 RELATED SECTIONS

- A. Section 31 10 00 - Site Clearing
- B. Section 31 14 13 - Earth Stripping and Stockpiling
- C. Section 31 22 13 - Rough Grading
- D. Section 31 23 16 – Excavation
- E. Section 31 23 23 – Fill
- F. Section 33 05 05 - Buried Pipe Installation

1.03 REFERENCES – *NOT USED*

1.04 SUBMITTALS

- A. Submit to Engineer a minimum of 48 hours prior, all requests for field engineering survey work.

1.05 QUALITY ASSURANCE

- A. Locate, verify, and protect control points prior to beginning Work; preserve permanent reference points during construction.
- B. Personnel Qualifications:
 - 1. Technician: Qualified, experienced instrument technician.
 - 2. Surveyor: Qualified land surveyor, licensed in the State of Illinois
 - 3. Engineer: Registered professional engineer of discipline required for specific service on the project licensed in the State of Illinois

1.06 DELIVERY, STORAGE, AND HANDLING - *NOT USED*

1.07 GUARANTEE - *NOT USED*

PART 2 PRODUCTS

2.01 CONSTRUCTION STAKING

- A. Unless otherwise specified in the specific sections, Owner shall provide engineering surveys to establish reference points for construction as follows:
 - 1. Sanitary Sewer and Storm Sewer:

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Section 01 71 23 – Field Engineering

- a. Staking will be furnished and set by the Engineer, offset for construction, for the control of the underground construction herein described.
 - b. Cuts to the proposed pipeline grade will be furnished by the Engineer.
 - c. Manholes and catch basins will be staked with an offset and a witness with a cut to the lowest structure invert.
 - d. Location staking shall be provided for service wyes for new construction. No staking will be provided for service wyes for reconstruction projects or where existing services are being connected to the new sewer line.
2. Watermain:
- a. The staking interval for watermain shall be 50 feet. Cuts to the proposed pipeline grade will be furnished by the Engineer.
 - b. Location staking shall be provided for valves and fittings.
 - c. Hydrants will be staked with an offset and a witness with a cut to the ground elevation at the hydrant.
3. Services:
- a. No staking will be provided for service line construction for reconstruction projects or where existing services are being connected to the new sewer line.
4. Street Grading and Top of Curb:
- a. A control line (usually offset from the curb line) with cuts and fills to proposed grade at 50 foot spacing on tangents, and 25 foot spacing on horizontal or vertical curves, shall be furnished and set on both sides for control of the construction herein described.
5. Concrete Paving:
- a. Control lines for paving forms or stringline control with cuts and fills to proposed finished grade at 25 or 50 foot stations shall be furnished and set by the Engineer for control of the concrete construction herein described.
 - b. The offset and actual form or stringline locations shall be in accordance with the paver manufacturer's recommendations and

the approved paving strategy as determined at the
Preconstruction conference.

6. Miscellaneous:
 - a. Location stakes will be provided for silt fence locations at 100 foot spacing.
 - b. Location stakes representing clearing and grubbing limits will be provided at 100 foot spacing.

PART 3 EXECUTION

3.01 PREPARATION

- A. The Contractor shall give the Engineer sufficient notice, minimally two working days, to provide staking for the orderly progress of the work and shall provide clear line of sight for all staking.
 1. The forty-eight (48)-hour time period will commence from the time ENGINEER receives such written request from CONTRACTOR.
 2. The forty-eight (48)-hour period excludes weekend days, holidays, organized union holidays, and days where weather conditions are detrimental to ENGINEER's ability to accurately perform the requested surveys.
- B. The stakes are an integral part of the project and the Contractor shall protect and preserve all such stakes and marks and may be charged with the expense of resetting all such stakes and marks destroyed or disturbed due to the Contractor's carelessness or negligence.
 1. Stakes that are destroyed due to vandalism, erosion or other incidents shall be re-staked by the Engineer, at the Contractor's expense.
- C. In the event a Benchmark or Control Point must be moved for construction purposes, the Contractor shall provide two working days notice as outlined elsewhere in these specifications. The point shall be relocated at no cost to the Contractor provided the notification requirement is met.
- D. In the event of apparent or questionable errors or inconsistencies in such stakes set for control of line and/or grade, the Contractor shall promptly notify the Engineer of such error or inconsistency and shall not proceed with the work until such stake, grade, or mark shall have been verified or corrected by the Engineer.
- E. All other line and grade staking shall be the responsibility of the Contractor. The Contractor shall furnish sufficient equipment and personnel for determination of

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 71 23 – Field Engineering

plan grades, cross sections, course thicknesses, etc. The survey cost of establishing stakes requested by the Contractor for the convenience of the Contractor, beyond those cited as basic project control, will be charged to the Contractor or withheld from the amounts due to the Contractor.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 71 23

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. General execution requirements for protection of Owner's facilities adjacent to areas of construction, lay-down, material storage, and access routes.

1.02 RELATED SECTIONS

1. None

1.03 PROTECTION

- A. Contractor's activities on the site, including accessing the site; delivering, unloading, handling, and storing materials and equipment; and all construction, erection, installation, testing, and start-up activities shall not interfere with the operation of the other contractors onsite. Contractors shall have open and constant dialogue between the various trades onsite to prevent work stoppage and/or disruptions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SHUTDOWN OF EXISTING FACILITIES (RAW WATERMAIN)

- A. Continuous operation of the existing water systems is of critical importance.
- B. The Contractor shall execute all work under this contract in such a manner as to not cause any unscheduled interruption of the continuous operation of the existing water system.
- C. Portions of the existing water mains may be relocated, extended, tapped, or otherwise modified during construction. The temporary shutdown of any existing main for modification shall be coordinated with the Resident Operator in Charge (ROINC) of the respective owner.
- D. Work required at remote sites (wells, towers) that require shutdown of the facility or SCADA control shall be coordinated with the Resident Operator in Charge (ROINC) of the respective owner.

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 71 33 – Protection of
Adjacent Construction

3.02 CONTRACTOR'S OPERATION OF EXISTING SYSTEM PROHIBITED

- A. At no time shall the Contractor close off or open any lines, open or close valves and/or gates, shutdown power or take any other action which would affect the operation of the existing facilities except as specifically required by the Specifications and only after written approval is granted by the OWNER and the municipality owning the facilities in question.

3.03 AUTHORIZATION FOR TEMPORARY INTERRUPTION OR SHUTDOWN

- A. Request approval from the Owner and the municipality owning such facilities seven (7) business days in advance of the time an interruption or shutdown of the existing facilities is required. **Under no circumstances** shall the Contractor proceed with a requested interruption or shutdown until written authorization is issued to the Contractor by the Owner and the owner of such facilities.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 71 33.

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Site maintenance and housekeeping during construction.
2. Waste management and legal disposal of construction debris.
3. Protection of public and adjacent properties.
4. Final cleaning of the Project prior to Substantial Completion.
5. Final plant-wide cleaning prior to Owner acceptance.

1.02 RELATED SECTIONS

1. Section 01 77 00 - Closeout Procedures
2. Division 01 – General Requirements.

1.03 REFERENCES

A. Comply with applicable requirements of the following:

1. Federal, State, and local codes and ordinances.
2. National Fire Protection Association (NFPA) standards.
3. Applicable environmental protection and anti-pollution laws.

1.04 GENERAL

- A. Maintain areas covered by the Contract, public properties, and adjacent properties free of waste, debris, and rubbish caused by construction operations at all times.
- B. Upon completion of the Work, or at such other times as directed by the Engineer, remove all waste, debris, rubbish, tools, equipment, machinery, and surplus materials.
- C. Leave the Project clean and ready for occupancy at completion.

1.05 QUALITY REQUIREMENTS

- A. Conduct cleaning and disposal operations in compliance with governing laws and regulations.
- B. Do not burn or bury rubbish or waste materials on the Project site.
- C. Do not dispose of volatile, harmful, or dangerous materials into storm drainage systems, sanitary drains, streams, or waterways.
- D. Remove waste materials from the site and legally dispose of them at public or private facilities off Owner's property.
- E. Provide approved on-site containers for collection and segregation of waste materials as required.
- F. Handle materials in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.

1.06 SAFETY REQUIREMENTS

- A. Standards:
 - 1. Maintain the Project in accordance with applicable Federal and State safety requirements.
 - 2. Comply with NFPA standards for fire prevention and protection.
- B. Hazards Control:
 - 1. Store volatile or flammable waste in covered metal containers and remove from premises daily.
 - 2. Prevent accumulation of waste materials that could create fire, safety, or health hazards.
 - 3. Provide adequate ventilation during use of volatile or noxious substances.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS

- A. Select cleaning materials and equipment that will not scratch, mark, deface, stain, or otherwise damage surfaces.

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 74 00 – Cleaning and
Waste Management

- B. Use only cleaning materials recommended by the manufacturer of the surface to be cleaned.
- C. Use cleaning agents only on surfaces recommended by the cleaning material manufacturer.
- D. Provide waste containers of sufficient size and quantity to contain construction debris and prevent overflow.

PART 3 EXECUTION

3.01 DURING CONSTRUCTION

- A. Perform continuous site cleanup during execution of the Work.
- B. Clean site and public properties and dispose of waste materials to prevent accumulation.
- C. Wet down materials and rubbish as necessary to control dust and prevent airborne debris.
- D. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from exposed and semi-exposed finished surfaces.
- E. Repair, patch, and touch up marred surfaces to specified finish to match adjacent surfaces.
- F. Broom clean paved and smooth surfaces; rake clean unpaved surfaces.
- G. Conduct daily cleanup of adjacent roads as required due to truck traffic and transport of materials and personnel.

3.02 WASTE MANAGEMENT

- A. Collect and remove waste materials on a regular basis to prevent hazardous or unsightly conditions.
- B. Segregate waste materials where required by law or recycling programs.
- C. Transport waste materials off-site and dispose of legally at approved facilities.
- D. Maintain records of disposal when required by governing authorities.

3.03 FINAL CLEANING

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 74 00 – Cleaning and
Waste Management

- A. Complete final cleaning prior to requesting inspection for Certification of Substantial Completion in accordance with Section 01 77 00 – Closeout Procedures.
- B. Clean entire site, including landscaping development areas, of rubbish, litter, and foreign substances.
- C. Broom sweep paved areas clean; remove stains, spills, and other deposits.
- D. Rake unpaved and unplanted areas to a smooth, even-textured surface.
- E. Repair, patch, and touch up marred surfaces to match adjacent finishes.
- F. Remove temporary protections and facilities installed to protect the Work.
- G. Maintain cleaned areas until the Project or designated portion thereof is accepted by the Owner.
- H. After Substantial Completion and completion of all punch list items, clean the entire plant to a condition acceptable to the Owner.
- I. Where extra materials of value have become Owner's property, arrange disposition as directed by the Owner.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 74 00

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for starting and adjusting equipment and products during prior to project completion to include:

1. Starting systems.
2. Testing, adjusting, and balancing.

1.02 RELATED SECTIONS

1. Section 01 33 00 – Submittal Procedures
2. Section 01 45 00 - Quality Control
3. Section 01 75 16 -Startup Procedures
4. Section 01 78 23 - Operation and Maintenance Data
5. Section 01 79 00 - Demonstration and Training

1.03 GENERAL

- A. The General Contractor shall coordinate the starting and adjusting as required by specification sections for the particular equipment and systems and as required below. Conduct thorough and systematic performance test of each element of the Work.

1.04 SUBMITTALS

- A. Submit a written report in accordance with Section 01 33 00 – Submittal Procedures, that equipment or system has been properly installed and is functioning correctly.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 STARTING SYSTEMS

- A. Contractor shall coordinate schedule for start-up of various equipment and systems.
- B. Contractor shall notify OWNER and ENGINEER in writing at least seven calendar days prior to start-up of each item.

- C. Contractor shall verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions, which may cause damage.
- D. Contractor shall verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Contractor shall verify that wiring and support components for equipment are complete and tested.
- F. Contractor shall execute start-up under supervision of applicable manufacturer's representative and/or Contractor's personnel in accordance with manufacturer's instructions.
- G. When specified in individual specification Sections, Contractor shall require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Contractor shall submit a written report in accordance with Section 01 33 00 - Submittal Procedures that equipment or system has been properly installed and is functioning correctly.
- I. The Contractor shall connect to the raw water main as shown on the plans. This line shall be used to do all testing and starting the plant. The connection shall allow the existing City of Albion and City of Grayville water treatment plants to remain in operation. Once the new plant is operational, the contractor shall coordinate the startup. This work shall be coordinated with the Owner.

3.02 TESTING, ADJUSTING, AND BALANCING

- A. Contractor shall appoint, employ, and pay for qualified personnel to complete services to perform testing, adjusting and balancing.
 - 1. This may be completed by manufacturers representative as a condition of sale.
- B. Reports will be submitted to OWNER, ENGINEER, and OWNER'S REPRESENTATIVE indicating observations and results of tests and indicating compliance or non-compliance with the requirements of the Contract Documents.

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 75 00 – Starting and Adjusting

- C. OWNER reserves the right to hire its own independent testing and balancing company to check the work and the report submitted by the Contractor's testing and balancing personnel.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 75 00

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for startup procedures pertaining to equipment and products after substantial completion of construction.

1.02 RELATED SECTIONS

- A. Section 01 43 33 – Manufacturer's Field Service
- B. Section 01 75 00 – Starting and Adjusting
- C. Section 01 79 00 – Demonstration and Training

1.03 GENERAL DEFINITIONS

- A. Startup: Starting and adjusting of entire project site collectively for hydraulic, mechanical, and electrical operation.

1.04 SUBMITTALS

- A. Submit a written and detailed step-by-step description of the startup procedure before beginning the startup procedure.

1.05 PRELIMINARY PROCEDURES

- A. Start and adjust all equipment as required by Section 01 75 00 – Starting and Adjusting prior to initiating startup.
- B. Provide manufacturer's inspection reports and installation certifications as required by Section 01 43 33 – Manufacturer's Field Service.
- C. Provide demonstration of equipment operation and training of Owner's personnel as required by Section 01 79 00 – Demonstration and Training for equipment and systems prior to initiating Startup where feasible.

1.06 STARTUP

- A. The General Contractor shall provide startup services and coordinate with the General Contractor for other contracts regarding startup procedures and as required by specification sections for all equipment and systems.

PART 2 PRODUCTS – NOT USED

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 75 16 – Startup Procedures

PART 3 EXECUTION – NOT USED

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 75 16

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for protecting installed equipment, products, and other components of the work during construction.

1.02 RELATED SECTIONS

A. None

1.03 GENERAL DEFINITIONS

- A. Finished Surface: shall mean any surface of any component of the Work that is exposed to view during normal operation of the facility.
- B. Unfinished Surface: shall mean any surface of any component of the Work that is exposed to view during normal operation of the facility and is specified with a surface treatment that has not been applied.
- C. Concealed Surface: shall mean any surface of any component of the Work that is not exposed to view during normal operation of the facility.
- D. Damaged Surface: shall mean any finished surface that has been altered by physical or chemical means in such a way that the performance, appearance, durability, or other significant attribute of the specified surface treatment has been affected.
- E. Contaminated Surface: shall mean any unfinished surface that has been altered by physical or chemical means in such a way that a reasonable chance exists that the performance, appearance, durability, or other significant attribute of the specified surface treatment will be inhibited.
- F. Surface Treatment: shall mean any application of coating, laminate, paint, sealer, veneer, fabric, wax, polish, or other product specified to enhance the performance, appearance, durability, or other significant attribute of the surface.

1.04 SUBMITTALS

- A. Submit in writing a detailed description of the means and methods for cleaning and restoring or otherwise correcting damaged surfaces.

- B. When requested by Engineer, submit in writing a detailed description of the means and methods for cleaning and restoring or otherwise correcting contaminated surfaces.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. Provide protection to all finished surfaces during shipping, handling, storing, fabricating, erecting, installing, and after installation. Protection shall be adequate to prevent marring, scratching, dulling, staining, abrading, denting, wrinkling, buckling and surface damage.
- B. Provide protection to all unfinished surfaces during shipping, handling, storing, fabricating, erecting, installing, and after installation. Protection shall be adequate to prevent all possible surface contamination.
- C. Cover, tape, mask, or otherwise shield adjacent surfaces from spills, drips, splashes, spatter, overspray, or other misapplication of paint, coating, sealant, or other liquid products.
- F. Normal accumulation of airborne dust particles, that are chemically inert, on a surface during routine construction operations shall not be considered surface damage. Marring, scratching, dulling, staining, or other chemical or physical alteration of a finished surface during cleaning operations shall be considered surface damage.
- G. ENGINEER shall make the final determination of whether a surface is a finished, unfinished, concealed, contaminated, or damaged surface.
- H. ENGINEER shall make the final determination of the acceptability of any component of the Work subject to cleaning, restoration, or any other correction of a contaminated or damaged surface.
- I. Damaged and contaminated surfaces that are not capable of being acceptably cleaned, restored, or otherwise corrected shall be considered defective.
- J. To prevent permanent transfer of adhesives to finished surfaces, tape, masking, or other adhesive-applied covering products shall not be left in place longer than one week unless Contractor can demonstrate an adhesive removal technique that is acceptable to the Engineer and accepted in writing by the manufacturer of the product or equipment affected.

DIVISION 01 – GENERAL REQUIREMENTS
Section 01 76 00– Protecting Installed Construction

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 76 00

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Administrative and procedural requirements for Contract closeout.
2. Procedures for Substantial Completion and Final Acceptance.
3. Closeout submittals including warranties, record documents, certifications, and affidavits.
4. Requirements for final Application for Payment.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 74 00 – Cleaning and Waste Management.
- C. Section 01 75 00 – Starting and Adjusting.
- D. Section 01 78 23 – Operation and Maintenance Data.
- E. Section 01 78 39 – Project Record Drawings.

1.03 SUBMITTALS

A. Project Documentation

1. Warranties and workmanship bonds.
2. Maintenance agreements.
3. Final certifications and test reports.
4. Certificates of insurance, including evidence of continuing coverage for completed operations.
5. Written declaration of compliance with Contract Documents.
6. Updated final statement accounting for all changes to the Contract Sum.
7. Certified copy of the Engineer's final inspection (punch) list.

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 77 00– Closeout Procedures

8. Final meter readings for utilities.
9. Measured record of stored fuel, if applicable.
10. Final liquidated damages settlement statement, if applicable.
11. Evidence of final, continuing insurance coverage.

B. Releases and Affidavits

1. Contractor's Affidavit of Release of Liens.
2. Contractor's Affidavit of Debts and Claims.
3. Final waivers of lien from Subcontractors and Suppliers.
4. Consent of Surety to Final Payment.
5. Releases enabling Owner unrestricted use of the Work, including occupancy permits and operating certificates.

C. Record Documents

1. Project Record Drawings in accordance with Section 01 78 39.
2. Operation and Maintenance Manuals in accordance with Section 01 78 23.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL CLOSEOUT REQUIREMENTS

- A. Coordinate closeout activities with the Owner and Engineer.
- B. Do not request Substantial Completion or Final Acceptance until required Work and documentation are complete.
- C. Maintain insurance, utilities, and temporary facilities until responsibility is formally transferred to the Owner.

3.02 PRELIMINARY PROCEDURES FOR SUBSTANTIAL COMPLETION

Before requesting inspection for Certification of Substantial Completion, complete the following and list exceptions in the written request:

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 77 00– Closeout Procedures

- A. Prepare and submit a comprehensive punch list of items to be completed or corrected.
- B. Submit an Application for Payment coinciding with, or first following, the date Substantial Completion is claimed.
 - 1. Show 100 percent completion for the portion of Work claimed substantially complete.
 - 2. Include supporting documentation.
 - 3. Provide accounting of changes to Contract Sum.
- C. If 100 percent completion cannot be shown, submit:
 - 1. List of incomplete items.
 - 2. Value of incomplete Work.
 - 3. Reasons Work is incomplete.
- D. Complete startup, testing, and training in accordance with Section 01 75 00 – Starting and Adjusting.
- E. Deliver tools, spare parts, extra materials, and attic stock required by Contract Documents.
- F. Complete final cleaning in accordance with Section 01 74 00 – Cleaning and Waste Management. Restore damaged finishes.
- G. Remove temporary facilities, construction tools, and similar items from the site.
- H. Complete permanent lock changeover and transmit keys to Owner.
- I. Notify Owner of insurance changeover requirements.

3.03 SUBSTANTIAL COMPLETION INSPECTION

- A. Upon receipt of request for inspection, the Engineer will:
 - 1. Conduct inspection; or
 - 2. Notify Contractor of unfulfilled requirements.
- B. Following inspection, the Engineer will:

1. Issue Certificate of Substantial Completion; or
 2. Provide list of items requiring completion or correction.
- C. Correct identified deficiencies and notify Engineer when ready for reinspection.
- D. Substantial Completion inspection results form the basis for Final Acceptance requirements.

3.04 FINAL ACCEPTANCE PROCEDURES

- A. Before requesting final inspection for certification of final acceptance and final payment, complete the following.
1. Submit final Application for Payment with all required supporting documentation.
 2. Submit written declaration of full compliance with the Contract Documents.
 3. Submit updated final accounting of the Contract Sum.
 4. Submit certified copy of Engineer's final inspection list indicating all items have been completed or otherwise resolved.
 5. Submit final meter readings, fuel records, and similar data as of Substantial Completion or date Owner assumed responsibility.
 6. Submit final liquidated damages settlement statement, if applicable.
 7. Submit evidence of continuing insurance coverage.
 8. Submit complete Project Record Drawings.
 9. Submit complete Operation and Maintenance Manuals.
 10. Submit all required affidavits, waivers, bonds, and releases.

3.05 REINSPECTION PROCEDURES

- A. Engineer will re-inspect the Work upon notice that deficiencies have been corrected.
- B. Engineer will advise Contractor of acceptance or remaining deficiencies.

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 77 00– Closeout Procedures

- C. Repeat reinspection as necessary until requirements for Final Acceptance are satisfied.

3.06 FINAL APPLICATION FOR PAYMENT

- A. Ensure all closeout documentation is complete and properly executed prior to submitting final Application for Payment.
- B. Engineer will process final Application in accordance with the General Conditions.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 77 00

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Preparation and submittal of complete Operation and Maintenance (O&M) Manuals for all equipment, systems, and components furnished under the Contract Documents.
2. Compilation of manufacturer's data, installation instructions, maintenance procedures, wiring diagrams, warranties, and related documentation necessary for proper operation and maintenance of installed systems.

B. Description:

1. Operation and Maintenance Manuals shall contain complete, coordinated, and project-specific information necessary to operate, maintain, troubleshoot, and repair equipment specified in the Contract Documents.
2. Manuals shall be organized in accordance with applicable divisions of the Technical Specifications sections.
3. O&M data shall reflect final as-built conditions and equipment actually installed.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 77 00 – Closeout Procedures.
- C. Section 01 78 39 – Project Record Documents.

1.03 SUBMITTALS

A. General:

1. Submit Operation and Maintenance Manuals in accordance with Section 01 33 00 – Submittal Procedures and as specified herein.

B. Preliminary Submittal:

DIVISION 01 – GENERAL REQUIREMENTS

Section 01 78 23 – Operation and Maintenance Data

1. Submit four (4) preliminary hard copies of each required O&M Manual no later than two (2) weeks after installation of associated equipment begins.
 2. Two (2) copies will be reviewed, marked, and returned to the Contractor.
 3. Submit samples of proposed binding materials and organization format if requested.
- C. Final Hard Copy Submittal:
1. Submit four (4) corrected and approved hard copies of the O&M Manuals.
 2. Deliver final copies no less than four (4) weeks prior to initial equipment start-up and checkout.
 3. Manuals must be reviewed and accepted prior to commencement of system startup.
- D. Electronic Submittal:
1. Submit two (2) complete electronic copies of the final approved manuals in searchable PDF format.
 2. Provide each copy on a separate USB flash drive.
 3. Deliver electronic copies upon completion of startup and prior to final acceptance by the Owner.
- E. Approval Requirement:
1. Final acceptance of the Work is contingent upon receipt and approval of complete Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.01 FORM OF MANUAL

- A. Binding
1. Three-ring, loose-leaf binders.
 2. Metal screw-post binding for smaller manuals, subject to Engineer approval.

DIVISION 01 – GENERAL REQUIREMENTS
Section 01 78 23 – Operation and Maintenance Data

B. Cover Requirements:

1. Oil-, moisture-, and wear-resistant material.
2. Size: 9 inches by 11-1/2 inches.
3. Clearly lettered on front cover and spine with:
 - a. Project Name
 - b. Contract Number (if applicable)
 - c. Equipment/System Name
 - d. "Record and Information Booklet"
 - e. Volume number, if multiple volumes are provided.

C. Page Requirements:

1. Page size: 8-1/2 inches by 11 inches.
2. Larger sheets shall be neatly folded to 8-1/2 inches by 11 inches and arranged as pull-outs.
3. Minimum of three (3) reinforced punched holes.
4. Legible original-quality documents reproduced by dry-copy method.
5. Provide clear diagrams, illustrations, and schedules as required.

D. Organization:

1. Provide indexed tab dividers separating each major system or specification section.
2. Organize contents in the same sequence as the Project Specifications.
3. Where multiple volumes are required, include a master table of contents in each volume referencing all volumes.

2.02 CONTENTS

A. General Requirements:

1. Provide complete and project-specific information necessary to operate, maintain, and repair each item of equipment. Manuals shall include, but not be limited to, the following:

B. Front-End Information:

1. Table of Contents and index for each volume.
2. Contractor's name, address, telephone number, and responsible principal.
3. List of products included in the volume, indexed to contents.

C. System Description:

1. Brief description of each system and principal components.
2. Identification of normal operating parameters and design capacities.

D. Operating Procedures:

1. Normal startup procedures.
2. Normal shutdown procedures.
3. Emergency operating procedures.
4. Troubleshooting guides identifying probable causes and corrective actions.

E. Installation and Maintenance Information:

1. Manufacturer's installation instructions.
2. Preventive maintenance procedures and intervals.
3. Overhaul and disassembly instructions.
4. Detailed assembly drawings with parts lists and part numbers.
5. Recommended spare parts list including recommended quantities and supplier contact information.

DIVISION 01 – GENERAL REQUIREMENTS
Section 01 78 23 – Operation and Maintenance Data

F. Lubrication and Service Schedule:

1. Recommended servicing intervals.
2. Technical data sheets indicating weights and types of oil, grease, or other lubricants.
3. Application procedures.

G. Electrical Information (Where Applicable):

1. Component wiring diagrams.
2. Complete system wiring diagrams showing wire size and identification.
3. Dimensioned installation drawings.
4. Control diagrams and connection diagrams.
5. List of materials for contactors, relays, and controls.
6. Protective relay schematics and recommended settings.

H. Testing and Certifications:

1. Approved copy of each submittal updated to reflect final installation.
2. Factory and field test reports.
3. Test certificates.
4. Recommended hydrostatic test procedures where applicable.

I. Product Data Sheets:

1. Include only data relevant to the specific installed product.
2. Clearly identify installed model and options.
3. Delete or clearly mark inapplicable information.

J. Drawings:

1. Illustrate relationship of component parts.

2. Provide control and flow diagrams.
3. Coordinate with Project Record Documents to reflect actual installation.
4. Do not use Project Record Documents as maintenance drawings.

K. Warranties and Bonds:

1. Copy of each warranty, bond, and service contract issued.
2. Written instructions describing procedures in the event of failure.
3. Statement of conditions that may void warranties or bonds.

L. Service Contacts:

1. Subcontractor name, address, and telephone number.
2. Maintenance contractor, if applicable.
3. Area of responsibility of each.
4. Local supply source for parts and replacement components.

M. Spare Parts:

1. Comprehensive spare parts list.
2. Identification of recommended on-site spare parts.

PART 3 EXECUTION

3.01 PREPARATION

- A. Review all approved submittals, shop drawings, and Project Record Documents prior to preparation of O&M Manuals.
- B. Verify that all equipment data reflects final installed conditions, including field modifications and approved substitutions.
- C. Coordinate manuals with equipment suppliers and subcontractors to ensure completeness and accuracy.

3.02 ASSEMBLY

- A. Assemble manuals in accordance with the requirements of Part 2 of this Section.
- B. Organize manuals by specification section and system.
- C. Insert tabbed dividers with clearly printed section titles.
- D. Include updated submittals and test reports reflecting final accepted conditions.
- E. Remove all superseded, voided, or inapplicable data prior to submission.

3.03 QUALITY CONTROL

- A. Contractor shall review each manual for completeness, accuracy, and legibility prior to submission.
- B. Manuals containing incomplete, illegible, or non-project-specific information will be rejected.
- C. Revise and resubmit manuals as required to obtain approval.

3.04 DELIVERY AND ACCEPTANCE

- A. Deliver approved manuals to the Engineer within the timeframes specified in Part 1.
- B. Do not schedule final startup or request Substantial Completion until O&M Manuals have been reviewed and approved.
- C. Final acceptance of the Work is contingent upon receipt of complete and approved manuals in both hard copy and electronic format.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 78 23

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for preparation of Record Documents (also known as "As-Built").

B. SYSTEM DESCRIPTION

1. Project Record Documents are a complete set of Contract Documents and Drawings prepared by Contractor from a set of Base Documents furnished by Engineer and from Field Sets of Contract Documents.
2. Field Sets of Contract Documents to be used for field construction purposes shall be maintained and annotated by the Contractor during construction to record approved changes, additions, addenda, options and deviations and pertinent field notes to Contract Documents.

1.02 RELATED SECTIONS

- A. 01 33 00 – Submittal Documents

1.03 SUBMITTALS

- A. Submit, at Substantial Completion, Project Record Documents not a Field Set of Contract Documents.

PART 2 PRODUCTS

2.01 MATERIALS.

A. BASE DOCUMENTS

1. Engineer will furnish the Contractor with one (1) set of Contract Drawings (black line prints), one set of Contract Specifications and one set of Contract Addenda to be used in preparation of Record Documents.

B. RECORD DOCUMENTS

1. Record Documents shall not be used for field construction purposes.

2. All changes, additions, addenda, options and deviations and pertinent field notes shall be clearly marked using neat, ruled lines and legible notes and dimensions as follows.
 - a. Options and deviations to Contract Documents with red ballpoint pen.
 - b. All notes, explanations, and sketches with blue ballpoint pen.
3. Maintain on project site, one (1) copy each of the following:
 - a. Contract Drawings
 - b. Bid Booklet
 - c. Interpretations and Supplemental Instructions
 - d. Addenda
 - e. Reviewed Shop Drawings
 - f. Change Orders
 - g. Other Modifications to Contract
 - h. Field Test Records
 - i. All Schedules
 - j. Correspondence File

C. FIELD SETS

1. Field Sets of Contract Documents shall be used for field construction purposes and shall be marked with information required for Project Record Documents.

D. INFORMATION TO RECORD

1. Label "PROJECT RECORD DOCUMENTS" in 2" high printed letters on each document.
2. Contract Drawings - record actual construction to include but not be limited to the following:

DIVISION 01 – GENERAL REQUIREMENTS
Section 01 78 39 – Project Record Document

- a. Depths of various elements of foundation in relation to floor level.
 - b. Horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface improvements.
 - c. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
 - d. Field changes of dimension and detail.
 - e. Changes made by Change Order.
 - f. Details not on original contract drawings.
3. Specifications and Addenda - legibly mark up each section to record:
- a. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed.
 - b. Changes made by Change Order or Field Order.
 - c. Other matters not originally specified.

PART 3 EXECUTION

3.01 MAINTENANCE

- A. Keep record documents up to date during progress of the Work by marking any and all changes, additions, addenda, options and deviations and pertinent field notes at the time the work is executed.

DIVISION 01 – GENERAL REQUIREMENTS
Section 01 78 39 – Project Record Document

- B. Indicate on Field Sets all alterations and deviations from original documents known to each Contractor's and Sub-Contractor's Superintendent on job during course of completion of project.
- C. Transfer required information to Record Documents using neat, ruled lines and legible notes and dimensions.

3.02 STORAGE

- A. Store documents in temporary field office apart from documents used for field construction.
- B. Provide files and racks for document storage.
- C. Maintain documents in clean, dry legible condition. Protect from deterioration and loss in secure, fire-resistive location.
- D. Make documents available during normal working hours for inspection by Engineer and Owner.

3.03 COMPLETION

- A. Maintain and store record documents until satisfactory completion of the Contract and submittal of record documents to the Engineer.
- B. The contract closeout and final payment under this contract will not be finalized and approved until a complete and accurate set of record documents, as described above, have been submitted to the Engineer, reviewed for accuracy, and accepted.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 78 39

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for demonstrating and training manuals prior to final handoff.

1.02 RELATED SECTIONS

- A. 01 33 00 – Section 01 43 33 – Manufacturer's Field Services
- B. 01 75 00 – Starting and Adjusting
- C. 01 75 16 – Startup Procedures
- D. 01 78 23 – Operation and Maintenance Data

1.03 SUBMITTALS

- A. For each equipment or system provided, submit approval of formal training procedure by equipment or system manufacturer or authorization of instructor by equipment or system manufacturer.
- B. Submit schedule of demonstration and training sessions.

1.04 COORDINATION

- A. Coordinate demonstration and training with Owner.
- B. Coordinate demonstration and training with equipment and system manufacturers.
- C. Coordinate demonstration and training with Startup procedures as required by Section 01 75 16 – Startup Procedures.

1.05 TRAINING

- A. Provide training as required by specification sections for individual equipment and systems and as required below for the remaining items not listed.
- B. The General Contractor shall provide training by manufacturer's authorized instructor or as approved by manufacturer for all the following systems and equipment at a date once the proposed project is complete and in operation:

DIVISION 01 – GENERAL REQUIREMENTS
Section 01 79 00– Demonstration and Training

1. SCADA/Telemetry
 - a. Pressure Transmitters
 - b. Level Indicators
 - c. Flow Meters
 - d. Etc.
 2. Valves
 3. VFDs
 4. Chemical Feeds
 5. Claricones
 6. Head Tank
 7. Recarbonation Vessel
 8. Filters and Controls
 - a. Media
 - b. Underdrains
 9. Air Scour
 10. Generator
 11. Additional Equipment not explicitly stated
- C. Provide preliminary O&M Manuals as required by Section 01 78 23 – Operation and Maintenance Data to serve as the basis for training.
- D. Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instruction.
- E. Provide training to Owner's personnel selected by Owner (not to exceed 10 persons).

1.06 DEMONSTRATION

- A. Provide demonstrations as required by specification sections for particular equipment and systems and as required below.
- B. For all equipment and systems, demonstrate compliance with the requirements of the Contract Documents, start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment to Engineer and Owner's personnel.
- C. Demonstrate operation and maintenance of Products to Owner's personnel two (2) weeks prior to date of final inspection.
- D. Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.01 MAINTENANCE

- A. Keep record documents up to date during progress of the Work by marking any and all changes, additions, addenda, options and deviations and pertinent field notes at the time the work is executed.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 01 79 00

DIVISION 02 – MAINTENANCE OF EXISTING CONDITIONS

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02 01 00	Maintenance of Existing Conditions	020100-1 – 020100-6

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Protection of existing utilities, facilities, and improvements not designated for removal.
2. Maintenance of continuous utility service.
3. Exploratory excavation and verification of existing utility locations.
4. Protection and restoration of survey markers and monuments.
5. Protection and restoration of pavements, sidewalks, curbs, gutters, and driveways.
6. Protection and replacement of trees, shrubs, lawns, and landscaped areas.
7. Coordination with utility owners, regulatory agencies, and property owners.

B. Related Requirements:

1. Division 01 – General Requirements.
2. Conditions of the Contract.
3. All applicable technical Sections affecting or affected by excavation, demolition, or site work.

1.02 GENERAL REQUIREMENTS

- A. The CONTRACTOR shall protect all existing utilities, improvements, and facilities not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than that existing prior to damage or relocation.
- B. The CONTRACTOR shall verify exact locations and depths of all utilities shown on the Drawings prior to construction. Exploratory excavations shall be performed as necessary to determine alignment and grade of utilities that may interfere with the WORK.

- C. Exploratory excavations shall be completed promptly after Notice to Proceed and sufficiently in advance of construction to avoid delays. If discrepancies are discovered, the CONTRACTOR shall immediately notify the ENGINEER.
- D. The number of exploratory excavations performed shall be sufficient to accurately determine the alignment and grade of utilities.
- E. All work shall comply with applicable federal, state, and local regulations and utility owner requirements.

1.03 RIGHTS-OF-WAY

- A. The CONTRACTOR shall not perform WORK affecting oil, gas, sewer, water pipelines, communication lines, electric transmission lines, fences, or other structures within rights-of-way until the OWNER has secured necessary permissions.
- B. After authorization is obtained, the CONTRACTOR shall notify affected utility owners as required and shall remove, shore, support, protect, or replace affected facilities as necessary.
- C. The OWNER and utility owners reserve the right to enter public rights-of-way or easements to make changes required by the WORK.

1.04 PROTECTION OF SURVEY MARKERS

- A. The CONTRACTOR shall not disturb existing survey monuments, benchmarks, or roadway markers without authorization.
- B. All markers subject to disturbance shall be properly referenced prior to construction.
- C. Survey markers disturbed by construction shall be accurately restored after completion of resurfacing or site restoration.

1.05 SUBMITTALS

- A. No submittals required.

1.06 QUALITY ASSURANCE

- A. Repairs to utilities or improvements shall be subject to inspection and approval by the utility owner or responsible agency prior to concealment.
- B. Tree trimming or removal within public rights-of-way shall be performed under permit and in accordance with jurisdictional requirements.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.01 EXISTING UTILITIES AND IMPROVEMENTS

A. General:

1. The CONTRACTOR shall protect all underground and aboveground utilities, whether shown on the Drawings or not.
2. Precautions shall be taken to prevent service interruptions.
3. Utilities encountered shall remain in service unless otherwise approved.

B. Utilities to Be Moved

1. When relocation of utility property is necessary, the OWNER will notify the utility owner upon request by the CONTRACTOR.
2. The CONTRACTOR shall coordinate relocation to avoid service interruption.
3. When utility lines that are to be moved are encountered within the area of operations, the CONTRACTOR shall notify the ENGINEER a sufficient time in advance to prevent interruption of service.

C. Utilities to be Removed:

1. When indicated or required, utilities shall be removed and temporarily replaced or relocated without unnecessary delay. in a manner satisfactory to the ENGINEER and the owner of the facility.
2. Permanent restoration by the CONTRACTOR shall return utilities to original location and condition or better.

D. Utilities Indicated:

1. Utilities indicated on the Drawings and intended to remain shall be protected.
2. Damage caused by the CONTRACTOR shall be immediately repaired at the CONTRACTOR's expense unless repaired by the owner.
3. If repaired by the owner, the CONTRACTOR shall reimburse repair costs.

E. Utilities Not Indicated:

1. Damage to unindicated utilities shall be reported immediately verbally and subsequently in writing to the ENGINEER.
2. If directed, repairs shall be performed by the CONTRACTOR.
3. Additional compensation of locating and repairing damage not due to failure of the CONTRACTOR to exercise reasonable care, if any, shall be determined by the OWNER in accordance with the General Conditions.

F. Maintaining in Service:

1. Oil, gas, water, sewer, irrigation, storm drain, electrical, and communication lines encountered during construction shall remain continuously in service unless otherwise authorized.
2. The CONTRACTOR shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

3.02 RESTORATION OF PAVEMENT

A. General:

1. All paved areas cut or damaged during construction shall be restored to match adjacent undisturbed areas in material and thickness, including sub-base, base, and surface course.
2. Pavement edges shall be neatly saw-cut in straight lines.
3. Restoration shall conform to requirements of the pavement owner or permitting agency.

B. Temporary Resurfacing:

1. Temporary surfacing shall be placed promptly after backfilling where required.
2. Temporary surfaces shall be maintained until permanent restoration is completed.

C. Permanent Resurfacing:

1. Edges shall be saw-cut to provide clean, vertical joints.

2. Final surfaces shall match adjacent grades and provide smooth transitions.

D. Restoration of Sidewalks, Driveways, Curb and Gutter:

1. Temporary sidewalks, driveways, curb, and gutter shall be installed promptly after backfilling and maintained until permanent restoration.
2. Permanent restoration shall match adjacent improvements in material, thickness, and finish unless otherwise specified.

3.03 TREES OR SHRUBS

A. General:

1. Unless designated for removal, the CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees, shrubs, or other plantings.
2. No trimming or removal shall occur without approval of the OWNER or jurisdictional agency.
3. Trees, shrubs, or other plantings which are damaged during construction shall be trimmed or replaced by the CONTRACTOR or a certified tree company under permit from the jurisdictional agency and/or the OWNER.

B. Trimming:

1. Tree symmetry shall be preserved.
2. Cuts shall be clean and close to trunk or branch; no stubs permitted.
3. Climbing spikes shall not be used on live trees.
4. Cuts over 1-1/2 inches diameter shall be treated with approved tree paint that is waterproof, adhesive, and elastic, and free from kerosene, coal tar, creosote, or other material injurious to the life of the tree.

C. Replacement:

1. Damaged trees or shrubs deemed beyond repair by the agency having jurisdiction or OWNER shall be replaced at the CONTRACTOR's expense.
2. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a smaller size, the CONTRACTOR shall pay to the owner of said

DIVISION 02 – Existing Conditions
Section 02 01 00 – Maintenance of Existing Conditions

- tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or OWNER.
3. The size of the tree or shrub shall be not less than 1-inch diameter nor less than 6 feet in height.
 4. Replacement plantings shall be in accordance with the recommendations of the nursery furnishing the plants. Unless otherwise indicated, the CONTRACTOR shall water and maintain the replacement trees and shrubs for 6 months after planting.

3.04 LAWN AREAS

- A. Damaged lawn or landscaped areas shall be restored to pre-construction condition to satisfaction of the OWNER and property owner.

3.05 NOTIFICATION

- A. The CONTRACTOR shall notify utility owners and responsible agencies not less than 3 days nor more than 7 days prior to excavation near underground facilities.
- B. Notification shall allow representatives to be present during excavation if desired.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 02 01 00

DIVISION 03 – CONCRETE

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03 30 00	Cast-in-Place Concrete	033000-1 – 033000-41

PART 1 GENERAL

1.01 SUMMARY

- A. Provide all plant, labor, tools, equipment, materials, and supervision necessary in accordance with applicable ACI standards to complete cast-in-place concrete work, including forming, reinforcing, placing, finishing, curing, jointing, testing, and repair.
- B. Concrete work includes, but is not limited to:
 - 1. Main Plant Foundation
 - 2. Office/Lab
 - 3. Lime Silo
 - 4. Ground Storage Tank
 - 5. Storage and Equipment Pads
 - 6. Clearwell
 - 7. Vehicle Parking Pavement and Driveways
 - 8. Sidewalks and Approaches
 - 9. All Remaining Concrete Items indicated on the Drawings
- C. Concrete foundations for the Pre-Engineered Metal Building and other structures shall be constructed utilizing the manufacturer's load data. Foundation drawings provided at bid are estimates only and may vary based on final manufacturer requirements. Furnish all labor, materials, and equipment necessary to meet required loads at no additional cost to the Owner.

1.02 RELATED SECTIONS

- A. Division 01 – General Conditions

1.03 REFERENCES

- A. AMERICAN CONCRETE INSTITUTE (ACI)
 - 1. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary

2. American Concrete Institute (ACI) 121R (2008) – Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
 3. ACI 301 (2020) – Specifications for Structural Concrete
 4. ACI 302.1R (2015) – Guide for Concrete Floor and Slab Construction
 5. ACI 304.2R (2017) – Guide to Placing Concrete by Pumping Methods
 6. ACI 304R (2000; R 2009) – Guide for Measuring, Mixing, Transporting, and Placing Concrete
 7. ACI 305.1 (2014) – Specification for Hot Weather Concreting
 8. ACI 305R (2020) – Guide to Hot Weather Concreting
 9. ACI 306.1 (1990; R 2002) – Standard Specification for Cold Weather Concreting
 10. ACI 306R (2016) – Guide to Cold Weather Concreting
 11. ACI SPEC 308.1 (2023) – External Curing of Cast-in-Place Concrete – Specification
 12. ACI 318 - Building Code Requirements for Reinforced Concrete.
 13. ACI 347R (2014; Errata 1 2017) – Guide to Formwork for Concrete
 14. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures.
 15. ACI MNL-2 (2019; 11th Edition) – ACI Manual of Concrete Inspection
 16. ACI MNL-15 (2020) – Field Reference Manual: Specifications for Concrete Construction
- B. AMERICAN WELDING SOCIETY (AWS)
1. American Welding Society (AWS) D1.4/D1.4M (2018; Amd 1 2020) – Structural Welding Code – Reinforcing Steel
- C. ASTM INTERNATIONAL (ASTM)
1. ASTM A36/A36M (2019) – Carbon Structural Steel
 2. ASTM A53/A53M (2024) – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

3. ASTM A184/A184M (2024) – Welded Deformed Steel Bar Mats for Concrete Reinforcement
4. ASTM A615/A615M (2025) – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
5. ASTM A706/A706M (2025) – Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
6. ASTM A767/A767M (2024) – Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
7. ASTM A775/A775M (2022) – Epoxy-Coated Steel Reinforcing Bars
8. ASTM A780/A780M (2020) – Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
9. ASTM A820/A820M (2022) – Steel Fibers for Fiber-Reinforced Concrete
10. ASTM A884/A884M (2025) – Epoxy-Coated Steel Wire and Welded Wire Reinforcement
11. ASTM A934/A934M (2022) – Epoxy-Coated Prefabricated Steel Reinforcing Bars
12. ASTM A955/A955M (2020c) – Stainless-Steel Bars for Concrete Reinforcement
13. ASTM A970/A970M (2018) – Headed Steel Bars for Concrete Reinforcement
14. ASTM A996/A996M (2016) – Rail-Steel and Axle-Steel Deformed Bars
15. ASTM A1022/A1022M (2016b) – Stainless Steel Wire and Welded Wire Reinforcement
16. ASTM A1044/A1044M (2016a; Errata 1) – Steel Stud Assemblies for Shear Reinforcement
17. ASTM A1055/A1055M (2025) – Zinc and Epoxy Dual Coated Steel Reinforcing Bars
18. ASTM A1060/A1060M (2016b) – Zinc-Coated Steel Welded Wire Reinforcement

19. ASTM A1064/A1064M (2024) – Carbon-Steel Wire and Welded Wire Reinforcement
20. ASTM A1094/A1094M (2020) – Continuous Hot-Dip Galvanized Steel Bars
21. ASTM C31/C31M (2026) – Making and Curing Concrete Test Specimens in the Field
22. ASTM C33/C33M (2024a) – Concrete Aggregates
23. ASTM C39/C39M (2024) – Compressive Strength of Cylindrical Concrete Specimens
24. ASTM C42/C42M (2020) – Obtaining and Testing Drilled Cores and Sawed Beams
- 25.
26. ASTM C78/C78M (2022) – Flexural Strength of Concrete
27. ASTM C94/C94M (2025a) – Ready-Mixed Concrete
28. ASTM C136/C136M (2025) – Sieve Analysis of Fine and Coarse Aggregates
29. ASTM C138/C138M (2024a) – Density (Unit Weight), Yield, and Air Content
30. ASTM C143/C143M (2020) – Slump of Hydraulic-Cement Concrete
31. ASTM C150/C150M (2024) – Portland Cement
32. ASTM C172/C172M (2017) – Sampling Freshly Mixed Concrete
33. ASTM C173/C173M (2024a) – Air Content by Volumetric Method
34. ASTM C231/C231M (2026) – Air Content by Pressure Method
35. ASTM C260/C260M (2024) – Air-Entraining Admixtures
36. ASTM C311/C311M (2025) – Sampling and Testing Fly Ash or Natural Pozzolans
37. ASTM C330/C330M (2017a) – Lightweight Aggregates for Structural Concrete
38. ASTM C494/C494M (2024) – Chemical Admixtures

- 39. ASTM C567/C567M (2019) – Density of Structural Lightweight Concrete
- 40. ASTM C595/C595M (2025) – Blended Hydraulic Cements
- 41. ASTM C618 (2025a) – Coal Fly Ash and Natural Pozzolan
- 42. ASTM C803/C803M (2023) – Penetration Resistance of Hardened Concrete
- 43. ASTM C845/C845M (2018) – Expansive Hydraulic Cement
- 44. ASTM C873/C873M (2015) – Compressive Strength of Cylinders Cast in Place
- 45. ASTM C900 (2015) – Pullout Strength of Hardened Concrete
- 46. ASTM C920 (2018; R 2024) – Elastomeric Joint Sealants
- 47. ASTM C989/C989M (2025) – Slag Cement
- 48. ASTM C1012/C1012M (2024) – Length Change Exposed to Sulfate Solution
- 49. ASTM C1074 (2019; E 2021) – Estimating Strength by Maturity Method
- 50. ASTM C1077 (2026) – Agencies Testing Concrete and Aggregates
- 51. ASTM C1107/C1107M (2020) – Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- 52. ASTM C1116/C1116M (2023) – Fiber-Reinforced Concrete
- 53. ASTM C1157/C1157M (2025) – Hydraulic Cement
- 54. ASTM C1218/C1218M (2020c) – Water-Soluble Chloride in Mortar and Concrete
- 55. ASTM C1240 (2020) – Silica Fume
- 56. ASTM C1260 (2023) – Alkali Reactivity of Aggregates (Mortar-Bar Method)
- 57. ASTM C1293 (2008; R 2015) – Length Change Due to Alkali-Silica Reaction
- 58. ASTM C1567 (2025) – Accelerated Mortar-Bar Method

- 59. ASTM C1602/C1602M (2022) – Mixing Water
- 60. ASTM C1611/C1611M (2021) – Slump Flow of Self-Consolidating Concrete
- 61. ASTM C1621/C1621M (2017; R 2023) – Passing Ability by J-Ring
- 62. ASTM C1758/C1758M (2023) – Fabricating Test Specimens with SCC
- 63. ASTM C1778 (2023) – Reducing Risk of Alkali-Aggregate Reaction
- 64. ASTM D412 (2016; R 2021) – Rubber Properties – Tension
- 65. ASTM D471 (2016a; R 2021) – Rubber Property – Effect of Liquids
- 66. ASTM D1751 (2018) – Preformed Expansion Joint Filler (Bituminous)
- 67. ASTM D1752 (2018) – Preformed Sponge Rubber, Cork, and PVC Expansion Joint Fillers
- 68. ASTM D2628 (2025) – Polychloroprene Elastomeric Joint Seals
- 69. ASTM D2835 (1989; R 2017) – Lubricant for Compression Seals
- 70. ASTM D3042 (2017) – Insoluble Residue in Carbonate Aggregates
- 71. ASTM D5759 (2012; R 2020) – Characterization of Coal Fly Ash
- 72. ASTM D6690 (2021) – Hot-Applied Joint and Crack Sealants
- 73. ASTM E96/E96M (2024a) – Water Vapor Transmission Rate
- 74. ASTM E329 (2025b) – Agencies Engaged in Construction Inspection
- 75. ASTM E1155 (2020) – Floor Flatness and Levelness
- 76. ASTM E1643 (2018a) – Water Vapor Retarders Under Slabs
- 77. ASTM E1745 (2017; R 2023) – Water Vapor Retarders Under Concrete Slabs
- 78. ASTM E1993/E1993M (1998; R 2020) – Bituminous Water Vapor Retarders

D. OTHER REFERENCED ORGANIZATIONS

1. Composite Panel Association (CPA) – ANSI/CPA A135.4 (2012; R2020) – Basic Hardboard
2. Concrete Reinforcing Steel Institute (CRSI) RB4.1 (2016) – Supports for Reinforcement Used in Concrete
3. CRSI SP0001-31-DL-I (2024) – Manual of Standard Practice
4. Forest Stewardship Council (FSC) STD 01 001 (2015) – Principles and Criteria for Forest Stewardship
5. National Institute of Standards and Technology (NIST) PS 1 (2009) – Structural Plywood
6. U.S. Army Corps of Engineers (USACE)
7. COE CRD-C 104 (1980) – Fineness Modulus of Aggregate
8. COE CRD-C 513 (1974) – Rubber Waterstops
9. COE CRD-C 572 (1974) – Polyvinylchloride Waterstops
10. U.S. General Services Administration (GSA) FS SS-S-200 (Rev E; Notice 1; Notice 2) – Joint Sealant for Portland Cement Concrete Pavement

1.04 DEFINITIONS

A. Cementitious Material

1. As used herein, "cementitious material" includes all portland cement, pozzolan, fly ash, slag cement, and silica fume.

B. Exposed to Public View

1. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

C. Chemical Admixtures

1. "Chemical admixtures" are materials in the form of powders or fluids that are added to concrete to impart certain characteristics not obtainable with plain concrete mixes.

D. Supplementary Cementing Materials (SCM)

1. "Supplementary cementing materials" include coal fly ash, silica fume, slag cement, natural or calcined pozzolans, and ultra-fine coal ash when used in proportions to replace portland cement in a manner that improves sustainability, durability, and reduces cost.

E. Design Strength (f'_c)

1. "Design strength" (f'_c) is the specified compressive strength of concrete at the time(s) specified in this section to meet structural design requirements.

F. Mass Concrete

1. "Mass concrete" is any concrete system that approaches a maximum temperature of 158°F within the first 72 hours of placement. It also includes all concrete elements with a section thickness of 3 feet or more, regardless of temperature.

G. Mixture Proportioning

1. "Mixture proportioning" is the process of designing concrete mixture proportions to meet strength, service life, and constructability requirements while minimizing initial and life-cycle costs.

H. Mixture Proportions

1. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic meter or cubic yard) of concrete.

I. Pozzolan

1. "Pozzolan" is a siliceous or siliceous and aluminous material that possesses little or no cementitious value on its own but, in finely divided form and in the presence of moisture, chemically reacts with calcium hydroxide at ordinary temperatures to form compounds with cementitious properties.

J. Workability (or Consistence)

1. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form or mold properly with the desired work (vibration) and without reducing concrete quality. Workability depends on water content, chemical admixtures, aggregate characteristics (shape and size distribution), cementitious content, and age (level of hydration).

1.05 SUBMITTALS

A. General

1. Submit the following in accordance with the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data

1. Submit product data for proprietary materials and items, including admixtures, waterstops, curing compounds, vapor retarders, bonding agents, epoxy adhesives, and related materials.

C. Concrete Mix Designs

1. Submit concrete mix designs a minimum of 30 days prior to placement for each class of concrete.
2. Include full material data, trial mix documentation, gradations, and strength history per ACI 301.
3. Obtain approval from the Engineer prior to placement.

D. Shop Drawings

1. Reinforcement Shop Drawings:
 - a. Submit detailing, fabricating, bending, and placing drawings in compliance with ACI 315 – Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - 1) Show bar schedules
 - 2) Stirrup spacing
 - 3) Bent bar diagrams
 - 4) Splices and laps
 - 5) Concrete cover
 - 6) Arrangement of reinforcement
 - 7) Special reinforcing required at openings

2. Formwork Shop Drawings (when required):
 - a. Include layout, joints, supports, shoring, reshoring, embedded items, and form removal schedule per ACI 347R.

E. Samples

1. Submit samples of materials as requested by the Engineer, including names, sources, and product descriptions. Samples may include:
 - a. Waterstops
 - b. Reinforcement
 - c. Supports

F. Laboratory Test Reports

1. Submit laboratory test reports for:
 - a. Concrete materials
 - b. Mix design tests
 - c. Slump
 - d. Air entrainment
 - e. Compressive Strength
2. Testing shall be performed by an approved independent laboratory meeting ASTM C1077 requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

A. General

1. Follow ACI 301, ACI 304R, and ASTM A934/A934M requirements and recommendations.
2. Do not deliver concrete until vapor retarders, vapor barriers, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement.
3. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb VOCs.

4. Do not store concrete curing compounds or sealers in occupied spaces.

B. Reinforcement

1. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

C. Epoxy Coated Reinforcing Steel

1. Record coating lot on each shipping notice and carefully identify and re-tag bar bundles from the bending plant.
2. Provide systems for handling coated bars with padded contact areas, such as nylon slings, all free of dirt and grit.
3. Lift bundled coated bars with strong back, multiple supports, or platform bridge to prevent sagging and abrasion. Pad bundling bands where in contact with bars.
4. Do not drop or drag bars or bundles. Store coated bars both in shop and field, aboveground, on wooden or padded cribbing.
5. Space dunnage close enough to prevent excessive sags. Stack large quantities of straight bars with adequate protective blocking between layers.
6. Schedule deliveries to avoid long-term storage. Protect from sunlight and weather. Cover bars stored longer than 12 hours with opaque polyethylene or equivalent protective material.

1.07 QUALITY ASSURANCE

A. Codes and Standards

1. Comply with the provisions of all applicable codes, specifications, and standards referenced in Section 1.03 of this specification, except where more stringent requirements are shown or specified.

B. Concrete Mix Design

- a. Engage a qualified independent testing laboratory to perform material evaluation tests and to design concrete mixes.
- b. Include all documentation required by ACI 301 Section 4.

- c. Provide complete list of materials, including type, brand, source, amount of cement, supplementary cementitious materials, fibers, admixtures, and applicable reference specifications.
 - d. Submit mill tests and other tests for cement, SCMs, aggregates, and admixtures.
 - e. Provide maximum nominal aggregate size, gradation analysis, percentage retained/passing sieve, and graph of % retained vs. sieve size.
 - f. Provide mix proportion data using at least three water-cementitious material ratios for each type of mixture, producing a range of strengths encompassing required values.
 - g. Resubmit if source material changes. Only use materials proven by trial mix studies to meet specification requirements unless otherwise approved.
 - h. Clearly indicate where each mix design is used when multiple designs are submitted.
 - i. Obtain Engineer approval before concrete placement.
2. Quality Control Program
- a. Develop and submit for approval Concrete Quality Control Program per ACI 121R.
 - b. Include approved laboratories and provide direct oversight for sampling/testing.
 - c. Submit all reports to Engineer, Contractor, Owners Representative, and Concrete Supplier.
 - d. Maintain Field Reference Manual, ACI MNL-15 - Specifications for Structural Concrete on site.
3. Quality Manager Qualifications
- a. Licensed professional engineer in Illinois with experience on ≥ 5 similar projects.
 - b. Evidence of extraordinary proven experience may be considered by the Engineer as sufficient to act as the Quality Manager.
4. Field Testing Technician and Testing Agency

- a. Submit qualifications for approval prior to testing.
 - b. Field Testing Technician shall hold a minimum of one of the following certifications:
 - 1) ACI Concrete Field Testing Technician - Grade I
 - 2) IDOT Portland Cement Concrete Technician - Level I
 - c. Testing agencies for reinforcing steel must meet ASTM E329.
 - d. Testing agencies for concrete materials must meet ASTM C1077.
5. Laboratory Qualifications for Concrete Testing
- a. Provide facilities for curing and protection of field specimens per ASTM C31/C31M. Laboratory shall be Illinois Department of Transportation
 - b. Submit most recent calibration certificates for testing equipment
 - c. Materials and installed work may require testing and retesting at any time during the progress of the Work. Tests, including retesting of rejected materials or installed Work, shall be performed at the Contractor's expense.

PART 2 PRODUCTS

2.01 FORM MATERIALS:

- A. General Requirements
 - 1. Form-facing material for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
 - 2. Form-facing material for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
 - 3. Design formwork, shores, reshores, and backshores to support all transmitted loads and comply with applicable building code requirements.

4. Design formwork and shoring to accommodate load redistribution resulting from post-tensioning. Formwork must allow movement caused by prestressing forces.
5. Design formwork to withstand pressure from placement and vibration of concrete and to maintain specified tolerances.
6. Design formwork to accommodate waterstops at joints as indicated.
7. Provide temporary cleanout openings where required for inspection and cleaning.
8. Design formwork joints to prevent leakage of mortar.
9. Limit deflection of facing materials for exposed concrete surfaces to:
 - a. $[1/240]$ of center-to-center spacing of supports for structural concrete.
 - b. $[1/400]$ of center-to-center spacing of supports for architectural concrete.
10. Do not use earth cuts as forms for vertical or sloping surfaces unless approved in writing by Engineer.

B. Wood Forms

1. Use lumber as specified below:
 - a. Lumber: Square edged or tongue-and-groove boards; free of raised grain, knotholes, or surface defects.
 - b. Plywood: Conforming with U. S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
 - c. Hardboard: Conforming to ANSI/CPA A135.4 for smooth form lining.

C. Steel Forms

1. Provide steel form surfaces free of irregularities, dents, sags, or surface defects.

2.02 FORMWORK ACCESSORIES

- A. Use commercially manufactured formwork accessories, including ties and hangers.
- B. Accessories shall not reduce required concrete cover over reinforcement.
- C. Form Ties
 - 1. Use removable-end or breakback type form ties that can be removed without damaging concrete surfaces.
 - 2. Where indicated, provide ties with integral water barrier plates or other positive water barriers.
 - 3. Minimum breakback distance for ferrous ties:
 - a. 1½ inches to the plane of the exposed concrete surface
 - b. Provide ties that, when removed, will leave holes not larger than ½ inch in diameter in the concrete surface.
 - 4. Where breakback distance is less than ¾ in., provide coated or corrosion-resistant ties.
 - 5. Submit manufacturer's data sheets for form ties.

2.03 REINFORCING MATERIALS

- A. Reinforcing Bars:
 - 1. ASTM A 615, Grade 60, deformed.
- B. Welded Wire Fabric:
 - 1. ASTM A 185, steel welded wire fabric, plain. ASTM A-497, steel welded wire fabric, deformed.
- C. Supports for Reinforcement:
 - 1. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.
 - a. For foundations and slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

- b. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

2.04 CONCRETE MATERIALS

A. Portland Cement:

- 1. ASTM C 150, Type I.
- 2. Use one brand of cement throughout Project unless otherwise acceptable to Engineer.

B. Fly Ash:

- 1. Shall be Class C or F.

C. Normal-Weight Aggregates:

- 1. ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.
 - a. For exposed exterior surfaces, do not use fine or coarse aggregates that contain substances that cause spalling.
 - b. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Engineer.

D. Water:

- 1. Potable.

E. Admixtures, General:

- 1. Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

F. Air-Entraining Admixture:

- 1. ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

- a. Air-Mix or Perma-Air, Euclid Chemical Co.
 - b. Darex AEA or Daravair, W. R. Grace & Co.
 - c. MB-VR or Micro-Air, Master Builders, Inc.
 - d. Sika AER, Sika Corp.
 - 3. Use air-entraining admixture in all concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1 percent of 5 percent.
- G. Reducing Admixture:
- 1. ASTM C 494, Type A.
 - 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Eucon WR-75, Euclid Chemical Co.
 - b. WRDA, W. R. Grace & Co.
 - c. Pozzolith Normal or Polyheed, Master Builders, Inc.
 - d. Plastocrete 161, Sika Corp.
 - 3. Use water-reducing admixture concrete, as required, for placement and workability.
- H. Water-Reducing, Accelerating Admixture:
- 1. ASTM C 494, Type E.
 - 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Accelguard 80, Euclid Chemical Co.
 - b. Daraset, W. R. Grade & Co.
 - c. Pozzutec 20, Master Builders, Inc.

3. Use admixtures for water reduction and set accelerating in strict compliance with manufacturer's directions.

I. Water-Reducing, Retarding Admixture:

1. ASTM C 494, Type D.
2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Eucon Retarder 75, Euclid Chemical Co.
 - b. Daratard-17, W. R. Grade & Co.
 - c. Pozzolith R, Master Builders, Inc.
 - d. Plastiment, Sika Corporation
3. Use admixtures for water reduction and retarding in strict compliance with manufacturer's directions.

2.05 PROPORTIONING AND DESIGNING MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.
 1. Do not use the same testing agency for field quality control testing.
 2. Limit use of fly ash to not exceed 25 percent of cement content by weight.
- B. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Engineer.
- C. Design mixes to provide normal weight concrete with the following properties as indicated on drawings and schedules:
 1. Compressive strength:
 - a. 4000-psi, 28-day
 2. Water-Cement ratio:

- a. 0.57 maximum (non-air-entrained),
 - b. 0.48 maximum (air-entrained).
3. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:
- a. Pavements and slabs: Not more than 3 inches.
 - b. Reinforced foundation walls and footings: Not more than 3 inches.
 - c. Plain footings and substructure walls: Not more than 3 inches.
 - d. Other concrete: Not more than 4 inches.

Note: The slump values shown are for mechanical vibration methods of consolidation. For hand consolidation methods, increase the slump values shown by 1 inch.

4. Air Content:
- a. 4% - 6%

D. Concrete Mixing:

- 1. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.
 - a. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1½ hours to 75 minutes, and when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

E. Adjustment to Concrete Mixes:

- 1. Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer.
- 2. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in Work.

2.06 RELATED MATERIALS

A. Waterstops:

1. Provide dumbbell-type or labyrinth-type waterstops at construction joints and other joints as indicated.
- B. Polyvinyl Chloride Waterstops:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
 - a. The Burke Co.
 - b. Greenstreak Plastic Products Co.
 - c. W. R. Meadows, Inc.
 - d. Progress Unlimited.
 - e. Schlegel Corp.
 - f. Vinylex Corp.
- C. Vapor Retarder:
1. Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:
 - a. Polyethylene sheet not less than 6 mils thick.
 - b. Water-resistant barrier consisting of heavy kraft papers laminated together with glass-fiber reinforcement and overcoated with black polyethylene on each side.
 - 1) Product: Subject to compliance with requirements, provide Moistop by Fortifiber Corporation.
- D. Absorptive Cover:
1. Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- E. Moisture-Retaining Cover:
1. One of the following, complying with ASTM C 171.
 - a. Waterproof paper.

- b. Polyethylene film.
- c. Polyethylene-coated burlap.

F. Liquid Membrane-Forming Curing Compound:

- 1. Liquid-type membrane-forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kg/sq. meter when applied at 200 sq. ft./gal.
- 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Sealco 309, Cormix Construction Chemicals.
 - b. Day-Chem Cure and Seal, Dayton Superior Corp.
 - c. Eucocure, Euclid Chemical Co.
 - d. Masterkure, Master Builders, Inc.

G. Evaporation Control:

- 1. Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
- 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Eucobar, Eudlic Chemical Co.
 - b. E-Con, L&M Construction Chemicals, Inc.
 - c. Confilm, Master Builders, Inc.
 - d. Waterhold, Metalcrete Industries.

H. Bonding Agent:

- 1. Polyvinyl acetate or acrylic base.
- 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

- a. Polyvinyl Acetate (Interior Only):
 - 1) Superior Concrete Bonder, Dayton Superior Corp.
 - 2) Euco Weld, Euclid Chemical Co.
 - 3) Weld-Crete, Larsen Products Corp.
 - 4) Everweld, L&M Construction Chemicals, Inc.
 - b. Acrylic or Styrene Butadiene:
 - 1) SBR Latex, Euclid Chemical Co.
 - 2) Daraweld C, W. R. Grace & Co.
 - 3) Acryl-Set, Master Builders Inc.
 - 4) Intralok, W. R. Meadows, Inc.
- I. Epoxy Adhesive:
- 1. ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.
 - 2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
 - a. Euco Epoxy System #452 or #620, Euclid Chemical Co.
 - b. Concreative Standard Luquid, Master Builders, Inc.
 - c. Sikadur 32 Hi-Mod, Sika Corp.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly constructed; verify that substrates are level.
- B. If substrate preparation is the responsibility of another installer, notify OWNERS REPRESENTATIVE of unsatisfactory preparation before processing.

- C. CONTRACTOR shall check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, or a conflict between plans exists, notify ENGINEER and wait for instructions before beginning installation. Additional payment for corrections to concrete due to conflicts in plans will not be allowable after concrete is placed.

3.02 PREPARATION

A. General

1. Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.
2. Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

B. Subgrade Under Foundations and Footings

1. When subgrade material is semi-porous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited, or seal subgrade surface by covering surface with specified vapor retarder.
2. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor retarder.

C. Subgrade Under Slabs on Ground

1. Before construction of slabs on ground, ensure underground work on pipes and conduits have been completed and approved.
2. Clean previously constructed subgrade or fill of foreign materials.
3. Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.
4. Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

D. Edge Forms and Screed Strips for Slabs

1. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface, strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment.

2. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

E. Reinforcement and Other Embedded Items

1. Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.
2. When concrete is placed, reinforcement must be free of materials deleterious to bond. Reinforcement with rust, mill scale, or a combination of both will be considered satisfactory, provided minimum nominal dimensions, nominal weight, and minimum average height of deformations of a hand-wire-brushed test specimen are not less than applicable ASTM specification requirements.

3.03 FORMS

A. General

1. Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads.
2. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:
 - a. Provide Class A tolerances for concrete surfaces exposed to view.
 - b. Provide Class C tolerances for other concrete surfaces.
3. Provide forms, shoring, bracing, scaffolding, and anchorage necessary for safe and proper concrete placement. Set forms mortar-tight and true to line and grade.
4. Provide positive means of adjustment (such as wedges or jacks) for shores and struts. Do not adjust formwork after concrete has reached initial set. Secure wedges in place after final adjustment and prior to concrete placement. Brace and anchor formwork to resist lateral deflection, instability, and uplift.

B. Form Construction

1. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures.
2. Construct formwork so concrete surfaces conform to tolerances in ACI 117.
3. Provide for openings, offsets, keyways, recesses, moldings, chamfers, blocking, anchorages, inserts, and other features required in the Work. Use selected materials to obtain required finishes.
4. Position and secure sleeves, inserts, anchors, and other embedded items such that embedded items are positioned within ACI 117 tolerances.
5. Solidly butt joints and provide backup at joints to prevent cement paste leakage. Design form joints to inhibit mortar leakage.
6. At construction joints, lap form-facing materials over previously placed concrete. Set formwork firmly against hardened concrete so offsets conform to specified tolerances.
7. To maintain specified elevation and thickness within tolerances, install formwork to compensate for deflection and anticipated settlement in formwork during concrete placement. Set formwork and intermediate screed strips for slabs to produce designated elevation, camber, and contour of finished surface before formwork removal. If specified finish requires use of vibrating screeds or roller pipe screeds, ensure that edge forms and screed strips are strong enough to support such equipment.
8. Construct formwork for openings to facilitate removal and to produce opening dimensions within specified tolerances.
9. Do not use earth cuts as forms for vertical or sloping surfaces.

C. Removal Considerations and Special Forming Requirements

1. General Requirements
 - a. Design, fabricate, and erect formwork to permit safe and orderly removal without damaging concrete surfaces or structural elements. Construct forms for easy removal without hammering, prying, or other actions that could mar, crack, or otherwise impair finished concrete surfaces.
 - b. Provide crush plates, wrecking plates, or other protective devices at locations where stripping operations could damage cast concrete surfaces.

- c. Kerf wood inserts used to form keyways, reglets, recesses, and similar features to facilitate clean and easy removal without spalling or surface damage.
- d. Provide top forms for inclined concrete surfaces where slopes are too steep to permit proper concrete placement using bottom forms only. Remove such forms in accordance with the requirements herein.
- e. Maintain curing and protection of concrete in accordance with specification requirements whenever forms are removed prior to completion of the specified curing period.

2. Removal of Non-Load-Bearing Formwork

- a. Formwork not supporting the weight of concrete, including sides of beams, walls, columns, and similar vertical elements, may be removed when:
 - 1) Concrete has cured cumulatively for at least 24 hours at a temperature not less than 50°F (10°C);
 - 2) Concrete is sufficiently hard to resist damage from form-removal operations; and
 - 3) Removal will not impair required surface finish or structural performance.
- b. Where vertical formed surfaces are specified to receive finishing, remove forms as soon as removal operations will not damage concrete, to permit timely completion of finishing work.
- c. Remove vertical formwork for columns, walls, and sides of beams without damaging concrete surfaces. Promptly perform required repairs and finishing.
- d. Continue curing and protection measures after form removal if the specified curing period has not been completed.

3. Removal of Forms on Sloping Surfaces

- a. Remove top forms on sloping surfaces as soon as removal will not cause concrete to sag or deform.
- b. Perform all required repairs and finishing immediately following removal.

- c. If removal occurs before the end of the specified curing period, implement and maintain required curing and protection measures.

4. Removal of Load-Bearing Formwork and Shoring

- a. Formwork and shoring supporting the weight of concrete, including beam soffits, joists, slabs, and other structural elements, shall remain in place until:
 - 1) Concrete has attained at least 75 percent of the specified 28-day design compressive strength; and
 - 2) A minimum of 14 days has elapsed after placement, unless otherwise approved based on strength test results.
- b. Determine in-place compressive strength by testing field-cured specimens representative of the concrete location or structural member.
- c. Leave formwork and shoring in place to support construction loads and the self-weight of concrete in beams, slabs, and other structural members until required in-place strength has been achieved.
- d. Form-facing materials and horizontal facing support members may be removed prior to the concrete reaching specified compressive strength, provided:
 - 1) Shores and other vertical supports remain in place;
 - 2) Supports are designed and arranged to permit removal of form-facing material without deflection or disturbance of the supported slab or structural member; and
 - 3) Removal does not loosen, shift, or otherwise impair shores or supporting members.
- e. Form-facing material may be removed not less than 4 days after concrete placement only when shoring and supports are properly arranged to allow such removal without affecting structural stability.

5. Protection and Repairs

- a. Do not damage concrete during form or shore removal operations.

- b. Promptly repair surface defects, honeycombing, or other damage resulting from form removal in accordance with specified concrete repair procedures.
 - c. Ensure that removal operations do not induce excessive deflection, cracking, or overstressing of structural members.
- D. Clean-Outs, Inspection, and Temporary Openings
 - 1. Provide temporary openings for clean-outs and inspection where interior areas of formwork are inaccessible before and during concrete placement.
 - 2. Securely brace temporary openings and fit tightly to prevent loss of mortar. Locate temporary openings in inconspicuous locations where possible.
 - 3. Inspect formwork and remove foreign materials before placing concrete.
- E. Chamfers and Exposed Edges
 - 1. Chamfer exposed joints, edges, and external corners of concrete above grade 3/4 inch, unless otherwise indicated.
 - 2. Install chamfer strips of wood, metal, PVC, or rubber to produce uniform smooth lines and tight edge joints.
 - 3. Do not bevel reentrant corners or edges of formed joints unless specifically indicated.
- F. Provisions for Other Trades
 - 1. Provide openings in concrete formwork to accommodate work of other trades.
 - 2. Determine size and location of openings, recesses, chases, sleeves, inserts, anchor slots, expansion joint materials, waterstops, and embedded items from trades providing such items.
 - 3. Accurately position and securely support embedded items to prevent displacement during concrete placement.
 - 4. Temporarily fill voids in sleeves, inserts, and anchor slots with removable material to prevent entry of concrete.
- G. Runways and Construction Loads

1. Provide runways for moving equipment as required.
2. Support runways directly on formwork or structural members. Do not support runways on reinforcing steel.
3. Ensure construction loads imposed by runways do not exceed the capacity of formwork or supporting structural members.

H. Cleaning and Tightening

1. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, debris, mortar, grout, and other foreign materials immediately prior to placement.
2. Clean surfaces of embedded materials prior to placement.
3. Retighten forms and bracing before placing concrete as required to prevent mortar leakage and maintain proper alignment.

3.04 EPOXY COATED REINFORCING

A. Splicing

1. Splice reinforcement as indicated in the Plans and Specifications. For splices not indicated follow ACI 301.
2. Do not splice at points of maximum stress.
3. Overlap welded wire reinforcement the spacing of the cross wires 2 inches.
4. Repair the cut ends of hot-dipped galvanized reinforcement steel to completely coat exposed steel.

B. Placing Reinforcement

1. Place reinforcement in accordance with ACI 301.
2. For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire reinforcement on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.
3. For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted

may be precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

4. Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:
 - a. Provide supports for reinforcing bars that are sufficient in number and have sufficient strength to carry the reinforcement they support, and in accordance with ACI 301 and CRSI SP0001-31-DL-I. Do not use supports to support runways for concrete conveying equipment and similar construction loads.
 - b. Equip supports on ground and similar surfaces with sand-plates.
 - c. Support welded wire reinforcement as required for reinforcing bars.
 - d. Secure reinforcements to supports by means of tie wire. Provide black, soft iron wire, not less than 1.6 mm 16 gage.
 - e. Accurately place reinforcement, securely tie at intersections, and hold in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to the Plans and Specifications.
 - f. Bending of reinforcing bars partially embedded in concrete is permitted only as specified in the Plans and Specifications.

C. Spacing of Reinforcing

1. As indicated in the Plans and Specifications.
2. Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to preapproval by the Engineer.

3.05 PLACING CONCRETE

A. General

1. Place concrete in accordance with ACI 301 Section 5.

B. Footing Placement

1. Concrete for footings may be placed in excavations without forms upon inspection and approval by the Engineer. Excavation width must be a minimum of 4 inches greater than indicated.

C. Pumping

1. ACI 304R and ACI 304.2R. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments.
2. Loss of slump in pumping equipment must not exceed 2 inches at discharge/placement.
3. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes.
4. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well-rounded aggregate to 40 percent of the pipe diameter.
5. Take samples for testing at both the point of delivery to the pump and at the discharge end.

D. Cold Weather

1. Meet the requirements of ACI 306.1 unless otherwise specified.
2. Do not allow concrete temperature to decrease below 50 degrees F.
3. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours.
4. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing.
5. Limit the rate of cooling to 5 degrees F in any one hour and 18 degrees F per 24 hours after heat application.

E. Hot Weather

1. Meet the requirements of ACI 305.1 unless otherwise specified.

2. Maintain required concrete temperature using Appendix A in ACI 305.1 to prevent the evaporation rate from exceeding 1 kg per square meter 0.2 pound of water per square foot of exposed concrete per hour.
3. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete.
4. Shade the fresh concrete as soon as possible after placing.
5. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage.
6. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period.
7. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets.
8. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.06 Quality Control Testing During Construction:

- A. General: The Owner will employ a concrete testing firm to perform tests and to submit test reports.
- B. Sampling and testing for quality control during concrete placement may include the following, as directed by Engineer:
 1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.
 - a. Slump: ASTM C 143; one test at point of discharge for each day's pour of each type of concrete; additional tests when concrete consistency seems to have changed or if the first test reveals an unacceptable slump.
 - b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each day's pour of each type of air-entrained concrete.
 - c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below, when 80 deg F and above, and one test for each set of compressive-strength specimens.

- d. Compression Test Specimen: ASTM C 31; one set of five standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.
 - e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. plus additional sets for each 50 cu. yd. more than the first 50 cu. yd. of each concrete class placed in any one day; one specimen tested at 7 days, one specimen tested at 14 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
 - 2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
 - 3. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
 - 4. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
 - 5. Failure of a specimen to reach the specified strength in the prescribed time shall require the removal of all concrete previously poured corresponding to the failed test in a timely manner and recast to prevent unnecessary delays in the construction schedule at no additional cost to the owner.
- C. Test results will be reported in writing to the Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for 7-day, 14-day, and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.
- E. Concrete Coring:

1. The testing agency may make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure only upon written authorization of the ENGINEER.
2. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.
3. All costs associated with coring, testing, patching, traffic control, and restoration of finishes shall be borne by the CONTRACTOR at no additional cost to the OWNER.

F. Cast-in-Place Testing Requirements:

W2E Water Treatment Plant Cast-in-Place Testing Requirements Summary							
Samples	Frequency	28-Day Strength	Water-Cement Ratio		Slump		Air
			Air Entrained	Non-Air Entrained	Slabs, Found., Footings, Walls	Other	
5 Cylinders per set	1 set if greater than 5 CY	4000 psi @ 28 days	0.48 Max	0.57 Max	≤ 3 inches	≤ 4 inches	4% - 6%
	1 set every additional 50 CY						

Note: The slump values shown are for mechanical vibration methods of consolidation. For hand consolidation methods, increase the slump values shown by 1 inch.

3.07 FIELD SAMPLE PROTECTION

A. General

1. The CONTRACTOR shall be solely responsible for the protection, handling, curing, security, and condition of all cast-in-place concrete field samples from the time of sampling until final acceptance by the testing laboratory.
2. Field samples shall be obtained, molded, cured, stored, protected, and transported in strict accordance with the latest editions of the following:
 - a. ASTM International C172/C172M – Sampling Freshly Mixed Concrete
 - b. ASTM International C31/C31M – Making and Curing Concrete Test Specimens in the Field

- c. ASTM International C39/C39M – Compressive Strength of Cylindrical Concrete Specimens
 - d. American Concrete Institute 301 – Specifications for Structural Concrete
3. Failure to properly protect samples shall be cause for rejection of test results and may require additional testing at the CONTRACTOR'S expense.

B. Sample Handling and Identification

- 1. Samples shall be molded immediately after obtaining concrete in accordance with ASTM C172.
- 2. Protect specimens from vibration, disturbance, contamination, and moisture loss immediately after molding.
- 3. Clearly and permanently label each specimen with:
 - a. Project name
 - b. Date and time of placement
 - c. Concrete mix designation
 - d. Pour location
 - e. Specimen identification number

C. Initial Curing (First 24–48 Hours)

- 1. Store specimens in a secure, protected curing enclosure immediately after molding.
- 2. Maintain curing temperature between 60°F and 80°F unless otherwise permitted by ASTM C31.
- 3. Prevent direct sunlight exposure, freezing, overheating, and rapid temperature fluctuation.
- 4. Maintain moisture conditions to prevent drying of specimens.
- 5. Provide insulated curing boxes, temperature monitoring devices, and protective coverings as required to maintain compliance.

D. Protection and Security

1. Maintain samples in a location protected from:
 - a. Construction traffic
 - b. Impact or vibration
 - c. Weather exposure
 - d. Unauthorized access
2. Restrict access to testing personnel and authorized quality control staff.
3. Maintain custody and security of specimens until released to the testing laboratory.

E. Transportation

1. After completion of initial curing, transport specimens to the testing laboratory in accordance with ASTM C31.
2. Protect specimens during transport from physical damage and temperature extremes.
3. Maintain documentation of transfer and delivery.

F. Nonconformance

1. Specimens damaged, disturbed, improperly cured, or otherwise compromised due to CONTRACTOR negligence shall be rejected.
2. When samples are deemed invalid, the CONTRACTOR shall bear the cost of additional testing, including but not limited to additional cylinders, coring of in-place concrete, laboratory testing, and associated corrective measures.

3.08 REPAIR, REHABILITATION AND REMOVAL

A. Inspection and Defect Documentation

1. Pre-Acceptance Inspection:
 - a. Prior to final acceptance of the structure, perform a comprehensive inspection to identify cracks, surface defects, damage, and substandard concrete placements that may adversely affect strength, durability, watertightness, or service life.

2. Defect Report:

- a. Prepare and submit a written report to the Engineer documenting observed deficiencies. Include:
 - 1) Location and description of each defect.
 - 2) Measured crack widths and depths, where applicable.
 - 3) Photographic documentation.
 - 4) Evaluation of potential structural or durability impact.
 - 5) Detailed recommendations for repair, rehabilitation, mitigation, or removal and replacement.
- b. No corrective work shall begin until the proposed methods and materials are reviewed and approved by the Engineer.

B. Crack Evaluation and Repair

1. General:

- a. Evaluate all cracks to determine cause, extent, and anticipated movement due to temperature variation, shrinkage, settlement, and structural loading.

2. Repair Requirements:

- a. Document and repair all cracks exceeding 0.50 mm (0.02 inch) in width prior to final acceptance. Submit proposed repair materials and procedures for approval, including consideration of anticipated crack movement.

3. Repair Methods:

- a. Select repair techniques appropriate to crack characteristics and structural function, which may include epoxy injection, routing and sealing, flexible sealants, or other approved methods. Ensure repairs restore durability, watertightness, and structural performance as required.

C. Repair of Weak or Defective Surfaces

1. Definition of Weak Surfaces:

- a. Weak surfaces include mortar-rich layers, rain-damaged concrete, improperly cured surfaces, laitance, exposed voids, honeycombing, rock pockets, or areas containing deleterious materials.
 - 2. Surface Removal Criteria:
 - a. Weak surfaces less than 1/4 inch thick: Remove by diamond grinding to sound concrete.
 - b. Weak surfaces greater than 1/4 inch thick: Remove and replace concrete or mitigate using an approved repair method.
 - 3. All repairs shall restore durability and intended service life.
- D. Quality Assurance Test Failures
- 1. When quality assurance test results fail to meet specified acceptance criteria, immediately investigate production, batching, delivery, and placement procedures to identify the source of nonconformance.
 - 2. Submit proposed mitigation measures to the Engineer for approval prior to implementation.
 - 3. Removal and replacement of hardened concrete shall be considered a last resort and required only when engineering evaluation determines that structural capacity, durability, or serviceability cannot be achieved through approved corrective measures.
- E. Concrete Surface Repairs
- 1. General
 - a. Perform repairs promptly after form removal when practical.
 - b. Use materials compatible with the original concrete in composition, strength, color, and durability.
 - c. Cure repaired areas in the same manner as adjacent concrete.
 - 2. Patching of Defective Areas
 - a. Dry-Pack Mortar:
 - 1) Use dry-pack mortar consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16

sieve. Add only sufficient water to permit placement and compaction.

b. Preparation:

- 1) Cut out honeycombs, rock pockets, voids exceeding 1/4 inch in any dimension, and holes left by tie rods and bolts to sound concrete, but not less than 1 inch deep.
- 2) Make edges perpendicular to the concrete surface.
- 3) Clean thoroughly, dampen with water, and apply approved bonding agent.
- 4) Place patching mortar before bonding agent dries.

c. Placement and Finishing:

- 1) Compact mortar firmly in place.
- 2) Strike off slightly higher than surrounding surface and finish to match adjacent concrete.
- 3) For exposed surfaces, blend white and gray Portland cement as necessary to achieve color match. Provide test patches in inconspicuous areas for approval prior to proceeding.

3. Repair of Formed Surfaces

- a. Repair or replace concrete with surface defects including cracks, spalls, air bubbles, honeycombing, fins, projections, discoloration, stains, or texture irregularities that cannot be removed by cleaning.
- b. Flush form tie holes and fill with dry-pack mortar or precast cement cone plugs secured with bonding agent.
- c. Repair concealed formed surfaces where defects impair durability. If satisfactory repair is not feasible, remove and replace affected concrete.

4. Repair of Unformed Surfaces

- a. Testing and Tolerances:

- 1) Verify smoothness and surface tolerances for slabs and other unformed surfaces.
- 2) Check sloped surfaces for proper drainage using templates set to required slope.
- b. Surface Defects Requiring Repair:
 - 1) Cracking and cracks exceeding 0.01 inch in width, penetrating to reinforcement, or extending completely through sections.
 - 2) Spalls, popouts, honeycombs, rock pockets, and other durability-impacting defects.
- c. Corrections:
 - 1) Grind high areas after at least 14 days of curing.
 - 2) Correct low areas during or immediately after finishing by cutting out and replacing with patching mortar. Proprietary underlayments may be used when approved.
 - 3) Remove and replace defective areas (except isolated random cracks and single holes not exceeding 1 inch diameter) with fresh concrete.
- d. Concrete Replacement Procedures:
 - 1) Make clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance around bars.
 - 2) Dampen substrate and apply bonding agent.
 - 3) Use patching concrete of same type or class as original concrete.
 - 4) Place, consolidate, finish, and cure to match adjacent concrete.
5. Removal and Replacement
 - a. Remove and replace concrete when defects cannot be repaired to restore required structural capacity, durability, appearance, or watertightness.

- b. Removal shall extend to sound concrete with clean, straight edges.
- c. Replacement concrete shall meet all specified requirements for strength, durability, finish, and curing.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 03 30 00

DIVISION 05 – METALS

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PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Furnishing all labor, materials, equipment, tools, supervision, and services necessary to fabricate, finish, deliver, and install miscellaneous metal items as indicated on the Drawings and as specified herein.
- B. Work Included:
 - 1. Pipe handrails.
 - 2. Steel bollards (guard posts).
- C. Provide all anchors, fasteners, embeds, concrete infill, coatings, and incidentals required for a complete and functional installation.

1.02 RELATED SECTIONS

- A. Conditions of the Contract and Division 01 – General Requirements, which apply to the Work of this Section.
- B. Section 03 30 00 – Cast-in-Place Concrete (for concrete fill and footings).
- C. Section 09 90 00 – Painting and Coating

1.03 REFERENCES

- A. ASTM International ASTM A653/A653M – Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM International ASTM A780 – Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- C. ASTM International ASTM A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- D. American Welding Society AWS D1.1 – Structural Welding Code – Steel.
- E. Occupational Safety and Health Administration OSHA 29 CFR 1910 – Walking-Working Surfaces (for handrail requirements).

1.04 SUBMITTALS

- A. Submit in accordance with Division 01 requirements.
- B. Shop Drawings:
 - 1. Submit shop drawings in PDF format to the Engineer prior to fabrication and delivery. Include:
 - 2. Layout, dimensions, elevations, and locations.
 - 3. Connection details and anchorage.
 - 4. Embedment depth and footing details for bollards.
 - 5. Finishes and coating systems.
- C. Product Data:
 - 1. Submit manufacturer's product data for pipe, coatings, anchors, and related components.
- D. Certificates:
 - 1. Submit certification that materials comply with referenced ASTM standards upon request.

1.05 QUALITY ASSURANCE

- A. Fabricator shall have a minimum of five (5) years experience in fabrication of similar miscellaneous metal products.
- B. Welding shall be performed by qualified welders in accordance with AWS D1.1.
- C. Field measurements shall be verified prior to fabrication.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in a manner that prevents damage.
- B. Store off the ground and protect from corrosion and contamination.
- C. Replace damaged materials prior to installation.

PART 2 PRODUCTS

2.01 MATERIALS – GENERAL

- A. Steel Pipe: ASTM A53, Schedule 40 unless otherwise indicated.
- B. Concrete Fill: 3,000 psi minimum compressive strength at 28 days.
- C. Anchors and Fasteners: Galvanized or corrosion-resistant type suitable for substrate and exposure.
- D. Coatings:
 - 1. Shop primer where applicable.
 - 2. Field-applied paint system as specified or as indicated on the Drawings.
 - 3. Repair damaged galvanized surfaces in accordance with ASTM A780.

2.02 PIPE HANDRAILS

- A. Fabricate handrails from ASTM A53 steel pipe, Schedule 40, unless otherwise indicated.
- B. Handrail height shall comply with OSHA 29 CFR 1910 (nominal 42 inches above walking surface unless otherwise indicated).
- C. Provide posts, top rails, mid-rails (where required), and fittings necessary for a complete guard system.
- D. Fabricate joints with smooth transitions and grind exposed welds smooth.
- E. Finish:
 - 1. Shop prime and field paint unless otherwise indicated; or
 - 2. Galvanize where indicated on the Drawings.

2.03 BOLLARDS

- A. Provide steel guard posts at locations indicated on the Drawings.
- B. Bollard Construction:
 - 1. 6-inch diameter steel pipe, ASTM A53, Schedule 40.
 - 2. Post length: 8 feet 0 inches.
 - 3. Embedment: 3 feet 0 inches below finished floor or grade.

4. Exposed height: 5 feet 0 inches unless otherwise indicated.
 5. Fill interior of pipe solid with 3,000 psi concrete.
- C. Footing:
1. Set bollards plumb in concrete footing sized as indicated on the Drawings or minimum 18 inches diameter unless otherwise directed.
 2. Crown top of footing to shed water.
- D. Finish:
1. Paint entire exposed area after installation.
 2. Surface preparation and painting shall be in accordance with manufacturer's instructions and Division 09 requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify substrates and site conditions are suitable for installation.
- B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install miscellaneous metals in accordance with approved shop drawings and applicable standards.
- B. Set items plumb, level, and true to line.
- C. Provide secure anchorage capable of withstanding imposed loads.
- D. Install bollards plumb and at proper embedment depth.
- E. After installation, clean surfaces and touch up damaged coatings.

3.03 FIELD QUALITY CONTROL

- A. Inspect installed items for alignment, proper anchorage, and finish quality.
- B. Repair or replace defective or damaged work prior to Substantial Completion.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL REMAINING ITEMS RELATED TO CONTRACT 1 OF W2E WATER TREATMENT PLANT NOT COVERED UNDER OTHER BID ITEMS OR CONTRACTS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 05 50 00

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Requirements for selection, fabrication, and installation of fixed, walk-through metal ladders.
 - 2. Wall-mounted fixed ladders with walk-through grab rails.
 - 3. Ladder mounting brackets and accessories required for complete installation.

1.02 RELATED SECTIONS

- A. Section 01 25 00 – Substitution Procedures.
- B. Section 01 33 00 – Submittal Procedures.
- C. Section 01 62 00 – Product Requirements.

1.03 REFERENCES

- A. Occupational Safety and Health Administration – 29 CFR 1910.23, Fixed Ladders.
- B. Occupational Safety and Health Administration – 29 CFR 1910.29, Fall Protection Systems and Falling Object Protection.
- C. American National Standards Institute – ANSI A14.3, Ladders – Fixed – Safety Requirements.

1.04 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data:
 - 1. Manufacturer's current technical data sheets for each product specified, including:
 - a. Preparation instructions and recommendations.
 - b. Storage and handling requirements and recommendations.
 - c. Detailed installation instructions.

- d. Material specifications and structural capacities.
- C. Shop Drawings:
 - 1. Provide detailed shop drawings including:
 - a. Plan, section, elevation, and perspective views as necessary.
 - b. Dimensions, ladder height and width.
 - c. Mounting details, anchorage, and connection methods.
 - d. Walk-through rail extensions and top landing interface.
 - e. Base and wall bracket attachment details.
 - f. Coordination with wall construction and penetration flashing where applicable.
- D. Warranty Documentation:
 - 1. Submit manufacturer's standard five (5) year limited warranty at project closeout.

1.05 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Comply with the most current adopted edition of the following standards, except where more stringent requirements are indicated:
 - a. Occupational Safety and Health Administration – 29 CFR 1910.23, Fixed Ladders.
 - b. Occupational Safety and Health Administration – 29 CFR 1910.29, Fall Protection Systems and Falling Object Protection.
 - c. American National Standards Institute – ANSI A14.3, Ladders – Fixed – Safety Requirements.
- B. Where conflicts occur, the most stringent requirement shall govern.

C. Manufacturer Qualifications:

1. Primary ladder products shall be supplied by a single manufacturer with a minimum of ten (10) years documented experience in manufacturing fixed access ladder systems of similar type and scope.

D. Installer Qualifications:

1. Installation shall be performed by a single installer with a minimum of five (5) years documented experience installing fixed ladder systems comparable in material and complexity to those specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened packaging with labels intact.
- B. Store materials off the ground on a hard, level surface.
- C. Protect from moisture, corrosion, physical damage, and contamination.
- D. Replace damaged materials prior to installation.

1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer.
- B. Do not install ladders under environmental conditions outside manufacturer's recommended limits.
- C. Do not proceed with installation until supporting substrates are structurally sound and ready to receive work.

1.08 WARRANTY

- A. Provide manufacturer's standard five (5) year limited warranty against defects in materials and workmanship.
- B. Warranty shall commence at Date of Substantial Completion.
- C. Warranty shall outline terms, conditions, and exclusions.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, acceptable manufacturers include:
 - 1. Fixfast USA
 - 2. Global Industries
 - 3. Ballymore Safety Products
- B. Requests for substitutions shall be submitted in accordance with Section 01 25 00 – Substitution Procedures.

2.02 FIXED ACCESS LADDERS

- A. General Requirements
 - 1. Standard fixed, wall-mounted walk-through ladder with extended grab rails.
 - 2. Factory-fabricated modular ladder system.
- B. Material
 - 1. High tensile 6106-T6 aluminum.
 - 2. Mill finish.
- C. Dimensions
 - 1. Ladder Height: Top rung shall be within normal step height to walking surface.
 - 2. Ladder Width: 23-1/2 inches nominal.
 - 3. Walk-Through Clear Width: 24 inches minimum.
 - 4. Grab rails shall extend a minimum of 42 inches above the top of the elevated walking surface.
- D. Structural Capacity
 - 1. Ladder assembly shall support a minimum concentrated load of 1,000 pounds without failure.
 - 2. Individual rungs shall withstand a minimum 1,000-pound concentrated load without failure.

3. Deflection shall not exceed limits permitted by governing OSHA and ANSI standards.

E. Performance Standards

1. Units shall be designed and manufactured to meet or exceed OSHA 29 CFR 1910.23 requirements.
2. Fabrication tolerances shall comply with ANSI A14.3.

F. Mounting

1. Off-floor mounted ladder configuration.
2. Heavy-duty wall fixing brackets designed for wall-mounted installations only.
3. Anchors and fasteners shall be corrosion-resistant and compatible with substrate.
4. Provide isolation where dissimilar metals occur.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify substrates and conditions are suitable for installation.
- B. Do not begin installation until unsatisfactory conditions have been corrected.
- C. If substrate preparation is the responsibility of others, notify Engineer in writing of deficiencies before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare substrates in accordance with manufacturer's written recommendations to achieve optimum performance under project conditions.

3.03 INSTALLATION

- A. Install ladders in accordance with:
 1. Manufacturer's written instructions.
 2. Approved submittals and shop drawings.

- 3. Applicable OSHA and ANSI requirements.
- B. Install plumb, level, and securely anchored.
- C. Coordinate installation with adjacent construction to maintain required clearances and access.
- D. Field modifications shall be minimized and performed in accordance with manufacturer's recommendations.

3.04 PROTECTION

- A. Protect installed products from damage until Substantial Completion.
- B. Repair, replace, or refinish damaged components prior to Substantial Completion.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL REMAINING ITEMS RELATED TO CONTRACT 1 OF W2E WATER TREATMENT PLANT NOT COVERED UNDER OTHER BID ITEMS OR CONTRACTS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 05 51 33

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Design, fabrication, galvanizing, delivery, and installation of galvanized metal catwalk (filter walkway) system.
2. Structural framing, grating, supports, railings, kick plates, and accessories.
3. Connection to clarifier walkways.
4. All anchorage, fasteners, and incidental components required for a complete and functional system.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 62 00 – Product Requirements.
- C. Section 03 30 00 – Cast-in-Place Concrete (for embedded anchors).

1.03 REFERENCES

- A. American Society of Civil Engineers (ASCE)
 1. ASCE 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- B. American Institute of Steel Construction (AISC)
 1. Steel Construction Manual.
 2. Specification for Structural Steel Buildings.
- C. ASTM International (ASTM)
 1. ASTM A36 – Carbon Structural Steel.
 2. ASTM A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 3. ASTM A123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

4. ASTM A307 – Carbon Steel Bolts and Studs.
 5. ASTM F3125 – High Strength Structural Bolts (including Grade A325).
 6. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing.
 7. ASTM A501 – Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 8. ASTM A572 – High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 9. ASTM A653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated.
 10. ASTM A780 – Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 11. ASTM A992 – Steel for Structural Shapes.
 12. ASTM A1011/A1011M – Steel, Sheet and Strip, Hot-Rolled.
- D. Research Council on Structural Connections (RCSC)
1. Specification for Structural Joints Using ASTM A325 or A490 Bolts.
- E. American Welding Society (AWS)
1. AWS D1.1 – Structural Welding Code – Steel.
- F. Occupational Safety and Health Administration (OSHA)
1. 29 CFR 1910 – Walking-Working Surfaces.

1.04 GENERAL REQUIREMENTS

- A. Contractor
1. Provide all plant, labor, tools, materials, equipment, and supervision necessary to completely furnish and install the fixed filter catwalk system as indicated on the Drawings.
 2. Extend catwalk system to a point connecting to clarifier walkways.

3. Field verify dimensions and coordinate elevations and connection details with clarifier walkway prior to fabrication.
4. Provide complete structural system capable of supporting design loads in accordance with referenced standards.

B. SUBMITTALS

1. General:
 - a. Submit in accordance with Section 01 33 00 – Submittal Procedures.
2. Product Data:
 - a. Manufacturer's data sheets including preparation, storage, handling, installation instructions, and structural properties.
3. Shop Drawings:
 - a. Plans, sections, elevations, and details.
 - b. Member sizes and spacing.
 - c. Grating layout and attachment details.
 - d. Guardrail and toe board details.
 - e. Anchorage and embedment details.
 - f. Coordination details at interface with Contract 1 work.
4. Structural Calculations:
5. Signed and sealed by a Professional Engineer licensed in the Project state.
- 6.
7. Warranty Documentation:
8. Submit executed five-year limited warranty at project closeout.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
1. Minimum ten (10) years documented experience in fabrication of galvanized steel walkway systems.
- B. Installer Qualifications:

1. Minimum five (5) years documented experience installing structural steel walkway systems of similar type and scope.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store materials off the ground on blocking or pallets.
- B. Protect from standing water, corrosion, and physical damage.
- C. Replace damaged materials prior to installation.

1.07 PROJECT CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's recommended limits.
- B. Verify supporting construction is complete and capable of supporting imposed loads.

1.08 GUARANTEE

- A. Provide manufacturer's five (5) year standard limited warranty against defects in materials and workmanship.
- B. Warranty shall begin at Date of Substantial Completion.

PART 2 PRODUCTS

2.01 DESIGN CRITERIA

- A. Design in accordance with ASCE 7 and AISC Steel Construction Manual.
- B. Minimum live load: 100 psf unless otherwise indicated.
- C. Guardrail and concentrated loads shall comply with OSHA 29 CFR 1910.

2.02 MATERIALS

- A. Structural shapes: ASTM A36, A572, or A992.
- B. Structural tubing: ASTM A500 or A501.
- C. Pipe railing: ASTM A53, Grade B.
- D. Steel sheet/plate: ASTM A36 or A1011.
- E. Grating: Galvanized steel bar grating to match Contract 1.

- F. Bolts: ASTM A307 or ASTM F3125 Grade A325 as indicated.

2.03 GALVANIZING

- A. Hot-dip galvanize all steel and hardware in accordance with ASTM A123.
- B. Minimum coating thickness: 0.005 inches.
- C. Complete all welding, cutting, and drilling prior to galvanizing.
- D. Perform touch-up in accordance with ASTM A780.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify substrates are properly prepared and capable of supporting imposed loads.
- B. Notify Engineer of deficiencies before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare substrates per manufacturer's written recommendations.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved submittals.
- B. Maintain professional appearance with uniform spacing, plumb and level installation.
- C. Secure grating to prevent movement.
- D. Coordinate connection to clarifier walkways.
- E. Ensure compliance with OSHA 29 CFR 1910 requirements.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products prior to Substantial Completion.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL REMAINING ITEMS RELATED TO CONTRACT 1 OF W2E WATER TREATMENT PLANT NOT COVERED UNDER OTHER BID ITEMS OR CONTRACTS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 05 51 36

DIVISION 09 – FINISHES

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PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Under this Section, the CONTRACTOR shall furnish all labor, materials, equipment, supervision, and incidentals necessary to provide complete high-performance coating systems as specified herein.
2. Work includes surface preparation, shop priming, field coating, inspection, testing, touch-up, protection of adjacent surfaces, and all appurtenances.
3. All exposed piping, valves, equipment, structural steel, tanks, and miscellaneous metal surfaces shall be coated whether specifically listed or not. Surfaces not listed shall be coated as directed by the ENGINEER.
4. Coating systems are intended for water and wastewater treatment facilities and shall provide long service life, corrosion resistance, and chemical resistance appropriate for the service environment.

1.02 RELATED SECTIONS

- A. Division 40 – Process Interconnections.
- B. Division 46 – Water and Wastewater Equipment.
- C. Section 01 25 00 – Substitution Procedures

1.03 REFERENCES

- A. SSPC Surface Preparation Standards, including SSPC-SP 10 (Near-White Metal Blast Cleaning).
- B. NAPF 500-03-04 and 500-03-05 for ductile iron preparation.
- C. AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants.
- D. NSF/ANSI 61 – Drinking Water System Components.
- E. Recommended Standards for Water Works (Ten State Standards), Great Lakes Upper Mississippi River Board.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data sheets and Safety Data Sheets for each coating product proposed.
- B. Coating Schedule: Submit a detailed schedule identifying:
 - 1. Items to be coated.
 - 2. Surface preparation methods.
 - 3. Primer, intermediate, and finish coats.
 - 4. Manufacturer and product name.
 - 5. Minimum and maximum dry film thickness (DFT) per coat and total system DFT.
- C. Color Samples: Submit three (3) sets of color chips for ENGINEER approval.
- D. Inspection Reports: Submit DFT measurements and holiday test results for immersed systems.

1.05 QUALITY ASSURANCE

- A. Pre-Coating Conference: Prior to commencement of field coating, conduct a pre-coating conference attended by the CONTRACTOR, coating subcontractor, ENGINEER, OWNER, and coating manufacturer's technical representative.
- B. Manufacturer's Technical Services: Provide manufacturer's representative for review of surface preparation and application procedures when requested.
- C. Manufacturer shall have a minimum of ten (10) years documented experience producing high-performance industrial protective coatings for water and wastewater facilities.
- D. Applicator shall be experienced in application of specified coating systems and, when requested, shall provide documentation of similar completed projects.

1.06 PERMITS AND UTILITIES

- A. The CONTRACTOR shall provide temporary ventilation, containment, lighting, and power necessary for proper surface preparation and coating application.
- B. The CONTRACTOR shall comply with all federal, state, and local environmental regulations regarding handling, storage, and disposal of coating materials and blasting debris.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original, unopened containers bearing manufacturer's label indicating:
 - 1. Manufacturer name.
 - 2. Product designation.
 - 3. Batch number.
 - 4. Color.
 - 5. Mixing and application instructions.
- B. Store in accordance with manufacturer's written instructions.
- C. Protect from freezing and temperatures exceeding manufacturer's recommendations.
- D. Do not use materials beyond shelf life.

1.08 ENVIRONMENTAL CONDITIONS

- A. Do not apply coatings to wet or damp surfaces.
- B. Do not apply coatings when ambient or substrate temperature is below 55°F unless permitted by ENGINEER and manufacturer.
- C. Maintain substrate temperature minimum 5°F above dew point.
- D. Provide ventilation and environmental controls as required.

1.09 GUARANTEE

- A. The CONTRACTOR shall guarantee all coating work against defects in materials and workmanship for a period of one (1) year from date of Substantial Completion.
- B. Coatings exhibiting peeling, blistering, delamination, excessive rusting, or failure due to improper application within the warranty period shall be repaired at no cost to the OWNER.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design Manufacturers:

1. Tnemec Company, Inc.
2. Sherwin-Williams

B. Substitutions:

1. No substitutions will be considered unless written request is received at least fifteen (15) days prior to bid in accordance with Section 01 25 00 – Substitution Procedures.
2. Submit complete technical and performance data.
3. Burden of proof rests with proposer.
4. ENGINEER/OWNER decision is final.

2.02 SHOP PAINTING

- A. Definition: Shop painting is application of coating in plant after fabrication and prior to shipment.
- B. All machinery, metal, pipe, and millwork shall receive minimum one (1) shop primer coat unless otherwise approved.
1. Stainless steel, copper, and galvanized metals shall not require painting.
- C. Shop coating shall be identified on shop drawings.
- D. Ductile iron pipe not buried shall receive rust-inhibitive primer; tar dipping not permitted.
- E. Valve interiors shall receive manufacturer's standard epoxy conforming to AWWA C550 and certified to NSF/ANSI 61.

2.03 FIELD PAINTING

- A. Definition: Field painting includes touch-up and complete field-applied systems after erection.
- B. Shop and field coatings shall be compatible.
- C. Damaged shop coatings shall be repaired per manufacturer's instructions.

2.04 COATING SYSTEMS

PAINT SYSTEMS

System	# of Coats	Point of Application	Total Dry Product			
			Tnemec	Total Dry Mil Thickness	Sherwin-Williams	Total Dry Mil Thickness
A	1	Shop	Series N69 HB Epoxoline II	3.0-5.0	Macropoxy 646	4.0-6.0
	1	Field	Series N69 HB Epoxoline II	4.0-6.0	Macropoxy 646	4.0-6.0
B	1	Shop	Series N69 HB Epoxoline II	3.0-5.0	Macropoxy 646	4.0-6.0
	1	Field	Series N69 HB Epoxoline II	4.0-6.0	Macropoxy 646	4.0-6.0
C	1	Shop	Series 91 H ₂ O Hydro-Zinc	2.5-3.5	Galvapak 1k Zinc Primer	2.5-3.5
	1	Field	Series 21 Epoxoline	12.0-14.0	Sherplate 600	8.0-16.0
D	1	Shop	Series 91 H ₂ O Hydro-Zinc	2.5-3.5	Galvapak 1k Zinc Primer	2.5-3.5
	1	Field	Series N69 HB Epoxoline Series 1094 Endura-Shield	4.0-6.0	Macropoxy 646	4.0-6.0
E	1	Shop	Series 91 H ₂ O Hydro-Zinc or Series 1 Omnithane	2.5-3.5	Galvapak 1k Zinc Primer	2.5-3.5
	1	Field	Series N69 HB Epoxoline	4.0-6.0	Macropoxy 646	4.0-6.0

PAINT LIST

Item	System	Color
Piping and Valves – Exterior Surface (Raw or Recycle)	A	Olive Green
Piping and Valves – Exterior Surface (Finished or Potable)	A	Blue
Piping and Valves – Exterior Surface (Settled or Clarified)	A	Aqua
Piping and Valves – Exterior Surface (Backwash Waste)	A	Light Brown
Piping and Valves – Exterior Surface (Sludge)	A	Dark Brown
Pumps (Raw)	B	Olive Green
Pumps (Transfer, Backwash and Distribution)	B	Blue
Head Tank, Claricone, Recarb Vessel and Filters (Submerged or Interior)	C	White
Head Tank, Claricone, Recarb Vessel and Filters (Non-submerged)	A	Blue
Ground Storage Tank, Additional UV Exposed Steel	D	TBD by Owner
Structural Steel	E	White

Notes:

- The color shown on the Paint List indicated the finish coat color. Prime coats shall be contrasting to finish coat color.

2. Use Series 1 Omnithane (Tnemec) or Marcopoxy 646 (SW) primer for purlins and others steel too thin to abrasive blast.
3. All areas where shop prime is damaged shall be sand blasted as specified and painted.

2.05 COLOR

- A. Finish coating colors to meet color requirements of the Recommended Standards for Water Works "Ten State Standards" by the Great Lakes Upper Mississippi River Board of State Public Health & Environmental Managers.
- B. Undercoats shall be tinted slightly to insure coverage of subsequent coats.
- C. It is the intent that the finish coat be gloss or semi-gloss.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

- A. Steel Surfaces:
 1. Abrasive blast in accordance with SSPC-SP 10.
 2. Achieve 1.5 mil surface profile.
- B. Ductile Iron:
 1. Prepare per NAPF 500-03-04 and 500-03-05.
- C. Remove oil, grease, dirt, mill scale, rust, and foreign matter.
- D. Damaged shop primer areas shall be re-blasted and reprimed.

3.02 APPLICATION

- A. Apply coatings in strict accordance with manufacturer's written instructions.
- B. Apply specified number of coats to achieve required DFT.
- C. If required DFT is not achieved, apply additional coats at no additional cost.
- D. Brush or roller applications may require additional coats.
- E. Areas inaccessible after erection shall be coated prior to installation.

3.03 COLD WEATHER

- A. During cold weather (less than 55°F), the CONTRACTOR shall comply with the paint manufacturer's recommendations as to the minimum temperature at which paint may be applied and shall not apply paint below that temperature without the express permission of the ENGINEER.

3.04 COATING THICKNESS

- A. Measure DFT using calibrated magnetic gauge.
- B. DFT listed is exclusive per layer (primer separate from finish).
- C. Provide inspection reports.

3.05 SPECIAL SURFACES

- A. Stainless steel, galvanized, aluminum, PVC, and fiberglass shall not be painted unless noted.

3.06 OVERSPRAY PROTECTION

- A. Protect adjacent surfaces.
- B. In sensitive areas, apply by brush or roller.

3.07 TOUCH-UP MATERIALS

- A. Provide one (1) gallon of touch-up paint for each color used.

3.08 REPAIR AND ACCEPTANCE

- A. Repair holidays, pinholes, runs, sags, and deficient thickness.
- B. Immersed coatings may require holiday testing at 100 volts per mil unless otherwise specified.
- C. Final acceptance subject to ENGINEER approval.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 09 96 00

DIVISION 22 – PLUMBING

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PART 1 GENERAL

1.01 SUMMARY

- A. Furnish and install stainless steel flexible flanged and reducing flanged pump connectors for plumbing piping systems as specified herein and as indicated on the Drawings.
- B. Provide connectors to isolate piping systems from noise and vibration transmission generated by pumps and rotating equipment.
- C. Provide pump connectors for each pump rated 1 horsepower (hp) and larger.
- D. Provide flexible connectors on all piping connected to equipment rated 5 hp and larger and where shown on equipment of lower horsepower.
- E. Work includes materials, accessories, and installation required for a complete vibration isolation system.

1.02 RELATED SECTIONS

- A. Section 01 33 23 – Shop Drawings, Product Data, and Samples.

1.03 REFERENCES

- A. ASME B31.9 – Building Services Piping.
- B. NSF 61 – Drinking Water System Components – Health Effects.
- C. MSS SP-44 – Steel Pipeline Flanges.
- D. ANSI B16.5 – Pipe Flanges and Flanged Fittings.

1.04 PERFORMANCE REQUIREMENTS

- A. Connectors shall be suitable for system working pressure and temperature of the piping system in which installed.
- B. Flexible connectors shall absorb vibration, accommodate minor axial, lateral, and angular movements, and prevent transmission of noise to building structure.
- C. Connectors shall not be used to compensate for piping misalignment.
- D. Connectors shall be certified to NSF 61.

1.05 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 01 33 23.
- B. Submittals shall include:
 - 1. Manufacturer's catalog data.
 - 2. Pressure and temperature ratings.
 - 3. Materials of construction.
 - 4. Dimensions and movement capabilities.
 - 5. NSF 61 certification documentation.
- C. Provide certification that materials comply with specified standards.

1.06 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of five (5) years' experience manufacturing stainless steel flexible connectors for plumbing applications.
- B. Products shall be factory tested for pressure integrity prior to shipment.

1.07 WARRANTY

- A. Provide a minimum one (1) year full warranty from date of acceptance by the Owner against defects in materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Metraflex Company.
- B. Engineer-approved equal meeting all specified performance and material requirements.
- C. Substitutions shall comply with Division 01 requirements and must demonstrate full compliance with this specification.

2.02 FLEXIBLE FLANGED CONNECTORS

- A. General Construction:

1. Flexible connectors shall consist of a single or multiple-ply corrugated stainless steel inner hose with external stainless steel braid reinforcement.

2. Assemblies shall be factory-fabricated and tested.

B. Materials:

1. Inner Corrugated Hose: Type 316 stainless steel.
2. Outer Braid: Type 304 stainless steel.
3. End Connections: Carbon steel or plate steel flanges drilled to ANSI B16.5 bolt pattern unless otherwise indicated.
4. Gaskets and bolting: Suitable for system pressure and service conditions.

C. Configuration:

1. Flanged flexible connectors.
2. Reducing flanged flexible connectors where indicated.
3. Length as recommended by manufacturer for pump isolation service.

D. Ratings:

1. Pressure rating shall be suitable for not less than system design pressure.
2. Temperature rating shall meet or exceed system operating temperature.

E. Potable Water Compliance:

1. All materials in contact with potable water shall comply with NSF 61.

2.03 ACCESSORIES

- A. Provide control rods where recommended by manufacturer for pressure thrust restraint.
- B. Provide flange gaskets compatible with piping system and service.
- C. Provide necessary bolts, nuts, and washers for installation unless specified under related piping sections.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install flexible connectors in accordance with manufacturer's written recommendations and instructions.
- B. Do not use flexible connectors to align pump connections with piping.
- C. Install connectors with minimal initial misalignment, offset, or deflection.
- D. Provide adequate pipe supports adjacent to connectors to prevent undue strain.
- E. Install connectors at pumps so that connectors are located between pump and isolation valve unless otherwise indicated.
- F. Ensure piping is properly aligned and anchored before tightening flange bolts.

3.02 FIELD QUALITY CONTROL

- A. Inspect connectors for shipping damage prior to installation.
- B. Replace any connector showing visible deformation, braid damage, or corrosion.
- C. Test piping system in accordance with general plumbing requirements; repair or replace connectors found to leak.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for PAY ITEM - PROVIDE AND INSTALL ALL PROCESS PIPING, VALVES, FITTINGS AND RELATED APPURTANANCES related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 22 05 48

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish, install, test, and place into operation complete factory-assembled packaged submersible grinder pump station(s), including:
 - 1. Duplex submersible grinder pumps
 - 2. Fiberglass or polyethylene basin assembly
 - 3. Internal discharge piping and check valves
 - 4. Guide rail system and movable fittings
 - 5. Level controls
 - 6. Alarm/control panel
 - 7. Installation of force main and connection to existing manhole
 - 8. All accessories and appurtenances required for a complete and operable system
- B. Equipment shall be furnished as a complete package from a single manufacturer.

1.02 RELATED SECTIONS

- A. Conditions of the Contract and Division 01 – General Requirements.
- B. Section 33 05 05 – Buried Pipe Installation.
- C. Section 33 05 19 – Ductile Iron Pipe.
- D. Section 33 05 31 – Thermoplastic Utility Pipe.

1.03 REFERENCES

- A. Hydraulic Institute Standards (HI)
- B. American Society for Testing Materials (ASTM)
- C. ASTM A48/A48M – 03 Standard Specification for Gray Iron Castings
- D. ASTM A470 Standard Specification for Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts

- E. American Iron and Steel Institute (AISI)
- F. Insulated Cable Engineers Association (ICEA)
- G. American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI)
- H. B16.1 Gray Iron Pipe Flanges and Flanged Fittings
- I. National Electrical Manufacturers Association (NEMA)
- J. Institute of Electrical and Electronics Engineers (IEEE)
- K. National Electric Code (NEC)
- L. American Bearing Manufacturers Association (ABMA)
- M. American Society for Testing and Materials International (ASTM)

1.04 SUBMITTALS

- A. Shop Drawings and Product Data
 - 1. Pump performance curves
 - 2. Motor data
 - 3. Basin details and dimensions
 - 4. Alarm/control panel wiring diagrams
 - 5. Guide rail and discharge assembly details
- B. Certified Factory Test Data
- C. Operation and Maintenance Manuals
- D. Warranty Documentation

1.05 QUALITY ASSURANCE

- A. Manufacturer shall have minimum five (5) years experience producing similar packaged systems.
- B. Pumps shall be factory performance tested.
- C. Electrical panels shall be UL listed.

- D. Manufacturer's representative shall provide startup and training.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. List the special storage and handling requirements for the products specified, including location and environmental conditions to protect from damage.
- B. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.
- C. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the unit and equipment are ready for operation.

1.07 GUARANTEE

- A. Minimum one (1) year from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Approved Manufacturers:
 - 1. Crane Pumps and Systems
 - a. Barnes RAZOR ZOGP Duplex Grinder Pump Station:
 - 2. Pumpman/Flo-Systems, Inc.
 - a. E-One WH472-92 Duplex Grinder Pump Station
 - 3. Engineer Approved Equal

2.02 SYSTEM DESCRIPTION

- A. Factory-assembled duplex grinder pump station consisting of:
 - 1. 92-inch deep wet well basin
 - 2. Two (2) submersible grinder pumps
 - 3. Internal discharge piping and check valves
 - 4. Level control system

5. Duplex alarm/control panel
6. Guide rail and removable pump assembly

2.03 BASIN ASSEMBLY

A. Basin Construction

1. Rotationally molded polyethylene (WH472) or fiberglass reinforced polyester resin.
2. Minimum 476 gallon capacity.
3. Rated for 3,500 GPD service.
4. Designed to withstand saturated soil loading of 120 pcf with 1.5 safety factor.
5. Maximum temperature rating: 150°F.
6. Ballast support flange (fiberglass units) extending minimum 3 inches on radius to prevent flotation.
7. Concrete ballast provided where required per manufacturer installation instructions.

B. Dimensions

1. Nominal Depth: 92 inches
2. Invert Depth: 57.8 inches
3. Inlet: 4-inch DWV pipe with EPDM grommet
4. Discharge: 1-1/2-inch NPT stainless steel female

C. Cover

1. HDPE or fiberglass reinforced cover.
2. Rated minimum 150 psf load.
3. Integral 2-inch bug-proof vent with bronze screen.
4. Lockable access.

2.04 PUMP DESIGN

A. General

1. Semi-positive displacement grinder type (WH472) or recessed vortex centrifugal grinder (Barnes).
2. Designed to reduce domestic sewage solids to fine slurry.
3. Continuous liquid temperature: 104°F.
4. Capable of dry operation without damage (where applicable per manufacturer).

B. Performance (WH472)

1. 15 gpm at 0 psig
2. 11 gpm at 40 psig
3. 7.8 gpm at 80 psig

C. Motor (WH472)

1. 1 HP – 2 HP
2. 1,725 RPM - 3450 RPM
3. 120/240V, 1 Phase, 60 Hz
4. Capacitor start
5. Thermally protected

2.05 PUMP MATERIALS

- A. Volute: ASTM A48 Class 30 Cast Iron (or equivalent per manufacturer)
- B. Impeller: 8-5-5-5 Bronze or proprietary positive displacement rotor
- C. Cutter and cutter plate: 440C Stainless Steel, hardened minimum Rockwell C55
- D. Shaft: 416 Stainless Steel
- E. Mechanical seal: Silicon carbide faces
- F. Bearings: Oil lubricated ball bearings

- G. Hardware: 300 Series Stainless Steel

2.06 DISCHARGE AND VALVING

- A. 1-1/4 inch stainless steel discharge piping.
- B. Integral anti-siphon check valve (Noryl or cast iron housing with nitrile flapper).
- C. Stainless steel C-channel guide rail system (duplex configuration includes two rails).
- D. True union PVC full-port ball valves, 150 psi rated.

2.07 LEVEL CONTROLS

- A. Environmentally sealed pressure switches (ESPS-200 Duplex or equivalent).
- B. CPVC housing with Buna-N diaphragm.
- C. Three-switch configuration:
 - 1. Pump 1 On/Off
 - 2. Pump 2 On
 - 3. High Water Alarm
- D. Thermal protection with auto-reset cutout.
- E. 18/5 SOW cable.

2.08 ALARM AND CONTROL PANEL

- A. Basis of Design
 - 1. Sentry Protect Plus Duplex Alarm Panel.
- B. Enclosure
 - 1. NEMA 4X thermoplastic or fiberglass enclosure.
 - 2. Corrosion resistant.
 - 3. Padlockable safety front.
- C. Electrical Features

1. 120/240 VAC service.
2. Individual pump circuit breakers.
3. IEC rated motor contactors.
4. Pump alternator.
5. Overload protection.
6. Manual run feature.
7. Run indicator lights.
8. Audible alarm (90 dB minimum) with silence pushbutton.
9. High water alarm light.
10. Predictive status display module (Protect Plus).
11. Hour meter and cycle counter.
12. Dry contacts for remote monitoring.
13. Brownout, over-pressure, and run-dry protection shutdown.

2.09 ACCESSORIES

- A. Stainless steel lifting cables or 1/2-inch polypropylene rope (3,780 lb breaking strength).
- B. Direct burial power/alarm cable, UL listed Type TC, THHN/THWN.
- C. Stainless steel hardware.
- D. Flexible inlet coupling (4-inch PVC Sch 40).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and applicable codes.
- B. Excavate and prepare subgrade in accordance with Section 33 05 05.

- C. Provide concrete ballast where required to prevent flotation.
- D. Set basin plumb and level.
- E. Connect inlet piping with flexible coupling.
- F. Install discharge piping with required check valve and curb stop.
- G. Install control panel in location shown on drawings.
- H. Provide all power and control wiring between pumps and panel, including direct burial cable.
- I. Provide grounding in accordance with NEC.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's representative shall:
 - 1. Inspect installation
 - 2. Megger motor leads
 - 3. Verify rotation
 - 4. Verify voltage and amperage
 - 5. Test level controls
 - 6. Cycle pumps individually and in parallel
 - 7. Verify alarm operation
- B. Perform minimum 30-minute operational test.
- C. Provide written certification of proper installation.

3.03 START-UP AND TRAINING

- A. Provide minimum one (1) day on-site startup assistance.
- B. Train Owner's personnel in operation and maintenance.

3.04 CLEANING AND PROTECTION

- A. Clean equipment.

B. Protect from damage until final acceptance.

PART 4 PAYMENT

4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item DOMESTIC WASTE LIFT STATION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 22 13 33

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

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PART 1 GENERAL

1.01 SUMMARY

- A. Furnish and install factory-assembled, constant-volume desiccant dehumidification air handling systems as shown on the Drawings and as specified herein.
- B. Units shall be complete with pre-cooling, post-cooling (if scheduled), desiccant rotor dehumidification section, reactivation heating section, filtration, supply and reactivation fans, electrical control panel, programmable logic controller (PLC), and all required accessories for a complete and functional system.
- C. Units shall be designed for continuous outdoor installation unless otherwise indicated.
- D. System connected utility requirements shall not exceed scheduled values.
- E. Work includes all equipment, materials, labor, controls, appurtenances, and accessories required for a complete and operational system.

1.02 RELATED SECTIONS

- A. See Conditions of the Contract and Division 1 – General Requirements, which contains information and requirements that apply to the work specified herein and are mandatory for this project.

1.03 REFERENCES

- A. ARI 410 – Forced-Circulation Air-Cooling and Air-Heating Coils
- B. ASHRAE 52.2 – Method of Testing General Ventilation Air-Cleaning Devices
- C. ASHRAE Climatic Design Conditions
- D. AMCA Certified Ratings Program
- E. ASTM C518 – Steady-State Thermal Transmission Properties
- F. ASTM C209 – Water Absorption of Core Materials
- G. ASTM E84 – Surface Burning Characteristics of Building Materials
- H. ANSI S2.19 / ISO 1940 – Mechanical Vibration Balance Quality
- I. UL 900 – Air Filter Units

- J. UL 508A – Industrial Control Panels
- K. National Electrical Code (NEC)
- L. ISO 9001-2008 – Quality Management Systems

1.04 SUBMITTALS

A. Product Data

1. Submit one (1) digital copy of project-specific documentation including:
 - a. Dimensioned plan and elevation drawings showing service clearances.
 - b. System weight including all mounted components.
 - c. Electrical schematic wiring diagrams.
 - d. Utility requirements and field connection points.
 - e. Gas piping schematic (if applicable).
 - f. Refrigeration piping schematic (if applicable).
 - g. Process flow diagram showing psychrometric performance before and after each component (SCFM, °F, gr/lb).
 - h. Certified desiccant rotor performance data.
 - i. Certified fan performance curves including sound power and vibration ratings.
 - j. Certified coil performance ratings and pressure test documentation.
 - k. Filter performance data.
 - l. Damper and louver performance data.
 - m. Static pressure calculations.
 - n. Sequence of operation.
 - o. Structural support requirements.

- p. Independent ASTM E84 flame spread test report for desiccant wheel.
- q. Certification that desiccant wheel contains no fibers smaller than 5 microns.
- r. Certification of NEC compliance.
- s. Certification of UL 508A panel compliance.
- t. Manufacturer's written Performance Guarantee.

B. Operating and Maintenance Manuals

- 1. Provide digital O&M manuals including:
 - a. Installation instructions.
 - b. Start-up procedures and checklist.
 - c. Sequence of operation.
 - d. Troubleshooting guide.
 - e. Recommended maintenance schedule.
 - f. Spare parts list.
 - g. MSDS for desiccant wheel.
 - h. 24-hour service contact information.
 - i. Manufacturer data for major components.

1.05 QUALITY ASSURANCE

- A. Manufacturer shall have minimum five (5) years documented experience producing desiccant dehumidification systems of similar type and capacity.
- B. Manufacturer shall maintain ISO 9001-2008 certification or provide equivalent documented quality assurance procedures with independent audit verification.
- C. Units shall be factory assembled and tested prior to shipment.
- D. Control panel shall be UL 508A listed and labeled.
- E. Wiring shall comply with NEC.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver units fully shrink-wrapped on factory-installed skids.
- B. Inspect upon arrival for shipping damage.
- C. Store in clean, dry location protected from weather and construction traffic.
- D. Handle carefully to prevent damage to casing, components, and finish.

1.07 GUARANTEE

- A. Performance Guarantee
 - 1. Manufacturer shall provide written certification that system performance will meet or exceed scheduled values without exceeding scheduled utility requirements.
- B. Equipment Warranty
 - 1. Parts warranty: Eighteen (18) months from shipment or twelve (12) months from startup, whichever occurs first.
 - 2. Manufacturer shall provide replacement parts and labor at no cost for defects within warranty period.
- C. Factory Start-Up
 - 1. Start-up shall be performed by factory-trained and employed technician.
 - 2. Technician shall verify installation, assist with commissioning, adjust system, and provide on-site training.
 - 3. Provide written start-up report.
 - 4. Start-up labor warranty: Ninety (90) days from substantial completion.
- D. Long-Term Support
 - 1. Manufacturer shall provide minimum fifteen (15) years support after shipment.
 - 2. Spare parts shall remain available for full support period.
 - 3. 24/7 emergency technical support required.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

- A. Basis of Design: Smart Dehumidifiers Model #SCP-75
 - 1. Desiccant Air Solutions (636.448.1226)
- B. Acceptable manufacturers shall have equivalent experience, certifications, and documented performance meeting this specification.

2.02 GENERAL CONSTRUCTION

- A. Unit shall be factory assembled unless shipping constraints require multiple sections.
- B. Provide welded independent structural steel base minimum 6 inches high with lifting lugs. Aluminum base rails are not acceptable.
- C. Casing:
 - 1. Double-wall galvanized steel, aluminum, or stainless steel.
 - 2. Minimum 0.125-inch thickness.
 - 3. Fully welded construction; screw-dependent aluminum construction not acceptable.
 - 4. Marine-grade UV-resistant exterior finish unless full stainless construction.
- D. Insulation:
 - 1. Minimum 2-inch thick.
 - 2. Minimum R-6.5 per inch.
 - 3. Water absorption $\leq 0.3\%$.
 - 4. Operating range -100°F to 250°F.
- E. Access Doors:
 - 1. Hinged, gasketed, labeled.
 - 2. Quick-release fasteners for filters.

3. Airtight and vapor-tight construction.

F. Outdoor Protection:

1. Weather-tight casing and penetrations.
2. AMCA-certified louvers with bird screens.
3. Weather hoods with inlet velocity $\leq$ 650 fpm.

2.03 DESICCANT WHEEL

A. Media:

1. Monolithic silica gel rotor.
2. Inert inorganic binders and glass fibers.
3. Fibers larger than 5 microns.
4. Flame spread index = 0; Smoke developed index = 10 per ASTM E84.
5. Hydrothermally stabilized silica gel.

B. Support and Drive:

1. Single-piece removable rotor.
2. Dual 200,000-hour sealed bearings.
3. Removable central shaft.
4. Full-face silicone or viton seals.
5. Differential pressure transmitters with HMI display.

2.04 REACTIVATION HEAT SOURCE

A. Electric Reactivation (if scheduled)

1. Open element heaters.
2. Solid-state proportional control.
3. NEC compliant.

B. Direct-Fired Gas (if scheduled)

1. Modulating gas valve (4:1 turndown minimum).
2. Cast iron manifold and stainless mixing plates.
3. Complete gas train with redundant valves.
4. Airflow proving switch.
5. Manual-reset high limit.
6. Ignition lockout safety.
7. Proportional temperature control.

2.05 FILTERS

- A. UL 900 listed.
- B. Process and reactivation filters:
 1. MERV 8.
 2. 2-inch pleated disposable.
 3. Reactivation filters rated to 500°F.
 4. Dirty filter pressure monitoring with HMI display.

2.06 FANS AND MOTORS

- A. Provide scheduled airflow and static pressure.
- B. Fans:
 1. SWSI centrifugal.
 2. Forward curve or backward inclined as scheduled.
 3. Balanced to G6.3 per ANSI/ISO standards.
 4. Coated steel construction; no uncoated steel allowed.
 5. Vibration isolation $\geq$ 95% efficiency.

C. Motors:

1. Premium efficiency TEFC.
2. Inverter duty rated.
3. Minimum service factor 1.15.
4. Each fan controlled by dedicated VFD.

2.07 COOLING COILS (IF PROVIDED)

- A. ARI 410 rated.
- B. Copper tubes, aluminum fins.
- C. 250 PSI working pressure; factory tested to 300 PSI.
- D. Stainless steel sloped drain pan with P-trap connection.
- E. DX systems factory charged and tested when packaged.

2.08 CONTROLS

- A. NEMA 4 UL 508A labeled control panel.
- B. Single-point power connection.
- C. PLC-based control system with:
 1. System status indications.
 2. Reactivation temperature control.
 3. Fault monitoring.
 4. Modbus or Ethernet communication.
 5. Start/Stop and alarm contacts.
- D. Condensation control option with dew point and pipe temperature sensors.

2.09 FACTORY TESTING

- A. Complete system operational and performance testing prior to shipment including:

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Section 23 84 19 – Desiccant Dehumidification Units

1. Fans
2. Coils
3. Heaters
4. Desiccant rotor
5. Controls
6. Packaged condensing units (if applicable)

2.10 UNIT SCHEDULE AND PERFORMANCE REQUIREMENTS

Unit Data					Process Fan Data			
Tag	Manufacturer	Model	Location	FASL (ft)	Airflow (CFM)	E.S.P. (in. w.g.)	Wheel Type	Motor HP
DH-1	SMART	SCP-75	Outside - On Grade	388	7,500	2.00	SWSI-DD	10

Regen Fan Data				Process & Regen		Desiccant Wheel Performance Data (Process)				
Airflow (CFM)	E.S.P. (in. w.g.)	Wheel Type	Motor HP	Depth (inches)	Efficiency (%)	Airflow CFM	EAT-DB (°F)	EAT-HR (gr/lb)	LAT-HR (gr/lb)	MIN M.R. (lb/hr)
2,250	0.10	SWSI-DD	3	2	30	2300	75	53.4	14.7	182.9

Regen Heating Coil Data			Unit Dimensions & Weight				Electrical Data			
Type	EAT-DB (°F)	LAT-DB (°F)	Length (in)	Width (in)	Height (in)	Weight (lbs)	Power (V/Ph/Hz)	FLA (A)	MCA (A)	MOCP (A)
EH	85	285	150	80	100	7000	460/3/60	196	245	250

Notes:

1. Unit exterior and interior panels and framing must be painted with a marine type quality paint, see specification for details.
2. Process & Regen fans shall be direct drive & VFD driven, belt driven are unacceptable. Motors shall be TEFC.
3. Provide non-fused disconnect in NEMA 4 (UL 508a) panel
4. Each filter shall be rated at the fully loaded / dirty condition and be provided with a dirty filter alarm switch.
5. Hinged access doors with vapor proof gaskets.
6. Unit needs to be suitable to run in all ambient conditions
7. Provide with condensation control option to prevent condensation forming on internal building piping.
8. Provide startup by factory technicians. Startup by non-factory technicians is unacceptable.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify foundations and supports are level and adequate.
- B. Coordinate electrical, gas, and piping connections.

3.02 INSTALLATION

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- A. Install in accordance with manufacturer's instructions.
- B. Provide vibration isolation.
- C. Seal all duct connections airtight.
- D. Connect controls to Building Automation System.

3.03 START-UP AND COMMISSIONING

- A. Factory-trained technician shall perform start-up.
- B. Verify airflow, temperatures, humidity ratios, and reactivation performance.
- C. Train Owner's personnel.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the contract unit price for ALL REMAINING ITEMS RELATED TO CONTRACT 1 OF W2E WATER TREATMENT PLANT NOT COVERED UNDER OTHER BID ITEMS OR CONTRACTS of the plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 23 84 19

DIVISION 31 – EARTHWORK

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PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Subsoil materials.
 - 2. Common borrow and granular borrow materials.
 - 3. Granular backfill borrow.
 - 4. Recycled fill materials.
 - 5. Native fill materials.
 - 6. Clay fill.
 - 7. Sand and bedding materials.
 - 8. Gravel materials.
 - 9. Untreated aggregate base course.
 - 10. Select bedding materials.
 - 11. Topsoil materials.
 - 12. Riprap materials.
- B. All soil material shall be considered classified excavation.
- C. Related Documents:
 - 1. Attachment A: Geotechnical Report

1.02 RELATED SECTIONS

- A. Section 31 05 16 – Aggregates for Earthwork.
- B. Section 31 22 13 – Rough Grading
- C. Section 31 23 16 – Excavation
- D. Section 31 23 23 – Fill

1.03 REFERENCES

A. AASHTO

1. AASHTO T180 – Moisture-Density Relations of Soils (Modified Proctor).

B. ASTM International

1. ASTM C29 – Unit Weight and Voids in Aggregate.
2. ASTM C131 – Resistance to Degradation of Small-Size Coarse Aggregate.
3. ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
4. ASTM C535 – Resistance to Degradation of Large-Size Coarse Aggregate.
5. ASTM D1883 – California Bearing Ratio (CBR).
6. ASTM D2419 – Sand Equivalent Value.
7. ASTM D2487 – Unified Soil Classification System (USCS).
8. ASTM D2844 – Resistance R-Value and Expansion Pressure of Compacted Soils.
9. ASTM D3282 – Classification of Soils and Soil-Aggregate Mixtures for Highway Construction.
10. ASTM D3740 – Evaluation of Agencies Engaged in Testing of Soil and Rock.
11. ASTM D4318 – Liquid Limit, Plastic Limit, and Plasticity Index.
12. ASTM D5821 – Percentage of Fractured Particles.
13. ASTM D698 – Standard Proctor Compaction.
14. ASTM D1557 – Modified Proctor Compaction.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01 33 00 – Submittal Procedures.
- B. Material Source Documentation:

1. Name and address of supplier.
 2. Location of material source.
 3. Soil classification (ASTM D2487 and/or ASTM D3282).
 4. Gradation analysis (ASTM C136).
 5. Plasticity characteristics (ASTM D4318).
 6. CBR or R-Value test results when required.
- C. Submit Modified or Standard Proctor data when material is intended for compacted fill.
- D. If change in material source is required, submit new test data prior to delivery.

1.05 QUALITY ASSURANCE

- A. Testing laboratory shall comply with ASTM D3740 and Section 01 45 00.
- B. Provide materials from a single approved source for each material type unless approved otherwise.
- C. Materials failing to meet specified requirements shall be removed and replaced at no additional cost to Owner.
- D. All imported material shall be free of contamination, debris, organic matter, frozen material, and deleterious substances.

1.06 SOURCE QUALITY CONTROL

- A. Verify gradation in accordance with ASTM C136.
- B. Sampling shall be random and representative of production.
- C. If tests indicate non-compliance:
1. Suspend delivery.
 2. Change source or processing method.
 3. Retest prior to continued use.

PART 2 PRODUCTS

2.01 COMMON BORROW

- A. Classification: A-1-a through A-4 in accordance with ASTM D3282.
- B. Maximum particle size: 6 inches.
- C. Free of organic material, rubbish, frozen material, and debris.

2.02 RECYCLED FILL

- A. Pulverized Portland cement concrete (PCC).
- B. Pulverized asphalt pavement (RAP).
- C. Combination of recycled material with new aggregate.
- D. Gradation shall conform to intended use classification.
- E. Free of reinforcing steel and foreign materials.

2.03 NATIVE MATERIAL

- A. May be reused when approved by Engineer.
- B. Must meet classification and compaction requirements.
- C. Remove organic matter, debris, and unsuitable materials.
- D. Maximum particle size: 6 inches unless otherwise approved.

2.04 CLAY FILL

- A. Classification: CL, CL-ML, or ML per ASTM D2487.
- B. Homogeneous and free of organic material.
- C. Not permitted in structural areas unless approved.

2.05 TOPSOIL

- A. Chemical Requirements:
 - 1. pH: 5.5 – 7.7
 - 2. Soluble Salts: < 2.0 mmhos/cm
 - 3. SAR: < 3.0

- 4. Organic Matter: > 2%
- B. Physical Requirements:
 - 1. Fertile, friable, workable
 - 2. Free of weeds and debris
 - 3. Stones > 1-1/2 inches removed
- C. Gradation:

Component	Percent
Sand	15 – 60
Silt	10 – 70
Clay	5 – 30

PART 3 EXECUTION

3.01 EXCAVATION AND MATERIAL HANDLING

- A. Excavate and separate topsoil from subsoil.
- B. Remove unsuitable material from site.
- C. Reuse approved native material when permitted.

3.02 STOCKPILING

- A. Stockpile at approved locations.
- B. Separate material types.
- C. Topsoil stockpile height: 8 feet maximum.
- D. Protect from erosion and contamination.
- E. Direct runoff away from stockpiles.

3.03 CLEANUP

- A. Installation requirements are specified in:
 - 1. Section 31 23 23 – Fill

2. Section 31 22 13 – Rough Grading

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor and shall be incidental to the LUMP SUM price for EXCAVATION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 31 05 13

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Coarse aggregate for use in earthwork operations.
 - 2. Fine aggregate for backfill, trench fill, and grading applications.
 - 3. Aggregate materials for subbase, drainage layers, and separation layers.
 - 4. Aggregate used beneath pavements and structures where specified in earthwork sections.
- B. All materials and construction shall conform to the latest edition of the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction (hereinafter "IDOT Standard Specifications"), including Sections 301, 302, 303, and 904, unless otherwise specified.

1.02 RELATED SECTIONS

- A. Section 31 22 13 – Rough Grading.
- B. Section 31 23 16 – Excavation.
- C. Section 31 23 23 – Fill.
- D. Section 31 25 00 - Erosion and Sedimentation Controls

1.03 REFERENCES

- A. Illinois Department of Transportation (IDOT):
 - 1. IDOT Standard Specifications for Road and Bridge Construction.
 - a. Section 207 – Embankment.
 - b. Section 301 – Aggregate Base.
 - c. Section 302 – Subbase.
 - d. Section 303 – Aggregate Shoulders.
 - e. Section 904 – Aggregate Materials.

- B. B. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO T 11 – Materials Finer Than No. 200 Sieve.
 - 2. AASHTO T 27 – Sieve Analysis of Fine and Coarse Aggregates.
 - 3. AASHTO T 99 – Moisture-Density Relations (Standard Proctor).
 - 4. AASHTO T 180 – Moisture-Density Relations (Modified Proctor).
- C. C. ASTM International:
 - 1. ASTM D6938 – In-Place Density and Water Content by Nuclear Methods.
 - 2. ASTM D1556 – Density of Soil in Place by Sand-Cone Method.
 - 3. ASTM D4318 – Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.04 DEFINITIONS

- A. Coarse Aggregate: Crushed stone, crushed concrete, or crushed gravel meeting IDOT gradation and quality requirements.
- B. Fine Aggregate: Sand or screenings meeting IDOT gradation and quality requirements.
- C. Dense Graded Aggregate: Aggregate containing a well-graded mixture of coarse and fine particles intended to achieve compaction and stability.
- D. Separation Layer: Aggregate layer placed to separate subgrade from overlying base or pavement.

1.05 SUBMITTALS

- A. Product Data:
 - 1. Source of aggregate.
 - 2. IDOT classification and size designation (e.g., No. 53, No. 8, No. 73).
 - 3. Certified gradation test results in accordance with Section 904.
- B. Test Reports (When Requested):
 - 1. Laboratory compaction test (AASHTO T 99 or T 180).

2. Plasticity Index results when required.

1.06 QUALITY ASSURANCE

- A. Aggregates shall be obtained from IDOT-approved sources.
- B. Materials shall conform to IDOT Section 904 for the specified class and size.
- C. Furnish each aggregate type from a single source throughout the Work unless otherwise approved.
- D. Testing shall be performed by a qualified independent laboratory when required by the Engineer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Transport aggregate to minimize segregation and contamination.
- B. Stockpile on firm, well-drained surfaces.
- C. Separate different aggregate sizes to prevent intermixing.
- D. Prevent contamination with soil, vegetation, debris, or frozen material.

PART 2 PRODUCTS

2.01 COARSE AGGREGATE MATERIALS

- A. General
 1. Coarse aggregate materials shall conform to the IDOT Standard Specifications, Section 904 – Aggregate Materials.
 2. Furnish each aggregate material from a single source throughout the Work.
 3. All aggregate shall be free of shale, clay lumps, organic matter, frozen material, and other deleterious substances.
- B. Acceptable Coarse Aggregate Types
 1. Type CA-1
 - a. Conforming to IDOT Standard Specifications.
 - b. Typically used for trench backfill, drainage applications, and where indicated on the Drawings.

2. Type CA-6 (Size No. 53 Equivalent)
 - a. Dense graded crushed aggregate conforming to IDOT Standard Specifications.
 - b. Suitable for subbase, base, and general earthwork applications.
 - c. Class D or higher unless otherwise specified.
3. Type CA-7 (Size No. 8 Equivalent)
 - a. Conforming to IDOT Standard Specifications.
 - b. Typically used for drainage layers, bedding, and separation layers.
 - c. Where specified as a drainage layer, aggregate shall be 100 percent crushed material in accordance with IDOT requirements.

C. Gradation

1. All coarse aggregate types shall meet the applicable IDOT gradation requirements for the specified designation under Section 904.

2.02 FINE AGGREGATE MATERIALS

A. Fine Aggregate Type FA-1

1. Conforming to IDOT Standard Specifications.
2. Free of clay lumps, organic matter, friable material, frozen lumps, and deleterious substances.

B. Sand

1. Natural river or bank sand.
2. Washed and free of silt, clay, loam, friable or soluble materials, and organic matter.
3. Conforming to IDOT Standard Specifications.

C. Gradation Requirements (When Specified for Special Backfill or Bedding Applications)

- D. Fine aggregate shall be graded in accordance with ASTM C136 and conform to the following limits:

Sieve Size	Percent Passing
No. 4	100
No. 14	10 to 100
No. 50	5 to 90
No. 100	4 to 30
No. 200	0

2.03 AGGREGATE SURFACE COURSE, TYPE A

A. Description

1. Aggregate Surface Course, Type A shall consist of crushed stone, crushed gravel, or crushed concrete meeting the requirements of IDOT Standard Specifications Section 301 and Section 904.
2. Material shall be dense graded and capable of being compacted to form a stable surface suitable for temporary or permanent roadway, shoulder, or parking applications as shown on the Drawings.

B. Material Quality

1. Aggregate shall meet IDOT quality requirements for fractured faces, wear resistance, and soundness.
2. Class D quality or higher unless otherwise specified.
3. Recycled concrete may be used when permitted by IDOT and approved by the Engineer.

C. Gradation

1. Aggregate Surface Course, Type A shall conform to the gradation requirements for IDOT CA-6 (Size No. 53) unless otherwise specified in the Contract Documents.
2. Gradation shall comply with IDOT Section 904 for the specified size designation.

D. Use

1. Typically used for:
 - a. Temporary access roads.
 - b. Aggregate driveways.

- c. Shoulders and surface courses not receiving bituminous or concrete pavement.
- E. May be placed directly on prepared subgrade or on subbase material as indicated.

2.04 AGGREGATE BASE COURSE, TYPE B

A. Description

- 1. Aggregate Base Course, Type B shall consist of crushed stone, crushed gravel, crushed concrete, or approved reclaimed materials meeting the requirements of IDOT Section 302 – Aggregate Base Course and Section 904 – Aggregate Materials.
- 2. Material shall be dense graded and designed to provide structural support beneath bituminous or Portland cement concrete pavement.

B. Material Quality

- 1. Aggregate shall meet IDOT durability and quality requirements for base course applications.
- 2. Class D quality or higher unless otherwise specified.
- 3. Reclaimed asphalt pavement (RAP) may be permitted only if specifically allowed by the Contract Documents and meeting IDOT requirements.

C. Gradation

- 1. Aggregate Base Course, Type B shall conform to the IDOT gradation for CA-6 (Size No. 53) unless otherwise indicated.
- 2. Where specified, other IDOT aggregate sizes may be used provided they meet Section 302 and Section 904 requirements.

D. Compaction Characteristics

- 1. Material shall be capable of being compacted to not less than 100 percent of maximum dry density in accordance with AASHTO T 99 unless otherwise specified.
- 2. Final compacted surface shall be tightly bound, free of segregation, and suitable to receive subsequent pavement courses.

E. Use

1. Aggregate Base Course, Type B shall be used beneath:
 - a. Bituminous pavement.
 - b. Portland cement concrete pavement.
 - c. Slab-on-grade structures where indicated.
 - d. Aggregate Surface Course areas.

2.05 SOURCE QUALITY CONTROL

- A. Testing and inspection services shall be in accordance with Section 01 40 00 – Quality Requirements.
- B. Aggregates shall be tested for compliance with IDOT Section 904 and applicable AASHTO or ASTM standards, including:
 1. Sieve analysis (AASHTO T 27 / ASTM C136).
 2. Material finer than No. 200 sieve (AASHTO T 11).
 3. Additional testing as required by the Engineer.
- C. When tests indicate materials do not meet specified requirements:
 1. Remove non-conforming material from the site.
 2. Replace with compliant material from an approved source.
 3. Retest at no additional cost to the Owner.
- D. Perform all work in accordance with the IDOT Standard Specifications.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subgrade or trench excavation has been completed in accordance with applicable sections.
- B. Do not place aggregate on frozen, muddy, or unstable surfaces.
- C. Notify Engineer of unsuitable conditions prior to placement.

3.02 PREPARATION

- A. Proofroll subgrade where required by IDOT Section 207.
- B. Correct soft or yielding areas prior to aggregate placement.
- C. Install geosynthetics where shown on plans in accordance with IDOT Section 214.

3.03 PLACEMENT

- A. Spread aggregate in uniform lifts using approved equipment.
- B. Maximum compacted lift thickness:
 - 1. 6 inches unless otherwise approved.
 - 2. 4 inches in confined areas.
- C. Place material to required lines and grades shown on Drawings.
- D. Maintain moisture content as necessary to achieve required compaction.
- E. Aggregate shall not be placed when air temperature is below 35°F or on frozen subgrade.

3.04 COMPACTION

- A. Compact each lift immediately after placement.
- B. Unless otherwise specified, compact to:
 - 1. 100 percent of maximum dry density per AASHTO T 99, or
 - 2. As required by IDOT deflection criteria where applicable.
- C. In-place density testing may be performed using:
 - 1. ASTM D6938 (Nuclear Method), or
 - 2. ASTM D1556 (Sand Cone).
- D. Repair displacement or rutting prior to placing additional material.

3.05 TOLERANCES

- A. Surface shall not vary more than 1/2 inch from required grade when tested with a 10-foot straightedge.

- B. Thickness shall not vary more than $\pm 1/2$ inch from specified thickness.

3.06 PROTECTION

- A. Protect aggregate from contamination and damage.
- B. Remove and replace contaminated material at no additional cost.
- C. Prevent construction traffic from damaging completed aggregate layers.

3.07 METHOD OF MEASUREMENT

- A. Measurement shall be by square yard (SY) as indicated in the Schedule of Pay Items for aggregate surfaces.
- B. Aggregate under slabs and foundations are considered incidental to foundations and shall not be paid for separately.
- C. Aggregate used for contractor lay down areas are at the contractors discretion and shall not be paid for separately.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor and shall be incidental to the SY price for AGGREGATE SURFACE COURSE, TYPE A and AGGREGATE BASE COURSE, TYPE B related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 31 05 16

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Clearing, grubbing, stripping, stockpiling, and disposal of vegetation, debris, and topsoil within the limits of construction.
 - 2. Removal and lawful disposal of trees, brush, stumps, roots, organic matter, and surface obstructions.
 - 3. Protection of existing features designated to remain.
 - 4. Stripping, stockpiling, and replacement of topsoil as indicated on the Drawings.
- B. Work under this Section includes all labor, equipment, materials, and incidentals necessary to complete site clearing in accordance with the Contract Documents for projects located in the State of Illinois.

1.02 RELATED SECTIONS

- A. Section 31 23 16 – Excavation
- B. Section 31 23 19 – Dewatering
- C. Section 34 71 00 – Roadway Construction
- D. Section 01 57 00 – Temporary Erosion and Sediment Control

1.03 REFERENCES

- A. Perform clearing operations in accordance with applicable federal, state, and local regulations including, but not limited to:
 - 1. Requirements of the Illinois Environmental Protection Agency (IEPA).
 - 2. Applicable regulations of the United States Environmental Protection Agency (USEPA).
 - 3. Local municipal and county ordinances governing tree removal, burning, hauling, and disposal.
- B. Where applicable, comply with requirements of the Illinois Department of Transportation (IDOT) Standard Specifications for Road and Bridge Construction for clearing and grubbing within public rights-of-way.

1.04 DEFINITIONS

- A. Clearing: Removal of trees, brush, down timber, and other vegetation above ground surface.
- B. Grubbing: Removal of stumps, roots, and embedded organic matter below ground surface.
- C. Stripping: Removal of topsoil and organic surface materials suitable for reuse.

1.05 SUBMITTALS

- A. None Required

1.06 QUALITY ASSURANCE

- A. The CONTRACTOR shall examine the site prior to submitting a bid and determine the full extent of clearing and grubbing required.
- B. No additional compensation will be allowed due to failure to visit the site or failure to fully assess site conditions prior to bidding.
- C. Perform work in a manner that prevents damage to adjacent property, utilities, structures, and vegetation designated to remain.
- D. Conduct operations in compliance with erosion and sediment control requirements and stormwater permits applicable within Illinois.

1.07 PERMITS AND UTILITIES

- A. Open burning is prohibited unless specifically authorized in writing by the appropriate governing authority and permitted by IEPA regulations.

1.08 PROJECT CONDITIONS

- A. Existing Utilities:
 - 1. Locate and protect underground and overhead utilities.
 - 2. Contact JULIE (Joint Utility Locating Information for Excavators) prior to excavation or grubbing operations.
- B. Protection:
 - 1. Protect benchmarks, survey monuments, trees to remain, and existing improvements.

2. Repair damage caused by clearing operations at no additional cost to the OWNER.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.01 PREPARATION

- A. Establish limits of clearing as shown on the Drawings or as directed by the ENGINEER.
- B. Install erosion and sediment control measures prior to commencement of clearing activities.
- C. Clearly mark trees and vegetation designated to remain.

3.02 CLEARING

- A. Remove all trees, saplings, brush, vines, logs, fallen timber, snags, and surface debris within the limits of construction.
- B. Cut trees and stumps as close to ground surface as practicable:
 1. Small trees: Maximum 6 inches above ground surface.
 2. Large trees: Maximum 12 inches above ground surface.
- C. Cut saplings and brush flush with ground surface.
- D. Carefully prune roots and branches of trees designated to remain where they interfere with construction.
- E. Remove refuse, organic matter, and miscellaneous debris from the site.

3.03 GRUBBING

- A. Remove stumps and major roots to a minimum depth of 2 feet below existing grade unless otherwise indicated.
- B. Remove subsurface organic material within building pads, pavement areas, utility trenches, and embankment areas.
- C. Backfill grubbed areas with suitable fill material and compact in accordance with Section 31 00 00.

3.04 STRIPPING TOPSOIL

- A. Topsoil stripping in accordance with Section 31 14 13 - Earth Stripping and Stockpiling

3.05 DISPOSAL

- A. Disposal of cleared and grubbed materials shall be the CONTRACTOR'S responsibility.
- B. Dispose of materials off-site in a legal manner in accordance with federal, state, and local regulations.
- C. Hauling and disposal costs shall be included in the Contract price.

3.06 FIELD QUALITY CONTROL

- A. The ENGINEER may inspect clearing limits, stump removal depth, and stripping operations.
- B. Work not conforming to these specifications shall be corrected at no additional cost to the OWNER.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor and shall be incidental to the LUMP SUM price for EXCAVATION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 31 10 00

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Stripping of vegetation and topsoil.
 - 2. Removal and lawful disposal of unsuitable materials.
 - 3. Stockpiling and protection of topsoil.
 - 4. Preparation of subgrade prior to topsoil placement.
 - 5. Placement and grading of salvaged topsoil.
 - 6. Final surface preparation for landscaping or seeding.
- B. Work under this Section includes all labor, materials, tools, equipment, and incidentals necessary to:
 - 1. Strip vegetation and topsoil from designated construction areas.
 - 2. Stockpile salvaged topsoil.
 - 3. Protect and maintain stockpiled materials.
 - 4. Redistribute and place topsoil in disturbed areas.
 - 5. Fine grade and prepare surfaces for seeding or planting.
- C. The intent of this Section is to preserve suitable existing topsoil for reuse and to ensure final site restoration meets project requirements and applicable standards.
- D. All work shall conform to applicable State of Illinois regulations and local governing authority requirements.

1.02 RELATED SECTIONS

- A. Section 31 10 00 – Site Clearing
- B. Section 31 23 16 – Excavation
- C. Section 32 90 00 – Planting

1.03 REFERENCES

- A. AASHTO T88 – Particle Size Analysis of Soils
- B. AASHTO T194 – Organic Matter Content of Soil
- C. ASTM standards for soil pH testing
- D. Illinois Environmental Protection Agency (IEPA) erosion control requirements
- E. Illinois Urban Manual for erosion and sediment control

1.04 SUBMITTALS

- A. Product Data (When Requested by Engineer Only):
 - 1. Laboratory test results for salvaged or imported topsoil.
 - 2. Organic matter content verification.
 - 3. Gradation and plasticity data.
 - 4. pH testing results.
- B. Certification (When Requested by Engineer Only):
 - 1. If imported topsoil is required, provide written certification that material complies with this specification.

1.05 QUALITY ASSURANCE

- A. Topsoil shall be inspected and approved by the Engineer prior to placement.
- B. Testing may be performed by an independent testing laboratory at the direction of the Owner.
- C. Topsoil not meeting specified requirements shall be removed from the site at no additional cost to the Owner.

1.06 PERMITS AND UTILITIES

- A. Contractor shall implement Best Management Practices (BMPs) in accordance with the project's Storm Water Pollution Prevention Plan (SWPPP)

1.07 GUARANTEE

- A. Topsoil placement shall support healthy vegetation growth.
- B. Areas failing to sustain vegetation due to improper placement, contamination, or improper grading shall be corrected at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 TOPSOIL

- A. Definition:
 - 1. Topsoil shall be fertile, friable surface soil reasonably free of subsoil, clay lumps, brush, weeds, roots, stones larger than ½ inch in diameter, and other extraneous or waste materials.
- B. Gradation Requirements:
 - 1. Minimum 90 percent passing No. 10 sieve.
 - 2. Clay content between 12 percent and 50 percent (AASHTO T88).
 - 3. Sand content not exceeding 55 percent (AASHTO T88).
- C. Organic Content:
 - 1. Between 1 percent and 10 percent organic matter (AASHTO T194).
- D. pH Requirements:
 - 1. Minimum pH of 5.0.
 - 2. Maximum pH of 8.0.
 - 3. Tested in accordance with ASTM procedures for soil pH.
- E. Performance Requirement:
 - 1. Topsoil shall be capable of sustaining vigorous plant growth.
- F. Imported Topsoil (if required):
 - 1. Imported topsoil shall meet all requirements specified herein and shall be subject to approval prior to delivery.

2.02 ACCESSORIES

A. Erosion Control Materials:

1. Silt fence.
2. Temporary seeding.
3. Erosion control blanket where required.

B. Soil Amendments:

1. Provide lime, fertilizer, or compost as recommended by soil testing results and approved by the Engineer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify limits of stripping with Engineer prior to commencement.
- B. Install required erosion and sediment control measures prior to earth disturbance.
- C. Protect utilities, benchmarks, and reference points.

3.02 STRIPPING

- A. Remove vegetation and topsoil from all structure and pavement areas and extend stripping a minimum of five (5) feet beyond construction limits.
- B. Strip topsoil from any borrow or fill source areas.
- C. Minimum stripping depth shall be six (6) inches unless otherwise directed by the Engineer.
- D. Avoid mixing topsoil with subsoil or unsuitable material.
- E. Dispose of excess or unsuitable material off-site in accordance with Illinois regulations.

3.03 STOCKPILING

- A. Stockpile topsoil in approved locations.
- B. Stockpiles shall:

1. Be placed outside drainageways and flood-prone areas.
2. Be shaped to promote drainage.
3. Be protected with temporary seeding or erosion control blanket if left in place more than 14 days.

C. Prevent contamination from construction traffic or foreign materials.

3.04 SUBGRADE PREPARATION

- A. Placement of topsoil shall not begin until subgrade lines and grades are approved.
- B. Hardened or crusted surfaces shall be scarified to a minimum depth of 2 inches to promote bonding.
- C. Remove sufficient material where necessary to prevent interference with drainage after topsoil placement.

3.05 PLACEMENT

- A. Place topsoil to a compacted depth of six (6) inches on all disturbed areas unless otherwise indicated.
- B. Grade topsoil to:
 1. Conform to lines and grades shown on the Drawings.
 2. Be level with adjacent pavement or rock surfaces.
 3. Slope away from structures and pavements to ensure positive drainage.
- C. Finished surface shall:
 1. Be free of clods, stones, and debris.
 2. Be reasonably smooth and uniform.
 3. Prevent ponding of water.
- D. Do not place topsoil during frozen or excessively wet conditions.

3.06 PROTECTION

- A. Protect placed topsoil from erosion, compaction, or contamination.
- B. Repair any areas damaged by construction operations at no additional cost to the Owner.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor and shall be incidental to the LUMP SUM price for EXCAVATION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 31 14 13

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Stripping and stockpiling topsoil.
 - 2. Excavating subsoil for rough grading.
 - 3. Cutting, grading, filling, rough contouring, and compaction of site for:
 - a. Building pads
 - b. Site structures
 - c. Pavement areas
 - d. General site grading
 - 4. Preparation of existing subgrade for placement of fill.
- B. Work under this Section includes grading associated with earthwork operations prior to placement of structural fill, aggregate base, topsoil, or pavement.

1.02 RELATED SECTIONS

- A. Section 31 05 13 - Soils for Earthwork: Soils for fill.
- B. Section 31 05 16 - Aggregates for Earthwork: Aggregates for fill.
- C. Section 31 10 00 - Site Clearing
- D. Section 31 23 16 - Excavation
- E. Section 31 23 23 - Fill

1.03 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T 99 – Moisture-Density Relations of Soils Using 5.5-lb Rammer (Standard Proctor).
 - 2. AASHTO T 180 – Moisture-Density Relations of Soils Using 10-lb Rammer (Modified Proctor).

B. ASTM International:

1. ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 – Laboratory Compaction Characteristics (Standard Proctor).
3. ASTM D1556 – Density and Unit Weight by Sand Cone.
4. ASTM D1557 – Laboratory Compaction Characteristics (Modified Proctor).
5. ASTM D2167 – Density by Rubber Balloon Method.
6. ASTM D2922 – In-Place Density by Nuclear Methods.
7. ASTM D3017 – In-Place Moisture by Nuclear Methods.

1.04 SUBMITTALS

- A. None required

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with applicable provisions of referenced standards.
- B. Testing shall be performed by a qualified independent testing laboratory when required by the Owner.
- C. Compaction equipment and methods shall be suitable for material type and lift thickness.

1.06 PERMITS AND UTILITIES

- A. Contact local utility locating service not less than three working days prior to excavation.
- B. Protect existing utilities to remain.
- C. Contractor shall be responsible for any damage to utilities resulting from operations.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: Type S3 and S4 as specified in Section 31 05 13.

- B. Subsoil Fill: Type S1 and S2 as specified in Section 31 05 13.
- C. Granular Fill: Type A1, A2, A3 and A4 as specified in Section 31 05 16.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify site clearing is complete.
- B. Verify benchmark locations and design elevations.
- C. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Identify required lines, grades, and control points.
- B. Protect:
 - 1. Benchmarks
 - 2. Survey control points
 - 3. Existing improvements
 - 4. Landscaping to remain
- C. Remove and legally dispose of unsuitable materials encountered.

3.03 TOPSOIL EXCAVATION

- A. Strip topsoil in accordance with Section 31 14 13.
- B. Do not strip excessively wet topsoil.
- C. Stockpile topsoil in designated areas:
 - 1. Maximum 8 feet in height
 - 2. Stabilize to prevent erosion
- D. Do not remove topsoil from site unless directed.

3.04 SUBSOIL EXCAVATION

- A. Perform in accordance with Section 31 23 16.
- B. Do not excavate frozen or excessively wet material.
- C. Bench existing slopes steeper than 4H:1V to key new fill into slope.
- D. Replace unstable or disturbed material with compacted fill.

3.05 PREPARATION OF EXISTING SUBGRADE

- A. Scarify exposed subgrade to depth of 6 inches.
- B. Remove debris, roots, and oversized materials.
- C. Adjust moisture to near optimum.
- D. Compact subgrade as follows:
 - 1. Building Pads and Pavement Areas:
 - 2. Minimum 95% of Modified Proctor (ASTM D1557 / AASHTO T180).
 - 3. General Lawn and Landscape Areas:
 - 4. Minimum 95% of Standard Proctor (ASTM D698 / AASHTO T99).
- E. Moisture content: $\pm 2\%$ of optimum.
- F. Do not place fill on frozen, muddy, or unstable subgrade.
- G. Proof roll when directed. Correct soft areas.
- H. Subgrade must be inspected and accepted prior to placement of aggregate base or structural fill.

3.06 FILLING AND ROUGH GRADING

- A. Do not place fill until subgrade is accepted.
- B. Place fill in horizontal lifts not exceeding 6 inches loose thickness unless otherwise approved.
- C. Maintain uniform gradation; eliminate lenses or pockets of dissimilar material.
- D. Compact as follows:

1. Structural Areas (Pads, Slabs, Pavement):
 2. 95% Modified Proctor.
 3. General Site Areas:
 4. 95% Standard Proctor unless otherwise noted.
- E. Moisture content during compaction: $\pm 2\%$ of optimum.
- F. No fill shall be placed:
1. On frozen ground
 2. During unsuitable weather
 3. On saturated subgrade
- G. Maintain embankments crowned for drainage during construction.
- H. Slope finished grade away from building minimum 5% for first 10 feet unless noted otherwise.
- I. Make grade transitions gradual and smooth.
- J. Remove material placed outside design lines when directed.
- K. Maintain excavations and embankments in stable condition until final acceptance.

3.07 TOLERANCES

- A. Top of Subgrade: ± 0.10 foot from required elevation.
- B. General Rough Grade: ± 0.10 foot unless otherwise indicated.

3.08 FIELD QUALITY CONTROL

- A. Laboratory Proctor Tests:
 1. ASTM D1557 for structural areas.
 2. ASTM D698 for general areas.
- B. In-place density testing:

1. ASTM D1556
 2. ASTM D2167
 3. ASTM D2922
- C. Moisture testing:
1. ASTM D3017.
- D. Frequency of testing as directed by Engineer.
- E. Areas failing compaction shall be:
1. Scarified
 2. Moisture adjusted
 3. Recompacted
 4. Retested
- F. All corrective work shall be at Contractor's expense.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor and shall be incidental to the LUMP SUM price for EXCAVATION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 31 22 13

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Common excavation.
 - 2. Rock excavation.
 - 3. Structure excavation.
 - 4. Trench excavation.
 - 5. Excavation support and protection.
 - 6. Dewatering incidental to excavation.
 - 7. Over-excavation and replacement.
 - 8. Excavation for pavements, utilities, and structures.
 - 9. Disposal of excess excavated material.
- B. Work includes all labor, materials, tools, equipment, transportation, and incidentals necessary to complete excavation as shown on the Drawings and specified herein.
- C. The Contractor shall determine the nature and extent of excavation required to complete the Work and shall include all associated costs in the Contract Sum. No additional compensation will be allowed for variations in subsurface conditions that could have been reasonably anticipated by review of available information and site investigation.

1.02 RELATED SECTIONS

- A. Section 31 10 00 – Site Clearing
- B. Section 31 14 13 – Earth Stripping
- C. Section 31 23 19 – Dewatering
- D. Section 31 25 00 – Erosion and Sedimentation Control

1.03 REFERENCES

- A. Illinois Department of Transportation (IDOT) Standard Specifications for Road and Bridge Construction.
- B. OSHA 29 CFR 1926 Subpart P – Excavations.
- C. ASTM International Standards:
 - 1. ASTM D2487 – Classification of Soils for Engineering Purposes.
 - 2. ASTM D1556 – Density and Unit Weight of Soil in Place by Sand-Cone Method.
 - 3. ASTM D6938 – In-Place Density and Water Content by Nuclear Methods.

1.04 SUBMITTALS

- A. Excavation Plan:
 - 1. Methods of excavation.
 - 2. Sheet piling, shoring, and bracing details sealed by a Professional Engineer licensed in Illinois when required.
 - 3. Dewatering plan, if required.
 - 4. Haul routes and disposal locations.
- B. Soil classification reports from testing laboratory, if performed.
- C. Permits and approvals required by local, county, or state authorities.

1.05 QUALITY ASSURANCE

- A. Comply with OSHA trench safety standards at all times.
- B. Provide a competent person on-site during excavation operations as defined by OSHA.
- C. Shoring and support systems shall be designed by a Professional Engineer licensed in the State of Illinois when required by depth or site conditions.
- D. Perform work in accordance with IDOT standards where applicable.

1.06 PERMITS AND UTILITIES

- A. Obtain all required excavation permits prior to commencing work.
- B. Contact JULIE (Joint Utility Locating Information for Excavators) at least 48 hours prior to excavation.
- C. Verify existing utility locations prior to excavation.
- D. Protect utilities indicated to remain.
- E. Repair damage to utilities at no additional cost to Owner.

1.07 PROJECT CONDITIONS

- A. Existing Conditions:
 - 1. Examine site prior to bidding.
 - 2. The Contractor shall be solely responsible for visiting and examining the site and becoming fully informed regarding all existing conditions affecting the Work. Failure to visit the site prior to submitting a bid shall not relieve the Contractor of responsibility for properly estimating the difficulty and cost of performing the Work. No additional compensation will be allowed due to the Contractor's failure to examine the site or become familiar with existing conditions.
- B. Subsurface Conditions:
 - 1. The Contractor is responsible for reviewing available geotechnical information attached to these specifications in Appendix A.
 - 2. No additional payment will be made for excavation in soil, rock, groundwater, or other materials encountered unless specifically identified as a separate pay item.

1.08 GUARANTEE

- A. Guarantee that excavation work will not adversely affect adjacent structures, pavements, or utilities.
- B. Repair settlement or damage caused by improper excavation at no cost to Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. No manufactured products are specified under this Section except for incidental materials required for protection and stabilization.
- B. Imported backfill material used for replacement of over-excavation shall comply with Section 31 23 23.

2.02 ACCESSORIES

- A. Sheeting, Shoring, and Bracing:
 - 1. Timber, steel sheet piling, trench boxes, or engineered systems designed for anticipated loads.
 - 2. Systems shall comply with OSHA requirements.
- B. Erosion Control Materials:
 - 1. Silt fence.
 - 2. Inlet protection.
 - 3. Temporary stabilization materials.

PART 3 EXECUTION

3.01 PREPARATION

- A. Establish lines, grades, and elevations prior to excavation.
- B. Install erosion and sediment control measures prior to earth disturbance.
- C. Strip topsoil in areas to be excavated and stockpile separately.

3.02 EXCAVATION

- A. General:
 - 1. Excavate to dimensions and elevations indicated.
 - 2. Remove unsuitable material encountered below subgrade as directed.
 - 3. Maintain excavation free of water.

B. Structure Excavation:

1. Excavate to allow for formwork and working space.
2. Do not disturb bearing soils below required elevation.

C. Trench Excavation:

1. Excavate trenches to required width for installation of utilities.
2. Provide stable trench walls or protective systems per OSHA.

D. Rock Excavation:

1. Defined as material that cannot be removed with conventional excavation equipment without drilling and blasting or use of hydraulic breakers.
2. Dispose of rock offsite unless otherwise directed.

E. Over-Excavation:

1. Over-excavation beyond limits shown shall be corrected at Contractor's expense.
2. Replace with approved compacted fill.

3.03 DEWATERING

- A. Dewatering shall be performed in accordance with procedures set forth in Section 31 23 19 – Dewatering

3.04 PROTECTION

- A. Protect excavation from collapse, erosion, and water infiltration.
- B. Provide barricades and warning lights as required.
- C. Maintain safe access for inspection.

3.05 FIELD QUALITY CONTROL

A. Subgrade Inspection:

1. Notify Engineer when subgrade is ready for inspection.
2. Do not place fill or concrete until approval is received.

B. Subgrade Verification

1. Prior to placement of foundations, slabs, or pavements, the Engineer shall review compaction test results and visually inspect subgrade conditions.
2. Proof-rolling may be required using a fully loaded tandem axle dump truck or similar approved equipment. Areas exhibiting pumping, rutting, or deflection shall be undercut and replaced with Type A material compacted to specified density.

C. Compaction Testing

1. Compaction testing shall be in accordance with Section 31 23 23 – Fill.

D. Rock and Bearing Verification

1. When foundations bear on native soils, confirm bearing capacity of 2 tons per square foot as specified.
2. Where unsuitable soils are encountered, follow over-excavation requirements in this Section.

3.06 DISPOSAL

- A. Dispose of excess excavated material offsite at a legally permitted location.
- B. Provide documentation of disposal site upon request.
- C. Burning of debris is not permitted.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor and shall be incidental to the LUMP SUM price for EXCAVATION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 31 23 16

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish all labor, materials, equipment, supervision, engineering, and incidentals necessary to design, install, operate, maintain, monitor, and remove temporary dewatering systems required for construction operations.
- B. Work includes, but is not limited to:
 - 1. Lowering and controlling groundwater levels.
 - 2. Intercepting, collecting, and disposing of seepage and surface water.
 - 3. Maintaining excavations, trenches, and foundations in a dry and stable condition.
 - 4. Preventing hydrostatic uplift and lateral pressures affecting structures and slabs.
 - 5. Protecting adjacent structures, utilities, pavements, and property from settlement or damage.
- C. Pre-Bid Responsibility:
 - 1. The Contractor shall, prior to submitting a Bid, review all available geotechnical data, soil borings, groundwater information, and site conditions to determine the extent and complexity of dewatering required to complete the Work.
 - 2. The Contractor is solely responsible for determining the type, extent, capacity, duration, and operational requirements of the dewatering system necessary to successfully complete the Work.
 - 3. Submission of a Bid shall constitute acknowledgment that the Contractor has evaluated site conditions and included all costs associated with dewatering operations in the Bid.
 - 4. No additional compensation will be allowed for groundwater conditions, surface water conditions, hydrostatic pressures, seepage, soil instability, differing groundwater elevations, seasonal fluctuations, or any other water-related conditions encountered during construction.
 - 5. All costs associated with design, permitting, installation, operation, monitoring, maintenance, treatment, standby equipment, and removal of the dewatering system shall be included in the Contract Price.

- D. Dewatering shall be performed as necessary to complete the Work in accordance with the Contract Documents and applicable State of Illinois and local regulations.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittals
- B. Section 01 51 00 – Temporary Utilities
- C. Section 01 57 00 – Temporary Controls
- D. Section 31 23 16 – Excavation
- E. Division 03 – Concrete

1.03 REFERENCES

- A. Occupational Safety and Health Administration (OSHA), 29 CFR Part 1926 – Safety and Health Regulations for Construction (Excavations).
- B. Illinois Department of Natural Resources (IDNR) regulations governing groundwater withdrawal and discharge.
- C. Illinois Environmental Protection Agency (IEPA) regulations governing discharge of groundwater and stormwater.
- D. Applicable local ordinances for discharge to storm sewers, sanitary sewers, or surface waters.
- E. Illinois Plumbing Code and local municipal utility requirements, where applicable.

1.04 DEFINITIONS

- A. Dewatering: Lowering groundwater levels and controlling surface water to provide stable, dry, and safe working conditions and to reduce hydrostatic pressures acting on temporary or permanent structures.
- B. Dewatering System: All wells, wellpoints, eductors, sumps, pumps, piping, controls, standby power, monitoring devices, discharge lines, filtration units, and appurtenances required to accomplish dewatering.
- C. Drawdown: Lowering of groundwater elevation relative to static groundwater level.

1.05 SYSTEM DESCRIPTION

- A. The dewatering system shall:
 - 1. Maintain groundwater levels below excavation subgrades and foundation levels as required for safe construction.
 - 2. Prevent loss of fines, piping, or soil instability.
 - 3. Prevent movement or settlement of adjacent structures and utilities.
 - 4. Prevent heave, boiling, or uplift of excavation bottoms.
 - 5. Operate continuously without interruption until dewatering is no longer required.
- B. Dewatering methods may include, but are not limited to:
 - 1. Wellpoint systems.
 - 2. Deep wells with submersible pumps.
 - 3. Eductor (ejector) systems.
 - 4. Sump pumping with drainage blankets.
 - 5. Horizontal drains.
 - 6. Combination systems.
- C. Contractor is solely responsible for selecting and designing the dewatering method appropriate for site soil and groundwater conditions.

1.06 SUBMITTALS

- A. Dewatering Plan: Submit within sixty (60) calendar days after Notice to Proceed or at least thirty (30) days prior to installation. Include:
 - 1. Plan drawings showing locations and elevations of wells, wellpoints, sumps, header piping, discharge piping, and monitoring points.
 - 2. Pump capacities, performance curves, and standby equipment.
 - 3. Calculations demonstrating adequacy of system (drawdown analysis, seepage calculations, uplift checks).
 - 4. Soil and groundwater assumptions used in design.

5. Discharge locations and erosion/sediment control measures.
 6. Sequence of installation and removal.
 7. Monitoring plan and frequency of readings.
 8. Emergency response procedures.
- B. Professional Engineer Certification: Dewatering design shall be signed and sealed by a Professional Engineer licensed in the State of Illinois.
- C. Permits: Copies of approved groundwater withdrawal permits and discharge permits, if required by IDNR, IEPA, or local authorities.
- D. Monitoring Reports: Submit weekly groundwater monitoring reports and daily logs upon request.
- E. Engineer's review does not relieve Contractor of responsibility for performance.

1.07 QUALITY ASSURANCE

- A. Dewatering design and supervision shall be performed by qualified personnel experienced in similar Illinois soil conditions.
- B. System shall be installed and operated under supervision of personnel experienced in groundwater control.
- C. Maintain records of groundwater elevations, pump operation hours, discharge rates, and maintenance activities.
- D. Provide instrumentation as required, including:
1. Observation wells or piezometers.
 2. Settlement markers if required.

1.08 PERMITS AND UTILITIES

- A. Obtain and pay for all permits required for groundwater withdrawal and discharge.
- B. Comply with IEPA National Pollutant Discharge Elimination System (NPDES) requirements where applicable.
- C. Discharge water shall meet applicable turbidity and contaminant limits prior to release. Provide filtration, sedimentation tanks, or treatment as required.

- D. Provide power for all dewatering equipment, including standby generators.

1.09 GUARANTEE

- A. Contractor shall guarantee stability of excavations and protection of adjacent facilities resulting from dewatering operations.
- B. Repair, at no cost to Owner, damage caused by inadequate design, operation failure, or improper maintenance of dewatering system.

PART 2 PRODUCTS

2.01 GENERAL

- A. Pumps shall be sized for continuous duty and capable of handling anticipated flow plus safety factor of at least 25 percent.
- B. Provide automatic controls with high-water alarms.
- C. Standby pumps and generators shall be provided for all critical installations.
- D. Discharge piping shall be watertight and protected from freezing and mechanical damage.

2.02 ACCESSORIES

- A. Wellpoints:
 - 1. Stainless steel or PVC screened wellpoints with appropriate slot size.
 - 2. Filter sand or gravel envelope where required.
- B. Deep Wells:
 - 1. PVC or steel casing with screen sections appropriate for soil conditions.
 - 2. Submersible pumps with abrasion-resistant impellers.
- C. Treatment Equipment (if required):
 - 1. Sedimentation tanks.
 - 2. Bag filters or sand filters.
 - 3. Oil-water separators if hydrocarbons are encountered.

PART 3 EXECUTION

3.01 PREPARATION

- A. Review available geotechnical data. Soil borings are provided for information only. Contractor shall verify conditions.
- B. Protect benchmarks and utilities.
- C. Establish surface drainage controls prior to excavation.

3.02 INSTALLATION

- A. Install wells and wellpoints to depths required to achieve specified drawdown.
- B. Protect excavation slopes from erosion.
- C. Route discharge piping to approved locations without causing erosion or property damage.
- D. Prevent migration of soil fines.

3.03 OPERATION

- A. Operate system continuously, 24 hours per day as required.
- B. Maintain groundwater a minimum of 2 feet below bottom of excavation unless otherwise required by design.
- C. Provide continuous monitoring during critical concrete placements.
- D. Protect system from freezing conditions.
- E. Maintain standby equipment in operational condition.

3.04 CONTROL OF WATER

- A. Grade site to divert surface runoff away from excavations.
- B. Prevent discharge water from re-entering excavation.
- C. Dispose of water legally and safely. Contractor is fully responsible for disposal methods.

3.05 MAINTENANCE AND SERVICE

- A. Maintain entire system during construction.

- B. Replace wells, wellpoints, or pumps that perform unsatisfactorily.
- C. No interruption of dewatering due to mechanical failure, power outage, or weather conditions shall be permitted.

3.06 DISCONTINUATION

- A. Do not discontinue dewatering until:
 - 1. Permanent structures can safely resist hydrostatic pressures.
 - 2. Excavations are backfilled to design grades.
- B. Remove dewatering equipment after approval.
- C. Abandon wells in accordance with Illinois Department of Public Health requirements.

3.07 DAMAGE RESTITUTION

- A. Contractor shall repair all damage caused by flooding, soil instability, settlement, or system failure at no cost to Owner.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor and shall be incidental to the LUMP SUM price for EXCAVATION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 31 23 19

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Furnishing, placing, and compacting fill and backfill materials.
 - 2. Backfilling building perimeters to required subgrade elevations.
 - 3. Backfilling site structures and utility excavations where not specified elsewhere.
 - 4. Fill under slabs-on-grade.
 - 5. Fill under pavements and exterior flatwork.
 - 6. Fill for over-excavation and unsuitable soil removal.
 - 7. Final grading of filled areas to required elevations.
- B. Work includes all labor, materials, equipment, testing, and incidentals necessary to complete fill operations in accordance with the Contract Documents and applicable standards of the State of Illinois.
- C. Coordinate with the Geotechnical Report and recommendations provided for the Project.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 57 13 – Temporary Erosion and Sediment Control.
- C. Section 31 23 16 – Excavation.
- D. Section 32 92 19 – Seeding.

1.03 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. T 180 – Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer.
- B. ASTM International:

1. D422 – Particle-Size Analysis of Soils.
 2. D698 – Laboratory Compaction Characteristics of Soil Using Standard Effort.
 3. D1556 – Density and Unit Weight of Soil in Place by Sand-Cone Method.
 4. D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.
 5. D2167 – Density and Unit Weight of Soil in Place by Rubber Balloon Method.
 6. D2922 – Density of Soil and Soil-Aggregate in Place by Nuclear Methods.
 7. D3017 – Water Content of Soil and Rock in Place by Nuclear Methods.
 8. D4318 – Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- C. Illinois Department of Transportation (IDOT) Standard Specifications for Road and Bridge Construction

1.04 DEFINITIONS

- A. Compaction: Mechanical densification of fill materials placed in uniform horizontal lifts not exceeding specified uncompacted thickness.
- B. Proof-Rolling: Operation of heavy rubber-tired equipment over subgrade or fill surface to identify yielding or unstable areas.
- C. In-the-Dry: Moisture content not more than 2 percentage points above optimum moisture content as determined by ASTM D1557.

1.05 SUBMITTALS

- A. Submit name and location of imported fill material suppliers. Materials shall be obtained from a single approved source unless otherwise approved by the Engineer.
- B. Submit 5-pound minimum sample of each proposed fill material in airtight containers one week prior to placement.
- C. Submit grain-size distribution test results in accordance with ASTM D422.
- D. Submit moisture-density curve data indicating maximum dry density and optimum moisture content as determined by ASTM D1557 for each proposed fill source.

- E. Provide daily compaction testing reports to the Engineer, including corrective actions for areas failing to meet specified density requirements.
- F. Product Data for geotextile fabric, where required, including manufacturer specifications and installation instructions.

1.06 QUALITY ASSURANCE

- A. Off-site imported fill shall be geotechnically tested at a minimum frequency of one test per 1,000 cubic yards per source.
- B. Imported fill shall be tested for geotechnical suitability prior to chemical testing, if required by project documents.
- C. Perform in-place density testing in accordance with ASTM D1556, ASTM D2922, or ASTM D3017.
- D. In-place density testing shall be performed at a minimum frequency of one test per lift per excavation area, or as directed by the Engineer.
- E. Areas failing to meet compaction requirements shall be reworked and retested at no additional cost to the Owner.
- F. Neither observation nor testing by the Engineer shall relieve Contractor of responsibility for defective work.

PART 2 PRODUCTS

2.01 GENERAL

- A. Fill materials shall be free of organic matter, frozen material, debris, trash, roots, or other deleterious substances.
- B. No fill shall contain hard lumps, chunks of frozen soil, or stones larger than 2 inches in greatest dimension unless specifically approved.

2.02 FILL MATERIALS

- A. Structural Fill / Subsoil Fill:
 - 1. Approved on-site soils meeting requirements of Section 31 05 13.
 - 2. Imported engineered fill meeting IDOT CA-6 or equivalent gradation where required.
- B. Granular Fill / Gravel Borrow:

1. Durable crushed stone and coarse sand.
2. Maximum stone size: 2 inches.
3. Gradation within the following limits:

U.S. Standard Sieve	Percent Passing
$\frac{1}{2}$ "	50 – 85%
No. 4	40 – 75%
No. 50	8 – 28%
No. 200	0 - 10%

C. Topsoil (where required):

1. Minimum 6-inch layer at surface in landscaped areas.
2. Free of subsoil, debris, and excessive clay.

D. Geotextile Fabric:

1. Orange warning geotextile where required to delineate contaminated or unsuitable soils.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify excavations are complete and approved prior to placement of fill.
- B. Verify subdrainage, waterproofing, and dampproofing installations have been inspected.
- C. Do not begin backfilling until foundation walls and structures have attained sufficient strength and bracing.

3.02 PREPARATION

- A. Remove soft, yielding, or unsuitable materials. Replace with approved structural fill compacted to required density.
- B. Scarify and moisture-condition subgrade prior to placement of fill.
- C. Proof-roll subgrade and compacted fill surfaces in the presence of the Engineer to identify unstable areas.
- D. Place geotextile fabric where indicated prior to backfilling.

3.03 PLACEMENT

- A. Do not place fill on frozen, snow-covered, or saturated surfaces.
- B. Place fill in uniform horizontal lifts not exceeding 12 inches uncompacted thickness.
- C. Step fill on slopes steeper than 3H:1V to ensure bond with existing ground.
- D. Maintain moisture content within +1% to -3% of optimum moisture content.
- E. Backfill simultaneously on both sides of foundation walls to avoid unbalanced loading.
- F. Slope finished grade away from building minimum 2 percent for a distance of 10 feet unless otherwise indicated.
- G. Laser-grade fill to match required elevations.

3.04 COMPACTION

- A. Structural fill beneath slabs, foundations, and pavements:
 - 1. Compact to minimum 95% of maximum dry density per ASTM D1557.
- B. General site fill and landscaped areas:
 - 1. Compact to minimum 90% of maximum dry density per ASTM D1557.
- C. No compaction shall occur when material is excessively wet or frozen.
- D. Areas failing density requirements shall be reworked and retested at Contractor's expense.

3.05 MOISTURE CONTROL

- A. Add water by sprinkler truck or approved method when moisture is below optimum.
- B. Aerate excessively wet materials to reduce moisture content.
- C. Cover stockpiled materials with polyethylene sheeting as necessary to control moisture.

3.06 FIELD QUALITY CONTROL

- A. Perform laboratory compaction tests per ASTM D1557.

- B. Perform in-place density and moisture tests per ASTM D2922 and ASTM D3017.
- C. Frequency of testing shall meet or exceed recommendations of the Project Geotechnical Engineer.
- D. Proof-roll surfaces beneath slabs and pavements prior to construction.

3.07 COMPACTION TESTING

A. General

- 1. Field density and moisture content testing of compacted subgrade, fill, and backfill will be performed by the Owner's testing laboratory in accordance with Section 01 45 00.
- 2. Testing shall verify compliance with the specified percentage of maximum dry density as determined by the Standard Proctor Test in accordance with:
 - a. ASTM D698
 - b. AASHTO T-99
- 3. Field density testing shall be performed in accordance with:
 - a. ASTM D6938 – Nuclear Methods (Density and Moisture Content)

B. Nuclear Density Testing Procedures

- 1. Equipment
 - a. Nuclear density gauge shall conform to ASTM D6938.
 - b. Gauge shall be calibrated in accordance with manufacturer's recommendations and verified at intervals required by the standard.
 - c. Operator shall be properly trained and licensed in accordance with Illinois Emergency Management Agency (IEMA) requirements for radioactive materials handling.
- 2. Test Locations
 - a. Tests shall be taken at representative locations as directed by the Engineer.

- b. Minimum testing frequency shall be:
 - 1) One test per lift per 2,500 square feet of placed fill.
 - 2) One test per 100 linear feet of trench per lift.
 - 3) Additional tests where visual observation indicates potential non-uniform compaction.
- c. Testing locations shall be staggered between lifts to provide representative coverage.

C. Testing Procedure

- 1. Tests shall be performed on each compacted lift prior to placement of subsequent lifts.
- 2. Lift thickness shall not exceed those specified in this Section.
- 3. Surface shall be smooth and level to ensure proper seating of the gauge.
- 4. Density shall be determined using direct transmission method unless otherwise approved.
- 5. Moisture content shall be recorded for each test.

D. Acceptance Criteria

- 1. Compaction shall meet or exceed the specified percentage of maximum dry density for the applicable area classification (foundations, pavements, slabs, trenches, etc.).
- 2. Moisture content at time of compaction shall comply with specified limits (not less than 2 percent below optimum unless otherwise approved).

E. Failed Tests

- 1. Areas failing to meet compaction requirements shall be:
 - a. Reworked by scarifying, adjusting moisture content, and recompacting; or
 - b. Removed and replaced as directed.
- 2. Retesting shall be performed until compliance is achieved.

3. Costs associated with rework and retesting due to failed compaction shall be borne by the Contractor.

F. Documentation

1. Testing laboratory shall provide written reports including:
 - a. Test location.
 - b. Elevation and lift designation.
 - c. Dry density.
 - d. Maximum dry density (Proctor value).
 - e. Percent compaction achieved.
 - f. Moisture content.
 - g. Pass/Fail determination.
2. Copies of reports shall be submitted to the Engineer and Contractor within 48 hours of testing.

3.08 FINISHED GRADES AND TOLERANCES

A. Finished surface tolerance:

1. Within building areas: ± 1 inch.
2. Under pavements: ± 1 inch.
3. General site fill: ± 1 inch.

- B. Final grades shall provide positive drainage and shall not result in erosion or damage to adjacent properties.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor and shall be incidental to the LUMP SUM price for EXCAVATION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 31 23 23

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish all labor, materials, equipment, supervision, and incidentals necessary to implement temporary and permanent erosion and sedimentation control measures for all phases of the Work, as indicated on the Drawings and as specified herein.
- B. Section Intent:
 - 1. Provide erosion and sediment control measures sufficient to:
 - a. Prevent sediment from leaving the project limits.
 - b. Protect adjacent properties, waterways, storm sewers, and public rights-of-way.
 - c. Comply with applicable federal, state, and local environmental regulations.
- C. Section Includes:
 - 1. Temporary erosion control measures.
 - 2. Permanent erosion control devices.
 - 3. Silt retention basins and sediment traps.
 - 4. Silt fence systems.
 - 5. Straw bale ditch checks.
 - 6. Erosion control blanket/matting.
 - 7. Temporary and permanent seeding.
 - 8. Stabilized construction entrances (where shown).
 - 9. Inlet protection devices.
- D. The Contractor shall be solely responsible for the installation, inspection, maintenance, repair, and removal of all temporary erosion and sediment control measures.

1.02 RELATED SECTIONS

- A. Section 01 57 19 – Temporary Environmental Controls
- B. Section 31 23 16 – Excavation
- C. Section 32 90 00 – Planting

1.03 REFERENCES

- A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction (Adopted April 1, 2022), including applicable Supplemental Specifications.
- B. Illinois Environmental Protection Agency: Illinois Urban Manual, latest edition.
- C. IDOT Standard Drawing 280001 – Temporary Erosion Control Systems.

1.04 SUBMITTALS

- A. Submit Storm Water Pollution Prevention Plan (SWPPP) acknowledgment and Contractor Certification Statement.
- B. Copy of IEPA Notice of Intent (NOI) confirmation and proof of fee payment.
- C. Traffic Control Plan (TCP) when work impacts public roadways, access drives, or pedestrian facilities.
- D. Documentation of required permits for lane closures, right-of-way work, or nighttime operations.
- E. Submit product data for erosion control blankets, silt fence fabric, and other proprietary systems.
- F. Submit certification that materials comply with IDOT specifications.

1.05 ENVIRONMENTAL CONDITIONS

- A. Temporary erosion control during clearing, grubbing, and earthwork operations shall comply with IDOT Standard Specifications and applicable standard drawings.
- B. Provide silt fence, straw ditch checks, erosion control blanket, temporary seeding, and other measures as necessary to prevent erosion and off-site sedimentation.

- C. Coordinate temporary measures with permanent erosion control features to ensure economical, effective, and continuous erosion control throughout construction and post-construction stabilization.
- D. All disturbed earth surfaces shall be seeded or otherwise stabilized immediately following final grading.
- E. No area shall remain unprotected for more than seven (7) calendar days without stabilization unless otherwise permitted by the Engineer.

1.06 PERMITS AND UTILITIES

- A. Secure permits as required in Section 01 57 19 – Temporary Environmental Controls

PART 2 PRODUCTS

2.01 GENERAL

- A. Materials shall conform to IDOT Standard Specifications and the Illinois Urban Manual.

2.02 EROSION CONTROL MATERIALS

- A. Hay or Straw Bales:
 - 1. Bales shall be clean, weed-free hay or straw.
 - 2. Compact, rectangular bales securely bound with biodegradable or synthetic twine.
 - 3. Anchored with minimum 2-inch by 2-inch hardwood stakes, driven a minimum of 18 inches into the ground.
- B. Silt Fence:
 - 1. Geotextile fabric meeting IDOT requirements for filtration and tensile strength.
 - 2. Posts: Steel or hardwood stakes spaced as specified in IDOT standards.
 - 3. Installed with trenching and backfilling to prevent undermining.
- C. Erosion Control Blanket:
 - 1. Biodegradable matting suitable for slope protection.

- 2. Installed per manufacturer's instructions and IDOT standards.
- D. Temporary Seed:
 - 1. Seed mix in accordance with IDOT requirements for seasonal application.
 - 2. Applied with fertilizer and mulch as required.
- E. Sediment Basins and Traps:
 - 1. Constructed of earth embankments or other approved materials.
 - 2. Outlet structures designed to control discharge velocity and minimize erosion.

PART 3 EXECUTION

3.01 INSPECTION

- A. The Contractor shall inspect erosion and sediment control measures:
 - 1. At least once every seven (7) calendar days.
 - 2. Within 24 hours after any rainfall event of 0.5 inch or greater.
- B. Document inspections and corrective actions. Provide records to the Engineer upon request.

3.02 INSTALLATION – TEMPORARY EROSION CONTROL

- A. Install perimeter controls prior to commencement of earth-disturbing activities.
- B. Incorporate permanent erosion control features into the Work at the earliest practicable time.
- C. Where permanent stabilization cannot immediately follow grading operations, provide temporary measures between construction stages.
- D. Install silt fence at locations necessary to prevent sediment deposition in:
 - 1. Roadway ditches.
 - 2. Storm sewer systems.
 - 3. Adjacent properties.

- E. Remove accumulated sediment when it reaches one-third the height of the control device and return sediment to graded areas or dispose of properly.

3.03 MAINTENANCE

- A. Maintain all erosion and sediment control systems in effective operating condition for the duration of the Contract.
- B. Repair or replace damaged devices immediately.
- C. Maintain temporary seeding, mulch, and blankets until permanent stabilization is achieved.
- D. Remove temporary measures upon establishment of permanent vegetation or as directed by the Engineer.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor and shall be incidental to the LUMP SUM price for EXCAVATION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 31 25 00

DIVISION 32 – EXTERIOR IMPROVEMENTS

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PART 1 GENERAL

1.01 SUMMARY

- A. Work under this Section shall consist of furnishing all labor, materials, equipment, controls, wiring, accessories, and incidentals necessary to provide complete, operable automatic gate operator systems for chain link vehicular gates as indicated on the Drawings and specified herein.
- B. The Contractor shall provide complete systems including operators, control panels, safety devices, mounting hardware, electrical components, and integration with gate assemblies specified in Section 32 31 13 – Chain Link Fence and Gates.
- C. Gate operators shall be fully automatic, electrically powered units designed for continuous-duty service in municipal and wastewater facility environments.

1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-In Place Concrete
- B. Section 32 31 13 – Chain Link Fence and Gates.

1.03 REFERENCES

- A. Comply with the latest editions of the following standards:
 - 1. UL 325 – Door, Drapery, Gate, Louver, and Window Operators and Systems.
 - 2. ASTM International applicable material standards.
 - 3. National Electrical Manufacturers Association (NEMA) – Enclosures for Electrical Equipment.
 - 4. National Fire Protection Association (NFPA) 70 – National Electrical Code (NEC).
 - 5. Institute of Electrical and Electronics Engineers (IEEE) – Applicable electrical standards.

1.04 SYSTEM DESCRIPTION

- A. Gate operators shall be designed for horizontal slide gates unless otherwise indicated. Where swing gates are shown, provide operators specifically designed for that configuration.

- B. Operators shall be industrial/commercial grade, rated for the gate size, weight, and duty cycle required. Units shall be suitable for continuous-duty operation in exterior environments.
- C. System shall include the following components:
 - 1. Electric gate operator with integral gear reduction and motor.
 - 2. Control panel with programmable logic controller or microprocessor-based controls.
 - 3. Safety devices including monitored photoelectric sensors and edge sensors.
 - 4. Radio receiver and transmitters (minimum two transmitters per gate unless otherwise indicated).
 - 5. Keyed manual disconnect for emergency operation.
 - 6. Loop detectors and in-ground vehicle detection loops where shown.
 - 7. Audible alarm and flashing warning light during gate movement.
- D. Provide all mounting brackets, posts, reinforcing members, anchor bolts, and hardware required for a complete installation.

1.05 SUBMITTALS

- A. Product Data: Manufacturer's technical literature including rated gate weight, maximum gate length, duty cycle, motor horsepower, voltage requirements, enclosure rating, and safety features.
- B. Shop Drawings:
 - 1. Layout drawings indicating operator placement, clearances, conduit routing, and control device locations.
 - 2. Wiring diagrams and schematic control diagrams.
 - 3. Foundation details for operator mounting pad.
- C. Certifications:
 - 1. Evidence of compliance with UL 325.
 - 2. NEMA enclosure rating certification.

D. Operation and Maintenance Manuals:

1. Installation instructions.
2. Wiring diagrams.
3. Parts lists.
4. Recommended maintenance procedures.

1.06 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of five (5) years documented experience manufacturing commercial gate operators.
- B. Installer shall be experienced in automatic gate operator installation with at least three (3) similar installations completed within the past five (5) years.
- C. Electrical work shall be performed by licensed electricians in accordance with applicable codes.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in original packaging, labeled with manufacturer's identification.
- B. Store in a dry, protected location off the ground. Protect from moisture, dirt, and damage.
- C. Replace damaged components at no additional cost to the Owner.

1.08 GUARANTEE

- A. Provide manufacturer's standard warranty, not less than two (2) years from date of Substantial Completion.
- B. Warranty shall include parts and labor for defects in materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable manufacturers include:
 1. LiftMaster.
 2. DoorKing.

3. FAAC.
4. HySecurity.
5. Approved equal meeting all specified requirements.

2.02 SLIDE GATE OPERATORS

- A. Type: Electromechanical or hydraulic slide gate operator, pad-mounted configuration.
- B. Electrical Requirements:
 1. 120V or 240V single phase unless otherwise indicated.
 2. Control voltage 24V nominal.
- C. Motor:
 1. Continuous-duty rated.
 2. Thermal overload protection.
 3. Sized to operate gate at a speed of approximately 10 to 12 inches per second unless otherwise noted.
- D. Drive Mechanism:
 1. Enclosed gear reducer with oil bath lubrication or sealed lubrication system.
 2. Heavy-duty chain or rack-and-pinion drive.
- E. Capacity:
 1. Rated for gate weight and length as shown on Drawings, minimum 1,000 pounds and 30-foot gate length unless otherwise indicated.
- F. Enclosure:
 1. NEMA 3R minimum for outdoor installation.
 2. Lockable, weather-resistant steel or aluminum housing.

2.03 SWING GATE OPERATORS (WHERE INDICATED)

- A. Type: Linear arm or articulated arm operator suitable for industrial swing gates.
- B. Duty: Continuous-duty, rated for gate leaf weight and width indicated.
- C. Provide positive stops and adjustable limit switches.

2.04 CONTROLS AND ACCESSORIES

- A. Control Board:
 - 1. Microprocessor-based controller with programmable open/close timing.
 - 2. Adjustable auto-close timer.
 - 3. Soft-start and soft-stop capability.
 - 4. Obstruction sensing with automatic reverse.
- B. Safety Devices:
 - 1. Monitored photoelectric sensors complying with UL 325.
 - 2. Safety edge sensors at leading edge of gate where required.
 - 3. Audible alarm and flashing beacon during gate motion.
- C. Access Controls:
 - 1. Radio receiver with minimum two (2) transmitters per gate.
 - 2. Keypad entry station where shown.
 - 3. Card reader integration where required.
 - 4. Interface contacts for SCADA monitoring
- D. Vehicle Detection:
 - 1. In-ground inductive loop detectors with preformed loops and lead-in cable.
 - 2. Loop detector module installed in operator enclosure or separate NEMA enclosure.
- E. Manual Operation:
 - 1. Provision for manual release with keyed lock.

2. Gate shall be operable manually without removal of operator.

2.05 FINISHES

- A. Exposed steel components shall be galvanized or factory-coated for corrosion resistance.
- B. Finish color shall be selected by Owner from manufacturer's standard colors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that gate assemblies are properly installed, plumb, level, and operate freely prior to operator installation.
- B. Verify electrical service is of correct voltage and capacity.

3.02 INSTALLATION

- A. Install operators in accordance with manufacturer's written instructions and approved shop drawings.
- B. Mount operators on reinforced concrete pads sized per manufacturer's recommendations. Anchor securely with stainless steel or galvanized anchor bolts.
- C. Install conduit, wiring, and grounding in accordance with Section 26 00 00 and NFPA 70.
- D. Install safety devices at heights and locations complying with UL 325 requirements.
- E. Adjust gate hardware as required to ensure smooth operation without binding.

3.03 FIELD QUALITY CONTROL

- A. Test gate operator for proper operation through a minimum of ten (10) complete open and close cycles.
- B. Verify proper operation of all safety devices, including obstruction sensing and automatic reversal.
- C. Demonstrate system operation to Owner.

3.04 TRAINING

DIVISION 32 – EXTERIOR IMPROVEMENTS

Section 32 31 11 – Gate Operators

- A. Provide on-site training for Owner's personnel, minimum two (2) hours, covering operation, safety features, and routine maintenance.

3.05 CLEANING AND PROTECTION

- A. Remove debris and excess materials from site.
- B. Protect installed equipment from damage until Substantial Completion.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the unit price for pay item FENCING related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 32 31 11

PART 1 GENERAL

1.01 SUMMARY

- A. Work under this Section includes furnishing all labor, materials, hardware, accessories, tools, equipment, services, and incidentals necessary to complete chain link fence and gate systems as indicated on the Drawings and as specified herein.
- B. Work includes, but is not limited to:
 - 1. Chain link fence fabric.
 - 2. Fence framework, posts, and rails.
 - 3. Barbed wire and extension arms.
 - 4. Bottom tension wire.
 - 5. Swing and sliding gates.
 - 6. Gate hardware and accessories.
 - 7. All fittings, fasteners, and appurtenances required for a complete installation.
- C. Fence height shall be 6 feet (72 inches), exclusive of barbed wire, unless otherwise indicated on the Drawings.

1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Section 32 23 16 – Excavation.
- C. Section 32 31 11 – Gate Operators.

1.03 REFERENCES

- A. ASTM A36 Standard Specification for Carbon Structural Steel
- B. ASTM A121 Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
- C. ASTM A392 Standard Specification for Zinc-Coated Steel Chain-Link Fabric

- D. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-dip Galvanized Coatings
- E. ASTM A817 Standard Specification for Metallic-Coated Steel Wire for Chain Link Fence Fabric and Marcellled Tension Wire
- F. ASTM A824 Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link
- G. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Bars, Rods, Wire Profiles and Tubes
- H. ASTM F552 Standard Terminology Relating to Chain Link Fencing
- I. ASTM F567 Standard Practice for Installation of Chain Link Fence
- J. ASTM F626 Standard Specification for Fence Fittings
- K. ASTM F900 Standard Specification for Industrial and Commercial Swing Gates
- L. ASTM F1043 Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
- M. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
- N. ASTM F1184 Standard Specification for Industrial and Commercial Horizontal Slide Gates
- O. ASTM F1910 Standard Specification for Long Barbed Tape Obstacles
- P. ASTM F1911 Standard Practice for Installation of Barbed Tape
- Q. ASTM F2200 Standard Specification for Automated Vehicular Gate Construction
- R. UL 325 Door, Drapery, Gate, Louver and Window Operators
- S. WLG2445 Chain Link Fence Manufacturers Institute, Chain Link Fence Wind Load Guide for the Selection of Line Posts and Line Post Spacing

1.04 SUBMITTALS

- A. Shop Drawings: Submit complete shop drawings and product data for approval prior to fabrication. Include:
 - 1. Fence layout and alignment.

2. Post spacing and embedment depths.
 3. Gate details and hardware.
 4. Barbed wire configuration.
 5. Connection details and accessories.
- B. Bill of Materials: Submit a complete material list identifying all components.
- C. Certifications: Submit manufacturer's certification that chain link fabric complies with applicable ASTM standards.
- D. Qualifications: Submit a list of at least three (3) fence projects of similar scope completed within the last two (2) years.

1.05 QUALITY ASSURANCE

- A. Manufacturer: Company having manufacturing facilities in the United States with a minimum 5 years experience specializing in manufacturing of chain link fence products.
- B. Fence contractor: Contractor having 5 years experience installing similar projects in accordance with ASTM F567.
- C. Single source: To ensure system integrity obtain the chain link system, framework, fabric, fittings, gates and accessories from a single source.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original, unopened packages with manufacturer identification.
- B. Store materials off the ground, protected from moisture, corrosion, and damage.

1.07 GUARANTEE

- A. Provide a written warranty covering defects in materials and workmanship for a period of one (1) year from the date of final acceptance by the Owner.
- B. Repair or replace defective materials and workmanship at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Approved Manufacturer:
 - 1. Master Halco, Inc.
3010 Lyndon B Johnson Freeway
Dallas, TX. 75234
Phone (800) 883-8384
- B. Engineer approved equal

2.02 CHAIN LINK FABRIC

- A. Fabric shall be aluminum-coated (aluminized) steel chain link fabric conforming to ASTM A491.
- B. Wire shall be aluminum-coated prior to weaving in accordance with ASTM A817.
- C. Fabric Characteristics:
 - 1. Mesh size: 2-inch.
 - 2. Wire gauge: 9 gauge (0.148 inch diameter).
 - 3. Fence height: 72 inches.
 - 4. Selvage: Twisted at top and knuckled at bottom. For fabric 72 inches and taller, one selvage shall be twisted and the opposite knuckled.
- D. Breaking strength of wire shall conform to ASTM A817 for 9 gauge aluminum-coated wire.

2.03 FRAMEWORK

- A. General: Framework shall be hot-dip galvanized steel pipe complying with ASTM F1043, Group IA, Schedule 40 pipe complying with ASTM F1083.
- B. Line Posts:
 - 1. Outside Diameter: 1.900 inches OD.
 - 2. Galvanized coating per ASTM F1043.
- C. Terminal Posts (End, Corner, and Gate Posts):
 - 1. Outside Diameter: 2.375 inches OD minimum unless otherwise indicated for gate size.

2. Galvanized coating per ASTM F1043.

D. Top Rail:

1. 1.660 inches OD galvanized steel pipe.
2. Provide rail sleeves per ASTM F626.

- E. Brace Rails and Truss Rods: Provide horizontal brace rail and adjustable truss rod assemblies at each terminal post. Truss rods shall comply with ASTM F626.

2.04 FITTINGS

- A. Fittings shall comply with ASTM F626 and be hot-dip galvanized.
- B. Provide post caps, loop caps, rail ends, tension bands, brace bands, tension bars, truss rods, carriage bolts, and wire ties as required for a complete installation.
- C. Tension Bars: Minimum 3/16 inch by 3/4 inch galvanized steel.
- D. Wire Ties: 9 gauge galvanized steel spaced as specified.

2.05 TENSION WIRE

- A. Bottom tension wire shall comply with ASTM A824, 7 gauge galvanized steel wire.
- B. Install 4 inches above finished grade.

2.06 BARBED WIRE

- A. Provide three strands of barbed wire above fence fabric.
- B. Barbed wire shall comply with ASTM A121, 12-1/2 gauge, 4-point barbs.
- C. Support Arms:
 1. Pressed steel barb arms complying with ASTM F626.
 2. Type I, single arm, 45-degree outward slope.
 3. Provide sufficient arms to support three strands.

2.07 SWING GATES

- A. Gates shall comply with ASTM F900.
- B. Gate frame shall be welded galvanized steel pipe matching fence framework.
- C. Gate fabric shall match fence fabric specification.
- D. Hinges shall permit 180-degree swing.
- E. Latch shall be forked type with provision for padlock.
- F. Double gates shall include drop rod and center stop.

2.08 POST SETTING MATERIALS

- A. Concrete shall have minimum 28-day compressive strength of 3,000 psi.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify layout, property lines, and finished grades prior to installation.

3.02 INSTALLATION – FRAMEWORK

- A. Install fence in accordance with ASTM F567.
- B. Post Spacing: Maximum 10 feet on center unless otherwise indicated.
- C. Post Setting:
 - 1. Set terminal and line posts in concrete.
 - 2. Embed posts minimum 36 inches below grade.
 - 3. Hole diameter shall be minimum four times post diameter.
 - 4. Crown concrete to shed water.
- D. Install top rail continuously through line post tops.
- E. Install horizontal brace rail and truss rod at each terminal post.

3.03 INSTALLATION – FABRIC

- A. Install fabric on security side of fence.
- B. Stretch fabric taut and secure to terminal posts with tension bars and bands spaced maximum 15 inches on center.
- C. Secure fabric to line posts at 15 inches on center and to top rail at 24 inches on center.
- D. Install bottom tension wire and secure fabric to tension wire with hog rings at 24 inches on center.
- E. Maintain 2 inches clearance between bottom of fabric and finished grade.

3.04 INSTALLATION – BARBED WIRE

- A. Install three strands uniformly spaced on 45-degree arms sloping outward.
- B. Stretch tightly and secure to each arm.

3.05 GATE INSTALLATION

- A. Install gates plumb and level in accordance with ASTM F567.
- B. Set gate posts in concrete sized to support gate loads.
- C. Adjust hinges and latches for smooth operation.

3.06 CLEANING

- A. Remove debris and excess materials from site.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for FENCING related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 32 31 13

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes furnishing all labor, materials, equipment, and supervision necessary to complete landscape installation, including but not limited to:
 - 1. Fine grading of planting areas.
 - 2. Topsoil placement and soil preparation.
 - 3. Seeding and mulching.
 - 4. Tree, shrub, and groundcover planting.
 - 5. Fertilizing and soil amendments.
 - 6. Planting bed preparation and edging.
 - 7. Mulch installation.
 - 8. Watering and establishment.
 - 9. Maintenance during establishment period.
- B. Work shall comply with applicable requirements of the Illinois Department of Transportation (IDOT) Standard Specifications for Road and Bridge Construction, latest edition.
- C. Landscaping shall be suitable for climatic conditions typical of the State of Illinois (USDA Hardiness Zones 5a–6b).

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures
- B. Section 31 25 00 – Erosion and Sedimentation Controls
- C. Section 31 14 13 – Earth Stripping and Stockpiling

1.03 REFERENCES

- A. Illinois Department of Transportation (IDOT) – Standard Specifications for Road and Bridge Construction, Section 250 (Seeding) and Section 251 (Mulching).
- B. American National Standards Institute (ANSI):

1. ANSI Z60.1 – American Standard for Nursery Stock.
2. ANSI A300 – Tree Care Operations.
- C. International Society of Arboriculture (ISA) – Best Management Practices.

1.04 SUBMITTALS

- A. Product Data:
 1. Seed mix composition and supplier certification (IDOT approved source).
 2. Fertilizer analysis and manufacturer data.
 3. Mulch product data.
 4. Herbicides (if specified).
- B. Plant List:
 1. Submit botanical and common names, sizes, quantities, and nursery sources.
- C. Soil Analysis:
 1. Submit soil test from an Illinois-recognized agricultural testing laboratory indicating pH, nutrient levels, and recommended amendments.
- D. Seeding Plan:
 1. Submit equipment list, calibration method, schedule, and application rates.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Contractor shall have minimum three (3) years documented experience in landscape installation and turf establishment in Illinois.
- B. Plants shall conform to ANSI Z60.1 standards.
- C. Landscape Professional Requirements:
 1. The Contractor shall retain and employ one of the following qualified professionals for plant selection review and soil condition verification:

- a. A Registered Landscape Architect licensed in the State of Illinois;
or
 - b. A professional Landscape Contractor with minimum five (5) years
documented experience in Illinois landscape installation; or
 - c. A commercial Nursery operating within the State of Illinois with
demonstrated expertise in supplying nursery stock meeting ANSI
Z60.1 standards.
2. The retained professional shall:
- a. Review proposed plant species and confirm suitability for USDA
Hardiness Zones 5a–6b and specific project site conditions.
 - b. Evaluate existing soil conditions based on submitted soil testing.
 - c. Verify soil pH, drainage characteristics, and nutrient levels are
appropriate for selected species.
 - d. Recommend soil amendments as necessary to ensure successful
plant establishment.
 - e. Provide written certification, submitted with plant submittals,
stating that selected plant material and soil conditions are
appropriate for long-term viability in Illinois climate conditions.
- D. All costs associated with retaining such professional services shall be incidental
to the Contract Sum.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver plants fresh, sound, and healthy. Protect root balls from drying and
damage.
- B. Store seed in sealed containers in dry location.
- C. Protect sod (if used) from drying and overheating.

1.07 PLANTING SEASONS

- A. Seeding operations shall occur between:
 - 1. April 1 – June 15
 - 2. August 1 – November 1

- 3. Unless otherwise approved in writing.
- B. Trees and shrubs shall be planted during recognized spring or fall planting seasons appropriate for Illinois climate conditions.
- C. Do not plant in frozen, saturated, or excessively dry soil conditions.

1.08 WARRANTY AND ESTABLISHMENT

- A. Provide a one (1) year warranty from date of Substantial Completion for:
 - 1. Trees
 - 2. Shrubs
 - 3. Groundcovers
 - 4. Seeded turf areas
- B. Replace dead, missing, or unhealthy plant material at no cost to Owner.
- C. Turf areas must achieve a minimum 95% uniform stand prior to final acceptance. Reseed deficient areas as required.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

- A. Design based on recommendations by:

Kiefer Landscaping LLC
3110 S Banker St
Effingham, IL 62401
(217) 347-7500

2.02 TOPSOIL

- A. Natural, friable loam free of subsoil, debris, stones over 1 inch, and toxic materials.
- B. pH range: 5.5 to 7.5 unless soil test indicates adjustment required.
- C. Organic matter content: 3–8%.

2.03 SOIL AMENDMENTS

- A. Agricultural limestone meeting IDOT requirements.

- B. Compost: Well-decomposed, weed-free organic compost.
- C. Fertilizer:
 - 1. Trees/Shrubs: Slow-release fertilizer tablets (minimum 12-8-8 analysis unless soil test indicates otherwise).
 - 2. Turf: Starter fertilizer as recommended by soil test and compliant with Illinois nutrient management regulations.

2.04 SEED

- A. Seed mixture shall be proportioned by Pure Live Seed (PLS) percentage.
- B. Seed mix shall be appropriate for Illinois climate and site conditions (sun/shade, native, detention basin, etc.).
- C. Provide certification of origin, purity, germination rate, and seed count per pound.
- D. All seed shall comply with USDA Federal Seed Act and IDOT requirements.

2.05 MULCH

- A. Straw mulch for seeded areas per IDOT Section 251.
- B. Shredded hardwood or aged pine bark mulch for planting beds.
- C. Mulch depth:
 - 1. 2–3 inches in planting beds
 - 2. As specified by IDOT for seeded areas

2.06 PLANTS

- A. General
 - 1. All plant material shall conform to ANSI Z60.1 – American Standard for Nursery Stock.
 - 2. Plants shall be nursery grown under climatic conditions similar to those in the State of Illinois (USDA Zones 5a–6b).
 - 3. Plants shall be free of disease, insect infestation, girdling roots, structural defects, or mechanical injury.

4. Contractor shall verify plant availability prior to procurement.
5. Substitutions shall require written approval by Owner.
6. Final plant selections shall be reviewed and approved in writing by the qualified landscape professional retained under Part 1.05 prior to procurement and delivery to the site.

B. Evergreen Screening Trees

1. The following species are identified as acceptable and recommended for privacy screening and windbreak applications. Final selection shall be made by the Owner from available nursery stock submitted by the Contractor.
 - a. *Thuja standishii* × *plicata* (Green Giant Arborvitae)
 - b. *Picea abies* (Norway Spruce)
 - c. *Pinus strobus* (Eastern White Pine)
 - d. *Thuja occidentalis* 'Smaragd' (Emerald Green Arborvitae)
 - e. *Thuja occidentalis* 'Techny' (Techny Arborvitae)
 - f. *Tsuga canadensis* (Canadian Hemlock)
 - g. *Abies concolor* (White Fir)
2. Minimum Size Requirement
 - a. All screening trees furnished under this Section shall meet the following:
 - 1) Minimum Height at Installation: 8 to 10 feet.
 - 2) Height shall be measured in accordance with ANSI Z60.1 standards.
 - 3) Trees smaller than 8 feet or larger than 10 feet shall not be furnished without written approval of the Owner.
 - 4) All height measurements shall be taken with branches in normal position and prior to pruning.

C. Seeding Mixtures

1. Fertilizing and seeding work shall be done in accordance with the IDOT Standard Specifications, Section 250, "Seeding".

- a. Final Seeding

- 1) IDOT Class 1B – Low Maintenance Lawn Mixture

- a) Fine Leaf Turf-Type Fescue - 150 lbs/acre
 - b) Lawn Mixture Perennial Ryegrass - 20 lbs/acre
 - c) Red Top - 10 lbs/acre
 - d) Creeping Red Fescue - 20 lbs/acre

- b. Temporary Seeding

- 1) IDOT Class 1B – Temporary Turf Cover Mixture

- a) Perennial Ryegrass - 50 lbs/acre
 - b) Cover Mixture Oats, Spring - 64 lbs/acre

- D. Substitutions require written approval.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify site grading and soil preparation completed prior to planting. Do not proceed until unsatisfactory conditions are corrected.

3.02 SOIL PREPARATION

- A. Remove stones larger than 1/2 inch, debris, and weeds.
- B. Till soil to minimum depth of 3 inches for turf areas and 12 inches for planting beds.
- C. Incorporate fertilizer and limestone per soil test recommendations.

3.03 TREE AND SHRUB INSTALLATION

- A. Excavate planting pits 2–3 times width of root ball.
- B. Set root flare at or slightly above finished grade.
- C. Remove burlap, rope, and wire basket from top one-third of root ball.
- D. Backfill with approved topsoil mix.

- E. Water thoroughly after planting.
- F. Stake only when necessary; remove staking at end of first growing season.
- G. Apply mulch 2–3 inches deep, keeping clear of trunk flare.

3.04 SEEDING

- A. Prepare seedbed in accordance with IDOT Section 250.
- B. Mechanically drill seed for direct soil contact.
- C. Roll seeded areas within 12 hours unless drill-seeded.
- D. Apply mulch per IDOT Section 251 immediately following seeding.
- E. Protect seeded areas from traffic.

3.05 WATERING

- A. Contractor responsible for watering until final acceptance.
- B. Provide minimum 1 inch of water per week (rainfall plus irrigation).
- C. Maintain adequate moisture for turf establishment and root development.

3.06 MAINTENANCE

- A. During establishment period:
 - 1. Water as required.
 - 2. Remove weeds by mechanical means.
 - 3. Replace dead plant material.
 - 4. Mow turf at 2.5–3 inches height once established.
 - 5. Re-mulch as necessary.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor and shall be incidental to the LUMP SUM price for LANDSCAPING related to plans titled W2E WATER TREATMENT PLANT.

DIVISION 32 – EXTERIOR IMPROVEMENTS

Section 32 90 00 – Planting

END OF SECTION 32 90 00

DIVISION 33 – UTILITIES

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PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of the minimum requirements for the disinfection of water treatment plants, including facility preparation, application of chlorine to the interior surfaces of water treatment units, and sampling and testing for the presence of total coliform bacteria. All surfaces in contact with finished water shall be disinfected.

1.02 RELATED SECTIONS

- A. Section 33 05 05 - Buried Pipe Installation
- B. Section 33 05 19 - Ductile Iron Pipe
- C. Section 33 05 31 - Thermoplastic Utility Pipe
- D. Section 33 16 23 - Ground-Level Steel Water Storage Tank
- E. Section 33 16 33 - Prestressed Concrete Water Storage Tanks
- F. Section 43 10 00 - Recarbonation Tank
- G. Section 43 23 21 - Between-Bearings Impeller Centrifugal Pumps
- H. Section 43 41 13 - Elevated Pillar-Type Steel Water Storage Tank
- I. Section 46 43 53 - Solids Contact Clarifiers
- J. Section 46 61 26 -High Rate Sand Filters

1.03 REFERENCES

- A. AWWA C651 Disinfecting Water Mains
- B. AWWA C652 Disinfection of Water Storage Facilities
- C. AWWA C653 Disinfection of Water Treatment Plants
- D. AWWA C654 Disinfection of Wells
- E. 35 Illinois Administrative Code, Title 602 Permits

1.04 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01 33 00 – Submittal Procedures, Division 1 – General Requirements. In addition, the Contractor shall provide the following specific information:
 - 1. The location, type, and quantity of disinfectant to be used.
 - 2. A comprehensive plan detailing components to be disinfected, procedure, and dates for disinfection and testing.
- B. Laboratory testing results

1.05 QUALITY ASSURANCE

- A. Disinfection of potable water mains and appurtenances shall conform to the requirements of the “Standard Specifications for Construction of Water and Sewer Main in Illinois”, 8th Edition (2020), and to the Rules and Regulations for Public Water Supplies as issued by the Illinois Pollution Control Board. Disinfection procedures shall also comply with the applicable provisions of American Water Works Association (AWWA) Standard C651, “Disinfecting Water Mains,” latest edition.
- B. All disinfecting agents shall be suitable for use in potable water systems and shall be certified in accordance with NSF International Standard 61 for Drinking Water System Components – Health Effects.
- C. Chlorination and bacteriological sampling shall be performed by personnel experienced in potable water system disinfection. Bacteriological samples shall be analyzed by a laboratory certified by the State of Illinois for drinking water testing.
- D. The Contractor shall coordinate disinfection activities with the Owner and the local regulatory authority. No newly installed or modified water main shall be placed into service until required bacteriological testing has been completed and written approval for use has been issued by the appropriate regulatory agency.
- E. Instruments used for measuring chlorine residual shall be calibrated and suitable for measuring free chlorine residuals in the range required by AWWA C651.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Disinfecting chemicals, including liquid chlorine, calcium hypochlorite, or sodium hypochlorite, shall be delivered in original, unopened containers bearing manufacturer’s label and concentration data.

- B. Store disinfecting agents in a cool, dry, well-ventilated location in accordance with manufacturer's recommendations and applicable safety regulations. Protect chemicals from moisture, contamination, and exposure to excessive heat or direct sunlight.
- C. Handle and apply disinfecting agents in strict accordance with manufacturer's safety data sheets (SDS) and all applicable federal, state, and local safety regulations. Provide appropriate personal protective equipment for personnel handling chemicals.
- D. Protect newly installed pipe from contamination during storage and installation. Keep pipe ends capped or plugged at all times when work is not in progress. Remove visible dirt and debris from the interior of pipe prior to disinfection.
- E. Dispose of heavily chlorinated water in accordance with applicable environmental regulations. Dechlorinate water prior to discharge to storm sewers, surface waters, or watercourses.

1.07 GUARANTEE

- A. The Contractor shall guarantee that all potable water piping installed under this Contract has been properly disinfected, flushed, and bacteriologically tested in accordance with the Contract Documents and applicable regulatory requirements.
- B. If bacteriological tests indicate the presence of coliform organisms or otherwise fail to meet regulatory requirements, the Contractor shall repeat flushing, chlorination, and testing procedures at no additional cost to the Owner until satisfactory results are obtained.
- C. The guarantee period for disinfection shall be concurrent with the Contract warranty period. Any contamination attributable to defective materials, improper installation, or inadequate disinfection procedures occurring within the warranty period shall be corrected by the Contractor at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 MATERIALS FOR DISINFECTANT CHLORINE SOLUTIONS

- A. Liquid chlorine
 - 1. Liquid chlorine contains 100 percent available chlorine and is packaged in steel containers, usually of 100-lb, 150-lb, or 1-ton net chlorine weight. Liquid chlorine shall be used only:

2. In combination with appropriate gas-flow chlorinators and injectors to provide a solution feed of controlled concentration to the water to be chlorinated
3. Under the direct supervision of a person who is familiar with chlorine's physiological, chemical, and physical properties, and who is trained and equipped to handle any emergency that may arise; and
4. When appropriate safety practices are observed to protect working personnel and the public.

B. Sodium Hypochlorite

1. Sodium Hypochlorite is available in liquid solution form (bleach)
2. Sodium Hypochlorite shall be a minimum of 12.5% available chlorine
3. Sodium Hypochlorite shall be used immediately upon procurement, or stored in a cool, dark, dry environment until such time as it is needed.

C. Calcium Hypochlorite

1. Calcium Hypochlorite is available in granular or tablet form.
2. Calcium Hypochlorite shall possess approximately 65% available chlorine.
3. Calcium Hypochlorite shall be used immediately upon procurement, or stored in a cool, dark, dry environment until such time as it is needed.
4. Calcium Hypochlorite may be difficult to dissolve in water with high calcium hardness (hardness in excess of 100 mg/L).

PART 3 EXECUTION

3.01 PLANT DISINFECTION PROCEDURES

A. Plant Piping

1. Plant process piping downstream of the filter, or the first point of disinfection and pump stations shall be disinfected using one of three alternative methods described in ANSI/AWWA C651, including application methods, chlorine solution strengths, contact times, disposal of highly chlorinated water, and bacteriological sampling and testing.
2. Basic Disinfection Procedure for New Mains

- a. The basic disinfection procedure consists of:
 - 1) Inspecting materials to be used to ensure their integrity
 - 2) Preventing contaminating materials from entering the water main during storage, construction, or repair and noting potential contamination at the construction site.
 - 3) Removing, by flushing or other means, those materials that may have entered the water main or appurtenances

B. Tanks and Clearwells

- 1. Water storage tanks, clearwells, and similar receptacles shall be disinfected using one of the methods described in ANSI/AWWA C652, including application methods, chlorine solution strengths, contact times, disposal of highly chlorinated water, and bacteriological sampling and testing.
 - a. Chlorination Method 1
 - 1) The water-storage facility shall be filled to the overflow level with potable water to which enough chlorine shall be added to provide a free chlorine residual in the full facility of not less than 10 mg/L at the end of the appropriate 6-h or 24-h period.
 - b. Chlorination Method 2
 - 1) A solution of at least 200 mg/L free chlorine shall be applied directly to the surfaces of parts of the storage facility that would be in contact with water when the storage facility is full to the overflow elevation.
 - c. Chlorination Method 3
 - 1) Water and chlorine shall be added to the storage facility in amounts such that the solution will initially contain at least 50 mg/L free chlorine and will fill approximately 5 percent of the total storage volume. This solution shall be held in the storage facility for a period of not less than 6 h. The storage facility shall then be filled to the overflow level by flowing potable water into the highly chlorinated water. It shall be held full for a period of not less than 24 h.

C. Filters

1. Disinfection is required for filter basins and gravel, silica sand, anthracite, and other mixed media materials except granular activated carbon (GAC). Before the filter is placed in service, the entire filter basin up to the maximum water level shall be disinfected by one of the following methods.

- a. Method 1

- 1) Sufficient chlorine shall be injected into the backwash water to produce a free chlorine residual of at least 25 mg/L throughout the filter. The chlorinated water shall be allowed to stand in the filter for at least 12 hr. At the end of the 12-hr contact time, the chlorinated water shall be tested to determine the amount of free chlorine residual. If the free residual is less than 15 mg/L, the chlorination process shall be repeated. Sufficient tests should be made both from the top and bottom of the unit (and at intermediate points if feasible) to ensure the residual readings measure the lowest chlorine level existing in the unit at the end of the 12-hr contact period. If satisfactory chlorine residuals are obtained after the chlorine contact period, the filter shall be run to waste or backwashed thoroughly to remove the highly chlorinated water.

- b. Method 2

- 1) Sufficient chlorine shall be continuously injected into the filter influent water while filtering to waste to produce a free residual of at least 25 mg/L. When water with at least a 25 mg/L free residual chlorine concentration reaches the filter-to-waste, the flow of water shall be stopped, and the filter shall be held full of the chlorinated water for a period of not less than 12 hr. At the end of the 12-hr contact time, the chlorinated water shall be tested to determine the free residual. If the free residual is less than 15 mg/L, the chlorination process shall be repeated. Sufficient tests should be made both from the top and bottom of the unit (and at intermediate points if feasible) to ensure the residual readings measure the lowest chlorine level existing in the unit at the end of the 12-hr contact period. After the chlorine contact period, if satisfactory chlorine residuals are obtained, the filter shall be run to waste or backwashed thoroughly to remove the highly chlorinated water.

2. GAC Filters

- a. GAC cannot feasibly be disinfected in the field. Therefore, when GAC is to be part of the filter media, special care shall be used to protect the GAC from contamination; all other media shall be placed in the filter basin and disinfected.
- b. The GAC must be stored and handled to avoid any contamination. Any equipment used in placing the GAC in the filter must be cleaned and disinfected with a 200 mg/L solution of free residual chlorine immediately before use. This includes shovels, spreading devices, or other equipment that comes in contact with the GAC. In addition, workers shall wear rubber boots and gloves that have been previously disinfected with a 200-mg/L free residual chlorine solution if coming in contact with the carbon or entering the filter.

3.02 CHLORINATED DISCHARGE

- A. If there is any question that the chlorinated discharge will cause damage to the environment, a reducing agent shall be applied to the water to neutralize the residual chlorine.

3.03 BACTERIOLOGICAL SAMPLING

- A. After the disinfection procedure is completed, and before the treatment unit or facility is placed in service, two or more samples shall be taken from the unit or facility not less than 30 min apart and shall be tested for the presence of total coliform bacteria in accordance with Section 9221, 9222, or 9223 of the Standard Methods for the Examination of Water and Wastewater. If none of the samples show the presence of total coliform bacteria, the unit or facility may be placed in service.
- B. If any of the samples show the presence of total coliform bacteria, one of the following procedures shall be followed before placing the unit or facility in service.
 - 1. Take repeat samples at least 24 hr apart until consecutive samples do not show the presence of total coliform bacteria.
 - 2. Chlorinate the unit or facility in accordance with the above stated procedures and resample.

3.04 REPORTING

- A. All bacteriological sampling results from certified testing facilities shall be forwarded to the ENGINEER, regardless of results.

PART 4 PAYMENT

- 4.01 This work shall include the installation, disinfection, sample collection, testing, and all other work necessary to secure an operating permit for the entirety of the plant operation processes and distribution systems related to this contract as required by the IEPA. The above work shall include all equipment, material, and labor; and shall be incidental to the contract unit price per lump sum for REMAINING ITEMS RELATED TO CONTRACT 3 W2E WATER TREATMENT PLANT.

END OF SECTION 33 01 10

PART 1 GENERAL

1.01 SUMMARY

- A. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to install and test all buried piping, fittings, and specials.
- B. The Work includes, but is not limited to, the following:
 - 1. All types and sizes of buried piping, except where specified under other Sections.
 - 2. Buried piping beginning at the outside face of structures or foundations, including piping beneath structures, and extending away from structures.
 - 3. Work on or affecting existing buried piping.
 - 4. Installation of jointing and gasket materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, cathodic protection, supports, restraints, and thrust blocks.
 - 5. Pipe encasements except piping embedded in structural concrete.
 - 6. Field quality control, including testing.
 - 7. Cleaning and disinfecting of potable water mains.
 - 8. Incorporation of valves, hydrants, tapping sleeves, tapping valves, meters, and special items into piping systems.
 - 9. Installation of water mains under roadways and driveways by bore and jack where shown.
 - 10. Installation of tracer wire systems.
- C. Coordinate installation procedures with related Sections and trades.

1.02 RELATED SECTIONS

- A. Section 01 78 39 – Project Record Documents
- B. Section 03 30 00 - Cast-in-Place Concrete
- C. Section 31 23 16 – Excavation
- D. Section 33 05 19 – Ductile Iron Pipe

- E. Section 33 05 31 – Thermoplastic Utility Pipe
- F. Section 33 12 16 - Tapping Sleeves and Valves
- G. Section 40 05 64 - Valves for Actuator Control

1.03 REFERENCES

- A. Standard Specifications for Construction of Water and Sewer Main in Illinois, 8th Edition, 2020.
- B. Illinois Pollution Control Board – Rules and Regulations for Public Water Supplies.
- C. ASTM A48 – Standard Specification for Gray Iron Castings.
- D. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- E. ASTM C924 – Standard Practice for Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method.
- F. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- G.
- H. ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping.
- I. ASTM F1417 – Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
- J. ANSI/AWWA C105/A21.5 – Polyethylene Encasement for Ductile-Iron Pipe Systems.
- K. ANSI/AWWA C111/A21.11 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- L. ANSI/AWWA C206 – Field Welding of Steel Water Pipe.
- M. ANSI/AWWA C500 – Metal-Seated Gate Valves for Water Supply Service.
- N. ANSI/AWWA C502 – Dry-Barrel Fire Hydrants.
- O. ANSI/AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service.

- P. ANSI/AWWA C600 – Installation of Ductile-Iron Water Mains and Their Appurtenances.
- Q. ANSI/AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.
- R. ANSI/AWWA C606 – Grooved and Shouldered Joints.
- S. ANSI/AWWA C651 – Disinfecting Water Mains.
- T. AWWA Manual M9 – Concrete Pressure Pipe.
- U. AWWA Manual M11 – Steel Pipe: A Guide for Design and Installation.
- V. AWWA Manual M23 – PVC Pipe – Design and Installation.
- W. AWWA Manual M41 – Ductile-Iron Pipe and Fittings.
- X. ASCE 37 – Design and Construction of Sanitary and Storm Sewers.
- Y. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Laying schedules for concrete pipe and restrained joints.
 - 2. Details of piping, specials, joints, thrust blocks, and connections.
 - 3. Bore and jack details including casing, spacers, and end seals.
- B. Product Data:
 - 1. Pipe and fittings (DIP, PVC, PVC YM, HDPE).
 - 2. Valves, hydrants, check valves.
 - 3. Tapping sleeves and valves.
 - 4. Tracer wire materials.
- C. Testing Procedures:
 - 1. Submit proposed testing methods, apparatus, sequencing, and forms.

- D. Certificates:
 - 1. Manufacturer certifications of compliance with referenced standards.
- E. Field Test Reports:
 - 1. Hydrostatic, air, deflection, and disinfection reports.
- F. Record Documentation:
 - 1. Record drawings showing actual pipe locations, elevations, offsets, and profiles.

1.05 QUALITY ASSURANCE

- A. Comply with authorities having jurisdiction.
- B. Obtain permits for work in roadways, rights-of-way, railroads, and easements.
- C. Maintain required separation between potable water mains and sewers:
 - 1. Minimum 10 feet horizontal separation.
 - 2. Minimum 18 inches vertical separation unless otherwise approved.
- D. Testing shall be conducted in the presence of the Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to ensure uninterrupted progress.
- B. Inspect materials upon delivery; remove damaged materials from site.
- C. Store materials off ground and protect from deterioration.
- D. Pipe and fittings other than PVC and CPVC may be stored outdoors without cover. Cover PVC and CPVC pipe and fittings stored outdoors.
- E. Handle pipe and fittings in accordance with manufacturer recommendations.
- F. Protect linings and coatings from damage.
- G. Keep pipe interiors free from dirt and foreign matter.

1.07 GUARANTEE

- A. Repair or replace defective materials and workmanship in accordance with Contract requirements.
- B. Contractor shall repair damage to existing utilities occurring prior to new system operation at no additional cost to Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. Piping materials shall be as specified on the Contract Drawings and related specifications.
- B. Each pipe and fitting shall be clearly marked with material, diameter, and class.
- C. Minimum cover shall be 42 inches unless noted otherwise.

2.02 TRACER WIRE

- A. #12 AWG copper clad steel, minimum 450 lb break load, 30 mil HDPE insulation.
- B. Installed continuously along top of pipe and secured at 5-foot intervals.
- C. Lockable dielectric silicon-filled connectors only; non-locking connectors prohibited.
- D. Provide access boxes at hydrants, valves, laterals, and dead ends.
- E. Ground tracer wire at dead ends using magnesium ground rod with insulated grounding wire.
- F. Install tracer wire through all borings.

2.03 IRON CASTINGS

- A. Conform to ASTM A48.
- B. Castings shall be sound, smooth, and free from defects.
- C. Machine surfaces as required for proper fit.

2.04 CASING PIPE FOR BORES

- A. ASTM A53 Grade B steel pipe unless noted otherwise.

- B. Minimum wall thickness of 0.250 inches unless otherwise required by permit.
- C. Bituminous tar lined inside and coated outside.
- D. Provide watertight end seals and casing spacers.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify trench excavation, alignment, and grade prior to pipe installation.
- B. Excavate trench to required lines and grades shown on the Drawings or as directed in writing by the Engineer. Excavation shall not proceed more than is necessary for orderly pipe installation.
- C. Minimum cover over buried water mains shall be 42 inches, measured from finished grade to top of pipe barrel, unless otherwise shown.
- D. Maintain groundwater a minimum of 24 inches below pipe invert during installation. Provide pumping, drainage, and dewatering as required.
- E. Shape trench bottom to provide firm, stable, and uniform support for the full length of pipe.
- F. Where unstable subgrade is encountered, over-excavate to depth directed by Engineer and refill with approved material at no additional cost to Owner.
- G. Where rock is encountered, provide granular bedding:
 - 1. 3 inches minimum for pipe less than 4 inches diameter.
 - 2. 6 inches minimum for pipe 4 inches diameter and larger.
- H. Stockpile excavated material to prevent obstruction of drainage, sidewalks, driveways, hydrants, valve boxes, and other utilities.
- I. Provide temporary support and protection for existing utilities encountered. Coordinate relocation or reconstruction with utility owners.
- J. Implement temporary erosion control measures in accordance with Storm Water Pollution Prevention Plan and applicable standards.

3.02 INSTALLATION

- A. Lay pipe true to line and grade. No deviation permitted without written approval of the Engineer.

- B. Maintain continuous positive or negative grade to eliminate high points and abrupt elevation changes.
- C. Lower pipe, fittings, valves, and accessories into trench using proper equipment. Dropping or dumping materials into trench is prohibited.
- D. Clean interior of pipe prior to installation. Keep pipe clean during installation. Plug open ends at end of each workday.
- E. Do not install pipe under unsuitable trench or weather conditions as determined by Engineer.
- F. Cut pipe neatly and square. Deburr and bevel ends per manufacturer recommendations. Flame cutting prohibited unless approved.
- G. Install fittings, valves, hydrants, and accessories at required locations with stems plumb.
- H. Where existing utilities obstruct alignment or grade, permanently support, relocate, or reconstruct obstruction in coordination with utility owner.
- I. Any pipe that has floated due to water accumulation shall be removed and bedding restored prior to reinstallation.

3.03 INSTALLATION UNDER ROADWAYS AND DRIVEWAYS

- A. Install water mains under permanent roadways and driveways by bore and jack unless otherwise permitted. Open trench construction shall not be permitted within traveled surfaces except where surface is dirt or rock.
- B. Minimum pipe length installed in bores shall be 40 feet.
- C. Casing pipe shall conform to ASTM A53 Grade B steel, minimum 0.250-inch wall thickness or as required by permit.
- D. Provide casing spacers and watertight end seals.
- E. Support water main in bore pits and recovery pits.
- F. Restore damaged pavement equal to or better than original condition.
- G. Open-cut roadway repairs shall include:
 - 1. Sand compacted in 8-inch lifts to within 6 inches of surface.
 - 2. 6 inches compacted CA-6 aggregate surface.

- H. Comply with all permit requirements at no additional cost unless otherwise specified.

3.04 INSTALLATION UNDER CREEKS AND RIVERS

- A. Install water mains by boring without disturbing creek or river beds and banks.
- B. Comply with Department of Natural Resources and drainage district permits.
- C. Provide adequate support for pipe within bore pits.

3.05 JOINTING PIPE

- A. Ductile Iron Mechanical Joint Pipe:
1. Immediately before making joint, wipe clean the socket, plain end, and adjacent areas. Taper cut ends and file off sharp edges to provide smooth surface.
 2. Lubricate plain ends and gasket with soapy water or manufacturer's recommended pipe lubricant, in accordance with ANSI/AWWA C111, just prior to slipping gasket onto plain end of the joint assembly.
 3. Place gland on plain end with lip extension toward the plain end, followed by gasket with narrow edge of gasket toward plain end.
 4. Insert plain end of pipe into socket and press gasket firmly and evenly into gasket recess. Keep joint straight during assembly.
 5. Push gland toward socket and center gland around pipe with gland lip against gasket.
 6. Insert bolts and hand-tighten nuts.
 7. If deflection is required, make deflection after joint assembly and prior to tightening bolts. Alternately tighten bolts approximately 180 degrees apart to seat gasket evenly. Bolt torque shall be as follows:

Pipe Diameter (in)	Bolt Diameter (in)	Range of Torque (ft-lbs)
3	5/8	45 – 60
4 – 24	3/4	75 – 90
30 – 36	1	100 – 120
42 - 18	1.25	120 - 150

Table 1: Mechanical Joint Torque Specifications

8. Bolts and nuts, except those of stainless steel, shall be coated with two coats, minimum dry film thickness of eight mils each, of high build solids epoxy or bituminous coating manufactured by Tnemec, or equal.
 9. Restrained mechanical joints shall be in accordance with Section 33 05 19, Ductile Iron Pipe.
- B. Ductile Iron Proprietary Joints:
1. Install pipe that utilizes proprietary joints for restraint specified in Section 33 05 19, Ductile Iron Pipe, or other such joints, in accordance with manufacturer's instructions.
- C. Thermoplastic Pipe Joints:
1. Solvent Cement Welded Joints:
 - a. Bevel pipe ends and remove all burrs before making joints. Clean pipe and fittings thoroughly. Do not attempt to make solvent cement joints if temperature is below 40 degrees F. Do not make solvent cement welded joints in wet conditions.
 - b. Use solvent cement supplied or recommended by pipe manufacturer.
 - c. Apply joint primer and solvent cement and assemble joints in accordance with recommendations and instructions of manufacturer of joint materials and pipe manufacturer.
 - d. Take appropriate safety precautions when using joint primers and solvent cements. Allow air to circulate freely through pipelines to allow solvent vapors to escape. Slowly admit water when flushing or filling pipelines to prevent compression of gases within pipes.
 2. Bell and Spigot Joints:
 - a. Bevel pipe ends, remove all burrs, and provide a reference mark at correct distance from pipe end before making joints.
 - b. Clean spigot end and bell thoroughly before making the joint. Insert O-ring gasket while ensuring that gasket is properly oriented. Lubricate spigot with manufacturer's recommended lubricant. Do not lubricate bell and O-ring. Insert spigot end of pipe carefully into bell until reference mark on spigot is flush with bell.

3. Mechanical Coupling Joints:

- a. Mechanical couplings include: sleeve-type flexible couplings, split flexible couplings, ANSI/AWWA C606 grooved or shouldered end couplings, plasticized PVC couplings, and other mechanical couplings.
- b. Prior to installing and assembling mechanical couplings, thoroughly clean joint ends with wire brush to remove foreign matter.
- c. For mechanical couplings that incorporate gaskets, after cleaning apply lubricant to rubber gasket or inside of coupling housing and to joint ends. After lubrication, install gasket around joint end of previously installed piece and mate joint end of subsequent piece to installed piece. Position gasket and place coupling housing around gasket and over grooved or shouldered joint ends. Insert bolts and install nuts tightly by hand. Tighten bolts uniformly to produce an equal pressure on all parts of housing. When housing clamps meet metal to metal, the joint is complete and further tightening is not required.
- d. For plasticized PVC couplings, loosen the stainless-steel clamping bands and remove clamps from coupling. Slide coupling over plain ends of pipes to be joined without using lubricants. Place clamps over each end of coupling at grooved section and tighten with torque wrench to torque recommended by manufacturer.

3.06 SEPARATION OF SEWERS AND POTABLE WATER PIPING

A. Horizontal Separation:

1. Where possible, existing and proposed potable water mains and service lines, and sanitary, combined, and storm sewers shall be separated horizontally by clear distance of at least ten feet.
2. If local conditions preclude the specified clear horizontal separation, installation will be allowed if potable water main is in separate trench or on undisturbed earth shelf on one side of sewer and with bottom of potable water main at least 18 inches above top of sewer.
3. Exception:
 - a. Where it is not possible to provide minimum horizontal separation described above, both the water and sewer main shall be constructed of water main quality pipe, either ductile iron, PVC, or HDPE, and shall possess slip on or mechanical joint connections.

The sewer shall be pressure tested to the maximum expected surcharge head before backfilling.

B. Vertical Separation:

1. A watermain shall be separated from a sewer so that its invert is a minimum of eighteen (18) inches above the crown of the sewer whenever water mains cross storm sewers, sanitary sewers, or sewer service connections. Vertical separation shall be maintained for ten feet horizontally from the outside casing of the sewer being crossed.
2. Center a section of potable water main pipe at least 17.5 feet long over sewer so that sewer joints are equidistant from potable water main joints.
3. Provide adequate structural support where potable water main crosses under sewer. At minimum, provide compacted select backfill for ten feet on each side of crossing.
4. Exceptions:
 - a. Where it is not possible to provide minimum vertical separation described above, construct potable water main of cement-lined ductile iron pipe with restrained push-on joint or restrained mechanical joint pipe. Hydrostatically test water main and sewer as specified in this Section, prior to backfilling. Hydrostatic test pressure at crossing shall be at least 150 psi.
 - b. Encase either potable water main or sewer in watertight carrier pipe extending ten feet on each side of crossing, measured perpendicular to potable water main.

3.07 PLUGS

- A. Temporarily plug installed pipe at end of each day of work or other interruption of pipe installation to prevent entry of animals, liquids, and persons into pipe, and entrance or insertion of deleterious materials into pipe.
- B. Install standard plugs in bells at dead ends, tees, and crosses. Cap spigot and plain ends.
- C. Fully secure and block plugs, caps, and bulkheads installed for testing to withstand specified test pressure.
- D. Where plugging is required for phasing of the Work or subsequent connection of piping, install watertight, permanent type plugs, caps, or bulkhead acceptable to Engineer.

3.08 HYDRANT INSTALLATION

- A. Install hydrants plumb with lowest nozzle minimum 18 inches above finished grade.
- B. Provide minimum 1/4 cubic yard coarse stone around base to 12 inches above weep holes.
- C. Set hydrant on concrete block to provide firm bearing.
- D. Provide thrust blocking minimum 1/4 cubic yard bearing against undisturbed soil. Do not obstruct weep holes.
- E. Install auxiliary gate valve with each hydrant.
- F. Field inspect hydrants upon delivery prior to installation.

3.09 THRUST RESTRAINT AND REACTION BLOCKING

- A. Provide thrust blocking or restrained joints at hydrants, valves, bends, tees, reducers, and dead ends.
- B. Thrust blocks shall bear against undisturbed soil.
- C. Install restrained joint systems, tie rods, clamps, or harness assemblies where indicated or required.
- D. Provide thrust restraint at all capped or plugged dead ends.

3.10 TRACER WIRE INSTALLATION

- A. General
 - 1. All piping installed outside of the plant shall have tracer wire.
 - 2. Tracer wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
 - 3. Tracer wire systems must be installed as a single continuous wire, except where using approved connectors. No looping or coiling of wire is allowed.
 - 4. Any damage occurring during installation of the tracer wire must be immediately repaired by removing the damaged wire and installing a new

section of wire with approved connectors. Taping and/or spray coating shall not be allowed.

5. Tracer wire shall be installed at the top of the pipe and secured (taped/tied) at 5' intervals.
6. Tracer wire must be properly grounded as specified.
7. Tracer wire on all service laterals/stubs must terminate at an approved tracer wire access box located directly above the utility, at the edge of the road right-of-way but out of the roadway. (See Tracer wire Termination/Access)
8. At all mainline dead-ends, tracer wire shall go to ground using an approved connection to a drive-in magnesium ground rod, buried at the same depth as the tracer wire. (See Grounding)
9. Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead-end and ground using an approved waterproof connection to a ground rod buried at the same depth as the tracer wire.
10. All service lateral tracer wires shall be a single wire, connected to the mainline tracer wire using an approved mainline to lateral lug connector, installed without cutting/splicing the mainline tracer wire.
11. In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall be connected using approved splice connectors and shall be properly grounded at the splice location as specified.

B. Connectors:

1. All mainline tracer wires must be interconnected in intersections, at mainline tees and mainline crosses using appropriate connectors.
2. Direct bury wire connectors - Shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground tracer wire installation.
3. Non-locking friction fit, twist on or taped connectors are prohibited.

C. Termination/Access

1. All tracer wire termination points must utilize an approved tracer wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.

2. All grade level/in-ground access boxes shall include a dual terminal switchable lid, be appropriately identified with applicable utility cast into the cap, and color coded per APWA standard for the specific utility being marked.
3. A minimum of 2 ft. of excess/slack wire is required in all tracer wire access boxes after meeting final elevation.
4. All tracer wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the tracer wire connection and the terminal for the ground rod wire connection.
5. Ground wire shall be connected to the identified (or bottom) terminal on all access boxes.

D. Grounding

1. Tracer wire must be properly grounded at all dead ends/stubs.
2. Grounding of tracer wire shall be achieved by use of a drive-in magnesium ground rod with a minimum of 20ft of #12 red HDPE insulated copper clad steel wire connected to anode (minimum 1.5 lb.) specifically manufactured for this purpose and buried at the same elevation as the utility.
3. When grounding the tracer wire at dead ends/stubs, the ground rod shall be installed in a direction 180 degrees opposite of the tracer wire, at the maximum possible distance.
4. When grounding the tracer wire in areas where the tracer wire is continuous and neither the mainline tracer wire or the ground rod wire will be terminated at/above grade, install ground rod wire directly beneath and in-line with the tracer wire. Do not coil excess wire from ground rod wire. In this installation method, the ground rod wire shall be trimmed to an appropriate length before connecting to tracer wire with a mainline to lateral lug connector.
5. Where the ground rod wire will be connected to a tracer wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

3.11 PIPE BEDDING

A. Provide uniform and continuous pipe support in accordance with:

1. ANSI A21.1 Field Conditions A, B, E, or F.

2. ASTM D2774.
 3. ASCE Manual 37 / WPCF Manual 9 Class B, C, or D bedding.
- B. Bedding material shall be placed and compacted as required to prevent settlement and maintain alignment.
 - C. Trench excavation and backfill, and bedding materials shall conform to the Standard Specification for Water and Sewer Construction in Illinois.
 - D. Where Engineer deems existing bedding material unsuitable, remove and replace existing bedding with approved granular material furnished, placed, and compacted in accordance with the Standard Specification for Water and Sewer Construction in Illinois.
 - E. Where pipe is installed in rock excavation, provide minimum of three inches of granular bedding material underneath pipe smaller than four-inch nominal diameter, and minimum of six inches of granular bedding material underneath pipes four-inch nominal diameter and larger.
 - F. Excavate trenches below bottom of pipe by amount shown and indicated in the Contract Documents. Remove loose and unsuitable material from bottom of trench.
 - G. Carefully and thoroughly compact pipe bedding with handheld pneumatic compactors.
 - H. Do not lay pipe until Engineer approves bedding condition.
 - I. Do not bring pipe into position until preceding length of pipe has been bedded and secured in its final position.

3.12 BACKFILLING

- A. Place select material by hand to one (1) foot above top of pipe.
- B. Balance of backfill may be machine placed and shall contain no large stones, frozen material, or debris.
- C. Trenches under pavements, sidewalks, and roads shall be compacted to 90 percent density per AASHTO T99. Trench backfill in these areas shall be paid for in accordance with IDOT standards.
- D. Supply additional backfill material if necessary to fill depressions caused by settlement.

3.13 FIELD QUALITY CONTROL

A. Pressure and Leakage Testing

1. Place sufficient backfill prior to testing to prevent pipe movement.
2. Minimum curing time for thrust blocks:
 - a. 7 days for Type I Portland cement.
 - b. 3 days for Type III high-early-strength cement.
3. Slowly fill pipeline and expel air at high points.
4. Test pressures:
 - a. Simultaneous Pressure and Leakage Test
 - 1) 150% of working pressure (not less than 125% of normal working pressure at highest elevation).
 - 2) Duration: 2 hours.
 - b. Separate Pressure Test
 - 1) 150% of working pressure (not less than 125% of normal working pressure at highest elevation).
 - 2) Duration: 1 hour.
 - c. Separate Leakage Test
 - 1) 150% of normal average working pressure.
 - 2) Duration: 2 hours.
5. Leakage defined as quantity of water required to maintain pressure within 5 psi of specified pressure.
6. Allowable leakage:
 - a. Contractor shall furnish gauges, pumps, connections, and apparatus required.
 - b. Repair defects and retest until acceptable.

- c. Contractor shall coordinate flushing and testing with Owner. Water supply may be limited. No additional compensation for delays due to water availability.
- d. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air in the pipeline has been expelled.
- e. No installation will be accepted if the leakage is greater than that determined by the formula:

$$L = ND\sqrt{P} / 7400$$

Where:

L = gallons per hour

N = number of joints

D = nominal pipe diameter (inches)

P = average test pressure (psi)

B. Leakage values determined by the above formula are to found in the table below:

Nominal Pipe Size, inches	Average Pressure in Line – P.S.I.				
	50	100	150	200	250
	Allowable Leakage Per 1000 Feet or 50 Joints				
4	0.19	0.27	0.33	0.38	0.43
6	0.29	0.41	0.50	0.57	0.64
8	0.38	0.54	0.66	0.76	0.85
10	0.48	0.68	0.83	0.96	1.07
12	0.57	0.81	0.99	1.15	1.28

Table 2: Allowable Leakage for PVC Plastic Pipe with Elastomeric Joints in
US Gallons per Hour

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the contract unit price for ALL PAY ITEMS INVOLVING BURIED PIPE INSTALLATION in plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 33 05 05

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes furnishing all labor, materials, equipment, and incidentals required for the manufacture, delivery, and installation of ductile iron pipe and fittings for buried water, force main, and other pressure piping systems as indicated on the Drawings.
 - 1. Work includes ductile iron pipe, fittings, joints, lining and coating systems, restrained joint systems, appurtenances, and related accessories.
 - 2. Pipe shall be suitable for potable water, wastewater force mains, and other pressure applications as shown on the Contract Documents.
- B. Coordination
 - 1. Review installation procedures under this and other Sections and coordinate with installation of additional items to be installed before conducting ductile iron pipe Work.
 - 2. Coordinate pipe materials, fittings, coatings, and appurtenances to ensure a fully integrated system.

1.02 RELATED SECTIONS

- A. Section 09 96 00 – High-Performance Coatings
- B. Section 31 23 16 – Excavation
- C. Section 33 01 10 – Operation and Maintenance
- D. Section 33 05 05 – Buried Pipe Installation

1.03 REFERENCES

- A. State of Illinois
 - 1. “Standard Specifications for Construction of Water and Sewer Main in Illinois”, 8th ed., 2020.
 - 2. Rules and Regulations for Public Water Supplies as issued by the Illinois Pollution Control Board.

B. American Water Works Association (AWWA):

1. AWWA C104, Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water.
2. AWWA C105 – Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110, Ductile Iron and Gray Iron Fittings for Water.
4. AWWA C111, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.
5. AWWA C115, Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.
6. AWWA C116, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Service.
7. AWWA C151, Ductile Iron Pipe, Centrifugally Cast, for Water.
8. AWWA C153, Ductile Iron Compact Fittings, 3 inch through 24 inch and 54 inch through 64 inch for Water Service.
9. AWWA C606, Grooved and Shouldered Type Joints.

C. American National Standards Institute (ANSI):

1. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series.
2. ANSI B18.2.2, Square and Hex Nuts. (Inch Series).

D. ASTM International:

1. ASTM A194, Specification for Carbon Steel and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
2. ASTM A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
3. ASTM A354, Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.
4. ASTM A563, Specification for Carbon and Alloy Steel Nuts.
5. ASTM D5162, Discontinuity (Holiday) Testing of Non-Conductive Protective Coating on Metallic Substrates.

- 6. ASTM G14, Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).
- 7. ASTM G62, Test Methods for Holiday Detection in Pipeline Coatings. CT053378 40 05 19-2
- 8. ASTM G95, Test Methods for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).
- E. MSS-SP 60, Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.
- F. NACE RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
- G. NAPF 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.
- H. NSF/ANSI 61, Drinking Water System Components - Health Effects.
- I. SSPC PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
- J. SSPC Painting Manual, Volume 1, Para. XIV.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's literature for pipe, fittings, joint materials, coatings, linings, and restrained joint systems for each size, class, material, and joint-type being provided.
- B. Shop Drawings: Submit layout drawings indicating pipe lengths, joint types, fittings, and special restraints.
- C. Certifications:
 - 1. Manufacturer's certification that pipe and fittings comply with specified AWWA and ASTM standards.
 - 2. NSF 61 certification for potable water applications.
- D. Informational Submittals: Submit the following as required:
 - 1. Certificates:
 - a. AIS Steel Certification

b. Build America, Buy America (BABA) Act Certification

E. Test Reports: Submit factory hydrostatic test reports upon request.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Pipe and fittings manufacturer shall have a minimum of five (5) years successful experience producing ductile iron pipe and fittings.
2. Manufacturer shall provide documentation of at least five (5) installations in satisfactory operation within the United States for similar service conditions.

B. Lining and Coating Qualifications

1. Lining and coating materials shall be manufactured by firms with a minimum of five (5) years successful experience protecting pipelines under similar service conditions.
2. If linings or coatings are applied by a subcontractor, the applicator shall have a minimum of five (5) years successful experience applying similar systems and shall provide documentation of at least five (5) satisfactory installations.

C. Supply and Compatibility

1. Unless otherwise approved, obtain pipe, fittings, and appurtenances from a single ductile iron pipe manufacturer.
2. The ductile iron pipe manufacturer shall review and approve or prepare all Shop Drawings and product submittals.
3. Pipe, fittings, joints, and coatings shall be fully compatible and integrated into a coordinated piping system.
4. The pipe manufacturer shall be responsible for all factory-applied linings and coatings, whether applied at the pipe manufacturing facility or at a supplier's facility.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original factory packaging with identification markings intact.

- B. Store pipe and fittings off the ground on timbers or padded supports. Protect from contamination and damage.
- C. Handle pipe using wide fabric slings or padded forks. Do not drop or roll pipe in a manner that damages lining or coating.

PART 2 PRODUCTS

2.01 GENERAL

- A. Piping systems shall be suitable for their intended service, including potable water and process applications as indicated.
- B. Joints shall comply with Section 33 05 05 – Buried Pipe Installation. Unless otherwise indicated, provide flanged joints for exposed piping and mechanical joints for buried piping.
- C. Provide couplings on pipe with plain or grooved ends where shown or approved by the Engineer.

2.02 DUCTILE IRON PIPE

- A. Flanged Pipe
 - 1. Fabricate in accordance with ANSI/AWWA C115.
 - 2. Pressure Rating:
 - a. 350 psi for 12-inch diameter and smaller
 - b. 250 psi for diameters greater than 12 inches.
 - 3. Thickness per ANSI/AWWA C150
- B. Non-Flanged Pipe
 - 1. Conform to ANSI/AWWA C151 for material, dimensions, tolerances, tests, and markings.
 - 2. Pressure Class: Class 350 psi unless otherwise indicated.
 - 3. Thickness per ANSI/AWWA C150

2.03 JOINTS

- A. Flanged Joints

1. Conform to ANSI/AWWA C110 and ANSI/AWWA C111.
2. Gaskets shall be minimum 1/8-inch thick synthetic rubber containing not less than 50 percent nitrile or neoprene, suitable for specified service.
3. Bolts shall comply with ANSI B18.2.1 and ASTM A307, Grade B.
4. Nuts shall comply with ANSI B18.2.2 and ASTM A563, Grade A, heavy hex.

B. Mechanical Joints

1. Conform to ANSI/AWWA C111 and ANSI/AWWA C151.
2. Rated for 350 psi.
3. Glands shall be ductile iron.
4. Bolts and nuts shall be high-strength, low-alloy steel.
5. Acceptable manufacturers include:
 - a. Clow Water Systems Company
 - b. Atlantic States Cast Iron Pipe Company
 - c. McWane Cast Iron Pipe Company
 - d. Pacific States Cast Iron Pipe Company
 - e. Griffin Pipe Products Co.
 - f. American Cast Iron Pipe Co.
 - g. U.S. Pipe and Foundry Co.
 - h. Engineer approved equal.

C. Restrained Joints

1. Restrained push-on joints shall permit deflection after assembly.
2. Field cutting of restrained pipe is not permitted without Engineer approval.
3. Acceptable mechanical joint restraint products include:
 - a. Megalug Series 1100

- b. MJ Coupled Joint
 - c. MJ Field Lok
 - d. Engineer approved equal.
4. Acceptable push-on restraint products include:
- a. Super-Lock
 - b. Lok-Ring; Flex-Ring
 - c. TR Flex
 - d. Snap-Lok
 - e. Engineer approved equal

2.04 FITTINGS

- A. Flanged and mechanical joint fittings shall conform to ANSI/AWWA C110 or ANSI/AWWA C153.
- B. Material shall be ductile iron.
- C. Pressure rating shall meet, but not exceed, the rating of the connected pipe.

2.05 LINING

- A. Pipe and fittings shall be cement mortar lined in accordance with ANSI/AWWA C104.
- B. Linings shall comply with NSF/ANSI 61 for potable water service.

2.06 EXTERIOR COATINGS

- A. Exposed Pipe and Fittings
 - 1. Prepare surfaces in accordance with NAPF 500-03.
 - 2. Shop prime exterior ferrous surfaces in accordance with Section 09 96 00.
 - 3. Field painting shall comply with Section 09 96 00.

B. Buried Pipe and Fittings

1. Provide asphaltic coating approximately one mil thick in accordance with ANSI/AWWA C151, C115, C110, and C153, as applicable.

2.07 MARKING

- A. Mark pipe and fittings with manufacturer identification, pressure class, country of origin, year of manufacture, and “DI” or “Ductile.”
- B. Flanged pipe shall include flange manufacturer’s mark, size, length, and weight.

PART 3 EXECUTION

3.01 PREPARATION

A. Exposed Pipe and Fittings:

1. Surface Preparation:
 - a. Initial Surface Inspection: Pipe and fitting manufacturer and coating applicator shall inspect surface to be coated and mutually determine recommended NAPF 500-03 surface preparation method.
 - b. Prepare surface in accordance with recommended NAPF 500-03 method.
2. Finished Surface Inspection: Prepared surfaces shall be inspected by coating applicator prior to application to determine acceptability of finished surface. If surface is unacceptable, repeat surface preparation and re-application as necessary.
3. After recommended surface preparation, prime coat exterior ferrous metal surfaces of pipe and fittings in the shop in accordance with Section 09 91 00, Painting.
4. Field painting shall comply with Section 09 96 00 – High-Performance Coatings

B. Buried Pipe and Fittings:

1. Asphaltic Coating: Coat pipe and fittings with an asphaltic coating approximately one-mil thick, in accordance with ANSI/AWWA C151, ANSI/AWWA C115, ANSI/AWWA C110, and ANSI/AWWA C153, as applicable.

3.02 INSPECTION

- A. Inspect pipe and fittings upon delivery and prior to installation to ensure materials are free from defects.
- B. Verify compatibility of pipe, fittings, gaskets, linings, and coatings.

3.03 INSTALLATION AND FIELD QUALITY CONTROL

- A. Install buried piping in accordance with Section 33 05 05 – Buried Pipe Installation.
- B. Perform testing and inspection as required by referenced standards and related Sections.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item YARD PIPING, 8" DIP, YARD PIPING, 12" DIP, YARD PIPING, 16" DIP, AND YARD PIPING, 18" DIP related to plans titled W2E WATER TREATMENT PLANT.
- 4.02 The above work shall also include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL ALL PROCESS PIPING, VALVES, FITTINGS AND RELATED APPURTANANCES and includes all process piping above and below grade to a point 10' outside building foundations related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 33 05 19

PART 1 GENERAL

1.01 SUMMARY

- A. This Section covers the furnishing of all labor, materials, equipment, tools, and incidentals required to provide and install thermoplastic utility pipe systems, including polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) pipe and fittings, complete and in place, as shown on the Drawings and as specified herein.
- B. The work includes, but is not limited to:
 - 1. Gravity sanitary sewer pipe
 - 2. Sanitary sewer force main pipe
 - 3. Water service pressure pipe
 - 4. Perforated PVC filter pipe
 - 5. Fittings, jointing materials, tracer wire, and appurtenances.
- C. Pipes or piping as used herein refers to pipe, fittings, gaskets, joint restraints, adapters, and all materials and accessories required to construct a complete operating system.
- D. Fittings, gaskets, joint restraints, adapters, and all materials and accessories required to construct a complete operating system are considered incidental to the project and shall not be paid for separately.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 31 23 16 – Excavation.
- C. Section 33 05 05 – Buried Pipe Installation.
- D. Section 33 05 61 – Concrete Manholes
- E. Section 40 05 64 – Valves for Actuator Control.

1.03 REFERENCES

- A. ASTM "Standard Specifications for Water and Sewer Construction in Illinois," 8th Edition, 2020.

- B. Illinois Environmental Protection Agency (IEPA) requirements and Illinois Pollution Control Board Rules and Regulations for Public Water Supplies.
- C. ASTM D1784 – Rigid PVC and CPVC Compounds.
- D. ASTM D2241 – PVC Pressure-Rated Pipe (SDR Series).
- E. ASTM D3034 – PVC Sewer Pipe and Fittings.
- F. ASTM F679 – PVC Large-Diameter Gravity Sewer Pipe.
- G. ASTM D3139 – Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- H. ASTM D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- I. ASTM F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- J. ASTM D2412 – Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
- K. ASTM D2444 – Impact Resistance of Thermoplastic Pipe and Fittings.
- L. ASTM F758 – Smooth-Wall PVC Underdrain Systems.
- M. AWWA C900 – PVC Pressure Pipe and Fabricated Fittings.
- N. AWWA C110 – Ductile-Iron and Gray-Iron Fittings.
- O. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- P. AWWA C153 – Ductile-Iron Compact Fittings
- Q. AWWA C605 – Installation of PVC Pressure Pipe and Fittings.
- R. AWWA C900, PVC Pressure Pipe and Fabricated Fittings, 4 In.-12 In., for Water Transmission and Distribution
- S. AWWA C905, PVC Pressure Pipe and Fabricated Fittings, 14 In.-48 In.
- T. AWWA C907, Injection-Molded PVC Pressure Fittings, 4 In. Through 12 In.
- U. NSF/ANSI 14-2021 - Plastics Piping System Components and Related Materials

V. UNI-B-13 – Recommended Practice for Joint Restraint of PVC Pipe.

1.04 SUBMITTALS

- A. Product Data for all piping, fittings, valves, and appurtenances.
- B. Manufacturer's installation instructions.
- C. Shop drawings indicating pipe layout, fittings, and bedding details.
- D. Certification of compliance with referenced ASTM and AWWA standards.
- E. Disinfection reports for potable water mains.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer:

- a. Shall have a minimum of five years' experience producing thermoplastic pipe and fittings substantively similar to the materials specified and shall be able to submit documentation of satisfactory service in at least five completed installations in operation for at least five years each.

2. Installer:

- a. Engage a single pipe installer who shall be responsible for all thermoplastic pipe Work, and who shall employ only tradesmen with specific skills and experience in the type of Work required.
- b. Installer shall have a minimum of five years' experience installing thermoplastic pipe and fittings substantively similar to the materials specified and substantively similar to or larger than the scope of thermoplastic piping on the Project and shall be able to submit documentation of satisfactory experience in at least five completed installations in operation for at least five years each.

B. Component Supply and Compatibility:

- 1. Obtain all materials included in this Section from a single thermoplastic pipe Supplier. All pipe of each material type shall be furnished by the same manufacturer.

2. Thermoplastic pipe Supplier shall review and approve to prepare all Shop Drawings and other submittals for all materials furnished under this Section.
3. Materials shall be suitable for specified service conditions and shall be integrated into overall assembly by thermoplastic pipe Supplier

1.06 DELIVERY, STORAGE AND HANDLING

- A. Load, transport, and unload pipe in accordance with manufacturer's recommendations. Pipe shall not be dropped or handled in a rough manner.
- B. Inspect materials upon delivery. Defective materials shall be segregated and removed.
- C. Store pipe on level supports spaced not more than 3 feet apart. Stacking heights shall not exceed manufacturer's recommendations.
- D. Protect pipe from prolonged sunlight exposure. Pipe exposed longer than six months shall be covered with opaque material allowing ventilation.
- E. Pipe showing visible cracks, holes, foreign inclusions, and other defects or impact damage shall be rejected.

1.07 GUARANTEE

- A. Provide a one-year guarantee for workmanship and materials, commencing upon final acceptance.
- B. Remedy any leaks, failures, or defects at no cost to the Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. Pipe materials shall be suitable for services intended. Refer to piping schedules and plans.
- B. Pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, and other defects. Unless otherwise shown or indicated, pipe shall be uniform in color, opacity, density, and other physical properties.
- C. Comply with NSF 14.
- D. Buried pipe shall be capable of withstanding external live load, including impact, equal to AASHTO H-20 loading, with cover shown or indicated on the Drawings.

- E. Pipe, fittings, and appurtenances in contact with potable water or water that will be treated to become potable shall be listed in ANSI/NSF 61 as being suitable for contact with potable water and shall comply with requirements of the authorities having jurisdiction at the Site.

2.02 POLYVINYL CHLORIDE (PVC) PIPING

2.03 PVC FORCE MAIN

- A. Manufacturers: Provide products of one of the following:
 - 1. Westlake Pipe & Fittings
 - 2. Spears Manufacturing Company.
 - 3. Engineer Approved equal.
- B. Material: Unless otherwise specified, comply with the following:
 - 1. PVC sanitary sewer force main pipe shall be green in color. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified in plan set.
 - 2. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.
- C. Fittings:
 - 1. Provide ductile iron fittings meeting requirements of AWWA C110 or AWWA C153, except furnish fittings with one of following approved internal linings:
 - a. Nominal 40 Mils (35 Mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting
 - b. Nominal 40 Mils (35 Mils minimum) polyurethane
 - c. Nominal 40 Mils (35 Mils minimum) ceramic epoxy
 - d. Nominal 40 Mils (35 Mils minimum) fusion bonded epoxy

2. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Specifications.

2.04 BURIED PVC GRAVITY SEWER PIPE.

- A. Manufacturers: Provide products of one of the following:

1. Westlake Pipe & Fittings
2. Spears Manufacturing Company.
3. Engineer Approved equal.

- B. Material: Unless otherwise specified, comply with the following:

1. PVC gravity sanitary sewer pipe shall be green in color and in accordance with provisions in following table except where specified differently on the Drawings:

Type of service	Acceptable Materials
Gravity Mains with depth of cover < 10 feet	PVC SDR 26
Gravity Mains with depth of cover 10-15 feet	PVC SDR 26
Gravity Mains with depth of cover > 15 feet	PVC SDR 21, Ductile Iron Pipe, or as shown on Drawings

2. When solid wall PVC pipe 18-inches to 27-inches in diameter is required in SDR 26, provide pipe conforming to ASTM F679, except provide wall thickness as required for SDR 26 and pipe strength of 115 psi.
3. For sewers up to 12-inch diameter crossing over water lines, or crossing under water lines with less than 2-feet separation, provide minimum 150 psi pressure rated pipe conforming to ASTM D2241 with suitable PVC adapter couplings.
4. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D3212 and ASTM F477, or ASTM D3139 and ASTM F477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D2444
5. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied,

either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.

2.05 BURIED PVC WATERMAIN PRESSURE PIPE:

- A. Manufacturers: Provide products of one of the following:
 - 1. Westlake Pipe & Fittings
 - 2. Spears Manufacturing Company.
 - 3. Engineer Approved equal.
- B. Material:
 - 1. PVC sanitary sewer force main pipe shall be blue in color. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified in plan set.
 - 2. Pipe shall comply with AWWA C900 or AWWA C905 (as applicable).
 - 3. Material shall comply with ASTM D1784.
- C. Fittings:
 - 1. Provide ductile iron fittings meeting requirements of AWWA C110 or AWWA C153.
- D. Joints:
 - 1. Provide bell and spigot joints. Bell shall consist of an integral wall section to hold securely in place (and prevent displacement during assembly of joint) elastomeric O-ring gasket.
 - 2. Jointing lubricant shall be as recommended by pipe manufacturer.
 - 3. Provide elastomeric gaskets complying with ASTM F477 and ASTM D3139.
 - 4. Restrained Joints: Provide restrained joints where shown or indicated.
 - a. Comply with Section 33 05 05, Buried Piping Installation.

- b. Proprietary Joint Systems: Comply with ASTM F1674. Provide restrained joint system by one of the following for bell and spigot joint PVC piping:
 - 1) Ebaa Iron Sales, Inc.: Series 1500 and Series 1600 Restraint Harness for C900 Pipe; Megalug Series 2500, 2800, and 1100HV Restraint Harness for C905 Pipe.
 - 2) PV-LOK Series, by Sigma Corp.
 - 3) Engineer Approved equal

2.06 SCHEDULE 40 AND SCHEDULE 80 PVC PIPE

- A. PVC and CPVC Schedule 40 or Schedule 80 pipe may be used where specifically indicated for plant piping, chemical piping, or non-distribution applications.
- B. Schedule 40 and Schedule 80 PVC systems may utilize solvent-welded PVC fittings conforming to applicable ASTM standards.
- C. Solvent cement shall conform to ASTM D2564 and shall be applied in accordance with manufacturer's instructions.
- D. Schedule 40 and Schedule 80 PVC piping shall not be used for sanitary sewer force mains or potable water distribution or collection mains unless specifically approved in writing by the Engineer.

2.07 PERFORATED PVC

- A. PVC Pipe, Perforated: ASTM F758. Holes for all pipe sizes shall be as indicated in plans. Perforated pipe shall conform to ASTM F758.
- B. Geotextile
 - 1. Use a geotextile of knitted, woven, or non-woven fibers of polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Do not use slit film woven fabrics. Conform to the following:
 - 2. TEST METHOD VALUE
 - a. Minimum grab tensile strength ASTM D4632 35 lb
 - b. Apparent opening size ASTM D4751 No. 30 - 200
 - c. Minimum permittivity ____ 1.35 s⁻¹

3. Numerical values represent minimum/maximum average roll values (i.e., the average of minimum test results on any roll in a lot should conform to or exceed the minimum values in the table).
4. Use knitted fabrics constructed from continuous yarn. Non-woven fabrics may be needle-punched, heat-bonded, resin-bonded, or combinations of these 3 types. Use woven fabrics constructed from monofilament or multifilament yarns.
5. Use knitted geotextile wraps that form a seamless sleeve and fit tightly over the pipe. If using woven or non-woven fabric geotextile wraps, tightly wrap and securely fix to the pipe.
6. Clearly mark the geotextile rolls to identify the type of fabric.
7. If the engineer determines it is necessary, they can obtain fabric samples for testing from the job site.
8. Filter sock shall be incidental to the cost of 4" perforated PVC.

2.08 ACCESSORIES

- A. Gaskets, lubricants, and couplings compatible with pipe materials.
- B. Thrust blocks or restrained joints at bends, tees, and valves are incidental to construction and will not be paid for separately.
- C. Marker tape, tracer wire (if required by local code), and identification labels for potable water mains are incidental to construction and will not be paid for separately. Follow provisions of Section 33 05 05 – Buried Pipe Installation.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify existing site conditions and locate all utilities.
- B. Inspect pipe, fittings, and materials for damage prior to installation.
- C. Maintain trench dewatering and safety measures in accordance with OSHA regulations.

3.02 INSTALLATION

- A. Install PVC pressure pipe in accordance with AWWA C605 and manufacturer's recommendations.
- B. Install gravity sewer pipe in accordance with the Standard Specifications for Water and Sewer Construction in Illinois
- C. Excavate trenches to line, grade, and depth as indicated on the plans.
- D. Place bedding material as specified and compact to support the pipe uniformly.
- E. Provide jointing, alignment, and slope as required.
- F. Use approved fittings at changes in direction or diameter.
- G. Backfill in layers with controlled compaction, avoiding damage to pipe.
- H. Install mechanically restrained fittings at all bends, tees, plugs, hydrants, valves, and other locations requiring thrust restraint in sanitary sewer force mains and potable water distribution systems.
- I. Install thrust blocks at all fittings as required.

3.03 TESTING AND DISINFECTION

- A. Conduct hydrostatic pressure and leakage tests for potable water mains per AWWA standards.
- B. Disinfect potable water piping using a chlorine solution and perform bacteriological tests prior to placing in service.
- C. Gravity sewer lines shall be tested for leakage and proper flow prior to final acceptance.

3.04 FIELD QUALITY CONTROL

- A. Engineer or Owner shall inspect trench, pipe, bedding, and backfill during installation.
- B. Remove and replace pipe or fittings that are defective, damaged, or not properly installed.

3.05 CLEANING AND RESTORATION

- A. Remove all debris from trench and work area.

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- B. Restore pavement, turf, and other disturbed surfaces to original or specified condition.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the contract unit price for ALL PAY ITEMS INVOLVING THERMOPLASTIC UTILITY PIPE in plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 33 05 31

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes furnishing and installing precast reinforced concrete manholes for sanitary sewer and storm sewer systems, including:
 - 1. Precast bases, risers, cones, and flat slab tops.
 - 2. Adjustment (grade) rings.
 - 3. Frames and covers.
 - 4. Pipe connectors and resilient boots.
 - 5. Joint sealants and gaskets.
 - 6. Manhole steps (where permitted).
 - 7. Exterior and interior coatings where indicated.
 - 8. Connections to new and existing manholes.
 - 9. Testing, adjustment, abandonment, and removal.
- B. Work shall conform to the Illinois Department of Transportation (IDOT) Standard Specifications for Road and Bridge Construction, the Illinois Environmental Protection Agency (IEPA) requirements for sanitary sewer construction, and local authority having jurisdiction requirements.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 31 05 13 – Soils for Earthwork.
- C. Section 31 23 23 – Fill.

1.03 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A48 – Gray Iron Castings.
 - 2. ASTM A536 – Ductile Iron Castings.

3. ASTM A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 4. ASTM C33 – Concrete Aggregates.
 5. ASTM C150 – Portland Cement.
 6. ASTM C260 – Air-Entraining Admixtures.
 7. ASTM C443 – Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 8. ASTM C478 – Precast Reinforced Concrete Manhole Sections.
 9. ASTM C497 – Test Methods for Concrete Pipe and Manhole Sections.
 10. ASTM C618 – Fly Ash and Pozzolan for Use in Concrete.
 11. ASTM C923 – Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
 12. ASTM C990 – Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
 13. ASTM C1244 – Negative Air Pressure (Vacuum) Test for Concrete Sewer Manholes.
- B. ACI (American Concrete Institute):
1. ACI 301 – Specifications for Structural Concrete.
 2. ACI 318 – Building Code Requirements for Structural Concrete.
 3. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures.
- C. AASHTO:
1. AASHTO M199 – Precast Concrete Manhole Steps.
 2. AASHTO LRFD Bridge Design Specifications (HL-93 loading).
- D. Illinois Department of Transportation (IDOT) Standard Specifications for Road and Bridge Construction.

1.04 SUBMITTALS

A. Product Data:

1. Precast manhole sections.
2. Frame and cover assemblies.
3. Joint sealants and gaskets.
4. Pipe connectors and boots.
5. Coatings (if required).

B. Shop Drawings:

1. Manhole dimensions and section details.
2. Reinforcing steel layout.
3. Opening locations and sizes.
4. Frame and cover details.

C. Design Calculations:

1. Structural calculations sealed by a Professional Engineer licensed in the State of Illinois for special structures or where required.

D. Concrete Mix Design.

E. Test Reports:

1. Concrete compressive strength results.
2. Vacuum or air test results.

1.05 QUALITY ASSURANCE

- A. Precast manufacturer shall have a minimum of five (5) years documented experience producing ASTM C478 compliant manholes.
- B. Materials shall be new and free from defects.
- C. OWNER or ENGINEER may inspect materials at plant or jobsite.
- D. Reject cracked, honeycombed, out-of-round, or otherwise defective sections.

1.06 GUARANTEE

- A. Provide one-year warranty against defects in materials and workmanship from date of final acceptance.

PART 2 PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Precast Concrete Manholes and Structures:
 - 1. County Materials Corporation
 - 2. Engineer Approved Equal
- B. Manhole Frame and Cover, CI and DI:
 - 1. EJ
 - 2. Neenah Foundry Company
 - 3. Engineer Approved Equal
- C. Manhole Steps or Rungs: M.A. Industries, No. PS2-PFS
- D. Preformed Flexible Joint Sealant:
 - 1. Hamilton-Kent, Kent Seal No. 2
 - 2. Henry Company, Ram-Nek
- E. Pipe Penetrations:
 - 1. Waterplug
 - 2. Embeco
 - 3. Flexible sleeve: Press-Seal, PSX Gasket
 - 4. Compression seal assembly: Link-Seal
 - 5. Compression gasket: A-LOK

2.02 PRECAST CONCRETE MANHOLE SECTIONS

- A. Conform to ASTM C478.

B. Design Requirements:

1. Minimum 4,000 psi compressive strength at 28 days.
2. Maximum water-cementitious materials ratio, by weight = 0.45
3. Compressive strength shall be increased to 5,000 psi at 28 days if water soluble sulfate (SO₄) in soil percent by weight is encountered in excess of 0.20.
4. Designed for AASHTO HL-93 loading.
5. Earth load based on 130 pcf soil unit weight.
6. Hydrostatic load with groundwater at finished grade.

C. Components:

1. Monolithic precast base with integral floor.
2. Riser sections with tongue and groove joints.
3. Eccentric cone top unless otherwise indicated.
4. Flat slab tops where depth from rim to pipe crown is less than 8 feet or as shown.
5. Precast grade rings, 2-inch to 6-inch thickness.

D. Joints:

1. Rubber gasket conforming to ASTM C443; or
2. Preformed flexible joint sealant conforming to ASTM C990.

E. Mark each section with manufacturer's name and date of manufacture.

2.03 CONCRETE

- A. Cement: ASTM C150, Type I or II. Use Type V where water soluble sulfate (SO₄) in soil percent by weight is encountered in excess of 0.20.
- B. Aggregates: ASTM C33.
- C. Fly Ash: ASTM C618, Class C or F.

- D. Admixtures: ASTM C260; non-chloride.

2.04 PIPE CONNECTIONS

- A. Provide resilient flexible connectors meeting ASTM C923.
- B. Connectors shall be cast-in-place or core-drilled and installed per manufacturer's instructions.
- C. Stainless steel clamps and hardware required.
- D. Provide watertight plugs for future connections.

2.05 MANHOLE STEPS

- A. Where permitted by Owner:
 - 1. Polypropylene-encased steel steps conforming to ASTM C478 and AASHTO M199.
 - 2. Reinforcing core: ½-inch Grade 60 steel per ASTM A615.
 - 3. Installed at 12 inches on center vertically.
 - 4. Top step 18 to 24 inches below cover.
- B. Steps are not permitted unless specifically approved by the Owner.

2.06 FRAMES AND COVERS

- A. Gray iron frame and ductile iron cover.
- B. Materials:
 - 1. Frame: ASTM A48, Class 35B minimum.
 - 2. Cover: ASTM A536, Grade 60-40-18.
- C. 24-inch clear opening minimum.
- D. Designed for AASHTO HL-93 loading.
- E. Solid cover unless otherwise noted.
- F. Mark cover as required by Owner (e.g., "SANITARY SEWER" or "STORM SEWER").

2.07 MORTAR AND GROUT

- A. Non-shrink grout for frame setting and interior joint finishing.
- B. Mortar: 1 part Portland cement to 2 parts sand.

2.08 CORROSION PROTECTION

- A. Provide interior protective coating for sanitary sewer manholes where indicated or where connected to force mains and drop manholes.
- B. Coating shall be polyurethane or epoxy, spray-applied, 5–10 mil minimum dry film thickness.

PART 3 EXECUTION

3.01 EXCAVATION AND BASE PREPARATION

- A. Excavate in accordance with Section 31 23 23 and IDOT requirements.
- B. Provide minimum 12 inches compacted CA-7 or CA-11 aggregate base beneath manhole base unless otherwise shown.
- C. Prevent flotation during high groundwater conditions.

3.02 INSTALLATION

- A. Set manhole base plumb and level.
- B. Seal joints with gasket or flexible sealant; fill interior joint with non-shrink grout.
- C. Core openings only; doghouse openings not permitted.
- D. Construct invert channels to match pipe curvature; smooth and steel trowel finish.
- E. Form bench to slope toward channel.
- F. Maximum adjustment from top of cone to frame shall not exceed 12 inches using grade rings.

3.03 FRAME AND COVER ADJUSTMENT

- A. In paved areas:
 - 1. Set frame to final grade prior to surface placement.

2. Adjust to ¼ inch below final asphalt surface.

B. In turf areas:

1. Set flush with finished grade.

C. Adjustment considered incidental unless separate pay item provided.

3.04 CONNECTIONS TO EXISTING MANHOLES

A. Core-drill opening.

B. Install ASTM C923 connector.

C. Reconstruct bench and invert as required.

D. Provide watertight joint.

3.05 BACKFILL

A. Backfill in 12-inch loose lifts.

B. Compact to IDOT trench backfill density requirements.

C. Use suitable material per Section 31 05 13.

3.06 TESTING

A. Sanitary sewer manholes shall be vacuum tested in accordance with ASTM C1244.

B. Test prior to backfill unless otherwise approved.

C. Maximum allowable leakage: pressure drop not exceeding 1 psi during required test period.

D. Repair and retest failed manholes at Contractor's expense.

3.07 CLEANING

A. Remove debris, laitance, and foreign material prior to final inspection.

3.08 ABANDONMENT OR REMOVAL

A. Plug pipes with concrete or flowable fill.

- B. Remove structure to minimum 4 feet below grade and backfill, or completely remove if required by plans.
- C. Restore disturbed surface.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the contract unit price for MANHOLE, 4' Ø related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 33 05 61

PART 1 GENERAL

1.01 SUMMARY

- A. Work under this Section includes furnishing all labor, materials, equipment, and services necessary to provide, install, test, and place into service all tapping sleeves, tapping saddles, and tapping valves as indicated on the Drawings and as specified herein.
- B. Work includes:
 - 1. Stainless steel tapping sleeves.
 - 2. Ductile iron tapping sleeves.
 - 3. Fabricated steel tapping sleeves.
 - 4. Tapping saddles.
 - 5. Tapping valves.
 - 6. Bolting and appurtenances.
 - 7. Hydrostatic testing of sleeve and valve assemblies.
 - 8. Protective coatings and polyethylene encasement.
- C. Tapping sleeves and valves shall be suitable for connection to existing water mains under pressure where indicated.

1.02 RELATED SECTIONS

- A. Division 01 – General Requirements and Conditions of the Contract.
- B. Section 01 33 00 – Submittals.
- C. Section 33 05 05 – Buried Pipe Installation.

1.03 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. AWWA C110 – Ductile-Iron and Gray-Iron Fittings.
 - 2. AWWA C111 (ANSI A21.11) – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

3. AWWA C207 – Steel Pipe Flanges for Waterworks Service.
 4. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service.
 5. AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants.
 6. AWWA C800 – Underground Service Line Valves and Fittings.
 7. AWWA M9 – Concrete Pressure Pipe Manual.
- B. ASTM International:
1. ASTM A36 – Carbon Structural Steel.
 2. ASTM A240 – Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip.
 3. ASTM A285 Grade C – Pressure Vessel Plates, Carbon Steel.
 4. ASTM A380 – Cleaning and Descaling Stainless Steel Parts.
 5. ASTM A743 – Castings, Iron-Chromium, Iron-Chromium-Nickel.
- C. ANSI Standards:
1. ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
 2. ANSI B18.2 – Square and Hex Bolts and Screws.
 3. ANSI B2.1 – Pipe Threads (NPT).
- D. MSS SP-60 – Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.

1.04 SUBMITTALS

- A. Submit manufacturer's current product data, technical specifications, and installation instructions for all tapping sleeves, saddles, valves, bolts, coatings, and accessories in accordance with Section 01 33 00.
- B. Submit evidence of compliance with NSF 61 for products in contact with potable water.
- C. Submit shop drawings indicating:
 1. Size range and pipe outside diameter compatibility.

- 2. Pressure ratings.
 - 3. Materials of construction.
 - 4. Coating systems.
- D. Submit hydrostatic test procedures.

1.05 QUALITY ASSURANCE

- A. All products shall be manufactured by firms regularly engaged in the production of tapping sleeves and valves for water utility service.
- B. All pressure-containing components shall be designed for the working pressures specified herein.
- C. All components in contact with potable water shall comply with NSF 61.
- D. Tapping operations shall be performed by personnel experienced in pressure tapping of water mains.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original, unopened containers with manufacturer's identification intact.
- B. Store materials off the ground and protect from dirt, moisture, and mechanical damage.
- C. Handle sleeves and valves carefully to prevent coating damage or distortion. Bent or damaged units will be rejected.

1.07 GUARANTEE

- A. Guarantee tapping sleeves, saddles, valves, and associated appurtenances for a period of one (1) year from date of acceptance against defects in materials and workmanship.
- B. Repair or replace defective materials at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. All tapping sleeves, saddles, and valves 12-inch and smaller shall be designed for a minimum working pressure of 250 psi.

- B. Valves shall have a minimum differential pressure rating of 250 psi and a minimum internal test pressure of 500 psi unless otherwise indicated.
- C. Size-on-size taps up to and including 12-inch by 12-inch may utilize ductile iron or stainless steel tapping sleeves.
- D. For taps greater than 12-inch by 12-inch, tapping sleeves and valves are not permitted. A tee and valve assembly shall be cut into the main as indicated on the Drawings.

2.02 STAINLESS STEEL TAPPING SLEEVES (4-INCH THROUGH 14-INCH)

- A. Construction:
 - 1. Entire fitting shall be Type 304 (18-8) stainless steel.
 - 2. Body, lugs, and gasket armor plate: ASTM A240.
 - 3. Flange: Cast stainless steel meeting ASTM A743.
 - 4. Mechanical joint outlet: One-piece stainless steel casting.
- B. Flange:
 - 1. Conform to AWWA C207, Class D.
 - 2. ANSI B16.1 drilling.
 - 3. Recessed for tapping valve per MSS SP-60.
- C. Gasket:
 - 1. 360-degree sealing surface.
 - 2. Vulcanized natural or synthetic rubber with antioxidant and antiozonant additives.
 - 3. No reclaimed rubber permitted.
 - 4. Heavy-gauge Type 304 stainless steel armor plate vulcanized into gasket.
- D. Lugs:
 - 1. Heliarc welded (GMAW) to shell.
 - 2. Pass-through bolt design.

- 3. Finger lug designs not permitted.
- 4. Bolts shall not be integrally welded to sleeve.
- E. Bolting:
 - 1. Type 304 stainless steel.
 - 2. Teflon coated or as specified in Article 2.08.
- F. Test Plug:
 - 1. 3/4-inch NPT per ANSI B2.1.
 - 2. Lubricated or coated to prevent galling.
- G. Finish:
 - 1. All stainless surfaces passivated per ASTM A380.
- H. Marking:
 - 1. Permanent, water-resistant identification of size range.

2.03 STAINLESS OR CARBON STEEL TAPPING SLEEVES (16-INCH AND LARGER)

- A. Body:
 - 1. ASTM A285 Grade C or ASTM A36.
- B. Working pressure rating: 200 psi minimum.
- C. Flange:
 - 1. AWWA C207, Class D drilling.
- D. Gasket:
 - 1. Vulcanized natural or synthetic rubber.
 - 2. No reclaimed rubber.
- E. Bolting:
 - 1. High strength, corrosion resistant, low alloy steel per AWWA C111.

- F. Coating:
 - 1. Electrostatically applied baked epoxy or polyurethane.
- G. For concrete steel cylinder pipe, provide load-bearing setscrews on gland flange to transfer outlet loads to sleeve.
- H. Marking: Permanent size identification.

2.04 DUCTILE IRON TAPPING SLEEVES

- A. Dual compression type when specified.
- B. Two-piece construction assembled around main.
- C. Outlet flange conforming to AWWA C110.
- D. NSF 61 compliant.
- E. Where indicated, provide corrosion-resistant sleeves and polyethylene encasement for corrosive soil conditions.
- F. Verify existing pipe type and outside diameter prior to fabrication.

2.05 FABRICATED STEEL TAPPING SLEEVES

- A. Conform to AWWA C207.
- B. Minimum 3/8-inch carbon steel meeting ASTM A285 Grade C.
- C. Outlet flange: AWWA C207, Class D, ANSI 150 lb drilling, recessed for tapping valve.
- D. Gasket: Vulcanized natural or synthetic rubber.
- E. Coating: Manufacturer-applied fusion bonded epoxy, minimum 12 mil thickness.
- F. Mechanical joint outlet compatible with resilient wedge gate valves per AWWA C509 and NSF 61 approved.

2.06 TAPPING SADDLES

- A. Conform to AWWA C800, High-Pressure Class.
- B. Ductile iron outlet casting.
- C. Stainless steel straps.

- D. O-ring seals.
- E. ANSI A21.10 flanged outlets counterbored for tapping valves and equipment.

2.07 TAPPING VALVES

- A. Conform to AWWA C509.
- B. Sizes 3-inch through 12-inch.
- C. Ductile iron body.
- D. Resilient-seated, non-rising stem.
- E. Nut-operated, open left.
- F. Suitable for buried service.
- G. Flanged inlet with mechanical joint outlet.
- H. Factory epoxy coating per AWWA C550 (6–8 mil average, 4 mil minimum).
- I. Enclosed bevel gears, bypass valve, rollers, tracks, and scrapers where required.

2.08 BOLTS

- A. Bolts shall conform to ANSI B18.2 heavy hex dimensions.
- B. Bolts shall be Xylan or FluoroKote #1 coated and suitable for direct burial in corrosive soils.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify existing pipe material, diameter, and outside diameter prior to installation.
- B. Confirm working pressure of existing main prior to tapping operations.
- C. Clean pipe surface to ensure proper gasket sealing.

3.02 INSTALLATION

- A. Install tapping sleeves, saddles, and valves in accordance with Section 33 05 05 and manufacturer's written instructions.

- B. Align sleeve to ensure outlet is properly oriented.
- C. Tighten bolts uniformly to manufacturer's recommended torque.
- D. Tapping procedure shall follow tapping machine manufacturer's instructions.
- E. For installations with polyethylene encasement, encase entire sleeve and valve assembly up to operating nut.

3.03 PROTECTION

- A. After installation, coat all external bolts except operating nut with tape coating or approved rubberized-bitumen spray-on undercoating prior to backfill.
- B. Repair damaged coatings in accordance with manufacturer's recommendations.

3.04 PRELIMINARY TESTING

- A. Perform hydrostatic test after installation of sleeve and valve but prior to tapping.
- B. Test with valve open using tapped mechanical joint cap.
- C. No leakage permitted.
- D. Maintain test pressure for minimum 15 minutes.
- E. Test tapping saddles in accordance with AWWA C800.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the contract unit price for CONNECT TO EXISTING, TAPPING SLEEVE AND VALVE for Contract 1 in plans titled W2E WATER TREATMENT PLANT.
- 4.02 The above work shall include all equipment, material, and labor; and shall be incidental to the contract unit price for RAW WATER MAIN CONSTRUCTION for Contract 2 in plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 33 12 16

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish all labor, materials, equipment, and services necessary to provide and install dry-barrel fire hydrants complete with extension sections, auxiliary valves, mechanical joint connections, joint restraints, drainage provisions, hydrant markers, coatings, and all appurtenances required for a complete and operable installation.
- B. Hydrants shall be post-type, dry-top design and suitable for five (5) foot minimum bury depth unless otherwise indicated.
- C. Work includes connection to water mains, thrust restraint, testing, painting, and identification.

1.02 RELATED SECTIONS

- A. Section 33 05 05 – Buried Pipe Installation

1.03 REFERENCES

- A. AWWA C502 – Dry-Barrel Fire Hydrants
- B. AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants
- C. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
- D. NSF/ANSI 61 – Drinking Water System Components
- E. UL Listed and FM Approved for fire service

1.04 SUBMITTALS

- A. Manufacturer's specifications, shop drawings, and descriptive literature shall be submitted with each bid.
- B. Product data indicating model, bury depth, nozzle configuration, materials of construction, coatings, and accessories.
- C. Certification of compliance with AWWA C502.
- D. Documentation of UL listing and FM approval.
- E. Independent verification of 400 psi factory hydrostatic testing and hydrant flow characteristics.

- F. Certification that hydrants are manufactured, assembled, and tested in facilities located within the continental United States.
- G. All required information shall be submitted with and attached to the bid. Failure to include required certificates of compliance and manufacturer's information shall result in rejection of the bid.

1.05 QUALITY ASSURANCE

- A. Hydrants shall comply in all respects with the latest revision of AWWA C502.
- B. Hydrants shall be designed for a minimum internal hydrostatic working pressure of 200 psi.
- C. Hydrants shall be UL listed and FM approved.
- D. Manufacturer shall maintain regional distribution and have an employee located within one (1) day drive of the Project location.
- E. Manufacturer shall have supplied hydrants to at least three (3) different cities in New England in quantities equal to the amount being bid.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hydrants fully assembled unless extension sections are required.
- B. Store hydrants off the ground in a clean, dry location protected from damage.
- C. Protect machined surfaces, coatings, and operating mechanisms from damage during handling and storage.
- D. Damaged hydrants shall be rejected and replaced at no additional cost to the Owner.

1.07 GUARANTEE

- A. Hydrants shall be guaranteed against defects in materials and workmanship for a period of one (1) year from date of final acceptance.
- B. Defective components shall be repaired or replaced at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Kennedy Valve – K81

- B. Mueller – Super Centurion
- C. Engineer approved equal

2.02 GENERAL

- A. Hydrants shall be post-type, dry-barrel, dry-top design with the main valve closing with normal water pressure.
- B. Minimum main valve opening shall be 5-1/4 inches.
- C. Hydrants shall open right (clockwise).
- D. Hydrant inlet connection shall be 6-inch mechanical joint conforming to AWWA C111.
- E. Hydrants shall be designed for installation with five (5) foot minimum depth of cover. Contractor shall verify bury depth prior to procurement.

2.03 MATERIALS AND COMPONENTS

- A. Operating Nut
 - 1. One-piece bronze construction.
 - 2. Pentagonal shape measuring 1-5/8 inches from point to opposite flat.
- B. Nozzles
 - 1. Two (2) 2-1/2-inch hose nozzles.
 - 2. One (1) 4-1/2-inch pumper nozzle.
 - 3. National Standard Thread.
 - 4. Quarter-turn type secured by O-ring seals and stainless steel retaining screws.
 - 5. Nozzle cap nuts pentagonal, 1-5/8 inches from point to opposite flat.
 - 6. Each nozzle cap provided with Buna-N rubber washer.
- C. Traffic Feature
 - 1. Hydrants shall be traffic model breakaway-type.

2. Breakable cast iron coupling retained by stainless steel pins.
3. Coupling shall have the word “TOP” cast on the appropriate half.
4. Two-piece traffic flange secured by nuts and bolts.
5. Upper barrel shall rotate 360 degrees without removal of bolts.

D. Barrel and Flanges

1. Lower barrel flanges constructed of ductile iron and permanently screwed onto the ductile iron lower barrel.
2. Flanges secured by snap rings are not acceptable.
3. Lower barrel bolt holes mating with break flange shall be notched to facilitate bolt replacement.

E. Drain System

1. Drain valve shall operate automatically without springs, pins, or toggles each time hydrant is used.
2. Drain mechanism shall be integrally cast part of upper valve plate.
3. Hydrant elbow interior and exterior shall be coated with fusion bonded NSF-approved epoxy.
4. Provide minimum two (2) copper or bronze-lined drain ports.
5. Seat ring shall thread into a bronze bushing or drain ring.
6. Pressure seals shall be O-ring type.

F. Dirt Shield

1. Provide weather cap or dirt shield marked with arrow and word “OPEN” indicating direction of operation.

G. Coatings and Finish

1. Interior and exterior ferrous surfaces coated in accordance with AWWA C550.
2. Hydrants painted RED above the break flange.

H. Hydrant Marker

1. Provide hydrant location identifier marker extending no more than four (4) feet above hydrant.

2.04 ACCESSORIES

- A. Mechanical joint glands, gaskets, and bolts.
- B. Auxiliary gate valve and valve box where indicated.
- C. Joint restraint devices.
- D. Thrust blocking materials as required.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify line, grade, and bury depth prior to installation.
- B. Confirm hydrant extension length required to provide minimum five (5) feet of cover.
- C. Ensure adequate drainage provisions at hydrant base in accordance with standard details.

3.02 INSTALLATION

- A. Install hydrants plumb and at elevations shown on the Drawings.
- B. Install auxiliary valve on hydrant branch line unless otherwise indicated.
- C. Make mechanical joint connections in accordance with AWWA C111 and manufacturer's instructions.
- D. Provide drainage stone at hydrant base where permitted.
- E. After installation, operate hydrant to verify proper operation and drainage.
- F. Touch-up paint as required.
- G. Install hydrant location marker.

3.03 APPLICATION

- A. After installation, hydrants shall be tested under system pressure.

- B. Hydrants shall open fully, close tightly, and drain properly.
- C. No leakage shall be permitted. Defective hydrants shall be removed and replaced.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for ALL REMAINING ITEMS RELATED TO CONTRACT 1 OF W2E WATER TREATMENT PLANT NOT COVERED UNDER OTHER BID ITEMS OR CONTRACTS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 33 13 13

PART 1 GENERAL

1.01 SUMMARY

- A. The Contractor shall furnish all labor, materials, supervision, equipment, and incidentals necessary for the complete design, fabrication, construction, erection, welding, painting, disinfection, and testing of one (1) welded carbon steel ground-supported flat-bottom potable water storage tank constructed at grade level on a reinforced concrete foundation.
- B. The tank shall be designed and constructed in accordance with AWWA D100, except as modified by these Contract Documents. The Contractor may use Section 14 of AWWA D100 as part of the design; tanks designed on this basis shall incorporate all provisions of this Section. Where conflicts occur, Section 14 provisions supersede Section 3 of AWWA D100.
- C. Work includes but is not limited to:
 - 1. Structural and foundation design.
 - 2. Construction of foundation or coordination with foundation construction.
 - 3. Shop fabrication and field erection.
 - 4. Welding and inspection.
 - 5. Interior and exterior coating systems.
 - 6. Appurtenances and accessories.
 - 7. Hydrostatic testing.
 - 8. Disinfection and bacteriological testing.
 - 9. Identification plate.
- D. The tank shall provide potable water storage and be suitable for fire protection service.

1.02 RELATED SECTIONS

- A. Conditions of the Contract and Division 01 – General Requirements.
- B. Section 03 30 00 – Cast-In-Place Concrete.
- C. Section 09 96 00 – High-Performance Coatings.

- D. Section 33 05 05 – Buried Pipe Installation.
- E. Section 33 05 19 – Ductile Iron Pipe.
- F. Section 33 05 31 – Thermoplastic Utility Pipe.
- G. Section 40 73 26 – Gauge Pressure Indicating Transmitters.

1.03 REFERENCES

- A. AWWA D100 – Standard for Welded Carbon Steel Tanks for Water Storage.
- B. AWWA D102 – Standard for Coating Steel Water-Storage Tanks.
- C. AWWA C652 – Standard for Disinfection of Water-Storage Facilities.
- D. AWS D1.1 – Structural Welding Code – Steel.
- E. NSF 61 – Drinking Water System Components – Health Effects.
- F. ASCE 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- G. ACI 318 – Building Code Requirements for Structural Concrete.
- H. ACI 301 – Specifications for Structural Concrete.
- I. API 650 – Welded Tanks for Oil Storage (reference only where applicable to fabrication practices).
- J. Steel Structures Painting Council (SSPC):
 - 1. SSPC-PA 1 – Shop, Field, and Maintenance Painting of Steel.
 - 2. SSPC-SP Surface Preparation Standards as specified in Section 09 96 00.
- K. OSHA Regulations – Occupational Safety and Health Standards, 29 CFR 1910 and 1926.

1.04 SUBMITTALS

- A. Submit five (5) complete sets of construction drawings and specifications for approval prior to fabrication.

- B. Provide complete structural calculations for tank and foundation.
- C. Submit engineered drawings and calculations sealed by a Professional Engineer licensed in the State of Illinois, including:
 - 1. Snow, wind, and seismic load coefficients.
 - 2. Methods of analysis.
 - 3. Foundation reinforcement details.
 - 4. Piping layout.
- D. Security feature details including:
 - 1. Ladder security gates.
 - 2. Locking hatch details.
- E. After approval, drawings marked “APPROVED FOR CONSTRUCTION” shall govern the work. Approval does not relieve Contractor of responsibility for dimensions or quantities.
- F. Radiographic reports and inspection documentation.
- G. Coating system data and NSF certifications.
- H. Bacteriological test results.

1.05 QUALIFICATION OF MANUFACTURER

- A. Minimum five (5) years’ experience in ground-supported flat-bottom welded steel tank construction.
- B. Minimum five (5) completed comparable installations.
- C. Safety Requirements:
 - 1. Experience Modification Rate (EMR) below 1.0.
 - 2. Total Recordable Incident Rate (TRIR) below 2.5 for past three (3) years.
 - 3. Submit insurance verification and OSHA 300 logs.

1.06 PERMITS AND UTILITIES

- A. Owner will provide required permits and easements.
- B. No overhead electrical lines are within 50 feet of tank footprint.

1.07 GUARANTEE

- A. One (1) year warranty from completion date against defects in design, materials, and workmanship.
- B. Excludes damage from electrolytic, chemical, abrasive, or abnormal service conditions.
- C. Assign all paint and accessory warranties to Owner.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

- A. Basis of Design Manufacturer:
 - 1. The tank configuration, structural design approach, fabrication standards, coating system performance, and accessories specified herein are based on a welded ground-supported tank as manufactured by Pittsburgh Tank & Tower Group.
- B. The Basis of Design establishes the minimum acceptable standards for:
 - 1. Structural configuration.
 - 2. Shell and roof fabrication practices.
 - 3. Welding quality and inspection procedures.
 - 4. Coating systems and application methods.
 - 5. Appurtenance configuration.
 - 6. Quality control and safety performance.
- C. Preapproved Equal:
 - 1. The following manufacturers are preapproved as an equal, subject to full compliance with the Contract Documents:

- a. Caldwell Tank
- D. Other manufacturers may be submitted for approval in accordance with Division 01 Substitution Procedures and shall require written approval by the Engineer.
- E. Approval of an equal manufacturer does not relieve the Contractor of responsibility to meet all structural, seismic, foundation, coating, inspection, and performance requirements specified herein.

2.02 TANK DESIGN

- A. Tank Size and Configuration
 - 1. Minimum Operating Capacity: 1,000,000 U.S. gallons (1.0 MG).
 - 2. Tank Diameter: 68 feet.
 - 3. Height (Top of Foundation to HWL): 37 feet.
 - 4. Freeboard: 3 feet above High Water Level.
 - 5. Top of Foundation Elevation: 416.50 feet.
 - 6. Finished Grade Elevation: 415.50 feet.
 - 7. All seams, including roof and areas above waterline, shall be continuously seal welded.
- B. Environmental Loads (per AWWA D100 and ASCE 7)
 - 1. Wind: Per AWWA D100 Section 3.1.4.
 - 2. Seismic: Site Class D
 - a. $S_s = 0.639g$
 - b. $S_1 = 0.21g$
 - c. Importance Factor (IE) = 1.5
 - d. Latitude: 38.2817501°N
 - e. Longitude: -87.9869353°W
 - 3. Snow: Per AWWA D100 Section 3.1.3.

C. Minimum Plate Thickness

1. Parts in contact with water: 1/4-inch minimum.
2. Parts not in contact with water: 3/16-inch minimum.

D. Roof

1. Self-supported, dome shaped roof
2. Designed per AWWA D100.
3. Roof plates minimum 3/16-inch thick.
4. Interior lap joints continuously seal welded.
5. Shell to roof connection shall be sloping bar connection point

2.03 FOUNDATION

- A. Designed per AWWA D100 and ACI 318.
- B. Constructed per ACI 301.
- C. Minimum foundation thickness: 36 inches.
- D. Bearing capacity per geotechnical report.
- E. Level tolerance: 1/4 inch maximum deviation.
- F. Anchor bolts installed per tank supplier requirements.

2.04 ACCESSORIES

A. Ladders and Fall Protection

1. Exterior ladder from foundation to roof.
2. Side rails: 3/8" x 2".
3. Rungs: 3/4" minimum, spaced 12 inches.
4. 16-inch clear width.
5. Safety cage per OSHA.

B. Roof Hatches

1. One (1) 30-inch diameter hinged hatch with locking hasp.
2. One (1) 24-inch diameter flanged hatch for ventilation use.
3. Minimum 4-inch curb.
4. 2-inch downward edge on hinged hatch cover.

C. Vent

1. Centrally located.
2. #24 stainless steel screen.
3. Designed frost proof and sized in accordance with venting calculations based on the inlet and outlet.

D. Shell Manholes

1. One (1) 30-inch and one (1) 24-inch diameter.
2. Located 180 degrees apart.
3. Hinged outward opening.

E. Rigging

1. Painter's rail or roof couplings for painting access.

F. Piping

1. 12-inch HSS inlet pipe elevated to 15' AFF.
2. 18-inch HSS effluent pipe with silt stop and vortex breaker.
3. Extend influent/effluent 10 feet beyond foundation.
4. Watertight floor penetration.
5. Overflow:
 - a. 12-inch steel pipe, 1/4-inch wall.

- b. Designed for 1500 GPM.
- c. Weir crest at HWL.
- d. Discharge 2 feet above concrete splash pad at grade with 45-degree bend and 24-mesh stainless steel screen.

2.05 ACCESS SECURITY MEASURES

- A. General: The tank shall incorporate physical security measures to prevent unauthorized access, tampering, or contamination of potable water.
- B. Ladder Security:
 - 1. Provide lockable ladder security gate at bottom of exterior ladder, located approximately 8 to 10 feet above finished grade.
 - 2. Gate shall be hinged steel construction with padlock provision compatible with Owner's locking system.
- C. Hatch Security:
 - 1. All roof hatches and shell manholes shall be equipped with heavy-duty locking hasps.
 - 2. Provide stainless steel or corrosion-resistant padlocks keyed to Owner's system (coordinate with Owner).
- D. Vent Security:
 - 1. Vent openings shall include corrosion-resistant insect and bird screens.
 - 2. Screens shall be securely fastened internally to prevent removal from exterior.
- E. Overflow Protection:
 - 1. Overflow discharge shall include #24 stainless steel screen securely clamped or welded in place.
- F. Intrusion Monitoring (if indicated on Drawings):
 - 1. Provide mounting bosses and conduit penetrations for future intrusion switches on hatches.

2. Coordinate with Division 28 for wiring and monitoring equipment.

G. Fasteners:

1. Exterior appurtenances accessible from grade shall utilize tamper-resistant fasteners where practical.

2.06 IDENTIFICATION PLATE

A. Corrosion-resistant plate mounted above shell manhole including:

1. Tank Contractor.
2. Project number.
3. Capacity.
4. Diameter and HWL height.
5. Base elevation.
6. Date erected.

PART 3 EXECUTION

3.01 INSPECTION

- A. Field butt welds inspected by spot radiography per AWWA D100.
- B. Radiographs become property of Owner.
- C. Sectioning, oil testing, or vacuum testing of shell butt welds not permitted.

3.02 STEEL TANK CONSTRUCTION

- A. Erection per Section 10 of AWWA D100.
- B. Welding:
 1. Qualified per ASME Section IX or AWS D1.1.
 2. Full penetration butt welds.
 3. No back-up bars.

- 4. Misalignment $\leq 1/16$ inch.
- 5. Banding/peaking $\leq 1/2$ inch in 36 inches.
- C. Bottom joints continuously lap welded top side only.
- D. Bottom shell ring welded inside and outside to floor plate.
- E. Radiographic inspection by independent agency.

3.03 PAINTING AND DISINFECTION

- A. Surface preparation and coatings per Section 09 96 00 and AWWA D102.
- B. Disinfection per AWWA C652:
 - 1. 50 mg/L chlorine.
 - 2. 24-hour detention.
 - 3. Two satisfactory bacteriological tests required.

3.04 HYDROSTATIC TESTING

- A. Fill to overflow elevation.
- B. 24-hour test period.
- C. No measurable leakage permitted.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL (1) WELDED STEEL GROUND STORAGE TANK related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 33 16 23

PART 1 GENERAL

1.01 SUMMARY

- A. This section describes the design and construction of the circular precast, wire-wound prestressed concrete tank, AWWA D110, Type III, complete with steel diaphragm. The selection of the prestressed concrete tank is predicated upon the design criteria and construction methods specified. Deviations from the requirements of this section will not be considered. In the case of conflict between this and other sections, the requirements of this section shall govern.

1.02 RELATED SECTIONS

- A. Section 03 30 00 - Cast-In-Place Concrete
- B. Section 31 23 16 – Excavation
- C. Section 33 05 05 - Buried Pipe Installation
- D. Section 33 05 19 - Ductile Iron Pipe
- E. Section 33 05 31 - Thermoplastic Utility Pipe
- F. Section 40 73 26 - Gauge Pressure Indicating Transmitters

1.03 REFERENCES

- A. When an edition or effective date of a reference is not given, it shall be understood to be the current edition or latest revision published.
- B. The following documents may be referenced in this section:
 - 1. American Concrete Institute (ACI):
 - a. 301 Specifications for Structural Concrete
 - b. 305 Hot Weather Concreting
 - c. 306 Cold Weather Concreting
 - d. 309R Guide for Consolidation of Concrete
 - e. 350 Code Requirements for Environmental Engineering Concrete Structures and Commentary

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- f. 350.3 Seismic Design of Liquid Containing Concrete Structures and Commentary
 - g. 350.5 Specification for Environmental Concrete Structures
 - h. 372R Guide to Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures
 - i. 506R Guide to Shotcrete
2. American Society of Testing and Materials (ASTM):
- a. A185/185M Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
 - b. A416/A416M Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
 - c. A475 Standard Specification for Zinc Coated Steel Wire Strand
 - d. A615/615M Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
 - e. A821/821M Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks
 - f. A1008/1008M Standard Specification for Steel, Sheet, Cold-Rolled Carbon Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
 - g. C31/31M Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - h. C33/33M Standard Specification for Concrete Aggregates
 - i. C39/39M Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - j. C42/42M Standard Test Method for Obtaining and Testing Drilled Cores and sawed Beams of Concrete
 - k. C618/618M Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
 - l. C881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

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- m. C920 Standard Specification for Elastomeric Joint Sealants
 - n. D1056/1056M Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber
 - o. C1140 Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels
 - p. C1385 Standard Practice for Sampling Materials for Shotcrete
 - q. C1604 Standard Test Method for Obtaining and Testing Drilled Cores of Shotcrete
 - r. D1752 Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
 - s. D1556 Standard Test Method for Density and Unity Weight of Soil in Place by the Sand-Cone Method
 - t. D2000 Classification System for Rubber Products in Automotive Applications
 - u. D2240 Standard Test Method for Rubber property – Durometer Hardness
3. American Society of Civil Engineers (ASCE):
- a. ASCE 7-16 Minimum Design Loads for Buildings and Other Structures
4. American Water Works Association (AWWA):
- a. C652 Standard Disinfection of Water-Storage Facilities
 - b. D110 Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks
5. US Army Corps of Engineers (USACE):
- a. CRD-C572 Specification for Polyvinylchloride Waterstop

1.04 SUBMITTALS

- A. Prequalified Tank Contractor Declaration:

1. The following shall be included with Bid Submittal:
 - a. All tank contractors are to be prequalified. The bidder is required to state on the face of their sealed proposal the NAME of the prequalified tank contractor. Sealed proposals which do not state the name of a prequalified tank contractor will be returned to the bidder unopened.
 - b. Completed and executed Certification of Tank Design Professional form, included with this specification, shall be submitted as part of the bidder's sealed proposal at time of bid.

B. Prequalification Submittals:

1. All tank contractors must be prequalified. Tank contractors not specifically listed in Article 1.05.B shall submit to the Engineer the following supporting documents at least fifteen (15) days prior to the date set for receipt of bids:
 - a. Detailed design drawings and calculations, of the tank specified, signed and sealed by a Professional Engineer registered in the State of Illinois. The signing Engineer shall certify the tank design is in conformance with the AWWA Standard D110 for a Type III tank.
 - b. A detailed description of construction procedures.
 - c. A complete list of tank contractor's experience, in the company's own name, in the design and construction of precast wire-wound prestressed concrete tanks conforming to AWWA Standard D110, Type III. The tank contractor shall indicate the size of the tank, the location, the year of construction, and the name of the Owner for each project included on the list.
 - d. A complete list of AWWA D110, Type III precast wire-wound prestressed concrete tanks designed by the Tank Design Professional in accordance with the requirements of Article 1.05.A.2. The Tank Design Professional shall submit verification affirming that they acted in the capacity of Engineer of Record.

C. Design: The following items shall be submitted for review and approval by the Engineer prior to the start of construction:

1. Drawings: Provide complete plan, elevation, and sectional views of the wire-wound prestressed concrete tank which detail the tank geometry, materials of construction, and primary dimensions. Construction

drawings shall be signed and sealed by a licensed design professional in the State of Illinois. Construction drawings should clearly show the following:

- a. Details of foundation preparation.
 - b. Thickness of all concrete sections.
 - c. Details of reinforcement in concrete sections including location, spacing, splice dimensions, and fabrication dimensions.
 - d. Required number of prestressing wires as well as a detailed schedule of application including the initial force and number of wires in each increment.
 - e. All pipe penetrations in the tank wall as well as under floor piping and encasement details.
 - f. Details of accessories as well as their location on the tank structure.
2. Design Calculations: Provide complete design calculations which meet the requirements of Article 2.01.E. The design calculations shall be signed and sealed by a licensed tank professional meeting the requirements of Article 1.05.A.2.
- D. Construction: The following items shall be submitted for review by the Engineer and approved prior to use in the construction of the finished product:
1. Concrete and Shotcrete Mix Designs: Provide mix design and strength data for each concrete and shotcrete mix proposed for individual portions of the work. Mix designs shall clearly show ingredient proportions and quantities of admixtures which are used and shall meet Articles 2.02 and 2.03.
 2. Quality Control Plan: Provide a written quality control plan for compliance and monitoring of quality on the project.
 3. Accessories: Provide product data for all accessories required which demonstrate compliance with this specification.
 4. Coatings: Provide product data for all coatings which demonstrate compliance with this specification.
 5. Disinfection Procedure: Provide a disinfection plan and procedure.

E. Project Close Out Documents:

1. Quality Control Reports: The following quality control reports shall be submitted to the engineer for record purposes prior to final inspection of the project:
 - a. Concrete and Shotcrete Testing Reports: Submit test reports from an independent laboratory demonstrating concrete and shotcrete quality which meets this specification.
 - b. Quality Control Checklist: Submit completed quality control checklists for each portion of the work.
 - c. Prestressing Logs: Submit summary of logs of the completed prestressing demonstrating compliance with the design. Complete at least one wire stress reading for every coil or a minimum of one per foot of wall height for each wire phase.
2. Record Drawings: Record actual locations and final configuration of the tank and accessories on the shop drawings.
3. Warranty Document: Submit warranty document in Owner's name in accordance with Article 1.06.

1.05 QUALITY ASSURANCE

A. Qualification of Bidders:

1. Tank contractors must be prequalified to bid on the design and construction of the AWWA D110, Type III tank specified and shall meet with the following minimum requirements for prequalification:
 - a. Tank contractor shall be a specialist in the design and construction of AWWA D110, Type III precast wire-wound prestressed concrete tanks with the skill and financial stability to construct and guarantee the tank in accordance with this specification. The tank contractor shall have constructed (in the company's own name) a minimum of twenty (20) AWWA D110, Type III precast wire-wound prestressed concrete tanks with steel shell diaphragm of 2.0 MG or greater which have been in successful service a minimum of five (5) years.
 - b. Each tank contractor shall have in its employ a full-time Tank Design Professional who is licensed as a Professional Engineer in the State of Illinois with a minimum of 10 years' experience designing AWWA D110, Type III precast wire-wound prestressed

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concrete tanks with a steel shell diaphragm. The Tank Design Professional shall have designed and acted in the capacity of Engineer or Record on a minimum of twenty (20 AWWA D110, Type III tanks, with a capacity equal or greater than 2.0MG, in the last ten (10) years. The Tank Design Professional shall have signed and sealed the tank construction drawings and calculations for the tanks included in their experience record.

- c. Each tank contractor shall have in its employ a project team consisting of a Project Manager along with the following key persons: a leadtank builder, erection foreman, a nozzleman, and a wire-winding specialist. Each member of the project team shall have constructed a minimum of five (5) AWWA D110, Type III tanks with a capacity equal to or greater than 2.0MG.
 - d. Equipment: The qualified firm shall own and maintain all specialty equipment used in the turn-key construction of the prestressed concrete tank as specified herein including the following:
 - 1) A specially designed machine for fabrication of the steel shell diaphragm which is capable of forming the material with the proper profile to provide a mechanical lock between the inside and outside concrete or shotcrete.
 - 2) A specially designed machine for wire- wrapping the prestressed concrete tank which is capable of meeting the performance and tolerance requirements specified herein.
 - e. Singular Responsibility: It is the express intent of this specification to create a singular responsibility for the design and construction of the prestressed concrete tank. The design and construction of all aspects of the floor slab, wall, prestressing, shotcrete, and dome roof of the prestressed concrete tank must be performed by the tank contractor and shall not be subcontracted with the exception of labor only for reinforcing steel installation and concrete placement, which may be performed under the direct supervision of the tank contractor.
2. Preload, LLC, Louisville, KY is prequalified to perform the design and construction of wire-wound prestressed concrete tanks as it pertains to this project. Additional companies wishing to be considered shall submit in accordance with Section 01 25 00 - Substitution Procedures to the Engineer at least 15 days prior to the date set for receipt of bids.

1.06 GUARANTEE

- A. Workmanship and Material Guarantee: The tank contractor shall provide a written warranty covering the workmanship and materials on the tank structure for a 1-year period from the date of acceptance of the work. In the event that any defects occur in workmanship or materials within the warranty period they shall be replaced or repaired by the tank contractor at its own expense upon written notification by the Owner.
- B. Design Warranty: The tank contractor shall warrant its design of the proposed tank structure to be structurally and functionally suitable to serve the intended use of the projected work. Such intended use is exemplified by the criteria of design, workmanship, and material expressed by the requirements of the specifications and drawings prepared by the Engineer. The Owner's or Engineer's review of the tank contractor's design, or the Owner's acceptance and final payment for the work shall not relieve the tank contractor of design responsibility. The Owner shall be the direct beneficiary of the warranty.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Wire-Wound Prestressed Concrete Tank: The wire-wound prestressed concrete tank shall consist of a cast in place reinforced concrete floor, a precast wire-wound prestressed concrete wall with a mechanically bonded steel diaphragm and a cast-in-place, clear-span concrete dome roof. The dimensions of the wire-wound prestressed concrete tank shall be in accordance with this specification and the project drawings.
- B. Accessories: The tank shall include accessories as specified in this specification.
- C. Painting and Coating: The tank shall include coatings as required by this specification.
- D. Design Requirements: The tank shall be designed in accordance with the applicable requirements of: AWWA D110 Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks; ACI 350 Code Requirements for Environmental Engineering Concrete Structures; ACI 372R Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures; and currently accepted engineering principles and practices for the design of such structures. An intrinsic feature of that standard and this specification is the use of continuous, circumferential, wire-wound prestressing. The use of circumferential tendon prestressing is not permitted.
- E. Design Criteria: Loads and conditions to be considered in the design of the tank shall include; internal liquid pressure, backfill, seismic loads, prestressing, edge

restraint, temperature and moisture gradients and dead and live loads.

Geotechnical subsurface investigation report is included with these specifications and shall be used for design purposes. The following criteria is a summarization of attached report:

1. Storage Capacity: 1MG
2. Dimensions:
 - a. Inside Diameter: 68 ft
 - b. Liquid Depth: 37 ft
3. Liquid Unit Weight: 62.4 lbs/ft³
4. Maximum Liquid Fill/Withdraw Rates:
 - a. Fill Rate: 2.16 MGD
 - b. Withdraw Rate: 2.16 MGD
5. Wind Load:
 - a. Basic Wind Speed, V: 113 mph
 - b. Importance Factor: 1.5
 - c. Exposure Category: C
6. Seismic Load:
 - a.
 - b. Seismic design shall be in accordance with the requirements of the ASCE 7-16 and AWWA D110 with the most stringent requirements controlling with the following design loads. Tank Contractor shall provide summary of seismic calculations and results. Mapped Spectral Response Accelerations
 - 1) 1 Second Mapped Response Acceleration, S₁: 0.21g
 - 2) Short Period Mapped Response Acceleration, S_s: 0.639g
 - a) Site Classification: Type D
 - b) Importance Factor: 1.25
7. Allowable Soil Bearing Pressure: 2000 psf

8. Dome Rise: 1:8 to 1:12
- F. Loads to be considered in the tank design shall include internal liquid pressure, backfill, seismic effects, prestressing, end restraints, temperature and moisture gradients, dead loads, and live loads.
- G. Floor: The floor shall be a highly reinforced, cast-in-place, membrane slab designed to transfer the load of the liquid contents directly to the subgrade. The floor shall be watertight and shall meet the following requirements:
1. The wall footing shall be an integral part of the membrane slab and designed to resist loads imposed by the tank wall and dome as well as any stresses caused by anticipated differential settlement between the footing and the membrane slab.
 2. The minimum floor thickness shall be 4".
 3. The minimum floor thickness at pipe encasements, sumps, and under baffle walls shall be 8" and shall include two layers of reinforcement. Reinforcement shall be designed to accommodate anticipated differential settlement in these areas.
 4. The minimum ratio of mild reinforcement shall be 0.6 % of the concrete area in each direction. 0.8 percent should be used for tanks over 150' in diameter. The minimum cover over the reinforcing steel shall be 1-¼". Maximum spacing of steel reinforcement shall be two times the floor thickness.
- H. Wall Design: The prestressed tank wall design shall be based on elastic cylindrical shell analysis and shall meet the following requirements:
1. Sloshing Height & Freeboard: Shall be calculated using both ASCE 7 and AWWA D110 and the more conservative value shall be utilized. Freeboard is defined as the vertical distance between the springline and the top of water elevation. The "sloshing wave" shall be accommodated by increasing the freeboard between the normal operating surface and the underside of the roof; or the roof shall be designed to resist the uplift due to such a wave. Any confined portion of the convective (sloshing) mass shall be calculated and applied as an additional impulsive mass. A minimum freeboard height of 6 inches for cast-in-place domes, and 11 inches for precast domes shall be utilized.
 2. Precast Core Wall: The core wall shall be constructed of precast panels, with vertical joints between panels filled with shotcrete or cast-in-place

concrete, and shotcrete cover over the diaphragm on precast panel. The minimum design requirements shall be as follows:

- a. The minimum core wall thickness shall be 4 ½”.
- b. The maximum allowable compressive stress in the core wall extreme fiber shall not exceed:
 - 1) $0.55 f'_{ci}$ initial where f'_{ci} represents the concrete strength at time of prestressing.
 - 2) $0.45 f'_c$ final where f'_c represents the 28-day concrete strength at a time after prestressing is complete and losses have taken place.
- c. Place concrete for each panel in one continuous operation.
- d. The prestressing force applied to the core wall shall result in a minimum of 200 psi residual compression for the aboveground portion of the wall tapering to 50 psi at 6 feet below grade.
- e. Reduction in hoop tension due to edge restraint shall not be allowed.
- f. A minimum ½” layer of shotcrete shall be applied over the diaphragm.
- g. Backfill loads shall not be used in the design of the core wall to counteract hydraulic loads or provide residual compression in the wall. The thickness of the core wall shall be calculated to accept the initial compressive force of the backfill.
- h. The core wall shall be reinforced using nonprestressed, mild reinforcement as necessary to account for edge effects as well as the effects due to shrinkage, differential drying and temperature and moisture gradients where required. Reinforcing steel shall be designed in accordance with the requirements of the Alternate Design Method of ACI 350. The strength requirements of ACI 350 shall also be satisfied. The minimum concrete or shotcrete clear cover over steel reinforcement shall be 1 inch. At a minimum, the following nonprestressed, mild reinforcement shall be incorporated into the core wall:
 - 1) Inside Face: The inside face of the wall shall contain vertical nonprestressed reinforcement in the minimum amount of 0.25 percent of the core wall concrete area.

- 2) Outside Face: The outside face of the wall shall contain vertical nonprestressed reinforcement in the minimum amount of 0.25 percent of the core wall concrete area.
 - 3) Steel Shell Diaphragm: The cross-sectional area of the steel diaphragm may be considered as part of the required vertical nonprestressed reinforcement.
3. Steel Shell Diaphragm: Provide full length continuous watertight, mechanically bonded, steel diaphragm which is continuous the full wall height to within 2 inches of the top without horizontal splices. The minimum design requirements shall be as follows:
 - a. Mechanically seam vertical diaphragm joints except where located between wall panels, where sealing with polysulfide or other suitable sealant shall be employed.
 - b. Seal all vertical diaphragm joints to be watertight.
 - c. Do not allow form ties to pierce the diaphragm.
4. Prestressing: The prestressing shall be designed to resist the forces due to internal loads after accounting for stress losses and residual compression and shall meet the following requirements:
 - a. The maximum permissible initial stress in the prestressing wire immediately after application to the wall shall not exceed:
 - 1) 0.75 fpu, where fpu represents the ultimate strength of the wire.
 - b. Stress losses due to shrinkage, creep and relaxation shall be calculated; however, the value used for the total of the losses shall not be less than 25,000 psi.
5. Wire Cover: The minimum clear cover over the prestressing wire shall be as follows:
 - a. The minimum clear cover over prestressing wires measured to the outside face of the wall shall be 1".
 - b. The minimum clear cover at penetrations in the tank wall measured from the edge of the penetration to the wire shall be 2".

- c. The minimum clear cover at the base of the tank wall measured from the top of footing to the wire shall be 3”.
- I. Dome Roof: The design of the dome roof shall be based on elastic shell analysis with a circumferentially prestressed dome ring to counteract the horizontal component of the thrust caused by the dome load and shall meet the following requirements:
 - 1. The edge regions of the dome shall be designed for bending moments caused by loads and the restraint of the dome.
 - 2. The minimum thickness of the dome shell shall be proportioned to resist buckling but in no case shall be less than 3 inches for cast-in-place and 4 inches for precast domes.
 - 3. Nonprestressed mild steel reinforcement shall be provided to control shrinkage and temperature effects as well as edge effects as follows:
 - a. Typical Dome Shell: A minimum of 0.25% of the net cross-sectional area shall be placed in two perpendicular directions with two layers required when the typical shell thickness is greater than 6 inches in thickness.
 - b. Dome Edge: A minimum of 0.25% of the net cross-sectional area with two layers of reinforcing steel where required by analysis.
 - 4. The minimum clear cover over steel reinforcement shall be 1 inch.

2.02 CONCRETE

- A. General Requirements: Concrete shall conform to ACI 301 except as modified herein:
 - 1. Cement shall be Portland Type I or Type II
 - 2. Air-entraining and water reducing admixtures shall be permitted. No other admixtures shall be used in the concrete mix unless approved by the engineer.
 - 3. Concrete in direct contact with prestressed reinforcement shall not contain water-soluble chloride ions in excess of 0.06 % by weight of cement.
- B. Pipe Encasement: Concrete used for pipe encasement shall have minimum 28-day strength of 3500 psi. The course and fine aggregate shall meet the requirements of ASTM C33.

- C. Floor and Footing: Concrete used for the floor and footing shall have a minimum 28-day compressive strength of 3500 psi and shall have the following properties:
1. Air Content: 0%
 2. Maximum Water-Cementitious Material Ratio: 0.42
 3. Fine and Course Aggregate: Meeting requirements of ASTM C33
 4. Fibers: Concrete for floor and footing construction shall contain polypropylene fibrillated fibers, (Grace Fibers™ or equal) or polypropylene monofilament fibers (Grace MicroFiber™ or equal), at a minimum addition rate of 1.0 lb. per cubic yard.
- D. Core Wall: Concrete used for precast wall panels shall have a minimum 28-day compressive strength of 4000 psi at 28 days with the following properties:
1. Air Content: 4½% +/- 1½%
 2. Maximum Water-Cementitious Material Ratio: 0.42
 3. Fine and Course Aggregate: Meeting requirements of ASTM C33
- E. Dome: Concrete used for precast wall panels shall have a minimum 28-day compressive strength of 4000 psi with the following properties:
1. Air Content: 4½% +/- 1½%
 2. Maximum Water-Cementitious Material Ratio: 0.42
 3. Fine and Course Aggregate: Meeting requirements of ASTM C33

2.03 SHOTCRETE

- A. General Requirements: Shotcrete shall be wet mix or dry mix conforming to ACI Standard 506 except as modified herein.
1. Cement shall be Portland Type I or Type II.
 2. Shotcrete in direct contact with prestressed reinforcement shall not contain water-soluble chloride ions in excess of 0.06 % by weight of cementitious material.

- B. Wire Coat: Shotcrete used for the wire coat shall have a minimum compressive strength equal to that for which the core wall is design but not less than of 4500 psi at 28 days with the following properties:
1. Shotcrete covering the prestressing wire shall consist of not more than three parts sand to one part cementitious material by weight. Additional coats of shotcrete shall consist of not more than four parts sand to one-part cementitious material by weight.
 2. Air Content: Entrained air may be used in wet mix shotcrete to facilitate placement in the amount of 6% +/- 1½%
- C. Cover coat: Shotcrete used for the cover coat shall have a minimum 28-day compressive strength of 4500 psi at 28 days with the following properties:
1. The shotcrete cover coat shall consist of not more than four parts sand to one part cementitious material by weight.
 2. Air Content: Entrained air may be used in wet mix shotcrete to facilitate placement in the amount of 6% +/- 1½%
 3. Maximum Water-Cementitious Material Ratio: 0.42

2.04 NON-PRESTRESSED REINFORCEMENT

- A. Non-prestressed deformed bar reinforcement shall conform to the requirements of ACI 350, Grade 60 steel meeting the requirements of ASTM A615.
- B. Non-prestressed welded wire reinforcement shall be plain and shall conform to the requirements of ASTM A185.
- C. Strand for seismic cables shall be galvanized and shall conform to the requirements of ASTM A416 prior to galvanizing.
- D. Protect reinforcing steel and wire fabric from damage and from dirt, oil, grease, other foreign matter, and rust-causing conditions.

2.05 PRESTRESSED REINFORCEMENT

- A. Prestressed reinforcement shall conform to the requirements of ASTM A821.
- B. The diameter of prestressed reinforcement may be 0.162" or 0.192".
- C. Splices for prestressed reinforcement shall be ferrous material compatible with the reinforcement and shall develop the full ultimate strength of the wire.

2.06 STEEL DIAPHRAGM

- A. The steel shell diaphragm shall conform to ASTM A1008 and shall be a minimum thickness of 0.017 " (26 gauge).
- B. The steel diaphragm shall be vertically ribbed with adjacent and opposing channels. The base of the channels shall be wider than the throat with reentrant angles which provide a mechanical lock to the inner and outer concrete or shotcrete.

2.07 BASE RESTRAINT CABLES

- A. Base restraint cables shall be galvanized, meeting the requirements of ASTM A416 for grade 250 or 270 before galvanizing and ASTM A475 after galvanizing.

2.08 ELASTOMERIC MATERIALS

- A. Bearing Pad: Bearing pads shall be neoprene or natural rubber meeting the following requirements:
 - 1. Neoprene Bearing Pads shall be 40 or 50 durometer hardness with a minimum ultimate tensile strength of 1500 psi, a minimum elongation of 500% and a maximum compressive set of 50% complying with ASTM D2000 Line Call Out M2BC410 A14 B14 or M2BC510 A14 B14.
 - 2. Natural Rubber Bearing Pads shall comply with D2000 Line Call Out M4AA414 A13 or M4AA514 A13.
- B. PVC Waterstop: Waterstops shall be composed of polyvinylchloride (PVC) meeting the requirements of CRD-C-572. Splices shall be made in accordance with the manufacture's recommendations. Waterstop shall be manufactured by Sika-Greenstreak or equal.
- C. Polysulfide Sealants: Polysulfide sealants used to seal diaphragm joints between precast wall panels shall be a two-component elastomeric compound meeting the requirements of ASTM C920, type M and must have permanent characteristics of bonding to metal surfaces, flexibility, and resistance to extrusion due to hydrostatic pressure. Air-cured sealants shall not be used.
- D. Epoxy Sealants: Epoxy sealants shall be a two component, 100% solids, moisture insensitive material meeting the requirements of ASTM C 881, Type III, Grade 1.
- E. Sponge Filler: Sponge filler shall be closed-cell neoprene or rubber conforming to ASTM D1056, Type 2, Class A and Grade 1. Compression deflection limited to 25% at 2 to 5 psi.

- F. Epoxy Adhesives: Epoxy adhesives shall be 100% solids, moisture insensitive, two component systems conforming to ASTM C 881, Type II, Grade 2

2.09 DECORATIVE COATING

- A. A decorative coating shall be applied to all exterior above grade surfaces. The exterior coating shall be an elastomeric system specifically developed for application on concrete surfaces. Acceptable products are as follows:

1. Loxon XP, The Sherwin Williams Company, Cleveland, Ohio
2. Series 156 Enviro-Crete, Tnemec Inc., Kansas City, Missouri
3. AC 403S-Smooth, Induron Protective Coatings, Birmingham, Alabama
4. Tammscoat Smooth, Euclid Chemical Company, Cleveland, Ohio

2.10 ACCESSORIES

- A. The tank construction company shall provide and install all appurtenances as shown on the drawings. Appurtenances shall include the following:
1. Influent/Effluent Piping: Influent and effluent piping shall be cement lined ductile iron. Pipe brackets fabricated from 304SS or concrete encasement of the pipe shall be included in sufficient number to secure pipe to the tank wall as required.
 2. Overflow Piping: Overflow piping shall be cement lined ductile iron. Pipe brackets fabricated from 304SS or concrete encasement of the pipe shall be included in sufficient number to secure pipe to the tank wall as required.
 3. Wall Manhole: The tank shall have a minimum of one manhole for access to the interior of the tank. The manhole shall be fabricated using 304SS and shall have a minimum 31" outside diameter and a minimum clear opening of 24".
 4. Roof Vent: The roof vent shall be manufactured from fiberglass or aluminum with 316SS fasteners and shall be sized to comply with the venting requirements of Article 1.04.E. The vent shall be screened with 24 x 24 mesh insect screen.

5. Interior Ladder: The interior ladder shall be fabricated from fiberglass or aluminum with 316SS fasteners and a safety climbing device conforming to applicable OSHA standards.
6. Exterior Ladder: The exterior ladder shall be fabricated from 6061-T6 aluminum with gate, and a safety climbing device conforming to applicable OSHA standards. Ladder shall be equipped with anti-climb security measures.
7. Roof Hatch: The roof hatch shall be fabricated from 6061-T6 aluminum, or fiberglass, with a minimum opening of 3'-6" x 3'-6". Roof hatch must meet requirements set forth in IAC Title 35, Section 604.
8. Handrail: The handrail shall encircle the roof hatch and shall be manufactured from 6061-T6 aluminum with 316SS fasteners and a 316SS chain gate at each access point. The handrail shall include an access point for the exterior ladder and the dome.
9. Dome Sleeves: Dome sleeves shall be formed and cast monolithic with the dome. Dome penetrations shall be fabricated of 304SS or PVC with flanged end and blind flange.

PART 3 EXECUTION

3.01 SAFETY

- A. Tank contractor shall conform to all Local & Federal Safety rules & regulations.
- B. Tank contractor shall have a detailed, written safety program specific to the construction of wire-wound prestressed concrete tanks.
- C. During the prestressing operations, extreme caution shall be taken to ensure the safety of the prestressing crew and others working on the construction site. During prestressing operations, a distance of 100' exterior of the tank walls shall remain clear of personnel. Only personnel actively assisting with the prestressing operation shall be permitted within this area.

3.02 SITE PREPARATION

- A. Clearing and Grubbing: All trees, shrubs and other vegetation in the tank area and temporary work areas designated for construction shall be removed as follows:
 1. All trees and vegetation will be disposed of offsite in an approved landfill.

2. All approved topsoil deemed suitable by the Engineer for finish grading may be stockpiled on the site as directed by the Engineer.

B. Excavation:

1. The site shall be excavated to an elevation and width as necessary to provide adequate work room for tank construction. A minimum radius 12' larger than the radius of the foundation at the subgrade elevation shall be provided.
2. The tank site shall be dewatered when required. The dewatering method shall prevent disturbance of the foundations soils.

C. Subgrade Preparation

1. Subgrade material which is disturbed or over excavated during the preparation of the site or loose foundation material shall be removed and replaced with compacted select fill.
2. After the excavation is complete, the site shall be proof rolled in the presence of the Owner's geotechnical professional prior to placement of any compacted select fill to determine the suitability of the subgrade for the tank foundation. Select fill shall consist of a clean, well graded angular or subangular material as directed by the Owner's geotechnical professional.

D. Granular Subbase

1. A minimum 6-inch thick layer of a granular leveling base shall be placed beneath the tank foundation prior to construction of the tank floor. The leveling base material shall be a clean, densely-graded crushed stone material with a balanced fine content to produce an easily constructed, low friction surface meeting the requirements of ASTM C33 with 100% of the material passing the 1" US Sieve size and not more than 8% passing the #200 Sieve size.
2. The leveling base material shall be fine graded to produce a subgrade elevation that is within a tolerance of +0", - 1/2" over the entire tank subgrade.
3. Compaction shall be by capable vibratory roller with a minimum of two passes in each direction.
4. Prior to construction of the floor, a 6-mil polyethylene vapor barrier shall be placed over the granular subbase. Edges of the polyethylene shall be overlapped a minimum 6 inches.

3.03 INSTALLATION

- A. Concrete: All concrete shall be placed and cured as required to meet applicable ACI standards and the following requirements:
1. Curing shall be by membrane-forming curing compound, by covering exposed surfaces with polyethylene sheets, or by water curing.
 2. Environmental Requirements: The following shall be required when placing concrete:
 - a. Cold Weather: Concrete shall not be placed without special protection when the ambient temperature drops below 35 degrees Fahrenheit and the concrete is likely to be subjected to freezing temperatures before the initial set has occurred and the concrete strength has reached 500 psi. Concrete shall be protected in accordance with ACI 306R. The temperature of the concrete shall be maintained in accordance with the requirements of ACI 301 and ACI 306R.
 - b. Hot Weather: In periods of high ambient temperature, low relative humidity, and high wind, concrete shall be placed in accordance with the requirements of ACI 305R.
- B. Shotcrete: All shotcrete shall be placed and cured as required to meet applicable ACI standards and the following requirements:
1. Shotcrete Placement: Shotcrete shall be placed in accordance with the requirements of ACI 506.
 2. Placement of shotcrete may start without special protection when the ambient temperature is 35°F and rising, but shall be suspended when the ambient temperature is 40°F and falling. Special protection for cold weather shotcreting shall be in accordance with the requirements of ACI 306R.
 3. Hot-weather shotcreting shall be in accordance with the requirements of ACI 305R. Shotcrete shall not be placed when shotcrete temperature exceeds 95°F.
 4. Each layer of circumferential prestressing shall be protected by a shotcrete wire coat of a thickness not less than 1/4". Each prestressing wire shall be individually encased in shotcrete. The outer wire layer shall be protected by the wire coat plus two or more additional coats of shotcrete, totaling at least 1 inch in thickness over the outer layer of wire.

5. Dust, efflorescence, oil and other foreign material shall be removed from surfaces to be shotcreted. The nozzle distance from the prestressing wires shall be such that shotcrete does not build up or cover the front face of the wire until the spaces between the prestressing elements are filled.
 6. Vertical shooting wires shall be installed under tension and spaced no more than 3 feet apart to maintain a uniform and correct coating thickness. Wires of 18 or 20 gauge high tensile steel or monofilament shall be used.
 7. All exposed shotcrete coatings shall be kept moist for at least three days. Moist curing shall be started as soon as possible without damaging the shotcrete. Curing shall be by fog spraying or sprinkling. Curing may be interrupted for subsequent application of prestressing and concreting. After completion of the final coat, wet cure for seven days.
 8. Exterior shotcrete shall have a natural gun/nozzle finish.
- C. Floor: The floor and footings shall be cast monolithically, where practicable without cold joints to the dimensions shown on the construction drawings and shall incorporate the following:
1. Concrete floors or floor sections shall be cast monolithically with no cold joints.
 2. The floor shall be vibratory screeded to effect consolidation of the concrete and ensure proper encasement of the reinforcement.
 3. The floor shall be cured by fogging during the placement of concrete. The floor shall be wet cured for a minimum of seven days, and then continue to be kept moist during the duration of the construction. An NSF-61 approved membrane forming curing compound may be used in conjunction with water.
 4. The floor slab shall receive a fresno finish.
- D. Waterstop: A PVC Waterstop shall be embedded in the concrete at the floor to wall joint and provide a water tight seal. The waterstop shall meet the requirements of Article 2.07.B and shall meet the following criteria:
1. The vertical waterstop shall be placed and supported so that the bottom of the center bulb is at the elevation of the top of the footing. The vertical tolerance of the waterstop shall be less than $\pm 1/4"$. The radial tolerance of the waterstop shall be less than $\pm 1/2"$.

2. The waterstop shall be supported in a secure manner that ensures proper positioning and consolidation of concrete around the waterstop and prevents displacement during concrete casting.
 3. The waterstop shall be secured using pre-manufactured holes or rings supplied by the manufacturer and shall not be punctured in the field.
 4. The waterstop shall be spliced using a thermostatically controlled splicing iron. Each splice shall be electronically spark tested prior to concrete encasement and any defects shall be repaired prior to installation.
- E. Precast Core Wall: The tank wall shall incorporate a steel diaphragm which meets the requirements of Article 2.05 and shall meet the following criteria:
1. The core wall shall be constructed of precast panels and vertical joints filled with shotcrete, mortar, or cast-in-place concrete.
 2. A continuous watertight steel diaphragm shall be provided throughout and within the tank wall, and shall be located between the stored tank contents and the prestressing wires. The steel diaphragm shall be full length without horizontal joints. Vertical diaphragm joints shall be mechanically seamed except where located between wall panels, in which case joints shall be sealed with polysulfide or other suitable sealant. All vertical diaphragm joints shall be sealed to be fully watertight. Piercing of the diaphragm shall not be permitted except by design.
 3. The steel diaphragm shall be protected from damage before, during and after placement. Holes for form ties, nails, or punctures will not be permitted unless they are predetermined due to penetrations.
 4. The tolerance requirements for the construction of the tank wall shall be as follows:
 - a. Tank Radius: The maximum out-of-round tolerance of the wall shall be +/- 1/2 inch per 100-feet diameter.
 - b. Wall Thickness: The core wall thickness should not vary more than + 1/2" or – 0" from the specified thickness.
 5. After each precast panel has firmed sufficiently, it shall be covered with polyethylene sheet for curing.
 6. The interior of precast wall panels shall be given a fine broom finish.
 7. The precast panels shall be erected around the circumference of the tank and aligned to proper tolerances.

8. Bearing pads shall be located and held in their proper position prior to erection of wall panels. Nailing of pads shall not be permitted.
 9. Sponge filler pads shall be properly secured. All voids around sponge which will be beneath the wall base curb shall be caulked with an approved nontoxic sealant to prevent mortar seepage.
 10. The steel diaphragm shall be covered with a minimum of ½" of shotcrete prior to prestressing.
- F. Dome Roof: The dome shall be cast to the dimensions shown on the construction drawings and shall incorporate the following:
1. The dome shall be cast-in-place concrete constructed to proper spherical curvature. Circumferential and radial construction joints, if required, shall be configured with a vertical joint above the reinforcement while that point below the reinforcing steel shall be sloped at approximately 45 degrees. Joints that become cold due to concrete hardening shall be cleaned and coated with a thixotropic fresh cement grout prior to placement off the adjacent fresh concrete.
 2. Dome forms shall be designed to resist all forces acting with respect to its sloped surface. No portion of formwork for domes shall be removed until the concrete has attained sufficient strength, and until the full circumferential prestressing force has been applied to the dome ring, unless otherwise directed by the Tank Design Professional.
 3. The dome reinforcement shall be supported using non-corrosive bolsters spaced at a maximum of 36" center to center.
 4. The average radius of curvature of any dome surface imperfection should not exceed 1.4 times the radius of the dome.
 5. The dome form shall be left in place a minimum of 7 days or until a sufficient amount of prestressing force has been applied to the dome ring to support anticipated dome dead and live loads, whichever is greater.
 6. The exterior surface of the dome shall receive a fine broom finish. The dome soffit shall be a form finish.
 7. The exterior dome surface shall receive a coat of membrane-forming curing compound immediately after completion of the final finishing operation.

- G. Prestressing: Circumferential prestressing of the tank shall be achieved by the application of prestressing wire meeting the requirements of Article 2.04 as follows:
1. Circumferential prestressing shall be accomplished by the application of high tensile steel wire. An essential feature of the wire-wound stressing system is the proper application of tension to the prestressing element before it is placed on the wall. Stressing may be performed by die-drawing or another process that results in continuous, uninterrupted elongation of the wire, thereby assuring a uniform stress throughout its length.
 2. The stressing system shall be capable of consistently producing a stress at any point around the wall, within a ± 7 percent tolerance of the specified initial stress, f_{psi} . A calibrated stress-measuring device which can be easily recalibrated shall be used to determine wire stress levels frequently throughout the wrapping process. At least one stress reading for every coil or foot of wall height shall be taken immediately after application on the wall, and all such readings shall be on straight lengths of wire. A written record of stress readings shall be maintained.
 3. If the measured wire stress falls below design f_{psi} , additional prestress wire shall be applied. If the applied stress in the wire exceeds $1.07 f_{\text{psi}}$, the wrapping operation shall be discontinued immediately upon discovery and satisfactory adjustment made to the stressing equipment before resuming. The total prestress force measured on the wall per vertical foot of height shall not be less than the design force, nor more than 5 percent greater.
 4. Each coil of prestressing wire shall be temporarily anchored. Ends of the individual coils shall be joined by suitable steel splicing devices capable of developing the full strength of the wire.
 5. The wire winding schedule shall be prepared for minimum spacing between the prestressing elements of $3/8$ inch, and the average minimum clear space between wires on the wall shall be $5/16$ inch or 1.5 wire diameters, whichever is greater. Wires in areas adjacent to openings or inserts shall be uniformly spaced in accordance with the above.
 6. A properly designed stress plate shall be used at all permanent wall penetrations that are located above the final backfill elevation and are greater than 24 inches in height. The stress plate shall accommodate a portion of the prestressing wires normally required over the height of the penetration. The remaining prestressing wires normally required shall be relocated into circumferential bands immediately above and below the

penetration. The effect of banded prestressing shall be taken into account in the design.

H. Wire Coat and Cover Coat:

1. Subsequent layers of circumferential prestressing and shotcrete shall proceed when the underlying layer has developed sufficient bond and compressive strength.
2. Visible cover coat surfaces shall be uniform and even textured. Finishing techniques shall be used includes a natural gun or nozzle finish.
3. After completion, the cover coat shall be moist cured by wrapping the tank with a polyethylene film or other means conforming to the requirements of ACI 308R.

I. Coating Applications:

1. Clean all concrete surfaces to be coated to remove dust, laitance, efflorescence or other foreign matter.
2. Repair any surface defects prior to the application of coatings with materials which are compatible with the coating. Repair materials shall provide a consistent finish with the exterior finish of the tank surfaces and shall be applied in accordance with the recommendations of the manufacturer.
3. Apply coatings in accordance with the recommendations of the manufacturer.

3.04 QUALITY CONTROL:

A. Testing: All concrete and shotcrete used in the construction of the tank shall be tested in accordance with the following requirements by an independent testing laboratory at the tank construction company's expense:

1. Concrete: Concrete shall be tested in accordance with ASTM C31 and C39 by an independent testing laboratory. A minimum of one sample for each 50 cubic yards shall be taken as follows:
 - a. Concrete Cylinders: A minimum of two sets of four cylinders for 6 x 12 cylinders or three sets of four cylinders for 4 x 8 cylinders. Test one cylinder at 7 days and 28 days and hold two
 - b. Slump and Air: Slump and air content shall be tested once for each 50 cubic yards of material placed.

2. Shotcrete: Shotcrete shall be tested in accordance with the requirements of ACI 506 as follows:
 - a. Panels: One panel shall be constructed and tested in accordance with the requirements of ACI 506 for the wire coat and the cover coat. The panel should be stored on the site and cured in the same manner as the shotcrete. The panels shall be cored or sawn to obtain 3 in. diameter cores or 3 in. cubes. Three cores or cubes should be tested at 7 days, three shall be tested at 28 days and three shall be held as spares.
- B. Quality Program: The tank contractor shall employ, within its normal construction practices, a first-time quality control program which includes but is not limited to:
 1. Written quality control program.
 2. Inspection checklists which ensure the quality of construction practices, materials, and equipment.
 3. Detailed inspection reports with critical hold points
 4. Detailed procedures for the control of any identified deficiencies during construction.
 5. Retention of quality control measures through a cloud-based database.

3.05 CLEANUP

- A. Tank Interior:
 1. Remove all construction debris and thoroughly clean interior floor and wall surfaces, and piping, using a low-pressure wash.
- B. Exterior Site:
 1. Remove and dispose of all construction debris, materials and equipment prior to leaving site. Dispose of all construction waste in an approved landfill.

3.06 DISINFECTION

- A. Disinfection shall be performed using Method 3 in accordance with AWWA C652 and shall meet the requirements of local and state agencies.
- B. A bacteriological test shall be performed prior to placing the tank into service.

3.07 WATERTIGHTNESS TESTING

- A. Upon completion of the tank, it shall be filled to overflowing with water furnished to the tank by the Owner. The tank shall remain filled for a period of at least 24 hours to allow for absorption and initial settlement.
- B. Measure the drop in liquid level over the next 72 hours. The net drop in liquid level shall not exceed the maximum allowable of 0.05 of 1 percent per 24-hour period.
- C. If the net drop in liquid level exceeds the maximum allowable, the liquid level test shall be extended to a total of 5 days. If at the end of 5 days, the average net drop in liquid level does not exceed the maximum allowable, the test shall be considered satisfactory. If the net liquid loss exceeds the maximum allowable, the test shall be considered unsuccessful, the source of leakage shall be corrected, and the tank shall be retested.
- D. Damp spots on the exterior wall surface shall not be permitted. Damp spots are defined as spots where moisture can be picked up on a dry hand. The source of water movement through the wall shall be located and permanently sealed in an acceptable manner. No leakage that includes visible flow through the wall-floor joint shall be permitted. Damp spots on the footing are permissible.
- E. Water for the initial watertightness test shall be furnished to the tank by the Owner. Water for any subsequent tests which are required will be at the expense of the tank contractor.

3.08 TANK BACKFILL

- A. Backfill material around the tank shall be placed in uniform layers and compacted as specified for the material and site conditions. Asymmetrical backfill placement, except as may be required by the design and site conditions, shall be avoided.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the contract unit price for ALTERNATE 1A, PRESTRESSED CONCRETE 1MG GST related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 33 16 36

PART 1 GENERAL

1.01 SUMMARY

A. Scope:

1. The Contractor shall provide all labor, materials, equipment, and incidentals required to furnish and install stormwater culverts as shown on the Drawings and specified herein.
2. Work includes excavation, bedding, pipe installation, jointing, end sections, backfilling, compaction, and all appurtenances necessary to complete a functional stormwater culvert system.
3. Culverts shall be installed at the locations, sizes, lengths, and elevations indicated on the Contract Drawings and in accordance with applicable Illinois Department of Transportation standards.

B. Intent:

1. It is the intent of this Section to provide complete and operational stormwater conveyance systems conforming to the requirements of the Illinois Department of Transportation (IDOT) Standard Specifications and applicable Standard Drawings.

1.02 RELATED SECTIONS

- A. Division 01 – General Requirements.
- B. Section 31 23 16 – Excavation.
- C. Section 31 23 23 – Fill
- D. Section 33 05 05 – Buried Pipe Installation.

1.03 REFERENCES

- A. The work of this Section shall conform to the latest adopted edition (unless otherwise noted) of the following:
 1. Standard Specifications for Road and Bridge Construction, Adopted April 1, 2022, including applicable Sections 540 through 550 and related Articles governing pipe culverts and storm sewers.
 2. Standard Specifications for Water and Sewer Main Construction in Illinois, except for measurement and payment provisions.

3. ASTM A798 – Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications.
 4. Applicable ASTM standards for pipe materials, coatings, and joint gaskets as referenced within IDOT Section 550.
 5. IDOT Standard Drawings for end sections including Standard Nos. 542301 and 542401, as applicable to pipe type and diameter.
- B. Where conflicts occur, the more stringent requirement shall govern, subject to approval by the Engineer.

1.04 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data:
1. Manufacturer's catalog data for each size and type of culvert pipe.
 2. Joint details, gasket materials, and coupling systems.
 3. End section details and IDOT Standard reference.
- C. Certifications:
1. The pipe manufacturer shall provide certification that the pipe has been sampled, tested, and inspected in accordance with the applicable ASTM standards and IDOT requirements.
 2. Certification shall be signed by an authorized representative of the manufacturer.
 3. Mill test reports and coating compliance documentation shall be submitted when required by the Engineer.

1.05 QUALITY ASSURANCE

- A. All materials shall comply with IDOT Section 550 for Class B, Type 1 pipe (storm sewer), unless otherwise indicated on the Drawings.
- B. Pipe manufacturer shall have a minimum of five (5) years documented experience producing culvert pipe of similar size and type.
- C. Materials shall be subject to inspection and testing by the Engineer and, where applicable, IDOT representatives.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be delivered, stored, and handled in accordance with manufacturer's recommendations and IDOT requirements.
- B. Pipe shall not be dropped or rolled against other pipe.
- C. Open ends shall be protected from entry of foreign material.
- D. Damaged pipe or coatings shall be rejected or repaired in accordance with manufacturer's written instructions and subject to approval by the Engineer.

1.07 GUARANTEE

- A. The Contractor shall guarantee all work for a period of one (1) year from the date of final acceptance against defective materials and workmanship.
- B. Any settlement, joint separation, structural failure, coating failure, or misalignment occurring within the guarantee period shall be corrected at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 GENERAL IDOT CLASS B TYPE 1 PIPE (STORM SEWER)

- A. Pipe shall be round storm sewer pipe meeting the requirements of IDOT Section 550 for Class B, Type 1 pipe.
- B. Pipe material shall be corrugated metal pipe or other material as shown on the Drawings and permitted under IDOT specifications.
- C. Coatings shall comply with IDOT requirements for galvanized, aluminized, or polymer-coated pipe, as specified in the Contract Documents.
- D. Joints:
 - 1. Pipe joints shall be gasketed bell-and-spigot or approved coupling bands designed to provide soil-tight joints.
 - 2. Coupling bands shall meet IDOT requirements for the specified pipe type and diameter.
 - 3. Gaskets shall be rubber or neoprene conforming to ASTM and IDOT standards for soil-tight applications.

2.02 END SECTIONS

- A. The inlet and outlet ends of all storm sewer runs shall be provided with an end section meeting the requirements of IDOT Standard Nos. 542301 or 542401, or as otherwise shown on the Drawings.
- B. End sections shall be compatible with the pipe diameter and material.
- C. End sections shall be supplied by the pipe manufacturer whenever possible. If not available, a metal end section conforming to IDOT requirements shall be provided.
- D. End sections shall be securely attached to the culvert pipe in accordance with IDOT standards and manufacturer's recommendations.

2.03 BEDDING AND BACKFILL MATERIALS

- A. Bedding and backfill materials shall comply with IDOT Section 550 and Section 31 23 16 of these Specifications.
- B. Bedding shall consist of granular material capable of providing uniform support along the full length of the pipe barrel.
- C. Material shall be free of frozen lumps, organic matter, debris, and stones larger than permitted by IDOT.

PART 3 EXECUTION

3.01 HANDLING

- A. Pipe shall be handled in accordance with manufacturer's recommendations.
- B. The use of cables or chains in direct contact with pipe shall not be permitted. Nylon or canvas slings shall be used.
- C. Bracing shall be provided during handling and storage as necessary to prevent excessive deflection or distortion.

3.02 EXCAVATION

- A. Excavation shall conform to Section 31 23 16 – Excavation and IDOT requirements.
- B. Trench width shall be sufficient to allow proper placement and compaction of bedding and backfill.

- C. Unsuitable foundation material shall be removed and replaced with approved granular material as directed by the Engineer.

3.03 BEDDING

- A. Bedding shall be shaped to provide uniform and continuous support under the full length of the pipe.
- B. For corrugated pipe, bedding shall be placed and compacted to allow corrugations to seat firmly in the bedding material.
- C. Minimum bedding thickness shall comply with IDOT Section 550.

3.04 INSTALLATION

- A. Installation shall conform to:
 - 1. IDOT Standard Specifications, Section 550.
 - 2. The Standard Specifications for Water and Sewer Main Construction in Illinois (excluding measurement and payment provisions).
 - 3. ASTM A798 for corrugated metal pipe installation.
- B. Pipe shall be laid true to line and grade as shown on the Drawings.
- C. Joints shall be properly aligned and fully engaged to ensure soil-tightness.
- D. Backfilling shall proceed evenly on both sides of the pipe to prevent displacement.
- E. Compaction shall meet IDOT density requirements for the location of the culvert (roadway, shoulder, or non-traffic areas).

3.05 BACKFILL

- A. Backfill and compaction shall be in accordance with Section 31 23 16 and IDOT Section 550.
- B. Mechanical compaction equipment shall not be operated directly over the pipe until sufficient cover has been placed as specified by IDOT.
- C. Settlement areas shall be restored to original grade and surface condition.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the contract unit price for EXCAVATION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 33 42 13

DIVISION 34 – TRANSPORTATION

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34 71 00	Roadways Construction	347100-1 – 347100-4

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Construction of proposed aggregate pavements and roadways.
 - 2. Furnishing all labor, materials, equipment, and incidentals required for preparation of subgrade, placement, grading, compaction, and finishing of aggregate base courses.
 - 3. Final grading and shaping of aggregate roadways to the lines and grades indicated on the Contract Drawings.
- B. Work shall include all excavation, subgrade preparation, aggregate placement, compaction, trimming, and finishing necessary to provide complete aggregate roadways ready for use.

1.02 RELATED SECTIONS

- A. Division 01 – General Requirements.
- B. Section 31 00 00 – Earthwork.
- C. Section 33 05 05 – Buried Pipe Installation.

1.03 REFERENCES

- A. Comply with applicable provisions of the Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, adopted April 1, 2022, and the Supplemental Specifications and Recurring Special Provisions, adopted January 1, 2022, hereinafter referred to as the IDOT Standard Specifications.
- B. Where conflicts occur between the Contract Documents and the IDOT Standard Specifications, the more stringent requirement shall govern as determined by the ENGINEER.

1.04 SUBMITTALS

- A. Submit aggregate source and material certifications demonstrating compliance with IDOT Standard Specifications, Section 1004.
- B. Submit certified gradation test results for each aggregate source.
- C. Submit compaction test results verifying compliance with specified density requirements.

1.05 QUALITY ASSURANCE

- A. All materials and construction methods shall conform to IDOT Standard Specifications.
- B. Aggregate materials shall be obtained from approved sources currently listed or approved by IDOT.
- C. Compaction testing shall be performed by a qualified testing laboratory in accordance with IDOT procedures.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver aggregate materials in a manner that prevents segregation and contamination.
- B. Stockpile aggregates on clean, well-drained surfaces. Prevent intermixing with soil or other foreign materials.
- C. Protect materials from excessive moisture or freezing conditions prior to placement.

1.07 GUARANTEE

- A. Guarantee that aggregate pavements will remain stable, properly graded, and free from rutting or displacement due to defective workmanship for a period of one year from the date of final acceptance.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Aggregate Base Course:
 - 1. Type B, Gradation CA-6, conforming to Section 1004 of the IDOT Standard Specifications.
 - 2. Aggregate shall consist of crushed stone only.
 - 3. Aggregate quality shall meet Class D or better quality requirements as defined in the IDOT Standard Specifications.
 - 4. Thickness shall be as indicated on the Drawings or as required to achieve finished grades shown.

B. Aggregate Surface Course:

1. Type A, conforming to Section 1004 of the IDOT Standard Specifications.
2. Gradation shall be as specified for Aggregate Surface Course, Type A in the IDOT Standard Specifications.
3. Aggregate shall consist of crushed stone or crushed gravel meeting IDOT quality requirements.
4. Surface course thickness shall be as shown on the Drawings.
5. Surface course shall be placed as the final wearing surface where indicated.

C. Concrete (where required for appurtenances or transitions):

1. Concrete materials shall comply with the IDOT Standard Specifications for Road and Bridge Construction, April 1, 2022 edition.

D. Water for compaction shall be clean and free from deleterious substances.

PART 3 EXECUTION

3.01 GENERAL

- A. Perform all roadway construction in accordance with IDOT Standard Specifications and accepted construction practices.
- B. Establish and maintain line and grade control throughout construction.

3.02 PREPARATION

A. Clearing and Grubbing:

1. Remove vegetation, topsoil, roots, and other unsuitable materials from areas designated for roadway construction.
2. Dispose of unsuitable materials in accordance with applicable regulations and Division 01 requirements.

B. Subgrade Preparation:

1. Shape and compact subgrade to required lines and grades.

2. Compact subgrade to not less than 95 percent of maximum dry density as determined by the Standard Proctor test (AASHTO T99), unless otherwise specified.
3. As an alternative or supplement, proof roll with a fully loaded tandem axle truck in accordance with IDOT requirements.
4. Undercut and replace soft or unstable areas as directed by the ENGINEER.

3.03 PLACEMENT OF AGGREGATE BASE AND SURFACE COURSES

- A. Place aggregate in lifts of uniform thickness not exceeding that permitted by IDOT for proper compaction.
- B. Spread material to avoid segregation and maintain uniform gradation.
- C. Moisture condition material as necessary to achieve proper compaction.
- D. Compact each lift to the density required by IDOT Standard Specifications.
- E. Construct aggregate roadways to the lines, widths, grades, and cross-sections shown on the Drawings.
- F. Place Aggregate Surface Course Type A as the final course where indicated and fine grade to provide a smooth, dense, and stable wearing surface free of ruts, depressions, or irregularities.

3.04 FINAL GRADING

- A. The General Contractor shall place aggregate in areas shown on the Drawings and finish the roadway around the plant to final grades once major construction activities are substantially complete.
- B. Perform final grading and shaping of the site as directed by the ENGINEER.
- C. Aggregate placement and finish grading shall be inspected and approved by the ENGINEER prior to the Contractor leaving the site and requesting final payment.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for AGGREGATE BASE COURSE, TYPE B and AGGREGATE SURFACE COURSE, TYPE A related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 34 71 00

DIVISION 40 – PROCESS INTERCONNECTIONS

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PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Design, fabrication, furnishing, and installation of piping support systems for process, mechanical, and utility piping.
 - 2. Pipe hangers, supports, anchors, guides, sway bracing, seismic restraints, anchoring devices, and accessories.
 - 3. Channel framing systems and support attachments to structural elements.
- B. Work includes supports for all piping systems shown or required for complete and operable installations, whether or not specifically detailed on the Drawings.
- C. Coordinate support systems with piping layouts, structural elements, equipment, and architectural features.

1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete
- B. Section 09 96 00 – High Performance Coatings
- C. Section 33 05 19 - Ductile Iron Pipe
- D. Section 33 05 31 - Thermoplastic Utility Pipe

1.03 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures.
- B. American Society of Mechanical Engineers (ASME):
 - 1. ASME B31.1 – Power Piping.
- C. ASTM International (ASTM):
 - 1. ASTM A123/A123M – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A653/A653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

- D. International Code Council (ICC):
 - 1. International Building Code (IBC).
 - 2. International Mechanical Code (IMC).
- E. Manufacturers Standardization Society (MSS):
 - 1. MSS SP-58 – Pipe Hangers and Supports – Materials, Design and Manufacture.
 - 2. MSS SP-69 – Pipe Hangers and Supports – Selection and Application.
 - 3. MSS SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices.
 - 4. MSS SP-127 – Bracing for Piping Systems, Seismic-Wind-Dynamic Design, Selection and Application.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings for piping 6 inches and larger, indicating:
 - a. Location and type of each support, hanger, anchor, guide, sway brace, and seismic restraint.
 - b. Catalog number and detail designation for each component.
 - c. Anchorage details and base plate loads.
 - 2. Product data for piping 4 inches and smaller, including catalog information for each support type.
 - 3. Calculations, sealed by a Professional Engineer registered in the State of the Illinois, when required for:
 - a. Seismic restraint systems.
 - b. Special or nonstandard supports.
 - 4. Revised support layouts reflecting changes in piping configuration or addition of expansion joints and flexible connections.

B. Informational Submittals:

1. Manufacturer's installation instructions.
2. Maintenance information for support systems and seismic restraints.

1.05 QUALITY ASSURANCE

- A. Design supports in accordance with MSS SP-58, SP-69, SP-89, and ASME B31.1.
- B. Seismic and wind design shall comply with IBC and ASCE 7, and Structural General Notes.
- C. Fabricate supports in accordance with MSS SP-58 tolerances and material requirements.
- D. Manufacturers shall have a minimum of five years' experience in production of pipe support components.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components in manufacturer's original packaging, labeled for identification.
- B. Store materials above grade and protected from corrosion and damage.
- C. Protect galvanized coatings and finishes from abrasion and impact.

1.07 WARRANTY

- A. Provide manufacturer's standard warranty, minimum one year from Substantial Completion, covering defects in materials and workmanship.

PART 2 PRODUCTS

2.01 GENERAL

- A. General:
 1. Design, size, and locate piping support systems throughout the facility.
 2. For piping smaller than 30 inches, supports are shown only where specific types are required; provide additional supports as necessary.
 3. Support systems for piping 30 inches and larger are generally indicated; verify adequacy for field conditions.

4. Maximum support spacing and minimum rod diameters shall comply with MSS SP-69 Tables 3 and 4 unless more stringent requirements are specified.

B. Loads:

1. Design supports for gravity loads including pipe, fluid, insulation, and appurtenances.
2. Consider thrust forces due to internal pressure and thermal expansion.
3. Design for seismic and wind loads per governing codes.

C. PVC Pipe Supports:

1. Straight runs: 5 feet maximum spacing.
2. Elbows and bends: Support each side.
3. Tees: Support each side of run and branch.

D. Anchoring Devices:

1. Size anchor bolts, inserts, and attachments to resist shear and pullout loads.
2. Minimum anchor diameter: 1/2 inch unless otherwise required.

E. Vertical sway bracing: 10 feet maximum spacing unless noted otherwise.

2.02 HANGERS

A. Clevis Hangers (MSS SP-58 Type 1):

1. Adjustable steel clevis type.
2. Acceptable Manufacturers:
 - a. Anvil International – Figure 260.
 - b. B-Line – Figure B3100.
 - c. Or equal.
3. For insulated pipe, provide insulated saddle system (ISS) compatible with hanger.

2.03 SADDLE SUPPORTS

- A. Nonadjustable Saddle (MSS SP-58 Type 37 with U-bolt):
 - 1. Schedule 40 pipe stanchion with base plate.
 - 2. Manufacturers:
 - a. Anvil – Figure 259 with Figure 63D base.
 - b. B-Line – Figure B3090 with B3088 base.
 - c. Or equal.
- B. Adjustable Saddle (MSS SP-58 Type 38):
 - 1. Manufacturers:
 - a. Anvil – Figure 264 with Figure 63T base.
 - b. B-Line – Figure B3093 with B3088T base.
 - c. Or equal.
- C. Elbow and flange supports: Provide adjustable or fixed stanchion types as required.

2.04 WALL BRACKETS AND SUPPORTS

- A. Welded Steel Wall Brackets (MSS SP-58 Type 33), galvanized.
- B. Offset Pipe Clamps.
- C. Channel-Type Framing Systems:
 - 1. 12-gauge steel, minimum 1-5/8 inch side dimension, or 1-1/2 inch FRP.
 - 2. Design loads shall not exceed one-half manufacturer's allowable loads.
 - 3. Manufacturers:
 - a. B-Line
 - b. Unistrut
 - c. Anvil Power-Strut

d. Aickinstrut (FRP)

e. or equal.

2.05 PIPE CLAMPS AND RISER SUPPORTS

A. Riser Clamps (MSS SP-58 Type 8).

B. U-bolts (MSS SP-58 Type 24) with double nuts providing 1/8- to 1/4-inch clearance for guides.

2.06 SEISMIC RESTRAINTS

A. Provide solid bracing assemblies with clevis cross brace and reinforced angle rod.

B. Design and installation in accordance with MSS SP-127 and project seismic criteria.

C. Manufacturer:

1. Mason Industries or equal.

2.07 PIPE GUIDES AND ANCHORS

A. Intermediate Pipe Guides:

1. Hold-down guides.

2. Spider alignment guides.

B. Pipe Anchors:

1. Anchor chair with U-bolt strap.

C. Provide guides at expansion joints and loops located at 4 pipe diameters and 14 pipe diameters from joint.

2.08 ACCESSORIES

A. Insulation Shields (MSS SP-58 Type 40), galvanized or stainless steel.

1. Type: Galvanized steel or stainless steel, MSS SP 58 and MSS SP 69, Type 40.

2. Manufacturers and Products:

- a. Anvil; Figure 167, sizes ½ inch through 24 inches.
 - b. B-Line; Figure B3151, sizes ½ inch through 24 inches.
 - c. Or equal.
- B. Welding Insulation Saddles (MSS SP-58 Type 39).
 - 1. Type: MSS SP 59 and MSS SP 69, Type 39.
 - 2. Manufacturers and Products:
 - 3. Anvil; Figure 160, sizes 1 inch through 36 inches.
 - 4. B-Line; Figure Series B3160, sizes ½ “ through 24 “.
 - 5. Or equal.
- C. Plastic Pipe Support Channel for small-diameter plastic pipe.
 - 1. Type: Continuous support for plastic pipe to increase support spacing.
 - 2. Manufacturer and Product:
 - a. B-Line; Figure Series B3106V, sizes ½ inch through 4 inches with Figure B3106 Vee bottom hangers
 - b. or equal.
- D. Hanger rods, nuts, clevises, turnbuckles per MSS SP-58.
- E. Attachments:
 - 1. I-beam clamps (Types 21, 28, 29, 30).
 - 2. Concrete inserts (Type 22).
 - 3. U-channel concrete inserts per Section 05 50 00.
 - 4. Concrete attachment plates.
- F. Dielectric Isolation:
 - 1. Provide isolation between dissimilar metals using plastic-coated hangers or isolator pads.
 - 2. Provide neoprene wrap between submerged pipe and clamps.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install supports in accordance with MSS SP-69 and MSS SP-89.
- B. Install hanger rods plumb within 4 degrees of vertical.
- C. Do not support piping from equipment or from other piping unless specifically indicated.
- D. Provide independent support for valves, strainers, and heavy fittings.
- E. Support piping at:
 - 1. Changes in direction and elevation.
 - 2. Adjacent to flexible joints and couplings.
 - 3. Locations shown on Drawings.
- F. Do not locate supports in equipment access zones or crane runways.
- G. Provide longitudinal and lateral sway bracing for suspended piping.
- H. Repair mounting surfaces to original condition after installation.

3.02 STANDARD SUPPORT APPLICATIONS

- A. Horizontal Suspended Piping:
 - 1. Single pipes: Clevis or swivel ring hangers.
 - 2. Grouped pipes: Trapeze supports.
- B. Wall-Supported Piping:
 - 1. Single pipes: Wall brackets with anchors.
 - 2. Stacked small piping: Channel framing systems.
- C. Floor-Supported Piping:
 - 1. Pedestal type stanchions with minimum 1-1/2 inch grout beneath base plate.

DIVISION 40 – PROCESS INTERCONNECTIONS

Section 40 05 15 – Piping Support Systems

2. Channel supports for small piping in trenches.
3. Concrete cradles for piping larger than 3 inches.

D. Insulated Piping:

1. Locate supports outside insulation.
2. Provide rigid insulation inserts and galvanized shields.
3. Wall clips not permitted for insulated piping.

E. Vertical Piping:

1. Provide offset clamps, riser clamps, and floor penetration supports.

3.03 FIELD FINISHING

- A. Repair damaged galvanized surfaces with zinc-rich coating.
- B. Paint exposed galvanized supports in accordance with Section 09 96 00.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL ALL PROCESS PIPING, VALVES, FITTINGS AND RELATED APPURTANANCES related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 40 05 15

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes manual and electric actuators for process valves and gates, complete with motors, gearing, controls, accessories, and appurtenances, in accordance with the Contract Documents.
- B. Work includes actuators for gate, butterfly, plug, ball, globe valves, and slide/slucice gates as indicated on the Drawings.
- C. Unit Responsibility: The valve or gate manufacturer shall be responsible for coordination of actuator sizing, mounting, assembly, and factory testing. The Contractor shall be responsible for complete compliance with the Contract Documents.
- D. Single Manufacturer: Where two or more actuators of the same type or size are required, they shall be produced by the same manufacturer.
- E. Basis of Design: Electric actuators shall be as manufactured by AUMA Actuators, Inc., Pittsburgh, Pennsylvania.

1.02 RELATED SECTIONS

- A. Section 40 05 64 – Valves for Process Control.
- B. Section 09 96 00 – High-Performance Coatings.
- C. Section 01 33 00 – Submittals.
- D. Section 01 43 33 – Manufacturer's Field Services.

1.03 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. AWWA C540 – Power-Actuating Devices for Valves and Slide Gates.
 - 2. C504 – Rubber-Seated Butterfly Valves.
 - 3. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service.
- B. National Electrical Manufacturers Association (NEMA) MG Standards.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01 33 00.
- B. Product Data:
 - 1. Manufacturer, model number, and size.
 - 2. Motor data including voltage, phase, frequency, insulation class, torque, and enclosure.
 - 3. Gear ratios and output torque ratings.
 - 4. Limit and torque switch data.
 - 5. Electrical schematics and wiring diagrams.
 - 6. Mounting details and dimensional drawings.
- C. Calculations:
 - 1. Actuator sizing calculations including seating, unseating, and dynamic torque.
 - 2. For modulating actuators, verification that required dynamic torque does not exceed 60 percent of rated breakaway torque.
- D. Operation and Maintenance Manuals.

1.05 QUALITY ASSURANCE

- A. Actuators shall conform to AWWA C540 unless otherwise specified.
- B. Electric actuators shall be specifically designed for valve and gate service in water and wastewater treatment facilities.
- C. Manufacturers shall have a minimum of five (5) years documented experience manufacturing actuators for similar applications.
- D. Field Services: Provide services of manufacturer's authorized representative for inspection, adjustment, startup, and training.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver actuators fully assembled and tagged for identification.

- B. Store in a clean, dry location protected from weather and construction damage.
- C. Protect machined surfaces, wiring compartments, and flange faces from corrosion and contamination.
- D. Handle actuators in accordance with manufacturer's written recommendations.

1.07 GUARANTEE

- A. Provide manufacturer's standard warranty, minimum one (1) year from date of Substantial Completion.
- B. Warranty shall cover defects in materials and workmanship under normal service conditions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Actuators shall be complete assemblies including motor, gearing, manual override, limit switches, torque switches, drive coupling, integral motor controls (where specified), wiring terminals, and position indication devices.
- B. Actuators shall have torque ratings equal to or greater than required for valve seating and dynamic conditions and shall be capable of holding any intermediate position without creeping or fluttering.
- C. Fasteners external to the actuator housing shall be stainless steel. Fasteners on limit switch and terminal compartments shall be captured to prevent loss.
- D. Actuator enclosures shall be NEMA 4 watertight unless otherwise indicated.

2.02 MANUAL ACTUATORS

- A. General
 - 1. Manual gear operators shall be furnished where indicated for gate, butterfly, plug, and ball valves.
 - 2. Gearboxes shall be the product of the valve manufacturer unless otherwise approved.
 - 3. Manual actuators shall comply with applicable provisions of AWWA C504 and AWWA C509.

B. Gear Requirements

1. Gearing shall be enclosed, grease lubricated, and designed to withstand full rated valve torque.
2. Gear units shall have non-rising stems where applicable.

C. Rim Pull

1. Butterfly valve gear operators shall be sized to meet AWWA C504 rim pull requirements without exceeding 60-pound rim pull.
2. Maximum handwheel diameters:
3. 12 inches or less: 12-inch handwheel.
4. 14 inches and larger: 18-inch handwheel.

D. Position Indication

1. Provide mechanical dial or pointer-type position indicators.
2. "OPEN" direction shall be permanently marked on actuator or handwheel.

2.03 ELECTRIC MOTOR ACTUATORS

A. General

1. Electric actuators shall comply with AWWA C540 and be specifically designed for water and wastewater service.
2. Basis of Design: AUMA Actuators, Inc., Pittsburgh, Pennsylvania.
3. Actuators shall be furnished and sized by the valve or gate manufacturer for required seating, unseating, and dynamic torque conditions.
4. Actuators shall be complete with motor, reduction gearing, torque and limit switches, manual override, drive coupling, integral controls (where specified), position indication, and mounting hardware.
5. Actuators shall be capable of holding any intermediate position without creeping or fluttering.
6. Enclosure shall be NEMA 4, watertight. External fasteners shall be stainless steel.

B. Motor

1. Induction type, totally enclosed non-ventilated (TENV).
2. Class F insulation with embedded thermal protection.
3. Voltage requirements:
 - a. 460V, 3-phase, 60 Hz for gate valves and sluice gates.
 - b. 460V, 3-phase, 60 Hz for quarter-turn valves over 16 inches.
 - c. 120V, single-phase, 60 Hz for quarter-turn valves 16 inches and smaller.
4. Motors shall operate satisfactorily within ± 10 percent of rated voltage.
5. Ambient temperature rating:
 - a. -20°F to +175°F without integral controls.
 - b. -20°F to +160°F with integral controls.

C. Gearing

1. Spur, helical, bevel, or worm type; grease lubricated in sealed housing.
2. Worm gears shall be bronze; helical gears hardened alloy steel.
3. Gearing shall withstand full motor stall torque.
4. Anti-friction bearings throughout.
5. Modulating actuators shall have zero backlash between motor and output.

D. Manual Override

1. Handwheel operated through power gearing.
2. Manual operation shall not rotate motor; electric operation shall not rotate handwheel.
3. Automatic return to electric mode upon motor start.
4. Manual operation shall be possible with failed motor.

E. Switches and Protection

1. Limit switches at each end of travel; adjustable without affecting manual operation.
2. One normally open and one normally closed contact at each end of travel where indicated.
3. Contacts shall be silver and suitable for low-voltage control circuits.
4. Mechanically operated torque switches at each end of travel, calibrated in engineering units.
5. Torque accuracy ± 5 percent.
6. Motor shall de-energize upon torque trip.
7. Provide jam protection and anti-nuisance torque feature.

F. Open/Close Service Actuators

1. Integral controls shall include reversing starter, control transformer, phase monitor, and monitor relay.
2. Provide Open–Stop–Close pushbuttons and Local–Off–Remote selector switch.
3. Provide red and green position indicator lights.
4. Provide optical isolation between external control signals and internal circuitry.
5. Provide padlockable local disconnect switch.
6. -turn actuators: 60-second closing time unless noted otherwise.
7. Gate and sluice gate actuators: 12 inches per minute operating speed unless noted otherwise.

G. Modulating Service Actuators

1. Actuator shall be sized so required dynamic torque does not exceed 60 percent of rated breakaway torque.
2. Provide integral positioner accepting 4–20 mADC signal.

3. Provide internal feedback potentiometer.
4. Positioner shall compare command signal to valve position and modulate accordingly.
5. Fail position on signal loss shall be field adjustable to fail open, fail closed, or fail last position.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install actuators in accordance with manufacturer's written instructions.
- B. Mount actuators securely with manufacturer-supplied brackets and hardware.
- C. Locate actuators for safe access and maintenance; do not mount to handrails, piping, or equipment supports.
- D. Install floor boxes, extension stems, guides, and supports as required.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's authorized representative shall:
 1. Inspect installation.
 2. Adjust limit and torque switches.
 3. Witness startup and operational testing.
 4. Certify proper operation.
- B. Demonstrate correct operation including open, close, stop, local, and remote functions.

3.03 FIELD PAINTING

- A. Exposed actuators shall receive coatings in accordance with Section 09 96 00.

DIVISION 40 – PROCESS INTERCONNECTIONS

Section 40 05 57 – Actuators for Process

Valves And Gates

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item in CONTRACT 1 for PROVIDE AND INSTALL ALL PROCESS PIPING, VALVES, FITTINGS AND RELATED APPURTANANCES and VALVE, MECHANICAL JOINT, 12" and VALVE, MECHANICAL JOINT, 16" and VALVE, MECHANICAL JOINT, 18" related to plans titled W2E WATER TREATMENT PLANT.
- 4.02 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item in CONTRACT 3 for RAW WATER MAIN CONSTRUCTION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 40 05 57

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of the requirements for valves with manual actuation, valves with automatic actuation, excluding solenoid control, and actuator brackets and mounting hardware.
- B. Like items of equipment provided hereunder, although for different services, shall be the end products of one manufacturer (ie. Butterfly; plug; gate; etc.) in order to achieve standardization for appearance, operation, maintenance, spare parts and manufacturer's service, unless specifically specified otherwise.

1.02 RELATED SECTIONS

- A. See Conditions of the Contract and Division 1 – General Requirements, which contains information and requirements that apply to the work specified herein and are mandatory for this project.
- B. See Division 9, Section 09 96 00 – High-Performance Coatings that contains surface preparation and painting requirements.

1.03 REFERENCES

- A. American Water Works Association (AWWA).
 - 1. AWWA C509: ANSI/AWWA C509-01, AWWA Standard for Resilient-Seated Gate Valves for Water Supply Service
 - 2. AWWA C517: Resilient-Seated, Cast-Iron Eccentric Plug Valves
 - 3. AWWA C550: ANSI/AWWA C550-05, AWWA Standard Protective Interior Coatings for Valves and Hydrants.
 - 4. AWWA C600: ANSI/AWWA C600-93, AWWA Standard for Installation of Ductile-Iron Water Mains and their Appurtenance
- B. Manufacturers Standardization society of the valve and Fittings Industry (MSS).
 - 1. MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

1.04 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01 33 00 – Submittal Procedures, Division 1 – General Requirements.

- B. The manufacturer shall furnish certified shop drawings, installation, operation and maintenance manuals, in accordance with the latest revision of AWWA C500 through C540 as applicable.
- C. Submit copies of the ordering schedule before ordering valves. The schedule shall include make, model, type, size, pressure rating and location.
- D. An affidavit of compliance in accordance with the latest revision of AWWA C500 through 540 as applicable, and certification of performance testing of each valve shall be furnished to the Engineer.
- E. The shop drawings shall include:
 - 1. Custom drawings showing how each valve operator is to be connected electrically (where applicable) in accordance with the schematics on the drawings.
 - 2. Valve torques used to size the operator.
 - 3. Valve operator orientation and dimensions and clearances (to adjacent surfaces within three feet) for each valve.
 - 4. Materials of construction.
 - 5. For manual actuators, provide force requirements for hand wheels, cranks, etc.
 - 6. Valve seating/unseating torque, maximum required torque, valve stem diameter at actuator mounting, and maximum allowable torque.
 - 7. Full open Cv values.
 - 8. Quality control procedures and system documents.
 - 9. Certification that the manufacturer has been engaged in the design, and manufacture or the specified valves for a minimum of ten (10) years.

1.05 MANUFACTURER'S SERVICE

- A. A factory manufacturer's representative for the equipment specified herein shall be present at the jobsite designated by the Owner for a period of time if specified in Division 1, Section 01 43 33 – Manufacturer's Field Services.

1.06 GUARANTEE

- A. The manufacturer/Contractor shall warrant the equipment to be free of material or workmanship defects for a period of two (2) years from the date of substantial completion established by the Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide adjustable cast iron valve boxes and lids marked "Water" for all buried potable water valves.

2.02 NON-AWWA BALL VALVES (3-inch and smaller)

- A. Ball valves 3-inch and smaller shall be of two-piece construction, with standard port diameter, and FNPT end connections.
- B. Manufacturers and Model/Style/Series:
 - 1. Milwaukee BA-150C
 - 2. Engineer approved equal
- C. All non-AWWA ball valves shall be furnished in accordance with MSS-SP-110 and with the performance features as follows:
 - 1. Body Construction – Bronze.
 - 2. Actuator – The valve shall be designed to permit installation of a steel zinc plated vinyl covered lever actuator.
 - 3. Valve Ball – Bronze with hard chrome plating.
 - 4. Valve Rating – Valves shall be rated for 600 PSI WOG cold service.
 - 5. Ball Seats – Reinforced TFE.
 - 6. Stem Packing – Valves shall be furnished with a stuffing-box and adjustable packing gland.

- D. All non-AWWA ball valves shall provide minimum Cv values as follows:

VALVE PIPE SIZE	Cv	VALVE PIPE SIZE	Cv
1/2"	9.8	1 1/2"	81
3/4"	25	2"	105
1"	35	2 1/2"	440
1 1/4"	47	3"	390

2.03 AWWA BALL VALVES (6-INCH THROUGH 48-INCH)

- A. Ball valves shall be metal-to-metal seated, trunnion mounted, with 100% circular port opening and shall conform to ANSI/AWWA C507 (latest revision).
- B. Valve body shall be cast iron meeting ASTM A48 Class 35 (150 lb class).
- C. Flanges shall conform to ANSI B16.1 Class 125. Body shall include integrally cast bronze bushed trunnions and support actuator without external supports.
- D. Ball shall be one-piece cast iron or ductile iron with full port opening equal to valve size. Seats shall be Type 304 stainless steel. Trunnions shall be bronze or stainless steel bushed. Maximum seat bearing pressure: 1,000 psi.
- E. Bearings shall be sleeve type, bronze (low zinc) or stainless steel, designed for maximum 2,000 psi bearing pressure.
- F. Operating shaft shall be integral with trunnion and constructed of ASTM A564 17-4 stainless steel, machined to 32 micro-inch finish or better.
- G. Manufacturers:
1. GA Industries – Series 507
 2. Apco Willamette – Series 2600
 3. Engineer approved equal

2.04 PLUG VALVES

- A. Valves shall be of the non-lubricated eccentric type with an elastomer covering all seating surfaces. The elastomer shall be suitable for the service intended. Flanged valves shall be manufactured in accordance with ANSI B16.1 Class 125/150 including facing, drilling and flange thickness. Mechanical joint ends shall be in compliance with AWWA / ANSI C-111- 92. Grooved ends shall be manufactured to the dimensions of ANSI / AWWA C606 for ductile or steel pipe as required. Ports shall be round on sizes 2-1/2"-12" and rectangular port design

on valves 14" and larger. All valves shall be capable of being "pigged" with a soft pig when required.

- B. Valve bodies shall be of ASTM A-126 Class B cast iron and thickness in accordance with AWWA C-517 Section 4.4.1.4. The interior of the valve bodies shall be covered with a suitable elastomer with a minimum thickness of 1/8". The elastomer shall extend through the valve flow way and onto the flanges to ensure a positive seal.
- C. Plugs shall be of ASTM A-536-Grade 65-45-12 for all sizes in compliance with AWWA C-517 Section 4.3.3.2. The plugs shall be of one piece solid construction with PTFE thrust bearings on the upper and lower bearing journals to reduce torque and prevent dirt and grit from entering the bearing and seal area.
- D. Valves shall be furnished with replaceable sleeve type bearings conforming to AWWA C-517, Section 4.3.3.6. Bearings shall be of sintered, oil impregnated type stainless steel. Valve shaft seals shall be of the "U" cup type in accordance with AWWA C-517 Section 4.4.7. Seals shall be self-adjusting and repackable without removing the bonnet from the valve.
- E. Worm gear operators shall be of the heavy duty construction with the ductile iron quadrant supported on the top and bottom by oil impregnated bronze bearings. The worm gear and shaft shall be manufactured of hardened steel and run on high efficiency roller bearings. All worm gear operators shall be sized for bi-directional shutoff at the valves design pressure rating.
- F. Valves shall be designed and manufactured to shut off bubble tight at 175 psi for valves 2-1/2"-12" and 150 psi for valves 14" and larger. Each valve shall be given a hydrostatic and seat test with the test results being certified when required by the customer. Certified copies of Proof-of-Design test reports shall be furnished as outlined in AWWA C-517 Section 5.2.2 when requested
- G. Manufacturers and Model/Style/Series:
 - 1. Mueller Co. (Pratt) – Ballcentric
 - 2. Kennedy – Port Eccentric
 - 3. GA – Series A517
 - 4. Engineer approved equal

2.05 BUTTERFLY VALVES

- A. Valves shall conform to AWWA C504, Class 150B and NSF 61. Manufacturer shall have minimum five (5) years experience.
- B. Valve bodies:
 - 1. Flanged: ASTM A126 Class B
 - 2. Wafer: ASTM A48 Class 40
 - 3. Flanges per ANSI B16.1 Class 125
- C. Seats shall be one-piece molded rubber bonded to valve body. Wafer style seats shall function as flange gaskets.
- D. Bearings shall be self-lubricating nonmetallic. Metal-to-metal bearings in flow stream are not allowed.
- E. Disc shall be lens-shaped for low headloss:
 - 1. Cast iron with Type 316 stainless steel edge
 - 2. Retained with stainless steel pins
 - 3. No disc stops in flow stream
- F. Shaft: Type 304 stainless steel with chevron packing. O-ring/U-cup packing not allowed.
- G. Coating:
 - 1. Interior: Asphalt varnish per TT-C-494 and AWWA C504
 - 2. Exterior: Primer compatible with field coating
- H. Testing: Hydrostatic and leakage per AWWA C504.
- I. Provide proof-of-design test reports upon request.
- J. Manual actuators:
 - 1. Traveling nut, self-locking type
 - 2. Max 80 lb input force
 - 3. With mechanical stops

4. Rated for 450 ft-lb input
5. Conform to AWWA C504

K. Manufacturers:

1. Mueller Co. (Pratt)
2. Kennedy
3. Engineer approved equal

2.06 KNIFE GATE VALVES

- A. Valves shall be bonnetless wafer type per MSS SP-81, rated 150 psi CWP. Bodies shall be ductile iron or stainless steel (CF8/CF8M). Flanges per ANSI B16.5 Class 150.
- B. Gate: 304 stainless steel, designed to resist deflection, with rounded bottom edge.
- C. Seat: Replaceable resilient seat (Natural Rubber, EPDM, or Neoprene), bubble-tight shutoff, debris-resistant design with molded steel reinforcement.
- D. Packing:
 1. Teflon-lubricated synthetic
 2. Minimum four rows
 3. Stainless steel hardware
- E. Yoke: Ductile iron, flat-top design for actuator mounting.
- F. Stem:
 1. 304 stainless steel with ACME threads
 2. Bronze stem nut
 3. Enclosed ductile iron retainer
- G. Actuation:
 1. Handwheel standard

- 2. Bevel gears for ≥ 14 -inch or high-pressure service
- H. Coating: Heat-cured powder coating on all components.
- I. Testing: Per MSS SP-81.
- J. Manufacturers:
 - 1. Pratt LVC Fig. 53
 - 2. Engineer approved equal

2.07 AWWA GATE VALVES

- A. Gate valves shall be equipped with a buried nut for manual operation as shown on the drawings. Gate valves have corrosion-resistant fasteners and Class 125 flanged end connections. Valves shall be provided with a fusion bonded epoxy coating complying with ANSI/AWWA C550 on all internal and external surfaces of the valve body and bonnet.
- B. AWWA Gate valves shall conform to the following:
 - 1. Resilient seat/wedge, NRS type rated for 250 p.s.i.g. cold water working pressure.
 - 2. In full accordance with ANSI/AWWA C515 for 30inch through 36-inch sizes or ANSI/AWWA C509 for 4-inch through 16-inch sizes or in accordance with all applicable provisions of ANSI/AWWA C509 for 18-inch through 24-inch sizes.
 - 3. Fitted with ductile-iron valve body, bonnet and gate.
 - 4. Marked with the words "D.I." or "Ductile Iron" cast on the valve or stamped on a permanently attached corrosion resistant metal tag.
 - 5. Provided with wedge gate that is encapsulated with rubber, symmetrical, and seals equally well with flow in either direction.
 - 6. Provided with O-ring stem seals.
 - 7. Certified to ANSI/NSF Standard 61 by either underwriters Laboratory or NSF International.
 - 8. Valves shown on the Drawings to be attached to a flanged hydrant shoe, tapping valve, tapping saddle or flanged branch of a tee or cross shall have one flanged end compatible with the mating flange.
 - 9. Valve shall open counterclockwise unless noted otherwise.

C. Manufacturers and Model/Style/Series:

1. Kennedy – Series 4500.
2. Mueller Co. (Pratt) – Series VE.
3. GA – Series 6000
4. Engineer approved equal.

2.08 MOUNTING HARDWARE

- A. Mounting hardware shall be 316 stainless steel nuts, bolts and washers unless specifically noted otherwise.

2.09 MOUNTING BRACKETS

- A. Mounting brackets may be fabricated from ASTM A36 steel plates, shapes and/or bars. The minimum material thickness shall be ¼-inch.

PART 3 EXECUTION

3.01 SHOP TESTING

- A. All valves shall be hydro-tested in accordance with AWWA specifications by the valve manufacturer.

3.02 VALVE AND ACTUATOR ASSEMBLY

- A. The valve and actuators shall be completely factory assembled and shipped as a unit. The assemblies shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final identification in the field.

3.03 WELDING

- A. All shop welding shall be in accordance with AWS D1.1.
- B. Welding symbols on shop drawings shall be per AWAS A2.0.

3.04 TESTING

- A. All valves shall be hydraulically tested to the pressures shown on the Valve Schedule.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item in CONTRACT 1 for PROVIDE AND INSTALL ALL PROCESS PIPING, VALVES, FITTINGS AND RELATED APPURTANANCES and VALVE, MECHANICAL JOINT, 12" and VALVE, MECHANICAL JOINT, 16" and VALVE, MECHANICAL JOINT, 18" related to plans titled W2E WATER TREATMENT PLANT.

- 4.02 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item in CONTRACT 3 for RAW WATER MAIN CONSTRUCTION related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 40 05 64

PART 1 GENERAL

1.01 SUMMARY

- A. This section consists of the requirements for pump control valves, check valves, and check valve assemblies.
- B. Work includes furnishing, shop testing, delivery, and field support for the following:
 - 1. Standard swing type check valves with external lever and weight and pneumatic cushion.
 - 2. Tilting disc check valves.
 - 3. Silent (non-slam) wafer check valves for pump discharge service.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 43 33 – Manufacturer's Services.
- C. Section 01 62 00 – Product Requirements.
- D. Section 09 96 00 – High-Performance Coatings.

1.03 REFERENCES

- A. American Water Works Association (AWWA).
 - 1. AWWA C508 — Swing Check Valves for Waterworks Service.
- B. Manufacturers Standardization Society (MSS).
 - 1. MSS-SP-71 — Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - 2. MSS-SP-80 — Bronze Gate, Globe, Angle and Check Valves.
- C. ASTM International.
 - 1. ASTM D1784 — PVC and CPVC Materials.
 - 2. ASTM A126 — Gray Iron Castings for Valves.

- D. ASTM A356 — Aluminum Alloy Castings.

1.04 SUBMITTALS

- A. Materials of construction.
- B. Dimensional drawings.
- C. Performance data including:
 - 1. Range for adjustment in time for complete valve closure.
 - 2. Manufacturer's performance certification.
- D. Certified hydrostatic test results.
- E. Evidence of manufacturer's quality assurance program.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications
 - 1. The valve manufacturer shall have been engaged in the design, manufacture, and testing of the specified type of valves and associated equipment for a minimum of ten (10) years.
- B. Standardization Requirements
 - 1. Like items of equipment provided under this Section, although for different services, shall be products of one manufacturer (i.e., swing, lift, ball, silent, tilting disc, etc.) to achieve uniformity in appearance, operation, maintenance, spare parts, and service unless otherwise specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver valves in accordance with Section 01 62 00 – Product Requirements.
- B. Valves shall be delivered with:
 - 1. Flange faces protected by bolted or strapped flange covers.
 - 2. Internal components protected from debris, moisture, and damage.
 - 3. All loose components packaged and clearly identified.
- C. Store valves above ground on blocking or pallets.

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- D. Protect from:
 - 1. Dirt and debris.
 - 2. Standing water.
 - 3. Direct weather exposure.
 - 4. Mechanical damage.
- E. Do not remove protective flange covers until installation.
- F. Handle valves using lifting lugs where provided. Do not lift by actuator, lever arm, counterweight, or pneumatic cylinder assemblies.

1.07 WARRANTY

- A. Manufacturer shall provide a written warranty guaranteeing equipment to be free from defects in material and workmanship for a period of one (1) year from the date of Substantial Completion as established by the Owner.

PART 2 PRODUCTS

2.01 STANDARD SWING TYPE CHECK VALVES

- A. Swing type check valves shall conform to the following:
 - 1. Utilize a thru-valve disc hinge shaft with outside lever and weight and pneumatic cushion chamber.
 - 2. Suitable for horizontal or vertical installation as shown.
 - 3. Provide resilient material-to-metal seat and full waterway design per AWWA C508.
- B. Acceptable Manufacturer:
 - 1. Henry Pratt 9001 Series
 - 2. Engineer approved equal.
- C. Valve Ends:
 - 1. Flanged ends per AWWA C508 with 125-pound flanges.

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2. Mechanical joint ends not permitted.
- D. Body Construction:
1. ASTM A126 Class B cast iron, minimum tensile strength 30,000 psi.
 2. One-piece globe pattern body.
- E. Design Pressure:
1. Class 125 rating.
- F. Body Seat Construction:
1. Cast bronze meeting AWWA C508.
 2. Replaceable in field.
- G. Disc Construction:
1. Cast or ductile iron, minimum 30,000 psi strength.
 2. Resilient seat ring meeting potable water requirements.
 3. Replaceable resilient ring secured with bronze follower and stainless steel fasteners.
 4. Stainless steel articulated hinge mechanism.
- H. Hinge Shaft:
1. Type 303 or 17-4PH stainless steel.
 2. Designed for reverse flow velocities up to 5 ft/sec.
 3. Bronze sleeve or solid bearings per AWWA C508.
 4. Adjustable packing glands.
- I. Pneumatic Cushion Cylinder:
1. Heavy-duty, corrosion-resistant construction.
 2. Adjustable air release to control closure rate.

J. Counterweight Assembly:

1. Steel lever arm with stainless steel key.
2. Cast iron counterweight with locking screw.

K. Accessibility:

1. Removable flanged cover permitting full internal access.

L. Operation:

1. Opens directly in response to pump discharge.
2. Closes by disc weight, lever weight, pneumatic cushion, and reverse flow.

2.02 TILTING DISC CHECK VALVES

A. Metal-seated, full body tilted disc type.

B. Two-piece body with central diagonal flange at 55 degrees.

C. Eccentric pivot trunnions dividing disc approximately 1/3 and 2/3.

D. Full nominal pipe size flow area expanding 40 percent at valve seat.

E. Position indicator required.

F. Construction:

1. Body: ASTM A126 Class B cast iron (Class 125).
2. Disc: A356 65-45-12 ductile iron.
3. Seat rings: Type 304 stainless steel.
4. Pivot pins and bushings: Type 304 stainless steel.

G. Acceptable Manufacturer:

1. Henry Pratt Series TDCV
2. Engineer approved equal.

2.03 SILENT WAFER CHECK VALVES

- A. Compact wafer-style silent check valve equal to pipe size.
- B. Rated minimum 150 psi WOG (distribution pumps: 250 psi).
- C. Suitable for horizontal or vertical installation and any flow direction.
- D. Construction:
 - 1. Body: ASTM A126 Class B cast iron.
 - 2. Spring: Type 302 stainless steel.
 - 3. Guide bushing: Bronze.
 - 4. Guide pins: Type 304 stainless steel or bronze.
- E. Acceptable Manufacturer: Henry Pratt Series 720 or approved equal.

PART 3 EXECUTION

3.01 SHOP TESTING

- A. All valves shall be hydrostatically tested in accordance with AWWA C508 prior to shipment.

3.02 FINISHES

- A. Cast or ductile iron valves shall receive coatings in accordance with Section 09 96 00 – High-Performance Coatings.

3.03 SHIPPING

- A. Deliver valves in accordance with Section 01 62 00 – Product Requirements.
- B. Protect flange faces with removable flange covers.

3.04 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Adjust lever weights, springs, and pneumatic cylinders as required to achieve non-slam operation.

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3.05 FIELD TESTS

- A. Field testing shall be performed by the Contractor as part of system testing.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL ALL PROCESS PIPING, VALVES, FITTINGS AND RELATED APPURTANANCES related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 40 05 65

PART 1 GENERAL

1.01 SUMMARY

- A. The Contractor shall provide, through the services of a qualified Instrumentation and Control System Subcontractor, all components, system installation services, and ancillary services required to furnish a complete Supervisory Control and Data Acquisition (SCADA) System.
- B. The System shall include all materials, labor, tools, equipment, services, fees, charges, and documentation required to design, furnish, install, configure, test, calibrate, train, and place into operation a complete and fully operable SCADA System.
- C. The System shall include, but not be limited to:
 - 1. Measuring elements and primary sensors.
 - 2. Signal converters, transmitters, and associated instrumentation.
 - 3. Control panels, field panels, and control cabinets.
 - 4. Programmable Logic Controllers (PLCs), Programmable Automation Controllers (PACs), and Remote Telemetry Units (RTUs).
 - 5. SCADA servers, operator workstations, and Human Machine Interface (HMI) software.
 - 6. Historical archiving, reporting, and database systems.
 - 7. Radio telemetry and signal/data transmission systems.
 - 8. Communication network hardware and software systems.
 - 9. Interconnecting wiring and cabling.
 - 10. Surge protection and grounding systems.
 - 11. Uninterruptible Power Supplies (UPS).
- D. The Contractor shall retain overall responsibility for the SCADA System, including coordination with all trades and suppliers. The intent of the Contract Documents is to provide a complete and working installation. Items of equipment or materials reasonably required to achieve this end shall be provided whether specifically stated or not.

1.02 RELATED SECTIONS

- A. Division 01 – General Requirements.
- B. Applicable instrumentation, electrical, and communications Sections of Division 40, Division 41, Division 43, and Division 46.

1.03 REFERENCES

- A. ISA S5.1 and S5.4 – Instrumentation Symbols and Loop Diagrams.
- B. UL 508A – Industrial Control Panels.
- C. National Electrical Code (NEC).
- D. FCC Regulations – Radio Communications.
- E. IEEE-472 (ANSI C37.90) – Surge Withstand Capability.
- F. IEC 61131-3 – PLC Programming Languages.

1.04 SYSTEM RESPONSIBILITY

- A. The Contractor shall be responsible for design, fabrication, assembly, inspection, software configuration, documentation, delivery, installation, calibration, testing, startup, training, warranty, and final documentation of a complete and coordinated SCADA System.
- B. The instrumentation and control subcontractor shall assume full responsibility for proper operation of the system, including signal coordination and equipment interfacing.
- C. The System shall simultaneously perform real-time control, monitoring, alarm management, trending, historical archiving, reporting, and operator interface functions without performance degradation.
- D. The Contractor shall:
 - 1. Examine mechanical and electrical drawings for interface requirements.
 - 2. Coordinate cable routing and conduit sizing.
 - 3. Inspect interfacing equipment furnished under other Divisions.
 - 4. Provide a signal transmission system free from electrical interference.
 - 5. Coordinate approved shop drawings between suppliers.

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- E. Owner and Engineer shall have access to fabrication and testing facilities.
- F. The Contractor shall provide a signal transmission system free from electrical interference detrimental to system operation.
- G. Where manufacturers are named, they establish acceptable quality and performance and do not relieve the Contractor from compliance with these Specifications.
- H. Radio System
 - 1. Radio System Licensing and Coordination:
 - a. The Contractor shall coordinate all radio frequency licensing requirements, including:
 - a) Coordination with an FCC-authorized Frequency Coordinator
 - b) Preparation and submittal of FCC Form 600 and associated schedules
 - c) Assistance with preparation of any required FAA documentation
 - d) All costs associated with licensing, coordination, and application fees shall be included in the Contract Price.
 - b. The Owner will execute required FCC documentation.
 - 2. Radio System Design:
 - a. The Contractor shall perform a radio propagation path analysis for the proposed telemetry system.
 - b. The system shall be designed to achieve a minimum of 98 percent communication reliability at each remote site.

1.05 SUBMITTALS

- A. General
 - 1. Submit complete, project-specific Shop Drawings and product data.

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2. Generic submittals without clearly identified options will be rejected.

3. Provide a Compliance, Deviations, and Exceptions (CD&E) Letter for substitutions.

B. Digital Hardware

1. System block diagrams showing equipment, model numbers, cable types, and locations.

2. Bill of materials.

3. Catalog cuts and technical specifications.

4. Environmental requirements.

5. Assembly and mounting drawings.

C. Software

1. Software bill of materials and module listings.

2. Operating system information.

3. Communication software details.

4. PLC programming software (no protected code permitted).

5. Control strategy narratives in plain English.

6. Application software documentation.

7. Backup configuration procedures.

8. Provide PLC program copy to Owner prior to startup testing.

D. Control Panels

1. Exterior and interior layout drawings (to scale).

2. Panel wiring diagrams (power, signal, surge protection).

3. Bill of materials.

4. Nameplate schedule.

5. Panels shall be UL 508A labeled.

E. Instruments

Submit detailed data for all field devices including ranges, materials, calibration data, environmental limits, and surge protection.

F. Wiring and Loop Diagrams

1. Submit ISA-compliant loop drawings and interconnection diagrams (11x17 format).

G. Operation and Maintenance Manuals

1. Two hard-copy O&M manuals in 3-ring binders (max 3.5").
2. Two electronic copies (searchable PDF).
3. Comprehensive index and functional descriptions.
4. As-built drawings.
5. Complete parts lists and troubleshooting procedures.
6. Software documentation and source listings (native and PDF formats).

H. Radio System Documentation:

1. Provide a dedicated section within the O&M manuals including:
2. Radio system block diagrams
3. Computer-generated radio path analysis and supporting calculations
4. FCC licensing documentation

I. Software Documentation:

1. Provide complete copies of all PLC programs, updated to as-built condition.
2. Provide programs in both native format and PDF.

1.06 QUALITY ASSURANCE

A. Systems Integrator Qualifications:

1. UL 508A certified panel manufacturer.

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2. Demonstrated experience integrating PLCs, instrumentation, valves, pumps, chemical feed systems, SCADA servers/workstations, radio telemetry, and networking equipment.
 3. 24/7 technical support capability.
 4. Demonstrated expertise with Wonderware InTouch Access Anywhere.
- B. All panels shall bear serialized UL 508A labels.
- C. PLC components shall meet UL, CSA, CE, and applicable surge and vibration standards.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in original packaging.
- B. Store in dry, climate-controlled environment within manufacturer limits.
- C. Protect sensitive electronic components from moisture, dust, and temperature extremes.

1.08 TESTING AND STARTUP

- A. All elements of the SCADA system shall be tested to demonstrate that the total system satisfies all of the requirements of this Specification.
- B. The Contractor shall provide all special testing materials and equipment.
- C. Testing shall include both a factory test and a field test. Testing requirements are as follows:
1. Factory Testing
 - a. Test PLCs, servers, panels, and associated hardware prior to shipment.
 - b. Provide certified written test results.
 2. Field Testing
 - a. Verify proper installation and terminations.
 - b. Perform witnessed functional testing of all system components.
 - c. Notify Owner one week prior to testing.

3. System Acceptance

a. Acceptance shall occur when:

- 1) All documentation is approved.
- 2) System passes all testing.
- 3) Training is completed.
- 4) Owner/Engineer sign acceptance documentation.

1.09 TRAINING

- A. Provide two (2) consecutive 8-hour days of training.
- B. Include classroom and field sessions.
- C. Provide all instructional materials.
- D. Proposed training dates shall be submitted to the owner a minimum of two weeks in advance.

1.10 WARRANTY

- A. Provide one-year minimum warranty from date of final acceptance.
- B. During warranty, investigate, repair, update, and document deficiencies.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide a scalable, modular, open-architecture PLC-based SCADA System.
- B. Same PLC model shall be used for Master and Remote sites.
- C. Systems using a PC as Master communications controller are not acceptable.

2.02 PROGRAMMABLE LOGIC CONTROLLERS (PLCs)

A. General

1. Modular, scalable architecture.
2. True 32-bit CPU, minimum 50 MHz.

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3. Minimum memory: 16 MB DRAM, 8 MB Flash.
4. Minimum six communication ports including Ethernet and serial.
5. Real-time clock with battery backup.
6. DIN-rail mounted with plug-in connectors.
7. Operating temperature: -40°C to +70°C.
8. Operate from a 10–30 VDC power supply
9. Include battery-backed real-time clock
10. Support high-level applications without degradation of control performance

B. Hardware Performance

1. PLC shall provide non-volatile memory sufficient to store a minimum of:
 - a. 8,000 system variables
 - b. 200,000 time-stamped historical data records
 - c. Stored data shall not be lost during power interruption.

C. Software

1. IEC 61131-3 compliant (all five languages supported).
2. Multitasking operating system.
3. Data logging up to 200,000 time-stamped records.
4. CSV export capability.
5. Diagnostics and fault logging.

D. Communications

1. Support Ethernet, RS-232, RS-485.
2. Support Modbus RTU/ASCII and open protocols.
3. Remote upload/download capability.

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4. Store-and-forward and report-by-exception modes.
5. The SCADA system shall support the following telemetry modes:
 - a. Polling
 - b. Peer-to-peer communication
 - c. Report-by-exception (quiescent)
 - d. Store-and-forward (repeater operation)
6. Remote Access and File Transfer:
 - a. The system shall support remote upload and download of PLC and RTU configuration files.
 - b. The system shall support retrieval and reassembly of historical data files from remote units in the event of communication interruptions.

E. I/O Systems

1. Modular local, remote, and Ethernet I/O.
2. Minimum 100% spare I/O capacity.
3. Removable under power.
4. Surge protected and electrically isolated.
5. Include diagnostic indicators
6. Be suitable for hazardous locations where required
7. System capacity shall support a minimum of:
 - a. 1,024 local I/O points
 - b. 1,024 remote I/O points
 - c. 50,000 total system points

F. Environmental and Compliance Requirements:

1. PLC and associated components shall comply with:

- a. UL and CSA standards
- b. Class I, Division 2 hazardous location requirements
- c. IEEE-472 (ANSI C37.90) surge withstand
- d. IEC vibration standards

2.03 RADIO TELEMETRY SYSTEM

A. General

- 1. VHF (150–174 MHz), UHF (450–475MHz) or 902–928 MHz spread spectrum.
- 2. Designed for minimum 98% reliability.
- 3. System shall include:
 - a. Frequency hopping spread spectrum
 - b. Minimum 240 channels
 - c. Pseudo-random hopping sequence
- 4. Provide radio path studies.
- 5. Assist Owner with FCC licensing.

B. VHF/UHF Radio Performance

- 1. Transmitter:
 - a. RF output adjustable from 1 to 10 watts
 - b. 100 percent duty cycle
 - c. Frequency stability ± 0.0005 percent
- 2. Receiver:
 - a. Sensitivity: minimum -109 dB at 12 dB SINAD
 - b. Selectivity: minimum 45 dB
 - c. Intermodulation rejection: minimum 75 dB

C. Radio Transceivers

1. Adjustable RF output (VHF 1–10 W).
2. FCC approved.
3. Diagnostics via serial port.
4. Minimum 8 kbps data rate.

D. Antennas

1. Directional (3-11 element Yagi) or omni (dipole array) as required.
2. Rated for 100 mph winds with ½-inch radial ice.
3. Lightning protection and grounding provided.
4. Provide antenna mast/tower at proposed WTP as required.
5. Provide antenna mast/tower at all wells, pump stations, water storage, etc., as required.

2.04 SERVERS AND WORKSTATIONS

A. Server Hardware:

1. Windows 11 Server (64-bit).
2. Intel 4.0 GHz or better CPU.
3. Minimum 1 TB hard drive.
4. Dual 22-inch LCD monitors.
5. Internal 56 kbps modem.

B. All hardware shall be Windows 11 compatible and FCC Class B certified.

2.05 OPERATING SYSTEM

A. Microsoft Windows 11, 64-bit.

B. Pre-emptive multitasking and virtual memory support.

2.06 HMI AND APPLICATION SOFTWARE

A. General

1. Wonderware InTouch latest version.
2. Native 64-bit GUI.
3. DDE and OPC support.
4. Password-protected security.

B. Graphics

1. Graphics development environment shall include:
 - a. Object-oriented graphics
 - b. CAD-like drawing tools
 - c. Animation linking capability
2. System shall:
 - a. Allow editing of graphics while runtime system is active
 - b. Not impose limits on number of animation links per object

C. Trending

1. Real-time and historical trends.
2. Operator-selectable time scales (1 minute to 1 year).
3. CSV import/export.

D. Alarming

1. High/High-High/Low/Low-Low.
2. Major/Minor deviation.
3. Hierarchical grouping.
 - a. Eight (8) primary alarm groups

- b. Sixteen (16) subgroups per group
- 4. Event logging.
- 5. Optional dialer notification.
- E. Reporting
 - 1. Daily, weekly, monthly, yearly reports.
 - 2. Microsoft InSQL database.
 - 3. OPS Systems reporting software.
 - 4. IEPA-compliant report capability.
- F. Databases
 - 1. Real-time database.
 - 2. Historical database with adjustable logging intervals.
 - a. System shall allow configurable data logging intervals per data point.
 - b. Data shall be exportable in CSV format.
 - 3. Third-party software used for reporting or data manipulation shall reside on separate computing hardware to avoid degradation of SCADA performance.
- G. Remote Diagnostics
 - 1. Password-protected remote access.
 - 2. Terminal login/logoff tracking.

2.07 CONTROL PANELS

- A. NEMA 4 (outdoor) or NEMA 12 (indoor).
- B. 14-gauge steel, baked enamel finish.
- C. Heater and thermostat for condensation control.
- D. UPS sized for minimum 4-hour backup.

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- E. 40% minimum spare power supply capacity.
- F. Numbered terminal blocks and color-coded wiring.

2.08 AUTO DIALER

- A. Provide a cellular-based auto dialer system.
- B. The auto dialer shall:
 - 1. Interface with the PLC via Ethernet
 - 2. Utilize Modbus protocol
 - 3. Provide alarm notification capability

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install equipment per manufacturer instructions and approved submittals.
- B. Coordinate installation to avoid interference with existing operations.
- C. Provide surge protection and proper grounding.

3.02 ON SITE SUPERVISION

- A. The Contractor shall provide experienced personnel to supervise, perform, and coordinate the installation, adjustment, testing, and startup of the SCADA system. The personnel shall be present on-site as required to affect a complete operating system.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, materials, labor, calibration, startup services, and incidentals; and shall be incidental to the price for pay item SCADA, COMPLETE related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 40 60 00

PART 1 GENERAL

1.01 SUMMARY

- A. This section specifies digital programmable logic controllers (PLC) for monitoring and controlling digital sensors in water and wastewater treatment processes.
- B. Controllers shall provide high-accuracy measurements, alarm management, and communication capabilities with SCADA systems.
- C. Work includes supply, installation, configuration, start-up, and testing of all equipment.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 43 33 – Manufacturer's Field Services.
- C. Section 40 60 00 – SCADA Systems.

1.03 REFERENCES

- A. CSA/CSANRTL Standards – General Purpose and Hazardous Location (USA/Canada)
- B. FM Approvals Standards – General Purpose and Hazardous Location (USA)
- C. UL Standards – Pending as applicable for electrical and safety compliance

1.04 SUBMITTALS

- A. Product Data: Provide manufacturer's literature and technical data sheets including:
 - 1. Controller model, dimensions, ratings, and power requirements.
 - 2. Display, control, and communication capabilities.
 - 3. Alarms and relay specifications.
 - 4. Sensor interface capabilities.
- B. Shop Drawings: Include installation diagrams, wiring schematics, and mounting details.
- C. Operation and Maintenance Manuals: Include:

1. Detailed controller operation instructions.
 2. Calibration procedures.
 3. Preventive maintenance instructions.
 4. Troubleshooting guide.
- D. Certificates: Provide certification of compliance with CSA/CSANRTL, FM, and UL standards.
- E. Warranty Documentation: Two-year manufacturer's warranty from shipment, minimum one-year from Owner acceptance.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 10 years experience in digital process control equipment.
- B. Installer Qualifications: Factory-trained personnel for controller installation and start-up.
- C. Compliance: Products and installation shall comply with applicable federal, state, and local codes, regulations, and industry standards in the United States.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in original, unopened containers with identification labels intact.
- B. Store equipment in a dry, protected location with temperatures within manufacturer's recommended range.
- C. Handle equipment to prevent damage, contamination, or exposure to harmful conditions.

1.07 WARRANTY

- A. Provide a two-year manufacturer's warranty from date of shipment against defects in materials and workmanship.
- B. Warranty shall extend a minimum of one year from Owner acceptance.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Hach Company, Loveland, CO
 - 1. Hach sc200 Digital Controller (LXV404.99.00552)
 - 2. Engineer approved equal.

2.02 SYSTEM DESCRIPTION

- A. Alternates
 - 1. Multi-parameter controllers requiring field replacement of boards or EEPROMs are not acceptable.
- B. Performance Requirements
 - 1. Accuracy:
 - a. Less than 1 ppm: ± 0.1 ppm
 - b. Greater than 1 ppm: ± 0.2 ppm
 - 2. Repeatability: ± 0.05 ppm
 - 3. Response Time:
 - a. Less than 40 seconds to reach 90% of reading at 20 °C
 - b. Less than 60 seconds to reach 95% of reading at 20 °C
- C. Functional Requirements
 - 1. Controller shall support menu-driven operation with graphic LCD display and LED backlighting.
 - 2. Support for temperature compensation on measurements.
 - 3. Alarm functions: low/high points, deadbands, on/off delays, and setpoint control.
 - 4. Communications: RS-232 (optional) and RS-485 MODBUS for SCADA or PLC integration.
 - 5. Data logging with non-volatile memory retention.

D. Environmental Requirements

1. Operational Temperature Range: 32 to 140 °F (0 to 60 °C)

E. Manufactured Unit

1. Microprocessor-based digital controller
 - a. 1/2 DIN, NEMA 4X enclosure, rated IP66
 - b. Connections for Hach digital sensors

F. Components

1. Standard Equipment:
 - a. Controller
 - b. Mounting hardware
2. Dimensions:
 - a. 1/2 DIN – Height: 144 mm (5.7 in.), Width: 144 mm (5.7 in.), Depth: 150 mm (5.9 in.)
 - b. Weight: 3.5 lbs. (1.6 kg)

G. Equipment Details

1. Power: 90–130 Vac or 180–230 Vac, 50/60 Hz, 10 VA max.
2. Menu-driven operation system.
3. Display: 128 x 64 pixel graphic dot matrix LCD with LED backlighting.
4. Temperature compensation enabled.
5. Supports up to two probes.
6. Data logger with RS-232 capability.
7. Three SPDT electromechanical relays, user-configurable: 100–230 Vac, 5 A @ 30 Vdc resistive max.
8. Two analog 4–20 mA outputs and/or optional digital I/O, max impedance 500 Ohms.

9. Alarms: low/high points, deadbands, on/off delays.
10. Controls: setpoints, high/low phasing, overfeed timer, deadband, on/off delays.
11. Communications: RS-232 optional; RS-485 MODBUS for direct SCADA/PLC integration.
12. All user settings retained in non-volatile EEPROM memory.

H. ACCESSORIES

1. Sun shield (exterior use only)
2. RS-232 MODBUS output card (point to point)
3. RS-485 MODBUS output card (multiple device)

PART 3 EXECUTION

3.01 PREPARATION

- A. Mounting: rail, panel, pipe, or wall.
- B. Maximum sensor-to-analyzer distance: 300 m (985 ft).

3.02 APPLICATION

- A. Contractor shall install the controller in strict accordance with the manufacturer's instructions.
- B. Manufacturer's representative shall provide up to half-day start-up services by a factory-trained technician if requested.
- C. Contractor shall schedule start-up date and time.
- D. Personnel to be present:
 1. General contractor
 2. Electrical contractor
 3. Hach Company factory-trained representative
 4. Owner's personnel
 5. Engineer

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Section 40 63 00 – Programmable Logic Controllers

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, materials, labor, calibration, startup services, and incidentals; and shall be incidental to the price for pay item SCADA, COMPLETE related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 40 63 00

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes electromagnetic flow meters for conductive liquid measurement.
- B. Furnish complete magnetic flow metering system including:
 - 1. Flow sensor (primary element)
 - 2. Remote-mounted transmitter/display
 - 3. Mounting hardware
 - 4. Signal and power cabling
 - 5. Grounding rings (where required)
 - 6. Commissioning and calibration services

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 43 33 – Manufacturer's Field Services.
- C. Section 40 60 00 – SCADA Systems.

1.03 REFERENCES

- A. ISO 4064 – Measurement of water flow in closed conduits
- B. IEC 61010 – Safety requirements for electrical equipment
- C. IEC 61326 – EMC requirements
- D. NEMA 250 – Enclosures for Electrical Equipment

1.04 QUALITY ASSURANCE

- A. Flowmeter manufacturers shall have a minimum of five (5) years experience in the manufacture and operation of flowmeters of the type specified herein.

1.05 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's technical data sheets

- 2. Performance curves and accuracy statements
 - 3. Installation instructions
- B. Shop Drawings:
 - 1. Dimensional drawings
 - 2. Wiring diagrams
 - 3. Remote mounting details
- C. Certificates:
 - 1. Factory calibration certificate
 - 2. Material compliance certificates
- D. Operation and Maintenance Manuals.

1.06 QUALITY ASSURANCE

- A. Manufacturer shall have minimum 10 years experience in production of electromagnetic flow meters.
- B. Equipment shall be factory calibrated using traceable standards.
- C. System shall be CE marked and comply with applicable EMC standards.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment from damage during shipment and storage.
- B. Store in dry, temperature-controlled environment.
- C. Protect liner and electrode surfaces from contamination.

1.08 WARRANTY

- A. Minimum 12-month manufacturer's warranty from date of substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND MODEL NUMBERS

- A. Flowmeter shall be manufactured by one of the following manufacturers:

1. MJK 7200 with remote display
2. Or engineer approved equal.

2.02 SYSTEM DESCRIPTION

- A. Electromagnetic flow meter system consisting of:
 1. Flanged-style flow tube
 2. Remote-mounted signal converter/display
 3. Shielded signal cable between sensor and transmitter
 4. Power supply
- B. Intended Service: Measurement of conductive liquids with minimum conductivity of 5 $\mu\text{S/cm}$.

2.03 PERFORMANCE REQUIREMENTS

- A. Accuracy: $\pm 0.25\%$ of rate ± 1 mm/s (or better).
- B. Repeatability: $\pm 0.1\%$ of rate.
- C. Flow Velocity Range: 0.1 to 10 m/s minimum.
- D. Temperature Range:
 1. Fluid: 0–150°C (liner dependent)
 2. Ambient: –20°C to +60°C
- E. Pressure Rating: Up to 16 bar (minimum), higher ratings available as required.
- F. Protection Class:
 1. Sensor: IP68 (submersible)
 2. Transmitter: IP67 minimum

2.04 FLOW SENSOR (PRIMARY ELEMENT)

- A. Body: Carbon steel with epoxy coating or stainless steel (as specified).
- B. Liner Material:

1. Hard rubber
- C. Electrodes: Stainless steel 316L standard; optional Hastelloy or equivalent.
- D. Process Connections: ANSI or DIN flanges.
- E. Grounding rings provided where non-conductive piping is used.

2.05 TRANSMITTER (REMOTE DISPLAY)

- A. Remote-mounted, microprocessor-based converter to be installed on CONTRACTOR provided, self-supporting panelboard as shown in plans.
- B. LCD backlit display with:
 1. Instantaneous flow rate
 2. Totalizer
 3. Diagnostic status
- C. Outputs:
 1. 4–20 mA analog output
 2. Pulse output
 3. Optional Modbus RTU (RS-485) or HART communication
- D. Power Supply: 85–265 VAC or 24 VDC (as specified).
- E. Configuration via keypad or PC interface.

2.06 ELECTRICAL REQUIREMENTS

- A. Signal cable between sensor and transmitter: Manufacturer-specified shielded cable.
- B. Maximum cable length: 100 meters minimum.
- C. Surge protection provided where required.

2.07 ACCESSORIES

- A. Mounting brackets for wall or pipe installation.

- B. Sunshade for outdoor installations.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Provide minimum straight pipe lengths:
 - 1. 5 diameters upstream
 - 2. 3 diameters downstream
- C. Install grounding rings where required.
- D. Ensure full pipe condition at all times.

3.02 FIELD QUALITY CONTROL

- A. Verify wiring and grounding.
- B. Program transmitter per project requirements.
- C. Perform functional test and verify output scaling.
- D. Submit startup report.

3.03 COMMISSIONING

- A. Provide factory-authorized technician for startup assistance.
- B. Train Owner's personnel in operation and maintenance.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, materials, labor, calibration, startup services, and incidentals; and shall be incidental to the price for pay item SCADA, COMPLETE related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 40 71 13

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Guided wave radar transmitters for level, level/interface, and volume measurement of liquids and solids.
2. Transmitters utilizing low energy microwave pulse technology transmitted along a probe for continuous level measurement.
3. Devices calculating level or interface level by measuring the time difference between transmitted and reflected pulses, with reflection intensity dependent on dielectric constant of the product.

B. Scope

1. Furnish, install, configure, calibrate, test, adjust, and place into satisfactory operation guided wave radar transmitters as shown on the Drawings and specified herein.
2. Provide all components, probes, mounting hardware, wiring, and accessories required for a complete and integrated level measurement system.

C. Coordination

1. Coordinate installation with tank fabricators, piping contractors, and SCADA system supplier to ensure proper integration and operation.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 43 33 – Manufacturer's Field Services.
- C. Section 40 60 00 – SCADA Systems.

1.03 REFERENCES

- A. IEC 61508 – Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems.
- B. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. Applicable TÜV and WHG requirements for overfill prevention.

- D. ISA standards applicable to level instrumentation.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data
 - 1. Manufacturer's literature including theory of operation and performance specifications.
 - 2. Probe selection data and installation requirements.
 - 3. Communication and diagnostic capabilities.
- C. Certificates
 - 1. SIL 2 certification documentation in accordance with IEC 61508 where required.
 - 2. Manufacturer's certificate(s) in accordance with Section 01 43 33.
 - 3. Warranty documentation.

1.05 QUALITY ASSURANCE

- A. Guided wave radar transmitters shall be the standard product of a manufacturer regularly engaged in the production of industrial radar level instrumentation.
- B. Like items shall be the end products of one manufacturer to ensure standardization of operation and maintenance.
- C. Transmitters shall be factory calibrated and tested prior to shipment.
- D. Devices shall be TÜV tested and WHG approved for overfill prevention where required.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver equipment to the site until submittals have been reviewed.
- B. Deliver in manufacturer's original, unopened containers, clearly labeled.
- C. Store indoors in a clean, dry location protected from mechanical damage and environmental extremes.

- D. Protect probes from bending, impact, and contamination during storage and handling.

1.07 WARRANTY

- A. Provide a full five-year manufacturer's warranty covering defects in materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Provide products from one of the following manufacturers:
 - 1. Rosemount Engineering Co.
 - a. Rosemount Model 5300
 - 2. Engineer approved equal.

2.02 GENERAL

- A. Level transmitters shall be of the guided wave radar type.
- B. Device shall transmit a low energy microwave pulse down a probe.
- C. Upon contact with the media, reflected energy shall travel back to the transmitter and the time difference between transmitted and reflected pulse shall be converted to distance for calculation of level or interface level.
- D. Measurement shall be suitable for liquids and solids and for level, interface, and volume calculations as indicated.
- E. Accuracy shall be ± 0.12 inches (3 mm).
- F. Repeatability shall be ± 0.04 inches (1 mm).
- G. Measurement range shall be up to 164 feet (50 m), depending on probe selection and application.
- H. Output shall be linear 4-20 mA with support for HART™, Foundation™ Fieldbus, or Modbus™ communication protocols as indicated.
- I. Transmitter shall be certified SIL 2 in accordance with IEC 61508 where required.
- J. Provide remote proof-test capability through verification reflector.

- K. Provide enhanced diagnostics for proactive maintenance.
- L. Operating pressure range shall be full vacuum to 5000 psi (345 bar).
- M. Operating temperature range shall be -196 to 400 degrees Celsius (-320 to 752 degrees Fahrenheit).

2.03 PROBES

- A. Provide probe type suitable for application and process conditions as indicated on the Drawings.
- B. Available probe types shall include:
 - 1. Rigid single lead.
 - 2. Segmented single lead.
 - 3. Flexible single lead.
 - 4. Rigid twin lead.
 - 5. Flexible twin lead.
 - 6. Coaxial and large coaxial.
 - 7. PTFE coated probes.
 - 8. Vapor probe.

2.04 ALTERNATES

- A. Other methods of level measurement that require glass windows subject to fouling or fogging, or that require air purge systems, are not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Contractor shall furnish, test, install, configure, and place into satisfactory operation the guided wave radar level transmitters complete with all accessories and appurtenances as specified and as shown on the Drawings.
- B. Install transmitters and probes in accordance with manufacturer's written instructions, ensuring proper clearance from internal obstructions and correct probe orientation.

DIVISION 40 – PROCESS INTERCONNECTIONS
Section 40 72 23 – Guided Wave Radar Transmitters

- C. Perform loop checks, configuration, and calibration in accordance with approved submittals.
- D. Manufacturer's representative shall provide a minimum one-half day of startup service by a factory-trained technician.
 - 1. Contractor shall schedule date and time for startup.
 - 2. The following personnel shall be present during startup:
 - a. General Contractor.
 - b. Engineer.
 - c. Owner's personnel.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, materials, labor, calibration, startup services, and incidentals; and shall be incidental to the price for pay item SCADA, COMPLETE related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 70 72 23

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Pressure gauges installed in piping systems as listed in the Equipment Schedule or as otherwise indicated on the Drawings.
2. Isolated pressure sensor diaphragm type (IPS/D) assemblies including gauge, diaphragm isolator, and accessories.

B. Scope

1. Furnish, install, and place into satisfactory operation pressure gauges complete with diaphragm isolators, gauge cocks, and accessories as specified herein and as shown on the Drawings.
2. Provide all components and labor necessary for a complete and operable pressure indication system.

C. Coordination

1. Coordinate installation with piping and related instrumentation to ensure proper placement, accessibility, and serviceability.

1.02 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures.

B. Section 01 43 33 – Manufacturer's Field Services.

1.03 REFERENCES

A. Comply with the latest applicable editions of the following standards:

1. ASME B40.100 – Pressure Gauges and Gauge Attachments.
2. ANSI/ASME B1.20.1 – Pipe Threads, General Purpose (Inch).
3. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
4. ISA standards applicable to pressure instrumentation.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data
 - 1. Manufacturer's literature for pressure gauges, diaphragm isolators, and gauge accessories.
 - 2. Performance data demonstrating compliance with specified accuracy and construction requirements.
- C. Certificates
 - 1. Manufacturer's certificate(s) as specified in Section 01 43 33 – Manufacturer's Field Services.

1.05 QUALITY ASSURANCE

- A. Pressure gauges and isolators shall be the standard products of manufacturers regularly engaged in the production of industrial pressure instrumentation.
- B. Like items of equipment specified herein shall be the end products of one manufacturer to achieve standardization for operation, maintenance, spare parts, and manufacturer's service.
- C. Gauges shall be factory calibrated and tested prior to shipment.
- D. Materials of construction shall be suitable for the intended service and compatible with the process fluid.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver pressure gauges to the site until product data submittals have been reviewed.
- B. Deliver materials in manufacturer's original, unopened containers and packaging, clearly labeled with product name and manufacturer.
- C. Store materials indoors in a clean, dry location protected from dust, moisture, vibration, and mechanical damage.
- D. Protect gauges from impact, excessive vibration, and temperature extremes during handling and storage.
- E. Handle in accordance with manufacturer's written instructions to prevent damage to Bourdon tubes, diaphragms, and cases.

1.07 WARRANTY

- A. Contractor shall provide a written guarantee for all materials and workmanship extending twelve (12) months after startup.
- B. All materials, equipment, and workmanship furnished under these Specifications shall be free from defects in material and workmanship.
- C. During the twelve (12) month period, the Contractor shall replace and install any part or parts which malfunction or corrode at no additional cost to the Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. Pressure gauges and associated components shall be new and of current manufacture.
- B. Materials of construction shall be suitable for the intended service and compatible with the process fluid.

2.02 ISOLATED PRESSURE SENSOR DIAPHRAGM TYPE (IPS/D)

- A. General
 - 1. Isolator assembly shall consist of a two-piece housing with a diaphragm installed between the two parts, serving as an isolator between the process fluid and the pressure transmitting fluid.
 - 2. One housing part shall have FNPT connection for attachment to process fluid piping.
 - 3. The opposite housing part shall have 1/4-inch FNPT connection for installation of a pressure gauge or other pressure instrumentation.
 - 4. Gauge installation portion shall include a fill/bleed connection to permit filling of the cavity between the diaphragm and the sensing element with a suitable pressure transmitting fluid compatible with the gauge.
 - 5. Materials of construction for the process fluid connection and diaphragm shall be compatible with the process fluid.
- B. Pressure Gauge
 - 1. Gauge shall have a 3-1/2 inch diameter dial.

2. Bourdon tube shall be 316 stainless steel.
 3. Socket shall be 316 stainless steel.
 4. Case shall be stainless steel.
 5. Gauge shall be silicone-filled.
 6. Accuracy shall be 1 percent of full scale in accordance with ASME B40.100, Grade 1A.
 7. Pressure range shall be 0 to 150 psi unless otherwise indicated.
 8. Pressure isolator and gauge shall be manufactured by a single manufacturer and furnished as a single, factory-filled unit.
- C. C. Process Connection
1. Process fluid connection diameter shall be as shown on the Drawings.
- D. D. Designations for IPS/D – Normal Service
1. Bottom housing material shall be steel.
 2. Diaphragm material shall be Type 304 stainless steel.
- E. E. Manufacturers
1. Manufacturer: Ashcroft or equal.
 2. Diaphragm Isolator: Ashcroft Type 100 or equal.
 3. Vacuum/Pressure Gauge: Ashcroft Type 1009, Grade 1A or equal.

2.03 GAUGE ACCESSORIES

- A. Gauge Cocks
1. Type 1 – 1/4-inch diameter, 3-ounce brass with tee handle, rated at 100 psi air. Ashcroft 1092 or equal.
 2. Type 2 – 1/4-inch diameter, 4-ounce brass with lever handle, rated at 100 psi air. Ashcroft 1095 or equal.
 3. Type 3 – 1/4-inch diameter, 10-ounce brass with lever handle and union, rated at 100 psi air. Ashcroft 1094 or equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Pressure gauges shall be of the type specified herein and shall be installed at the locations shown on the Drawings, as detailed on the plans, and as recommended by the manufacturer.
- B. Install gauges plumb and in a readable orientation.
- C. Provide gauge cocks and isolators as specified to permit removal and maintenance without system shutdown where applicable.

3.02 MANUFACTURER'S CERTIFICATES

- A. Provide manufacturer's certificate(s) in accordance with Section 01 43 33 – Manufacturer's Field Services.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL ALL PROCESS PIPING, VALVES, FITTINGS AND RELATED APPURTANANCES related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 40 73 13

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Gauge pressure indicating transmitters of the capacitance type with process-isolated diaphragm and silicone oil fill.
2. Microprocessor-based “smart” electronics with digital signal processing and field-adjustable rangeability of 200:1 input range.
3. Transmitters providing linear, isolated 4-20 mA output with integral LCD indication and digital communication capability.

B. Scope

1. Furnish, install, configure, calibrate, test, adjust, and place into satisfactory operation gauge pressure indicating transmitters as shown on the Drawings and specified herein.
2. The Drawings and Specifications illustrate and specify functional and general construction requirements of pressure transmitters and do not necessarily show or specify all components, wiring, mounting hardware, and accessories required for a complete and integrated system. Provide all components, wiring, accessories, and labor required.

C. Coordination

1. Coordinate installation with piping, electrical, and SCADA system suppliers to ensure proper interfacing and operation.

1.02 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures.

B. Section 40 60 00 – SCADA Systems.

1.03 REFERENCES

A. Comply with the latest applicable editions of the following standards:

B. 1. NEMA 250 – Enclosures for Electrical Equipment.

C. 2. ISA standards for pressure instrumentation.

1.04 SUBMITTALS

- A. Submit manufacturer's current literature and installation specifications in PDF format to include:
 - 1. 1. Product Data
 - a. Transmitter operating manual.
 - b. Installation and wiring instructions.
 - c. Performance and accuracy data.
 - 2. Shop Drawings
 - a. Wiring diagrams and terminal identification.
 - b. Mounting details and accessories.
 - 3. Manufacturer's Certifications
 - a. Certification that materials comply with specified requirements.
 - 4. Warranty Documentation.

1.05 QUALITY ASSURANCE

- A. Gauge pressure transmitters shall be the standard product of a manufacturer regularly engaged in the production of industrial pressure instrumentation.
- B. Transmitters shall be factory calibrated prior to shipment.
- C. Overfill prevention approval shall be provided where indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver transmitters to the site until product information and shop drawings have been approved.
- B. Deliver materials in manufacturer's original, unopened containers clearly labeled.
- C. Store indoors in a clean, dry area protected from damage and environmental extremes.
- D. Handle in accordance with manufacturer's written instructions.

1.07 WARRANTY

- A. Provide a full five-year manufacturer's warranty covering defects in materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Provide products from one of the following manufacturers:
 - 1. Rosemount Engineering Co.
 - a. Rosemount Model 3051S
 - 2. Engineer approved equal.

2.02 GENERAL

- A. Gauge pressure transmitter shall be of the capacitance type with a process-isolated diaphragm and silicone oil fill.
- B. Transmitter shall be microprocessor-based with smart electronics and digital signal processing.
- C. Field adjustable rangeability shall be 200:1 minimum.
- D. Repeatability shall be ± 0.04 inches (1 mm) or better where applicable.
- E. Accuracy, including nonlinearity, hysteresis, and repeatability errors, shall be ± 0.025 percent of calibrated span, zero based.
- F. Span and zero shall be continuously adjustable externally over the entire range and shall be capable of being disabled internally.
- G. Maximum zero elevation and zero suppression shall be adjustable within sensor limits.
- H. Output shall be linear, isolated 4-20 mA, 24 VDC, two-wire design.
- I. Communication protocol shall support 4-20 mA with HART™, Foundation™ Fieldbus, or Modbus™ as indicated.
- J. Provide adjustable output signal damping with time constant selectable from 0 to 36 seconds.
- K. Total long-term stability shall be no less than ± 0.20 percent of URL over 10 years.

- L. Overload capacity shall be rated at a minimum of 25 MPa.
- M. Capacitance pressure sensor shall be mechanically, electrically, and thermally isolated from the process and environment and shall include an integral temperature compensation sensor.
- N. Sensor shall provide a digital signal to transmitter electronics for processing.
- O. Factory-set correction coefficients shall be stored in non-volatile memory for correction and linearization.
- P. Electronics shall convert processed digital signal to 4-20 mA analog output and support digital communication superimposed on the loop signal.
- Q. Configuration parameters and diagnostic data shall be stored in non-volatile EEPROM memory.
- R. Provide integral 4-digit LCD indicator capable of displaying engineering units and/or milliamperes.
- S. Housing shall be NEMA 4X weatherproof and corrosion-resistant, constructed of low-copper aluminum with 316 stainless steel process wetted parts.
- T. Each transmitter shall be provided with required mounting hardware.
- U. Other methods of pressure or level measurement that require glass windows subject to fouling or fogging, or that require air purge systems, are not acceptable.

2.03 ENVIRONMENTAL AND OPERATING REQUIREMENTS

- A. Ambient operating temperature limits shall be -40 to 85 degrees Celsius at 0 to 100 percent relative humidity.
- B. Operating temperature range of sensing assembly shall be -196 to 400 degrees Celsius (-320 to 752 degrees Fahrenheit), where applicable.
- C. Each transmitter shall have a stainless-steel tag with calibration data permanently attached to the body.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify installation location, mounting orientation, and process connections prior to installation.

- B. Verify power supply voltage and loop wiring continuity before energizing.

3.02 INSTALLATION

- A. Contractor shall furnish, test, install, configure, and place into satisfactory operation the gauge pressure indicating transmitters complete with all accessories and appurtenances as specified and as shown on the Drawings.
- B. Install transmitters in accordance with manufacturer's written instructions and industry best practices.
- C. Provide proper grounding and shielding of signal wiring in accordance with Division 26 requirements.
- D. Perform loop checks and field calibration to match ranges indicated on the Drawings and Instrument Index.
- E. Manufacturer's representative shall provide a minimum one-half day of startup service by a factory-trained technician.
 - 1. Contractor shall schedule date and time for startup.
 - 2. The following personnel shall be present during startup:
 - a. General Contractor.
 - b. Engineer.
 - c. Owner's personnel.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, materials, labor, calibration, startup services, and incidentals; and shall be incidental to the price for pay item SCADA, COMPLETE related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 40 73 26

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Sensor that continuously measures pH in aqueous solutions.
2. Includes the capability to remotely monitor sensors on any browser-enabled device and present diagnostics on the overall health of the measurements (on Predictive Diagnostics-enabled sensors), as well as upcoming and required maintenance - reducing user risk and downtime.

B. Scope

1. Furnish, install, calibrate, test, adjust, and place into satisfactory operation pH sensors as shown on the Drawings and specified herein.
2. The Drawings and Specifications illustrate and specify functional and general construction requirements of pH sensors and do not necessarily show or specify all components, wiring, piping, and accessories required to make a completely integrated system. Provide all components, piping, wiring, accessories, and labor required for a complete and integrated system.

C. Coordination:

1. Coordinate with other suppliers for the installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

1.02 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures.

B. Section 40 60 00 - SCADA Systems

1.03 REFERENCES

A. Comply with the latest applicable editions of the following standards:

1. EN 61326 – Electrical equipment for measurement, control and laboratory use – EMC requirements.
2. CSA/CSANRTL certification standards.
3. FM approval standards.

1.04 SUBMITTALS

- A. Prior to delivery and application of any materials, the Contractor shall submit manufacturer's current literature and installation specification covering all materials to be installed under this section of the Specifications to the Engineer in pdf format to include:
 - 1. Product data:
 - a. Sensor operating manual.
 - b. Mounting bracket / sensor holder installation instructions.
 - 2. Manufacturer's Certifications:
 - a. Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application.
 - 3. Warranty documentation:
 - a. Submit manufacturer's standard warranties.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. The pH measurement system shall be the standard product of a manufacturer regularly engaged in the production of online analytical instrumentation.
- B. Certifications
 - 1. General Purpose CSA/CSANRTL and FM (UL Pending) when used with an approved controller.
 - 2. Class I, Division 2, Groups A through D, CSA/CSANRTL and FM (UL Pending) when used with an approved controller.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver pH measurement system to the site until product information and system shop drawings have been approved.
- B. Deliver materials in manufacturer's original, unopened containers and packaging, clearly labeled with product name and manufacturer.
- C. Store and handle materials in accordance with manufacturer's written instructions.

- D. Store materials indoors in a clean, dry area.
- E. Protect materials during storage, handling, and installation to prevent damage.
- F. Storage temperature range: 23°F to 149°F (–5°C to 65°C).

1.07 WARRANTY

- A. Provide a 30-month pro-rated warranty from the date of shipment as follows:
 - 1. 0 to 12 months: 100 percent free from manufacturer defects.
 - 2. 0 to 18 months: Replacement at one-third current list price for any reason.
 - 3. 19 to 30 months: Replacement at two-thirds current list price for any reason.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Provide products from the following manufacturer:
 - 1. Hach Company, Loveland, CO
 - a. Hach model pHD-SC pH Sensor
 - 2. Engineer approved equal

2.02 GENERAL

- A. Measurement principle shall be potentiometry by means of an ion selective electrode.
- B. Connect pH sensor assembly to field-mounted junction box or expansion modules specified in Section 40 95 00 with sensor connecting cable specified in Section 2.3.A.3.
- C. pH measurement system components shall be designed to be part of an analytical process control system with enhanced protection from overvoltage due to lightning and power supply fluctuations according to EN 61326 when installed using manufacturer's recommended components per manufacturer's instructions.

2.03 MEASUREMENT PRINCIPLE AND PERFORMANCE REQUIREMENTS

- A. Measurement Principle

- B. Potentiometry by means of an ion selective electrode.
 - 1. Differential electrode measurement technique utilizing three electrodes.
 - a. Two electrodes shall compare the process value to a stable internal reference standard buffer solution.
 - b. Internal electrode shall be non-flowing and fouling-resistant.
- C. Performance Requirements
 - 1. Measurement range: 0 to 14 pH.
 - 2. Sensitivity: 0.01 pH.
 - 3. Stability: 0.03 pH per 24 hours, non-cumulative.

2.04 ENVIRONMENTAL AND OPERATING REQUIREMENTS

- A. Temperature range: 23°F to 158°F (–5°C to 70°C).
- B. Sample flow rate: 3 meters (10 feet) per second maximum.
- C. Pressure: 100 psi at 158°F (6.9 bar at 70°C).
- D. Transmission distance: 1000 meters (3240 feet) maximum.
- E. System components shall provide enhanced protection from overvoltage due to lightning and power supply fluctuations in accordance with EN 61326 when installed per manufacturer's recommendations.

2.05 MANUFACTURED UNIT

- A. The pH sensor shall consist of:
 - 1. Encapsulated sensor with digital signal processor, pre-amplifier, reference electrode, measuring electrode, ground electrode, and replaceable salt bridge.
 - 2. Integral 10-meter cable
 - 3. Wetted material [select one]:
 - a. PEEK®
 - b. Ryton®.

B. Sensor shall include a built-in Pt1000 RTD temperature compensator.

C. Sensor shall operate with Hach SC platform controllers only.

2.06 MOUNTING CONFIGURATIONS

A. Sensor body shall include 1-inch NPT threads on both ends to mount into:

1. Standard 1-inch pipe tee.
2. GLI adapter pipe for union mount with standard 1.5-inch tee.
3. End of pipe for immersion into vessel.

B. For PEEK® housing only, provide one of the following as indicated:

1. Insertion body style with 1-inch NPT threads on cable end only for installation in GLI ball valve hardware assembly allowing insertion or retraction without stopping process flow.
2. Sanitary body style with 2-inch flange for mounting into GLI 2-inch sanitary tee with special cap and EPDM compound gasket.

2.07 COMPONENTS

A. Standard equipment:

1. Probe
2. Salt bridge
3. 10-meter integral cable
4. Manual

B. Dimensions

1. Length: 10.75 in. (28.8 cm)
2. Diameter 1.25 in. (3.1 cm)

C. Weight: 11 oz. (0.316 kg)

2.08 ACCESSORIES

A. Air blast cleaning system

- B. Junction box for extension cables. Must be used for lengths greater than 100 meters.
- C. Extension cables
- D. ModBUS® RS-232 or RS-485 digital output card
- E. Mounting hardware
- F. pH buffer solutions

PART 3 EXECUTION

3.01 PREPERATION

- A. Mount sensor to a manufacturer-approved mounting assembly directly in the solution to be measured.
- B. Mount sensor vertically with electrode pointing downward. A minimum of 15 degrees above horizontal is acceptable.

3.02 INSTALLATION

- A. Install the pH sensor in strict accordance with the manufacturer's written instructions and recommendations.
- B. Manufacturer's representative shall provide a minimum one-half day of startup service by a factory-trained technician, if requested.
 - 1. Contractor shall schedule startup.
 - 2. The following personnel shall be present at startup:
 - a. General Contractor.
 - b. Electrical Contractor.
 - c. Manufacturer's factory-trained representative.
 - d. Owner's personnel.
 - e. Engineer.

3.03 START-UP

- A. Provide manufacturer's services to perform startup, including basic operational training and certification of instrument performance.
- B. Provide a manufacturer's Service Agreement covering recommended preventative maintenance, regularly scheduled calibration, and necessary repairs from equipment startup through Owner acceptance and the first 12 months of Owner operation after turnover.
- C. Startup, field service, and factory repair shall be performed only by manufacturer-employed, factory-trained personnel.
- D. Use of manufacturer's service parts and reagents is required. Third-party parts and reagents are not acceptable.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item SCADA, COMPLETE related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 40 75 13

PART 1 GENERAL

1.01 SUMMARY

- A. Provide all labor, materials, equipment, and incidentals required to furnish, install, test, and place into operation chlorine analyzers for monitoring free residual chlorine as indicated on the Drawings and specified herein.
- B. Other methods of chlorine measurement, including amperometric, potentiometric, and iodometric methods utilizing electrodes, are not acceptable.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 40 60 00 - SCADA Systems

1.03 REFERENCES

- A. National Electrical Code (NEC).
- B. Underwriters Laboratories (UL).
- C. Canadian Standards Association (CSA).
- D. Applicable IEPA approved methods for chlorine measurement.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 01 33 00.
- B. Submittals shall include, at a minimum:
 - 1. Manufacturer's product data sheets and technical specifications.
 - 2. Measurement range, accuracy, precision, and detection limits.
 - 3. Dimensional drawings and mounting details.
 - 4. Electrical wiring diagrams and connection requirements.
 - 5. Sample piping and conditioning requirements.
 - 6. Operation and maintenance manuals.
 - 7. Warranty documentation.

8. Recommended spare parts list for one (1) year of operation.

1.05 QUALITY ASSURANCE

- A. The chlorine analyzer shall be the standard product of a manufacturer regularly engaged in the production of online chlorine monitoring equipment for potable water treatment applications.
- B. Equipment shall be factory assembled and tested prior to shipment.
- C. Analyzer shall be CE approved, ETL listed to UL 1262, and ETL certified to CSA 22.2 No. 142.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in original unopened containers with manufacturer's labeling intact.
- B. Store equipment in a clean, dry location protected from moisture, excessive heat, freezing, and physical damage.
- C. Handle equipment in accordance with manufacturer's written instructions to prevent damage to electronic and colorimetric components.

1.07 WARRANTY

- A. The Contractor shall provide a one (1) year warranty from the date of acceptance by the Owner.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Acceptable Manufacturer: Hach Company, Loveland, Colorado.
 1. Acceptable Model: Hach CL17sc (Free Chlorine)
 2. Engineer approved equal.

2.02 MEASUREMENT METHOD

- A. Free chlorine shall be measured using colorimetric chemistry.
- B. The chemistry shall be the USEPA-accepted N,N-diethyl-p-phenylenediamine (DPD) method.

2.03 PERFORMANCE REQUIREMENTS

- A. Measurement range: 0 to 5 mg/L free residual chlorine.
- B. Accuracy: ± 5 percent of reading or ± 0.035 mg/L, whichever is greater.
- C. Precision: ± 5 percent of reading or ± 0.005 mg/L, whichever is greater.
- D. Minimum detection limit: 0.035 mg/L.
- E. Resolution: 0.01 mg/L.
- F. Repeatability: 0.05 mg/L.
- G. Cycle time: 2.5 minutes.

2.04 OPERATIONAL CRITERIA

- A. Sample flow rate: 200 to 500 mL per minute.
- B. Sample pressure: 1 to 5 psig.
 - 1. Supplied conditioning kit shall allow for up to 120 psig.
- C. Sample temperature: 5 to 40 degrees C.
- D. Ambient operating temperature: 0 to 40 degrees C.
- E. Operating humidity: 90 percent at 40 degrees C maximum.

2.05 MAINTENANCE REQUIREMENTS

- A. Scheduled Maintenance
 - 1. Reagent replenishment: Monthly, approximately 15 minutes per month.
 - 2. Pump tubing replacement:
 - a. Below 80 degrees F: six-month intervals.
 - b. Above 80 degrees F: three-month intervals.
 - 3. Analyzer tubing replacement: Annually.
- B. B. Unscheduled Maintenance
 - 1. Replace fuse.

2. Clean instrument enclosure.
3. Clean colorimeter.
4. Replace sample conditioning filter.
5. Clean reagent spills.

2.06 MANUFACTURED UNIT

- A. The chlorine analyzer shall consist of a sample valve, flow cell, and buffer and indicator reagent solutions.
- B. The analyzer shall be housed in a NEMA 12 enclosure, IP62-rated with gasketed and latched door.

2.07 EQUIPMENT AND OUTPUT FEATURES

- A. The analyzer shall operate using selectable 100 or 240 VAC power.
- B. Between analysis points, the analyzer shall perform self-test auto-blanking to eliminate potential drift.
- C. The analyzer shall operate unattended for 30 days between reagent changes and sample cell cleaning.
- D. The analyzer shall provide two feed control operation modes for chemical feed pumps:
 1. On/off control using concentration alarm outputs.
 2. Proportional control using scaled 4–20 mA output signal.
- E. Output Features
 1. One optically isolated analog output selectable as 0–20 mA or 4–20 mA, programmable over any portion of the analyzer range.
 2. Two internal SPDT alarm relays rated 5 amp resistive load at 230 VAC. Alarm functions shall include concentration set point, analyzer system warning, and analyzer system shutdown.

2.08 COMPONENTS AND ACCESSORIES

- A. Standard Equipment

1. Analyzer.
 2. One-month supply of reagents.
 3. Pump tubing.
 4. Wall mount kit.
 5. Manufacturer's manual.
- B. Dimensions
1. 5.7 inches wide.
 2. 5.7 inches high.
 3. 7.1 inches deep.
- C. Weight: 3.75 pounds.
- D. Standard sample conditioning element consisting of pressure regulator, strainer, and shut-off valve.
- E. Connections
1. Sample inlet: 1/4-inch O.D. quick-connect polyethylene tubing.
 2. Sample drain: 1/2-inch I.D. flexible tubing.
 3. Overflow drain: 1/2-inch I.D. flexible tubing.
 4. Air purge: 1/4-inch O.D. quick-connect polyethylene tubing.
- F. Accessories
1. Power cord.
 2. One-year maintenance kit (reagents).
 3. Maintenance kit with pre-assembled tubing.
 4. Sample conditioning kit.
 5. Flow meter with 1/4-inch O.D. tubing.
 6. RS-232 output kit.

7. SEVERN TRENT network interface.

PART 3 EXECUTION

3.01 PREPARATION

- A. Analyzer shall be wall mounted.
- B. Minimum clearances:
 1. Horizontal: 15.2 inches minimum, 27 inches ideal.
 2. Vertical: 19 inches.
 3. Depth: 20 inches.
- C. Power connection shall be made by three-wire barrier terminal block through 1/2-inch conduit opening using 12 to 18 AWG conductors.

3.02 INSTALLATION

- A. Install the chlorine analyzer in strict accordance with the manufacturer's written instructions. Provide drain piping from all analyzers to the nearest floor drain.
- B. Manufacturer's representative shall provide a minimum one-half day of startup service by a factory-trained technician, if requested. The Contractor shall schedule startup and ensure attendance of the General Contractor, Owner's personnel, and Engineer.
- C. Provide a 1/2-inch copper line from the plant water supply to the chlorine analyzer mounted on the filter and discharge the bypass flow into the top of the filter.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item SCADA, COMPLETE related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 40 75 21

PART 1 GENERAL

1.01 SUMMARY

- A. Provide all labor, materials, equipment, and incidentals required to furnish, install, test, and place into operation low-range turbidimeters for monitoring sample turbidity from 0.001 to 100 NTU as indicated on the Drawings and specified herein.
- B. Other methods of turbidity measurement, including those requiring a sample cell with glass window subject to fouling or fogging, or requiring air purge, desiccant, or frequent manual cleaning, are not acceptable

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 40 60 00 – Scada Systems

1.03 REFERENCES

- A. National Electrical Code (NEC).
- B. Underwriters Laboratories (UL).
- C. National Electrical Manufacturers Association (NEMA).
- D. American National Standards Institute (ANSI).
- E. Applicable IEPA turbidity measurement standards for drinking water compliance.

1.04 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 01 33 00.
- B. Submittals shall include, at a minimum:
 - 1. Manufacturer's product data sheets.
 - 2. Complete technical specifications, including measuring range, accuracy, outputs, and environmental limitations.
 - 3. Dimensional drawings and mounting details.
 - 4. Electrical connection diagrams and wiring schematics.
 - 5. Installation instructions.

6. Operation and maintenance manuals.
7. Warranty documentation.
8. List of recommended spare parts for five (5) years of operation.

1.05 QUALITY ASSURANCE

- A. The turbidimeter shall be the standard product of a manufacturer regularly engaged in the production of low-range turbidity measurement instrumentation for potable water applications.
- B. The complete unit shall be factory assembled, piped, wired, and wet bench tested prior to shipment.
- C. All equipment shall comply with applicable UL and NEMA standards.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in original, unopened containers with manufacturer's identification intact.
- B. Store equipment in a clean, dry location protected from weather, humidity, and physical damage.
- C. Storage temperature shall be maintained between -20 and 60 degrees C.
- D. Handle equipment in accordance with manufacturer's recommendations to prevent damage to optical and electronic components.

1.07 GUARANTEE

- A. The turbidimeter manufacturer shall provide a full four (4) year warranty covering materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Acceptable Manufacturer:
 1. Hach Company, Loveland, Colorado.
 - a. Hach LPV 442.99.01012 (Laboratory)
 - b. Hach LxV 445.99.53112 (Online)

c. Hach LxV 404.99.00552 (control panel configuration)

2. Engineer approved equal

2.02 PERFORMANCE REQUIREMENTS

- A. The turbidimeter shall operate on 85–265 VAC or 24 VDC incoming power and shall provide two selectable 0–20 mA or 4–20 mA analog signal outputs. An optional third analog output shall be available.
- B. The turbidimeter shall utilize a non-contact method of measurement. Influent and effluent turbidity shall be measured without direct contact between optical surfaces and the process sample. The analyzer design shall prevent fouling of optical surfaces.
- C. The turbidimeter shall be capable of measuring sample flowrate and shall provide a 4–20 mA output for flowrate monitoring.
- D. Measuring range shall be 0.000 to 100.0 NTU with automatic range switching.
- E. The instrument shall utilize an LED light source and shall provide the capability to verify readings using an optical verification reference standard.
- F. Precision shall be ± 0.003 NTU or ± 1 percent of reading, whichever is greater.
- G. The turbidimeter shall include the capability for an automatic drain valve for the sample chamber.
- H. The complete turbidimeter assembly shall be factory mounted on a PVC backpanel, fully piped, wired, and wet bench tested prior to shipment.

2.03 OPERATIONAL CRITERIA

- A. Sample flow rate shall be 200 to 650 mL per minute.
- B. Sample temperature shall be 0 to 50 degrees C.
- C. Ambient operating temperature shall be 0 to 40 degrees C.
- D. Operating humidity shall be 5 to 95 percent, non-condensing.

2.04 MAINTENANCE REQUIREMENTS

- A. The turbidimeter shall be factory calibrated with Formazine and shall require only periodic verification using a simple verification kit. Routine Formazine recalibration shall not be required under normal operating conditions.
- B. An optional degasser shall be available to remove entrained gases from the sample stream.
- C. The manufacturer shall furnish all required replacement parts, lamps or LEDs, calibration solutions, and consumables necessary to provide maintenance for a period of five (5) years.

2.05 MANUFACTURED UNIT

- A. The turbidimeter shall consist of an LED light source, photocell detector, and internal bubble trap.
- B. The turbidimeter shall be housed in a NEMA 4X/IP66 enclosure constructed of corrosion-resistant polystyrene.
- C. Optical components shall be mounted in a sealed, removable head assembly.
- D. The controller shall be microprocessor-based with non-volatile memory backup (EEPROM) and shall contain the DC power supply.
- E. The controller enclosure shall be NEMA 4X, constructed with a polycarbonate face panel, epoxy-coated cast aluminum door and case, and stainless steel hardware.

2.06 EQUIPMENT AND CONTROLLER FEATURES

- A. The turbidimeter shall operate using selectable 100 to 230 VAC power and shall operate continuously.
- B. The sample stream shall pass through an internal bubble trap prior to measurement.
- C. The system shall be factory-configured as “plug and play.”
- D. The controller shall be capable of functioning with one or two turbidimeter sensors.
- E. The controller display shall be a 128 x 64 pixel backlit LCD, readable in full sunlight, with menu-driven conversational text.
- F. The controller shall display single or dual turbidity readings simultaneously and auxiliary information including analog output values, date and time, relay status, diagnostic warnings, and error messages.

- G. The controller shall provide signal averaging, bubble removal, alarm and recorder output hold, and self-test diagnostics.
- H. The controller shall log measurement data for one or two sensors at selectable intervals and shall store 15-minute interval data for up to six months.
- I. Communications shall include Modbus® or LonWorks® capability, with expansion to additional networking protocols without hardware modification.
- J. Wireless data transfer shall be available via integrated infrared (IrDA) port.
- K. The controller shall include two isolated 0–20 mA or 4–20 mA analog outputs with 12-bit resolution, capable of driving loads up to 600 ohms, and three SPDT alarm relays rated 5 amperes.

2.07 COMPONENTS AND ACCESSORIES

- A. Standard Equipment
 - 1. Turbidimeter sensor head.
 - 2. Turbidimeter body.
 - 3. Controller.
 - 4. Manufacturer's manual.
- B. Accessories
 - 1. Power cord with strain relief.
 - 2. Calibration/verification module (Model ICE-PIC for 1720E).
 - 3. StablCal® verification standards.
 - 4. Formazin calibration kit.
 - 5. Modbus®/RS485 output.
 - 6. Modbus®/RS232 output.
 - 7. LonWorks® output.
 - 8. Floor stand.

PART 3 EXECUTION

3.01 PREPARATION

- A. Turbidimeter shall be wall mounted.
- B. No special side clearances shall be required.

3.02 INSTALLATION

- A. Install the turbidimeter in accordance with the manufacturer's written instructions. Provide drain piping from all turbidimeters to the nearest floor drain.
- B. The manufacturer's representative shall provide a minimum one-half day of startup service by a factory-trained technician. The Contractor shall schedule startup and ensure attendance of the General Contractor, Engineer, and Owner's personnel.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item SCADA, COMPLETE related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION XXX

PART 1 GENERAL

1.01 SUMMARY

- A. Provide all labor, materials, equipment and incidentals required, and install, place in operation and field test variable frequency drives.
- B. The adjustable frequency controller shall be a space vector Pulse-Width Modulated (PWM) design. The final responsibility of distributor or packager modifications to a third-party standard product will reside with the VFD manufacturer. All drives shall be supplied by one manufacturer. The VFD will be manufactured within the United States of America to alleviate concerns of future serviceability and parts availability.
- C. The VFD system must fit in the space indicated on the drawings.

1.02 QUALITY ASSURANCE

- A. The entire VFD system as described in Article 2.01 shall be factory assembled and system tested by the VFD manufacturer to assure a properly coordinated system.
- B. Codes: Provide equipment in full accordance with the latest applicable rules, regulations, and standards of:
 - 1. Local Laws and Ordinances.
 - 2. State and Federal Laws.
 - 3. National Electric Code (NEC).
 - 4. Underwriters Laboratories (UL).
 - 5. American National Standards Institute (ANSI).
 - 6. National Electrical Manufacturers Association (NEMA).
 - 7. Institute of Electrical and Electronics Engineers (IEEE).
- C. The complete drive system shall be UL listed.

1.03 SUBMITTALS

- A. Submittals shall conform in all respects to Section 01 33 00.
- B. Submittals shall be custom prepared by the VFD manufacturer for this specific application.

- C. Submittal information shall include, but not be limited to:
1. Equipment dimensions, including stub-up locations, shipping splits and shipping weights.
 2. Catalog cuts of major components.
 3. Spare parts list, per Paragraph 3.03.
 4. Certifications, including:
 - a. Warranty, per Article 1.04.
 - b. Efficiencies, per Article 2.02.A.

1.04 GUARANTEE

- A. All equipment furnished under this section shall be warranted for parts and labor by the contractor and the equipment manufacturers for a period of one (1) year after completion of startup.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer and Model:
1. Danfoss VLT
 2. ABB Model ACQ580
 3. Engineer approved equivalent.
- B. All drives shall be supplied by a single manufacturer. Any modifications to a standard product required to meet this specification shall be performed only by the VFD manufacturer or the manufacturer's authorized representative. Distributor or system integrator changes to the VFD manufacturer's product are specifically disallowed.

2.02 MATERIAL AND EQUIPMENT

- A. Provide an input circuit breaker interlocked with the enclosure door and equipped with a through-the-door handle to provide positive disconnect of incoming AC power. The circuit breaker shall be rated in accordance with NEC and UL requirements.

- B. The VFD system shall maintain a power factor of 0.95 or better throughout the entire speed range.

2.03 VARIABLE FREQUENCY DRIVES

A. Ratings

1. Efficiency. The drive system shall be 97 percent efficient at full load and full speed and 96 percent efficient at 51 percent load and 80 percent speed. Losses utilized in the efficiency calculation shall include input transformer, harmonic filter, power factor correction components if applicable, VFD converter, output filter if applicable, and auxiliary controls including internal control boards, cooling fans, and pumps.
2. Rated Input Power. 460 to 480 volts, 60 Hz, plus 10 percent, minus 10 percent at rated load, three-phase.
 - a. Voltage Dip Ride-Through. The VFD shall sustain continued operation with a 20 percent dip in nominal line voltage. Output speed may decline only if the current limit rating is exceeded.
 - b. Power Loss Ride-Through. The VFD shall provide a minimum three-cycle power loss ride-through without fault activation.
3. Output Power. Horsepower, RPM, 460-volt motor voltage, 60 Hz, and motor current (amps) shall be as indicated on the Drawings for each motor served.
4. Ambient Temperature Range. 0 to 40 degrees C.
5. Elevation. Up to 3,300 feet above mean sea level without derating. Drives above 150 HP shall operate up to 6,600 feet without derating.
6. Atmosphere. Non-condensing relative humidity up to 95 percent.
7. AC Line Frequency Variation. 47 to 63 Hz.
8. Power Unit Rating Basis. 110 percent rated current for one minute or 150 percent for 10 seconds at rated temperature for variable torque applications; 150 percent rated current for one minute at rated temperature for constant torque applications.

B. Construction

1. The controller shall produce an adjustable AC voltage and frequency output and include an output voltage regulator to maintain proper V/Hz ratio despite incoming voltage variations.

2. Continuous output current rating shall be not less than 100 percent of motor nameplate current.
3. Converter section shall be six-pulse utilizing diodes.
4. The inverter output shall be generated by IGBTs using space vector PWM to generate a sine-coded output voltage. Drives rated 150 HP or greater shall be capable of providing 97 percent of input voltage at the output.
5. The worst-case RMS motor line current at rated speed, torque, and voltage shall not exceed 1.05 times the rated RMS motor current for pure sine wave operation.
6. The controller shall be suitable for use with standard NEMA-B squirrel-cage induction motors with 1.15 service factor or with existing motors as shown on the Drawings. Future substitution of equivalent standard motors shall be possible.
7. Control logic shall be fully digital and shall not require analog adjustment potentiometers or fixed selector resistors. Power failure shall not require reload of drive parameters.

C. Basic Features

1. Provide a door-mounted membrane keypad with integral 240 x 64 pixel LCD display capable of controlling the VFD and setting parameters. Display and menu functions shall be in plain English engineering units. Three levels of password security shall be provided.
2. The keypad shall include numerical keys, increase/decrease keys, LOCAL/REMOTE selector, RUN light, ALARM light, FAULT light, manual START and STOP pushbuttons, and FAULT RESET functionality.
3. Displayed parameters shall include speed (RPM), output current (amps), output frequency (Hz), DC bus voltage, output voltage, total three-phase output power (kW or HP), torque (Nm), and elapsed time running meter.
4. Provide customer-selectable automatic restart programmable for up to ten attempts within a programmable period up to 600 seconds.
5. Provide MODBUS communication via onboard Ethernet port. VFD parameters, fault log, and diagnostic log shall be downloadable via RS-232 or Ethernet port.
6. Provide integral PID algorithm and configurable function blocks including logic, mathematical operations, and storage elements.

D. Enclosure

1. All VFD components shall be factory mounted and wired within a dead-front, grounded, NEMA 1 filtered enclosure. Free-standing enclosures shall be suitable for mounting on a concrete housekeeping pad.

E. Protective Features and Circuits

1. The Provide instantaneous overcurrent and overvoltage trip; undervoltage and power loss protection; overtemperature alarm and protection; ground fault protection; electronic motor overload protection; motor temperature detector input; catch-a-spinning-load capability; and protection from output short circuit, open circuit, loss of input phase, and loss of input power without requiring an output contactor.

F. Parameter Settings

1. Field-adjustable parameters shall include motor nameplate data, acceleration and deceleration rates, maximum and minimum speed, voltage boost settings, V/Hz ratio, overspeed and overload trip settings, PID control settings, critical speed avoidance bands, auto start functions, and programmable speed profile functions.
2. All drive settings shall be stored in a parameter log accessible via keypad display and RS-232, RS-485, or Ethernet port. The controller shall provide a slot for downloading parameters to a compact flash memory card using the keypad.

G. Input/Output Features

1. Two programmable analog inputs (0-20mA/0-10V), optionally isolated.
2. Two programmable analog outputs (0-20mA), optionally isolated.
3. Minimum nine programmable digital inputs (24VDC).
4. Minimum three programmable digital outputs.
5. Temperature sensor input (PTC or KTY84).
6. System Program providing built-in drive control or application specific configuration capability.

H. Diagnostic Features and Fault Handling

1. The Provide a microprocessor-based diagnostic system monitoring control functions and displaying faults and operating conditions in English text.
2. Provide a fault log recording the 64 most recent events with time stamp and fault type accessible via keypad and serial communications.
3. Provide Windows-based software for startup, commissioning, monitoring, optimization, and diagnostics supporting all supplied drives. Software shall include guided commissioning wizards, configurable I/O, setpoint channels, speed control, logic and mathematical functions, diagnostics, self-optimization, and trace functions.

PART 3 EXECUTION

3.01 FACTORY TESTING

- A. The VFD manufacturer shall perform incoming inspection of components and raw materials based on strategic supplier base and experience.
- B. All products shall be subject to 100 percent testing and final inspection. Sampling plans are not permitted.

3.02 STARTUP AND TRAINING

- A. VFD manufacturer shall provide the services of a factory trained technician for startup assistance and training.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the contract unit price for the BELOW LISTED PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

1. ALBION DISTRIBUTION PUMPS AND APPURTENANCES
2. GRAYVILLE DISTRIBUTION PUMPS AND APPURTENANCES
3. TRANSFER PUMPS AND APPURTENANCES
4. BACKWASH PUMPS AND APPURTENANCES
5. ALL REMAINING ITEMS RELATED TO CONTRACT 1 OF W2E WATER TREATMENT PLANT NOT COVERED UNDER OTHER BID ITEMS OR CONTRACTS

END OF SECTION 40 97 00

DIVISION 41 – MATERIAL PROCESSING AND HANDLING EQUIPMENT

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PART 1 GENERAL

1.01 SUMMARY

- A. Furnish, factory assemble, test, deliver, and place into service a complete skid-mounted Bulk Bag-Handling Batching Equipment system as specified herein and as shown on the Contract Documents.
- B. The system shall be a completely integrated chemical feed package consisting of standard equipment of a manufacturer regularly engaged in the design and manufacture of similar bulk bag chemical batching systems.
- C. Equipment included as part of this Section shall include, but not be limited to:
 - 1. Bulk bag hoist and spreader assembly.
 - 2. Bulk bag support frame.
 - 3. Bulk bag untie box with iris valve.
 - 4. Quick-disconnect flexible transition.
 - 5. Volumetric feeder with 1.5 cubic foot hopper.
 - 6. Wetting cone assembly.
 - 7. Eductor assembly.
 - 8. Local control panel with PLC and VFD.
 - 9. All interconnecting piping and wiring within skid limits.
- D. The entire batching system shall be factory skid-mounted with all mechanical, electrical, and control components interconnected and tested prior to shipment.

1.02 RELATED SECTIONS

- A. Section 40 60 00 – Supervisory Control and Data Acquisition (SCADA).
- B. Section 01 33 00 – Submittal Procedures.
- C. Section 01 43 00 – Quality Assurance.

1.03 REFERENCES

- A. NFPA 70 – National Electrical Code (NEC).
- B. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. ANSI/ISA standards applicable to instrumentation and control devices.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Detailed description of the complete scope of supply.
 - 2. Complete bill of materials identifying all major components.
 - 3. Annotated manufacturer's specification sheets for all mechanical and electrical components.
- B. Shop Drawings:
 - 1. Dimensioned layout drawings including plan, elevation, shaded isometric, and orthogonal views.
 - 2. System dimensions and shipping weights.
 - 3. Piping and instrumentation diagram (P&ID).
 - 4. Complete wiring diagrams, control schematics, and control logic diagrams.
- C. Operation and Maintenance Manuals:
 - 1. Storage and handling instructions.
 - 2. Installation procedures.
 - 3. Start-up and commissioning procedures.
 - 4. Operating instructions.
 - 5. Preventative maintenance requirements.
 - 6. Safety precautions and hazard warnings.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturer shall have a minimum of five (5) years documented experience producing bulk bag chemical batching systems of similar size and complexity.
2. Equipment shall be standard catalogued products of the manufacturer.

B. Electrical Components:

1. All electrical equipment shall be UL listed where applicable.
2. Control panel shall comply with NFPA 70.

C. Hazardous Location Requirements:

1. Equipment installed in Class II, Division I areas shall be rated accordingly.
2. Control panels installed within Class II, Division I rated areas shall be pressurized and purged to prevent arcing or sparking from contacting hazardous dust atmospheres.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment fully assembled to the maximum extent practical.
- B. Protect equipment from damage, moisture, and contamination during shipment and storage.
- C. Store equipment indoors in a dry, temperature-controlled environment until installation.

1.07 WARRANTY

- A. Provide manufacturer's standard warranty, minimum twelve (12) months from date of startup or eighteen (18) months from shipment, whichever occurs first.
- B. Warranty shall cover defects in materials and workmanship.

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Batching Equipment

1.08 TRAINING

- A. Provide a qualified factory representative at the project site for a minimum of two (2) days for system startup assistance and training of Owner's personnel in operation and maintenance.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Velocity Dynamics Inc. (VeloDyne).
 - 1. The system shall be as manufactured by Velocity Dynamics Inc., Louisville, Colorado.
- B. Substitution of equipment by other manufacturers shall require prior written approval by the Engineer in accordance with Division 01 requirements. Proposed substitutions shall demonstrate complete compliance with performance, materials, construction, controls, and hazardous location requirements of this specification.

2.02 SYSTEM DESCRIPTION

- A. Provide a completely integrated bulk bag chemical feed and batching system designed for handling and feeding soda ash or powder activated carbon from bulk bags (super sacks) weighing up to 2,000 pounds.
- B. The system shall:
 - 1. Support and discharge bulk bag contents into a volumetric feeder.
 - 2. Meter dry chemical at controlled rates.
 - 3. Wet and slurry the chemical in a wetting cone.
 - 4. Convey slurry via eductor to the Owner's injection point.
 - 5. Interface with plant control system for remote start/stop and feed rate pacing.

2.03 BULK BAG SUPPORT FRAME ASSEMBLY

- A. Provide a Bulk-bag frame system designed to position and support bulk-bags weighing up to 2,000 pounds over the dry Feeder hopper inlet.

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- B. The frame system shall be constructed of 3" structural steel tubing with a minimum of 1/4" wall thickness. Each corner shall have gusset reinforced construction, with the exception of the travel zone of the big-bag.
- C. The entire bag support system shall be a powder coated finish.
- D. Provide a bag-lifting/hanging adaptor. The adaptor shall be constructed with bag loop positioning tabs to position the bag loops at the end of each bar arm.
- E. Provide a Bag untie box complete with hinged gasketed doorway and Iris valve for safe untying of the bulk bag.
- F. Provide a quick disconnect flexible transition manufactured by BFM

2.04 VOLUMETRIC FEEDER

- A. A VeloDyne. Series Barracuda 1500A volumetric feeder shall be connected to the untie box by means of a flexible connection. The feeder shall be provided to feed chemical at up to 1.2 ft³ per hour.
- B. Feeder shall have an inlet opening of at least 144 square inches to insure a positive flow of chemical out of the Super Sack and through the feeder.
- C. Feeder shall have a repeatable accuracy of plus or minus 2%.
- D. The volumetric feeder body shall be fabricated of not less than 10-gauge 304 stainless steel 1/4" drive end plates, and wetted parts with the exception of the screw, which will be 304 heat-treated stainless steel. The lower portion of the hopper shall be not less than 70 degrees to facilitate flow of the dry product with varying degrees of angle of repose to the ensuing screw feeder.
- E. All welds shall be ground & polished smooth and passivated.
- F. The drive shall be mounted to the feeder body with a stainless-steel adapter having a double lip seal to seal the feed section of the hopper from the feeder drive.
- G. Feeder shall be of the closed screw type for handling powder activated carbon material.
- H. Feeder shall have up to a 1" dia. screw discharging through a stainless steel spout, attached to a sanitary clamp, which will allow for optional auger sizes for future use.

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- I. The feeder shall be equipped with an anti-flooding drip lip system to eliminate chemical over-run or flooding on a stop command.
- J. The feeder shall be constructed with heavy-duty gear reducer drives.
- K. Auger shall be connected to the hollow drive shaft via reverse threading the auger directly to the drive shaft.
- L. The auger and spout shall be easy to remove from the face of the feeder without any tools.
- M. In order to optimize accuracy and repeatability of the feed, the auger shall maintain even flow of Soda Ash to the metering screw by a concentric conditioning helix.
- N. The volumetric feeder design shall allow the motor, gear reducer and auger to be removed as a single unit. Accessing the hopper from the storage section shall not be required.
- O. The feeder shall be provided with a hermetically sealed mechanical variable speed drive, providing a 60:1 turn down of feed rate.
- P. The feeder drive motor shall be a 1/2 HP 230 VAC TENV motor Rated for Class II Div I rated area.
- Q. Feeder variable speed control shall be provided by an Allen Bradley Powerflex 40 VFD drive. The feeder shall be paced by a local potentiometer in manual mode, and paced in remote mode via a 4-20 ma input signal. A digital speed indicator shall be mounted on the control panel door and provide a corresponding 4-20 ma output signal of actual feed rate.

2.05 WETTING CONE

- A. A 316 stainless steel wetting cone will be installed to promote down-flow into the mouth of the eductor.
- B. The wetting cone will be mounted between the drop tube discharge and the eductor.
- C. Water will be added tangentially to the wetting cone, which will form a vortex to sweep the inner surfaces of the wetting cone, preventing bridging and subsequent blockages.
- D. Side wall wash down shower shall also be required via flexible tubing surrounding the inner wall of the cone.

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- E. The wetting cone assembly will have a piped overflow equipped with a conductivity switch which will immediately trip the dosing system if the presence of a fluid is sensed, indicating a high water level in the wetting cone.

2.06 EDUCTOR

- A. An eductor will be installed to mix and convey the slurry to the Purchaser's injection point.
- B. The unit will be designed based on field requirements of flow, pressure, discharge pressure, length, and orientation of discharge piping (see table below). Motive water shall move the material from the wetting chamber to the final injection point. The pressure and quantity of motive water required to wet and convey the carbon slurry will be ultimately dependent on the configuration (which relates to back pressure) of the Purchaser's slurry transport piping system and the injection point pressure.

Soda Ash Feed Line Parameters				
Flow	Inlet Pressure	Line Pressure	Feed Diameter	Feed Length
1-10 gph	10-20 psi	5-10 PSI	1" Flex	80 ft

2.07 Controls

- A. Control Panel
1. Frame mounted local control panel.
 2. NEMA 4X
 3. 230 VAC, 3phase
 4. Panel shall house all starters, overloads, VFD's and all other required devices
 5. Panel mounted touch screen for PLC control
 6. All switches and alarms will be available on the touchscreen.
 7. HOA selector switches for the solenoid valve and vibrator
 8. On/Off/Remote selector switch for the feeder
 9. 10 kilo-ohm potentiometer for local feeder speed adjustment

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10. Feeder speed display

B. Communications

1. Start and stop by dry contact from the plant control room
2. Feeder pace by 4-20mA signal from the plant control room
3. Alarm and running lights per the manufacturer's standard design.
4. Dry contact relay for System Alarm, Running
5. 4-20mA signal to SCADA for feeder speed.

C. Controls to be mounted inside the Class II Div I rated area the panel shall be pressurized and purged to isolate any arching or sparking occurrences in the panel.

PART 3 EXECUTION

3.01 INSTALLATION

A. The equipment shall be installed per the contract documents and manufacturer's recommendations.

PART 4 PAYMENT

4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL BULK BAG HANDLER AND SODA ASH FEED SYSTEM related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 41 14 23

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EQUIPMENT

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PART 1 GENERAL

1.01 SUMMARY

- A. Work includes furnishing, fabricating, delivering, erecting, coating, and placing into service one (1) welded steel Recarbonation Tank (HeliCarb contact vessel) complete with appurtenances as shown on the Drawings and specified herein.
- B. The Recarbonation Tank shall provide controlled contact between carbon dioxide (CO₂) gas and lime-softened water for pH adjustment. The vessel shall:
 - 1. Utilize a downward helical flow path to create high downward water velocity.
 - 2. Promote efficient dissolution of rising CO₂ gas bubbles.
 - 3. Operate without mixers, pumps, or other moving mechanical equipment.
 - 4. Rely solely on hydraulic energy provided by influent flow through the inlet nozzle.
- C. The tank shall be a shop-fabricated and field-erected welded steel structure designed in accordance with AWWA and applicable structural codes.

1.02 RELATED SECTIONS

- A. Section 09 96 00 - High-Performance Coatings
- B. Section 03 30 00 – Cast-in-Place Concrete (Foundations)
- C. Section 40 05 15 – Piping Support Systems
- D. Section 40 05 64 - Valves for Actuator Control
- E. Section 46 31 43 – Carbon Dioxide Storage and Feed System

1.03 REFERENCES

- A. AWWA D100 – Welded Steel Tanks for Water Storage
- B. AISC – Steel Construction Manual, Allowable Stress Design
- C. ASME Section IX – Welding and Brazing Qualifications
- D. AWS D1.1 – Structural Welding Code – Steel

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- E. ASTM – Applicable Material Specifications
- F. SSPC-PA1 – Paint Application Specification
- G. OSHA – Occupational Safety and Health Standards

1.04 SUBMITTALS

- A. Submit shop drawings and calculations including:
 - 1. Plan, elevation, and sectional views.
 - 2. Shell thickness calculations.
 - 3. Nozzle schedule.
 - 4. Anchor bolt layout and loads.
 - 5. Design wind and seismic calculations.
 - 6. Welding procedures and welder certifications.
- B. Coating system data sheets.
- C. Installation and operation instructions.
- D. Certification of compliance with specified standards.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications
 - 1. The Recarbonation Tank shall be designed, fabricated, and erected by a single supplier regularly engaged in the manufacture of similar recarbonation contact vessels.
 - 2. The supplier shall have successfully designed, fabricated, and erected a minimum of ten (10) recarbonation contact vessels of similar configuration and size using its own organization.
 - 3. At least ten (10) installations shall have been in continuous satisfactory operation for a minimum of two (2) years on similar water treatment applications.
 - 4. Fabrication and erection shall not be subcontracted without prior written approval of the Engineer.

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Section 43 10 00 – Recarbonation Tank

B. Personnel Qualifications

1. Field supervision shall have a minimum of fifteen (15) years' experience in fabrication and erection of welded conical or double-curvature steel plate structures.
2. Field erection personnel shall have documented experience in welded steel tank construction.
3. All shop and field welders shall be certified in accordance with ASME Section IX or AWS D1.1.
4. The supplier shall maintain an Experience Modification Rate (EMR) of less than 0.80.

C. Design and Construction Standards

1. Tank design shall conform to AWWA D100 allowable stresses.
2. Structural members shall conform to AISC.
3. Welding procedures shall conform to ASME Section IX and AWS D1.1.
4. Field inspection of butt welds shall be performed by spot radiography in accordance with AWWA D100.
5. Radiographs shall become the property of the Owner.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect all materials from damage and corrosion.
- B. Store materials off the ground and protect flange faces and machined surfaces.
- C. Handle components in a manner that prevents distortion or coating damage.

1.07 GUARANTEE

- A. Provide a one (1) year warranty from date of Substantial Completion covering defects in materials and workmanship.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

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Section 43 10 00 – Recarbonation Tank

- A. The Basis of Design is the HeliCarb Recarbonation Contact Vessel as manufactured by CB&I.
- B. Approved equal manufacturers shall demonstrate strict compliance with this Section, including hydraulic performance, fabrication tolerances, structural design, and operating history.

2.02 GENERAL

- A. Furnish one (1) welded steel Recarbonation Tank complete with nozzles, anchor bolts, internals, and accessories.
- B. External piping, CO₂ storage, feed systems, diffusers, and controls are specified under Section 46 31 43 and shall be provided by others unless noted otherwise.

2.03 DESIGN CRITERIA

- A. Hydraulic Design
 - 1. Minimum Flow: 600 gpm
 - 2. Average Design Flow: 1,200 gpm
 - 3. Maximum Flow: 1,500 gpm
 - 4. Hydraulic Retention Time: Greater than 5 minutes
- B. Major Dimensions
 - 1. Major Diameter: 12'-0"
 - 2. Minor Diameter: 2'-3"
 - 3. Overall Height: 22'-7.5"
- C. Loading Conditions
 - 1. Liquid Level: Full to top angle
 - 2. Specific Gravity: 1.0
 - 3. Burial: Above grade (no external soil load)
 - 4. Wind Design:
 - a. 115 mph (3-second gust)

- b. Exposure C
- c. Importance Factor 1.25
- 5. Seismic Design:
 - a. Seismic Use Group III
 - b. Soil Classification D
 - c. Importance Factor 1.25
 - d. $S_s = 0.639$
 - e. $S_1 = 0.21$

2.04 MATERIALS

- A. Shell Plates: ASTM A36 steel
- B. Structural Members: ASTM A36
- C. Minimum Shell Thickness:
 - 1. Shell: 1/4 inch
 - 2. Bottom Plate: 3/8 inch
- D. Minimum Internal Component Thickness: 3/16 inch
- E. Permanent Fasteners: Type 304 Stainless Steel
- F. Anchor Bolts: Hot-dip galvanized ASTM A36

2.05 COMPONENTS

- A. Upper Cylinder
 - 1. Small-diameter cylinder with inlet and outlet nozzles.
 - 2. Annular space sized to provide minimum 1.0 ft/sec downward velocity at design flow.
 - 3. Vent fitting for discharge of unreacted CO_2 .

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Section 43 10 00 – Recarbonation Tank

B. Internal Riser / Outlet

1. Centrally located vertical riser extending from near tank bottom to top.
2. Designed to prevent short-circuiting.
3. Outlet nozzle connected to riser.

C. Transition Section

1. Conical transition connecting upper and lower cylinders.
2. Provides gradual velocity reduction.

D. Lower Cylinder

1. Sized to meet contact time requirement.
2. Provided with drain nozzle, manway, and CO₂ couplings.

E. Nozzles

Description	Qty	Size	Type
Inlet	1	12-inch	Flanged
Outlet	1	12-inch	Flanged
Drain	1	4-inch	Flanged
CO ₂ Feed	2	2-inch	Coupling
Manway	1	24-inch	Flanged
Vent	1	2-inch	Coupling

1. Flanged nozzles shall extend minimum 12 inches beyond shell. Flanges for field piping shall be furnished loose for final alignment.

2.06 FABRICATION

- A. All vessel boundary butt welds shall be full penetration.
- B. Misalignment of butt joints shall not exceed 1/16 inch.
- C. Back-up bars are not permitted.
- D. Banding and peaking shall not exceed 1/2 inch in 36-inch arc.
- E. Conical shell plates shall be shop formed into radial cone segments.

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Section 43 10 00 – Recarbonation Tank

- F. Sweep board tolerances shall not exceed 1/8 inch in 36 inches.

2.07 COATINGS

- A. Surface Preparation
 - 1. Exterior and non-submerged: SSPC-SP6
 - 2. Interior/submerged: SSPC-SP10
- B. Shop Primer
 - 1. Tnemec Series N140 Pota-Pox Plus Primer (Beige), 3.0–5.0 mils DFT, or approved equal.
- C. Interior Finish (Shop-Applied)
 - 1. Tnemec Series N140 Pota-Pox Plus (Tank White), 4.0–6.0 mils DFT.
- D. Field Coating
- E. General Contractor shall provide touch-up and final coatings per Section 09 96 00 - High-Performance Coatings
- F. No coating required for stainless steel or galvanized materials.

PART 3 EXECUTION

3.01 FOUNDATION

- A. Foundation provided under Section 03 30 00.
- B. Minimum foundation thickness: 16 inches.
- C. Level tolerance: $\pm 1/4$ inch around circumference.

3.02 SAND CUSHION OR GROUT

- A. Provide minimum 1-inch sand cushion beneath bottom plate per AWWA D100, or
- B. Fully grout bottom plate with non-shrink grout.
 - 1. Outer perimeter shall be sealed with non-shrink grout.

3.03 ERECTION

DIVISION 43 – PROCESS GAS AND LIQUID HANDLING,
PURIFICATION, AND STORAGE EQUIPMENT

Section 43 10 00 – Recarbonation Tank

- A. Erect in accordance with approved shop drawings.
- B. External piping shall be independently supported.
- C. Supplier shall provide field supervision.

3.04 START-UP SERVICE

- A. Provide one (1) trip and one (1) day of process engineering services for start-up and operational verification.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL (1) RECARBONATION TANK related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 43 10 00

PART 1 GENERAL

1.01 SUMMARY

A. Scope of Work

1. Furnish, install, test, and place into operation horizontal, between bearings, impeller centrifugal pumps complete with drivers, baseplates, couplings, guards, seal systems, lubrication systems, and all appurtenances as specified herein and as shown on the Drawings.
2. Pumps shall be designed for continuous duty service in water or wastewater applications as indicated in the Contract Documents.
3. Each pump unit shall be furnished as a complete, factory-assembled package by a single manufacturer regularly engaged in the design and manufacture of between bearings centrifugal pumps.

B. Description of Equipment

1. Pumps shall be horizontal, radially split or axially split case, double suction or single suction, multi-stage or single-stage, as shown on the Plans.
2. Units shall be designed for high efficiency, low vibration, ease of maintenance, and long service life.
3. The specification is based on pumps as manufactured by an established manufacturer with a minimum of 10 years documented experience in the manufacture of between bearings centrifugal pumps for municipal service.

1.02 RELATED SECTIONS

- A. Section 40 05 15 – Piping Support Systems
- B. Section 40 05 57 – Actuators for Process Valves and Gates
- C. Section 40 05 64 - Valves for Actuator Control
- D. Section 40 05 65 - Valves for Pump Control and Check Services
- E. Section 40 60 00 – Supervisory Control and Data Acquisition (SCADA)
- F. Section 40 97 00 - Variable Frequency Drive

1.03 REFERENCES

- A. Hydraulic Institute (HI) Standards
- B. American National Standards Institute (ANSI)
- C. American Society of Mechanical Engineers (ASME)
- D. ASTM International (ASTM)
- E. American Bearing Manufacturers Association (ABMA)
- F. National Electrical Manufacturers Association (NEMA)
- G. American Water Works Association (AWWA), where applicable

1.04 SUBMITTALS

- A. Submit the following in accordance with Division 01 requirements:
 - 1. Shop Drawings including:
 - a. Certified dimensional drawings with nozzle locations and sizes.
 - b. Pump assembly sectional drawings.
 - c. Baseplate and foundation bolt details.
 - d. Coupling and guard details.
 - e. Seal and lubrication system details.
 - 2. Certified Performance Curves:
 - a. Head vs. capacity.
 - b. Efficiency vs. capacity.
 - c. Brake horsepower vs. capacity.
 - d. NPSHr vs. capacity.
 - e. Operating point clearly indicated.

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Impeller Centrifugal Pumps

3. Materials of construction.
4. Motor data sheets.
5. Bearing life calculations (L10 minimum life).
6. Installation, operation, and maintenance manuals.
7. Factory test reports.

1.05 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of ten (10) years experience in the manufacture of between bearings centrifugal pumps of similar size and hydraulic characteristics.
- B. Pumps shall be factory assembled and tested prior to shipment.
- C. Pumps shall be designed such that the head-capacity curve shall continuously rise to shutoff and shall not exhibit instability within the specified operating range.
- D. Each pump shall be capable of operating continuously at any point from minimum continuous stable flow to runout without excessive vibration or overheating.
- E. Maximum vibration levels shall not exceed the limits established by Hydraulic Institute standards.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Pumps shall be delivered to the site fully assembled to the greatest extent possible.
- B. All openings shall be sealed to prevent entry of dirt and moisture.
- C. Pumps shall be stored in a clean, dry location protected from weather and construction damage.
- D. Shafting shall be protected against distortion during storage.

1.07 GUARANTEE

- A. The manufacturer shall guarantee the pumps and appurtenances against defects in materials and workmanship for a period of one (1) year from date of Substantial Completion.

- B. The manufacturer shall guarantee pump performance to meet the specified operating conditions.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

- A. Ruhrpumpen
 - 1. Series: ZW and HSD between bearings, axially split case pumps
- B. Engineer approved equal

2.02 GENERAL

- A. Type: Horizontal, single-stage, axially split case, between bearings (BB1).
- B. Liquid: Water, 68°F maximum, 1.0 SG, 1.0 cP.
- C. Casing: Cast Iron.
- D. Impeller: 316 Stainless Steel.
- E. Shaft: Carbon steel or AISI 4140 as noted.
- F. Shaft Sleeves: 316 Stainless Steel.
- G. Wear Rings: Cast iron or bronze as indicated per pump.
- H. Bearings: Grease lubricated with lip seals.
- I. Mechanical Seals:
 - 1. Single mechanical seal.
 - 2. Carbon vs. Ceramic seal faces.
 - 3. Internal recirculation flush.
- J. Baseplate: Fabricated steel baseplate.
- K. Coupling: Flexible coupling with OSHA-compliant guard.

- L. Coating: Manufacturer's C3 coating system, SSPC-SP10 surface preparation, epoxy topcoat, RAL 5003 exterior finish.

2.03 ALBION DISTRIBUTION

A. Model

- 1. Ruhrpumpen Model ZW 6x4x10 (F)

B. Hydraulic Data

- 1. Rated Flow: 1,300 GPM
- 2. Rated Head: 310 ft (313.8 ft actual)
- 3. Speed: 3550 RPM
- 4. Efficiency: 77.7%
- 5. NPSHr: 20.3 ft
- 6. MCSF: 445 GPM
- 7. Shutoff Head: 391 ft

C. Pressure Data

- 1. Maximum Discharge Pressure: 169 psi
- 2. Hydrostatic Test Pressure: 220 psi

D. Nozzles

- 1. Suction: 6-inch, 250# RF
- 2. Discharge: 4-inch, 250# RF

E. Mechanical

- 1. Impeller Diameter (Rated): 9.69 inches
- 2. Shaft Material: Carbon Steel
- 3. Shaft Sleeves: 316 SS

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4. Wear Rings: Cast Iron

F. Driver

1. Motor: 150 HP
2. Speed: 3600 RPM
3. Frame: 445TS
4. Voltage: 460V, 3PH, 60Hz
5. Enclosure: TEFC, NEMA Premium
6. Service Factor: 1.15

G. Approximate Weight

1. Total Assembly: 2,226 lbs

2.04 GRAYVILLE DISTRIBUTION

A. Model

1. Ruhrpumpen Model HSD 4x3x17 (A)

B. Hydraulic Data

1. Rated Flow: 600 GPM
2. Rated Head: 250 ft (251.7 ft actual)
3. Speed: 1775 RPM
4. Efficiency: 68.6%
5. NPSHr: 18.33 ft
6. MCSF: 186 GPM

C. Pressure Data

1. Maximum Discharge Pressure: 121 psi
2. Hydrostatic Test Pressure: 182 psi

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D. Nozzles

1. Suction: 4-inch, 125# FF
2. Discharge: 3-inch, 125# FF

E. Mechanical

1. Shaft: AISI 4140
2. Case Wear Ring: Bronze
3. Impeller Wear Rings: None
4. Seal Type: Type 21, 316SS/Carbon/Buna/Ceramic
5. Seal Plan: 7301

F. Driver

1. Motor: 60 HP
2. Speed: 1800 RPM
3. Frame: 364T
4. Voltage: 230/460V, 3PH, 60Hz
5. Enclosure: TEFC, NEMA Premium

G. Approximate Weight

1. Total Assembly: 1,340 lbs

2.05 BACKWASH

A. Model:

1. Ruhrpumpen Model ZW 12x10x13 (A)

B. Hydraulic Data

1. Rated Flow: 2,250 GPM

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2. Rated Head: 30 ft (30.11 ft actual)
 3. Speed: 1185 RPM
 4. Efficiency: 79.2%
 5. NPSHr: 9.02 ft
 6. MCSF: 1,121 GPM
- C. Pressure Data
1. Maximum Discharge Pressure: 24 psi
 2. Hydrostatic Test Pressure: 31 psi
- D. Nozzles
1. Suction: 12-inch, 125# FF
 2. Discharge: 10-inch, 125# FF
- E. Mechanical
1. Impeller Diameter (Rated): 11.02 inches
 2. Seal Plan: 7311
- F. Driver
1. Motor: 25 HP
 2. Speed: 1200 RPM
 3. Frame: 324T
 4. Voltage: 230/460V, 3PH, 60Hz
 5. Enclosure: TEFC, NEMA Premium
- G. Approximate Weight
1. Total Assembly: 2,016 lbs

2.06 TRANSFER

A. Model:

1. Ruhrpumpen Model ZW 10x6x12 (F)

B. Hydraulic Data

1. Rated Flow: 1,500 GPM
2. Rated Head: 50 ft (50.42 ft actual)
3. Speed: 1200 RPM
4. Efficiency: 81.9%
5. NPSHr: 6.65 ft
6. MCSF: 330 GPM

C. Pressure Data

1. Maximum Discharge Pressure: 31 psi
2. Hydrostatic Test Pressure: 40.9 psi

D. Nozzles

1. Suction: 10-inch, 250# RF
2. Discharge: 6-inch, 250# RF
3. Mechanical
4. Impeller Diameter (Rated): 12.28 inches
5. Seal Plan: 7311

E. Driver

1. Motor: 25 HP
2. Speed: 1200 RPM
3. Frame: 324T

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4. Voltage: 230/460V, 3PH, 60Hz
5. Enclosure: TEFC, NEMA Premium

F. Approximate Weight

1. Total Assembly: 1,653 lbs

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install pumps in accordance with manufacturer's written instructions and as shown on the Plans.
- B. Baseplates shall be grouted using non-shrink grout after alignment.
- C. Pumps and motors shall be field aligned prior to operation.
- D. All piping shall be independently supported and aligned to prevent strain on pump nozzles.

3.02 FIELD QUALITY CONTROL

- A. After installation, each pump shall be field tested for:
 1. Proper rotation.
 2. Vibration levels.
 3. Bearing temperatures.
 4. Seal leakage.
 5. Operating amperage.
- B. Field vibration shall not exceed Hydraulic Institute allowable limits.

3.03 START-UP SERVICE

- A. Manufacturer shall provide the services of a qualified factory representative for start-up assistance for a minimum of one (1) day.
- B. Representative shall:

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1. Verify alignment.
2. Inspect installation.
3. Assist with initial operation.
4. Provide operator training.

PART 4 PAYMENT

4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the contract unit price for the BELOW LISTED PAY ITEMS related to plans titled W2E WATER TREATMENT PLANT.

1. ALBION DISTRIBUTION PUMPS AND APPURTENANCES
2. GRAYVILLE DISTRIBUTION PUMPS AND APPURTENANCES
3. TRANSFER PUMPS AND APPURTENANCES
4. BACKWASH PUMPS AND APPURTENANCES
5. ALL REMAINING ITEMS RELATED TO CONTRACT 1 OF W2E WATER TREATMENT PLANT NOT COVERED UNDER OTHER BID ITEMS OR CONTRACTS

END OF SECTION 43 23 21

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Section 43 41 13 – Pillar-Type Steel
Water Storage Tank (Head Tank)

PART 1 GENERAL

1.01 SUMMARY

- A. Work Included: Furnish all labor, materials, equipment, and incidentals required to design, fabricate, shop test, deliver, and assist with installation and commissioning of a complete pillar-type steel water storage tank (Head Tank) system as shown on the Drawings and as specified herein.

- B. The Work includes, but is not limited to:
 - 1. Steel tank and appurtenances.
 - 2. Tank foundation interface requirements.
 - 3. Access ladders, platforms, and safety appurtenances.
 - 4. Inlet, outlet, overflow, drain, and vent piping within the tank structure.
 - 5. Level indication and transmitter.
 - 6. Interior and exterior coating systems.
 - 7. Shop testing and inspection.
 - 8. Field technical assistance for erection and commissioning.

- C. Description:
 - 1. The Head Tank shall receive raw water and discharge to downstream solids contact clarifiers.
 - 2. The Head Tank shall provide sufficient hydraulic head to initiate and maintain clarifier operation.
 - 3. The Head Tank shall prevent backflow from clarifiers to the raw water source.
 - 4. The Head Tank shall provide sufficient detention time and depth to allow release of entrained air from the raw water.
 - 5. The Head Tank shall be designed with sufficient separation between inlet and outlet to prevent hydraulic short circuiting.

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1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete (Foundation and Anchor Bolts)
- B. Section 09 96 00 - High-Performance Coatings

1.03 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. AWWA D100 – Welded Steel Tanks for Water Storage.
 - 2. AWWA D102 – Coating Steel Water-Storage Tanks.
- B. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- C. American Welding Society (AWS):
 - 1. AWS D1.1 – Structural Welding Code – Steel.
- D. American Institute of Steel Construction (AISC):
 - 1. Steel Construction Manual, Allowable Stress Design.
- E. American Petroleum Institute (API):
 - 1. API 650 – Welded Steel Tanks for Oil Storage.
- F. American Society of Mechanical Engineers (ASME)
 - 1. ASME Section IX – Welding and Brazing Qualifications.
- G. ASTM International
 - 1. Applicable material standards.
- H. Society for Protective Coating (SSPC)
 - 1. SSPC-PA1 – Paint Application Specification.
- I. Occupational Safety and Health Administration (OSHA) – Applicable safety regulations.

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1.04 SUBMITTALS

A. Shop Drawings:

1. Tank geometry, dimensions, and capacities.
2. Structural calculations sealed by a Professional Engineer registered in the State of Illinois.
3. Foundation reactions and anchor bolt loads.
4. Piping layout within tank and riser.
5. Access ladders, platforms, and safety devices.

B. Product Data:

1. Steel material specifications.
2. Coating system data sheets.

C. Certificates:

1. Welding procedures and welder qualifications per AWS D1.1.
2. Coating applicator certification.

D. Operation and Maintenance Manuals.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The Head Tank shall be designed, furnished, and erected by a single Supplier without subcontracting portions of the work.
2. The Supplier shall have designed, fabricated, and constructed at least one (1) Head Tank using the fabrication techniques and tolerances specified herein with its own employees.
3. Erection personnel shall have significant prior experience in the Boilermaker trade.

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4. Field supervision shall have a minimum of fifteen (15) years' experience in fabrication and erection of welded conical or double-curvature steel plate structures.
5. All shop and field welders shall be certified in accordance with American Society of Mechanical Engineers Section IX or American Welding Society D1.1.
6. The Supplier's Experience Modification Rate (EMR) shall be less than 0.80.
7. The Supplier shall submit a list of at least one (1) Head Tank with aerators operating satisfactorily for a minimum of two (2) years on water of similar characteristics and treatment chemistry.
8. The Supplier shall certify in writing that its bid includes all patent licensing costs and fully complies with this Specification. Any exceptions shall be clearly identified.

B. Design Requirements:

1. Tank shall be designed in accordance with AWWA D100.
2. Structural supports shall be designed in accordance with AISC and ASCE 7 for wind, seismic, and ice loads applicable to the Project location.
3. All welding shall conform to AWS D1.1.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fabricated components clearly identified and protected from damage.
- B. Store materials off the ground and protect from corrosion, distortion, and contamination.

1.07 GUARANTEE

- A. The Supplier shall warrant the Head Tank against defects in materials and workmanship for a period of one (1) year from the date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL

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Section 43 41 13 – Pillar-Type Steel
Water Storage Tank (Head Tank)

- A. Basis of Design
 - 1. CB&I, Plainfield, Illinois
 - 2. Engineer approved equal.
- B. Operating Conditions
 - 1. Minimum Flow: 600 gpm
 - 2. Average Design Flow: 1200 gpm
 - 3. Maximum Flow: 1500 gpm
 - 4. Annular Velocity: < 0.0675 gpm/ft²
- C. Major Dimensions
 - 1. Diameter: 10'-6"
 - 2. Overall Height: 27'-7 ½"
- D. Hydraulic Criteria
 - 1. Downflow velocity shall be less than 0.5 ft/sec at Maximum Flow based on net cross-sectional area.
 - 2. Total detention time: 14.5 minutes.
 - 3. Total downflow volume: 17,377 gallons.
- E. Design Conditions
 - 1. Liquid Level: Full to top angle.
 - 2. Product Specific Gravity: 1.0.
 - 3. Burial (external soil pressure): 0 (constructed above grade).
 - 4. Wind and Seismic Loads in accordance with AWWA D100.
- F. Wind:
 - 1. Wind Speed: 115 mph (3-second gust).

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2. Exposure: C.
3. Importance Factor: 1.25.

G. Seismic:

1. Seismic Use Group: III.
2. Soil Classification: D.
3. Importance Factor: 1.25.
4. $S_s = 0.639$; $S_1 = 0.21$.

H. Materials

1. Shell and structural steel: ASTM A36 unless otherwise specified.
2. Anchor bolts: ASTM A36 steel, hot-dip galvanized.
3. Permanent fasteners: 304 stainless steel.
4. No corrosion allowance required.

I. H. Minimum Thicknesses

1. Shell pressure boundary: 1/4-inch minimum.
2. Bottom plate: 3/8-inch minimum.
3. Internals and structural components: 3/16-inch minimum.

2.02 ACCESSORIES

A. Inlet

1. One (1) 12-inch flanged nozzle.
2. Located near bottom or near top as shown on Plans.
3. If bottom inlet, provide internal riser pipe centered on tank axis, fabricated of 1/4-inch wall thickness material, extending to flanged termination.

B. Outlet

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1. One (1) 16-inch flanged nozzle near tank bottom.

C. Overflow

1. One (1) 8-inch flanged nozzle with blind flange, bolts, and gasket set.

D. Drain

1. One (1) 4-inch flanged nozzle with blind flange, bolts, and gasket set.

E. Manway

1. One (1) 24-inch diameter flanged manway with cover plate, handles, bolts, and gasket set.

F. Nozzle Requirements

1. Flanged nozzles shall extend minimum 12 inches beyond shell.
2. Flanges for external piping shall be furnished loose for field welding and alignment.

G. External Piping

1. All piping, valves, ducting, and supports beyond the first vessel flange shall be provided by others.
2. External piping shall be independently supported to prevent loads from being transmitted to the shell or nozzles.

PART 3 EXECUTION

3.01 PREPARATION

A. Foundation

1. Foundation shall be constructed in accordance with applicable Specifications and Geotechnical Report.
2. Minimum foundation thickness: 16 inches.
3. Foundation shall be level within 1/4 inch around circumference.
4. Anchor bolts shall be installed in accordance with Supplier's instructions.

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B. Sand Cushion

1. Provide minimum 1-inch sand cushion beneath bottom plate in accordance with AWWA D100 Section 12.6.
2. Alternatively, bottom plate may be fully grouted with non-shrink grout, pumpable grout, or 1:1.5 cement-sand grout.
3. Outer circumference shall be fully grouted to contain sand.

3.02 APPLICATION

A. Fabrication and Erection

1. Welding procedures and personnel shall be qualified in accordance with ASME Section IX or AWS D1.1.
2. Shell plate forming tolerances:
 - a. Plate diagonal tolerance: 1/8 inch.
 - b. Sweep board tolerance: 1/8 inch in any 36-inch arc.
 - c. Butt joint misalignment: maximum 1/16 inch.
 - d. Banding and peaking: maximum 1/2 inch in any 36-inch arc.
3. Back-up bars are not permitted.
4. All vessel boundary butt welds shall be full penetration welds.
5. Weld spatter, burrs, and slag shall be removed.

B. Inspection

1. Field butt welds shall be inspected by spot radiography in accordance with AWWA D100.
2. Radiographs shall become the property of the Owner.
3. Sectioning, oil testing, or vacuum testing will not be permitted.

C. Coatings

1. Surface preparation:

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- a. Exterior surfaces: SSPC-SP6.
- b. Interior/submerged surfaces: SSPC-SP10.
2. Shop primer: Tnemec Series N140-1255 (Beige) Pota-Pox Plus Primer, 3.0–5.0 mils DFT, or equal.
3. Interior finish (if shop fabricated): Tnemec Series N140 Pota-Pox Plus (Tank White), 4.0–6.0 mils DFT.
4. Field touch-up and finish coats by others.
5. No coatings required on stainless steel, galvanized steel, aluminum, or other non-ferrous materials.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL (1) HEAD TANK related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 43 41 13

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

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PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Above-ground, vertical, flat-bottom, closed-top polyethylene storage tanks.
2. Double-wall polyethylene storage tanks with integral secondary containment.
3. Tank appurtenances including nozzles, vents, fittings, and level monitoring where indicated.
4. Anchorage and accessories required for a complete and operable installation.

B. Tanks shall be rotationally molded, one-piece construction, designed for atmospheric storage of water and water treatment chemicals as indicated in the Contract Documents.

C. Capacities shall be as shown on the Drawings and may range from 5 gallons to 12,000 gallons for single-wall tanks and 5 gallons to 6,500 gallons for double-wall tanks.

D. Tanks are intended for above-ground installation only and shall not be used for pressurized, vacuum, buried, or elevated temperature service beyond manufacturer's recommendations.

1.02 RELATED SECTIONS

A. Section 03 30 00 – Cast-in-Place Concrete

B. Section 40 60 00 – Supervisory Control and Data Acquisition (SCADA).

1.03 REFERENCES

A. ASTM International (ASTM):

1. ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
2. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics.
3. ASTM D883 – Standard Terminology Relating to Plastics.

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

Section 46 30 00 – Vertical Storage Tank

4. ASTM D1505 – Standard Test Method for Density of Plastics by the Density-Gradient Technique.
 5. ASTM D1693 – Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
 6. ASTM D1921 – Standard Test Method for Particle Size (Sieve Analysis) of Plastic Materials.
 7. ASTM D2765 – Standard Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics.
 8. ASTM D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
 9. ASTM F412 – Standard Terminology Relating to Plastic Piping Systems.
 10. ASTM D1998 – Standard Specification for Polyethylene Upright Storage Tanks.
- B. ANSI – American National Standards Institute (ANSI) B16.5 – Pipe Flanges and Flanged Fittings.
- C. ARM – Association of Rotational Molders – Low Temperature Impact Resistance (Falling Dart Test).

1.04 SUBMITTALS

- A. Product Data:
1. Manufacturer's literature for each tank furnished.
 2. Resin data sheets and certification of material properties.
 3. Tank dimensions, wall thickness calculations, and specific gravity rating.
 4. Nozzle and fitting schedule.
 5. Level monitoring equipment data where provided.
- B. Shop Drawings:
1. Tank outline dimensions and capacity.
 2. Fitting sizes, types, and elevations.
 3. Anchorage and base requirements.

4. Double-wall interstitial details (if applicable).

C. Certifications:

1. Certification that tanks comply with ASTM D1998.
2. Resin supplier certification for each lot.
3. Hydrostatic design basis documentation per ASTM D2837.

D. Operation and Maintenance Manuals.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Manufacturer shall have a minimum of five (5) years' experience producing rotationally molded polyethylene tanks.
2. Manufacturer shall maintain documented quality control procedures.

B. Resin Control:

1. Resin shall be virgin polyethylene.
2. Each lot shall be visually inspected and traceable.
3. Crosslinked resin lots shall be tested for gel content.

C. Testing (upon request):

1. Impact testing.
2. Ultrasonic thickness testing.
3. Hydrostatic testing.
4. Gel test for cross-linked polyethylene.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Tanks shall be shipped upright and protected from damage.
- B. Store tanks upright on smooth, level surfaces free of sharp objects.
- C. Protect from mechanical damage and prolonged exposure to excessive heat.

- D. Inspect tanks upon delivery and report damage immediately.

1.07 GUARANTEE

- A. Provide manufacturer's standard warranty, minimum two (2) years from date of acceptance by Owner, covering defects in materials and workmanship.

PART 2 PRODUCTS

2.01 GENERAL

- A. Acceptable Manufacturers:
 - 1. Norwesco
 - 2. Chem-Tainer Industries
 - 3. Poly Processing
 - 4. Assmann Corporation of America
 - 5. Engineer approved equal
- B. Tanks shall comply with ASTM D1998 and be designed for a minimum specific gravity rating of 1.5 unless otherwise noted.
- C. Construction:
 - 1. One-piece, seamless, rotationally molded polyethylene.
 - 2. Integrally molded top and bottom heads.
 - 3. Uniform wall thickness, minimum 3/16 inch.
 - 4. Parting lines located in upper one-third of tank sidewall.
- D. Materials:
 - 1. Virgin linear polyethylene (LLDPE) or cross-linked polyethylene (XLPE).
 - 2. UV stabilized for outdoor exposure.
 - 3. FDA-compliant resin where required.
 - 4. Maximum service temperature:

- a. Cross-linked polyethylene: 150°F.
- b. Linear polyethylene: 120°F.

2.02 DESIGN REQUIREMENTS

A. Wall Thickness:

- 1. Minimum wall thickness determined by:

$$T = (0.433 \times \text{S.G.} \times H \times \text{O.D.}) / (2 \times \text{SD})$$

- 2. Where:

T = wall thickness (inches)
S.G. = specific gravity of fluid
H = fluid height (feet)
O.D. = outside diameter (inches)
SD = hydrostatic design stress (psi)

B. Maximum hydrostatic design stress:

- 1. XLPE: 600 psi.
- 2. LLDPE: 550 psi.

C. Top Head:

- 1. Integrally molded.
- 2. Minimum thickness 3/16 inch.
- 3. Molded-in lifting lugs where required.

D. Bottom Head:

- 1. Integrally molded flat bottom.
- 2. Designed for full surface support.

E. Double-Wall Tanks (Where Indicated):

- 1. Secondary containment capacity minimum 120 percent of primary tank.
- 2. Integral top cover protecting interstitial space.
- 3. Interstitial monitoring port provided.

2.03 FITTINGS AND NOZZLES

- A. Sidewall nozzles shall be bolted type.
- B. Flanged nozzles shall conform to ANSI B16.5, 150-lb bolt pattern.
- C. Materials:
 - 1. PVC
 - 2. CPVC
 - 3. Polypropylene
 - 4. 304 or 316 stainless steel
- D. Gaskets: EPDM, Viton, Buna-N, silicone, or chemical-compatible material.
- E. Venting:
 - 1. Sized to prevent vacuum or overpressure.
 - 2. Downturned and screened with corrosion-resistant mesh.
- F. Fill Connections:
 - 1. 2-inch cam-lock connection unless noted otherwise.
 - 2. Clearly labeled for contents.
 - 3. Spill containment at fill location.
- G. All piping shall be independently supported. Flexible connections shall be provided to accommodate tank expansion.

2.04 ACCESSORIES

- A. Level Monitoring (Where Indicated):
 - 1. Ultrasonic level transmitter, 4-20 mA output.
 - 2. PVDF transducer.
 - 3. NEMA 4X display panel with digital readout in gallons.
 - 4. 24 VDC loop-powered system.

- B. Ladders, tie-down systems, seismic restraints, and tie-down lugs where required by site conditions.
- C. Graduated gallon indicators molded into tank exterior.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify concrete pad is level within 1/8 inch over tank diameter.
- B. Confirm pad dimensions meet manufacturer's requirements.
- C. Ensure unobstructed access for tank placement.

3.02 INSTALLATION

- A. Install tanks in accordance with manufacturer's written instructions.
- B. Set tank plumb and level on full-bearing base.
- C. Connect piping with flexible couplings to allow for thermal and hydrostatic expansion.
- D. Route vents to exterior and terminate downward with screen.
- E. Install level instrumentation and integrate with SCADA where required.
- F. Field verify fitting elevations prior to final piping connections.

3.03 FIELD QUALITY CONTROL

- A. Inspect for visible defects prior to filling.
- B. Verify all fittings are properly gasketed and tightened.
- C. Conduct initial fill under observation to confirm structural performance and leak-free operation.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL ALL CHEMICAL FEED SYSTEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 46 30 00

PART 1 GENERAL

1.01 SUMMARY

- A. Work Included: Furnish, factory assemble, test, deliver, and place into operation a complete liquid carbon dioxide (CO₂) storage, vaporization, heating, pressure regulation, feed control, diffusion, and pH control system as shown on the Drawings and specified herein.
- B. The system shall include, but not be limited to:
 - 1. Liquid CO₂ storage receiver with integral refrigeration system.
 - 2. Electric CO₂ vaporizer.
 - 3. CO₂ vapor heater.
 - 4. First stage pressure regulator.
 - 5. Automatic pH controlled CO₂ gas feed panel.
 - 6. Fine bubble CO₂ diffusers.
 - 7. pH sampling stations and electrode assemblies.
 - 8. Instrumentation, alarms, and control interfaces for SCADA integration.
- C. The carbon dioxide system shall be furnished as a complete, coordinated package by a single manufacturer regularly engaged in the design and fabrication of CO₂ systems for municipal water and wastewater treatment applications for a minimum of 30 years.

1.02 RELATED SECTIONS

- A. Section 40 05 15 – Piping Support Systems.
- B. Section 40 60 00 – Supervisory Control and Data Acquisition (SCADA).

1.03 REFERENCES

- A. ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- B. CGA (Compressed Gas Association) Standards for CO₂ Service.
- C. NFPA 70 – National Electrical Code (NEC).

D. NEMA Standards for Electrical Enclosures.

1.04 SUBMITTALS

A. Product Data:

1. Storage tank fabrication drawings, ASME code documentation, and pressure vessel certifications.
2. Refrigeration system data including compressor, refrigerant type, and controls.
3. Vaporizer and vapor heater data.
4. Gas feed panel piping and instrumentation diagram (P&ID).
5. Control valve, regulators, gauges, and safety relief valve data.
6. pH controller and electrode data.

B. Shop Drawings:

1. Plan and elevation views with overall dimensions and weights.
2. Electrical schematics and interconnection diagrams.
3. SCADA interface points list (I/O schedule).

C. Certificates:

1. ASME pressure vessel certification.
2. Factory test reports.
3. Manufacturer's certification of compliance with this Section.

D. Operation and Maintenance Manuals.

1.05 QUALITY ASSURANCE

- A. Manufacturer shall be the actual fabricator of the storage vessel and system components and shall operate an ASME-certified pressure vessel shop with certified welders.
- B. Manufacturer shall maintain a qualified engineering staff and service organization capable of start-up and technical support.

- C. System shall be shop assembled, pressure tested, calibrated, and functionally tested prior to shipment.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Equipment shall be factory assembled to the maximum extent possible.
- B. Protect equipment from damage during shipping and storage.
- C. Provide rigging and lifting lugs as required.
- D. Contractor shall coordinate unloading and placement.

1.07 GUARANTEE

- A. Provide a minimum one (1) year warranty from date of start-up and acceptance.
- B. Include one (1) factory start-up and training visit, up to three (3) days onsite.

PART 2 PRODUCTS

2.01 GENERAL

- A. Basis of Design Manufacturer:
 - 1. TOMCO2 Systems.
- B. The CO₂ storage and feed system shall be a fully integrated package consisting of storage, refrigeration, vaporization, heating, pressure regulation, automatic pH control, and gas diffusion equipment.
- C. System design parameters:
 - 1. Storage Capacity: 20,000 pounds liquid CO₂ (nominal 10-ton capacity).
 - 2. Maximum Allowable Working Pressure (MAWP): 350 psig.
 - 3. Operating Pressure: Approximately 300 psig at 0°F.
 - 4. Maximum CO₂ Feed Rate: 30 lb/hr.
 - 5. Minimum CO₂ Feed Rate: 2 lb/hr.

2.02 LIQUID CARBON DIOXIDE STORAGE RECEIVER

- A. Storage tank shall be Model 1075CA as manufactured by TOMCO2 Systems.
- B. Vessel Construction:
 - 1. Horizontal skid-mounted ASME pressure vessel.
 - 2. Designed and constructed per ASME Section VIII, Division 1.
 - 3. MAWP: 350 psig.
 - 4. Elliptical manway for inspection and cleaning.
 - 5. Dual ASME safety relief valves with three-way switching valve and dual bleeder relief valves.
- C. Insulation:
 - 1. Minimum 4-inch polyurethane insulation.
 - 2. Pre-painted aluminum outer jacket with dished heads.
- D. Instrumentation:
 - 1. Six-inch diameter liquid level gauge calibrated in pounds.
 - 2. Six-inch diameter pressure gauge (0–600 psig).
 - 3. High and low pressure alarms with dry contacts.
 - 4. Liquid level transmitter with 4–20 mA output.
- E. Piping and Connections:
 - 1. Type 304 stainless steel piping.
 - 2. CGA fill connections extending through tank cabinet.
 - 3. Single CO₂ process outlet connection.
- F. Refrigeration System:
 - 1. Scroll compressor, 2 HP.
 - 2. Refrigerant: R-459A.

3. 480 Volt, 3-phase, 60 Hz power supply.
 4. NEMA 4X Type 304 stainless steel electrical enclosure.
 5. Automatic pressure control maintaining approximately 295–305 psig.
- G. Enclosure:
1. Front-end aluminum cabinet housing refrigeration unit, vaporizer, vapor heater, and first-stage regulator.
 2. Oversized lockable access doors.
 3. Adequate ventilation for cooling air circulation.

2.03 ELECTRIC VAPORIZER

- A. Model M-259CI as manufactured by TOMCO2 Systems.
- B. Capacity: Suitable for system demand up to 30 lb/hr.
- C. Electrical: 12 kW, 480 Volt, 3-phase, 60 Hz.
- D. Features:
 1. Automatic pressure-actuated operation.
 2. Safety relief valve.
 3. Over-temperature protection thermostat.
 4. NEMA 4X stainless steel enclosure.
 5. Pre-piped and pre-wired within tank cabinet.

2.04 VAPOR HEATER

- A. Model CVH-4SS as manufactured by TOMCO2 Systems.
- B. Rating: 4 kW, 480 Volt, single phase, 60 Hz.
- C. Adjustable temperature control range 30°F to 110°F.
- D. Overheat protection with manual reset.

- E. Stainless steel construction with thru-the-door disconnect.

2.05 FIRST STAGE PRESSURE REGULATOR

- A. Reduces pressure from approximately 300 psig to 120 psig.
- B. Malleable iron body with stainless steel trim and nitrile diaphragm.
- C. Downstream pressure gauge (0–600 psig).
- D. Upstream relief valve set at 450 psig.

2.06 CARBON DIOXIDE GAS FEED PANEL

- A. One (1) automatic pH controlled CO₂ gas feed panel rated 30 lb/hr, 120 Volt, 60 Hz.
- B. Construction:
 - 1. Free-standing Type 304 stainless steel enclosure.
 - 2. 1/2-inch Schedule 80 Type 304 stainless steel piping.
 - 3. NEMA 4X electrical enclosure mounted on panel door.
- C. Components:
 - 1. Y-strainer.
 - 2. Second stage regulator (to 40 psig operating pressure).
 - 3. Electronic, linear actuated CO₂ flow control valve, controlled via an electronic proportional 4-20 ma signal from the pH electrode. Valve body will be type 316-stainless steel with stainless steel internal trim. Valve body and internals shall be type 316-stainless. Valve and actuator shall be Badger SEVA Series.
 - 4. Glass tube rotameter (±2% full scale accuracy).
 - 5. Manual bypass valve.
 - 6. Isolation valves, check valve, and safety relief valves.
 - 7. Piston actuated CO₂ solenoid shutoff valve with bypass. The solenoid valve shall have a stainless steel body, CO₂ actuator and a 120-volt solenoid on the CO₂ pneumatic source.

8. pH indicating PID controller with 4–20 mA output.
 9. High and low pH alarm lights.
- D. Controller shall accept pH input signal and provide proportional 4–20 mA output to the I/P transducer for automatic modulation of CO₂ feed rate.
- E. SCADA Integration: Provide dry contacts and analog signals as required for monitoring tank level, pressure, pH, alarms, and control status.

2.07 CO₂ DIFFUSERS

- A. Two (2) fine bubble gas diffusers.
- B. Ceramic and stainless steel construction.
- C. Designed for installation in recarbonation tanks by others.

2.08 pH SAMPLING AND ELECTRODES

- A. Provide pH electrode assembly including:
 1. Combination pH glass electrode.
 2. Reference electrode.
 3. Temperature compensator.
 4. Preamplifier in corrosion-resistant body.
 5. Electrode assembly will be located in the sample lines, 90 to 180 seconds downstream of the CO₂ application points for measurement of the pH.
 6. Electrode assembly shall transmit the pH measurement signal to the pH analyzer/controller on the feed panel.
 7. Electrode assembly will be complete with 10 meters of cable and insertion hardware for mounting on a 1 ½-inch nozzle on a spool piece in the sample line.
 8. The electrode assembly shall be manufactured by Rosemount.
- B. Provide sampling assembly with stainless steel piping, manual flow control valve, and flow indicator.

1. One (1) Sampling station shall be constructed of type 304L stainless steel and consist of a 1" schedule 10 welded piping and isolation valves.
2. A type 316L stainless steel manual flow control valve and polycarbonate flow indicator will be provided.
3. The assembly shall be mounted on a type 304-stainless steel back plate suitable for wall mounting.
4. One (1) sample wand will be provided for withdrawing a representative sample from the recarbonation basin. The sample flow shall be diverted to the pH sampling station.
5. Sampling wand shall be constructed of type 304L stainless steel with 2-inch flanged and 1-inch MP T connection.
6. Sample wand to be installed by Contractor.

- C. Provide insertion hardware and cabling.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify concrete pad dimensions and anchor bolt placement.
- B. Confirm electrical service (480V, 3-phase and 120V single-phase).

3.02 INSTALLATION

- A. Install storage tank and cabinet per manufacturer's recommendations.
- B. Contractor to provide interconnecting CO₂ piping between storage tank, feed panel, and diffusers.
- C. Provide vent piping to outdoors.
- D. Coordinate SCADA connections.
- E. Provide CO₂ gas detector in storage area (by Contractor).
- F. Provide initial liquid CO₂ fill.

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

Section 46 31 43 – Carbon Dioxide
Storage and Feed

3.03 START-UP

- A. Manufacturer's factory technician shall inspect installation, calibrate instruments, and place system into operation.
- B. Provide operator training.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL CARBON DIOXIDE GAS FEED SYSTEM related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 46 31 43

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes the furnishing, installation, calibration, and commissioning of digital scales for chemical storage tanks, day tanks, totes, drums, cylinders, and other process vessels as indicated on the Drawings and specified herein.
- B. Scales shall be used for monitoring chemical usage, inventory control, and feed verification for water and wastewater treatment processes.
- C. The Work includes:
 - 1. Load cell assemblies and mounting hardware.
 - 2. Digital weight indicators/transmitters.
 - 3. Cables and interconnecting wiring.
 - 4. Signal output to control system.
 - 5. Calibration weights and start-up services.
- D. This specification applies to all scales included in the Project, of varying capacities and configurations. Contractor shall verify correct size, capacity, and configuration for each application prior to procurement.

1.02 RELATED SECTIONS

- A. Section 40 60 00 - Supervisory Control and Data Acquisition

1.03 REFERENCES

- A. National Institute of Standards and Technology (NIST):
 - 1. Handbook 44 – Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.
- B. National Electrical Manufacturers Association (NEMA).
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 – National Electrical Code (NEC).
- D. Underwriters Laboratories (UL).

1.04 SUBMITTALS

A. Product Data:

1. Manufacturer's literature for load cells, scale frames, and indicators.
2. Rated capacity, accuracy, resolution, and environmental ratings.
3. Mounting details and dimensions.
4. Electrical requirements and wiring diagrams.
5. Output signal type (4-20 mA, digital, etc.).

B. Shop Drawings:

1. Layout and mounting configuration for each scale.
2. Cable routing and termination details.
3. Interface requirements with control panel or SCADA system.

C. Certificates:

1. Certificate of calibration.
2. Factory test reports.

D. Operation and Maintenance Manuals:

1. Installation instructions.
2. Calibration procedures.
3. Maintenance and troubleshooting guide.

1.05 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of five (5) years experience in the design and manufacture of industrial weighing systems.
- B. Scales shall be designed for industrial chemical service and suitable for indoor or outdoor installation as indicated.
- C. Equipment shall comply with NIST Handbook 44 where applicable.
- D. Electrical components shall be UL listed or recognized.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in original, unopened packaging with manufacturer's identification intact.
- B. Store equipment in a clean, dry location, protected from weather and physical damage.
- C. Handle load cells carefully to prevent shock or overloading prior to installation.

1.07 GUARANTEE

- A. Provide manufacturer's standard warranty, minimum one (1) year from date of Substantial Completion, against defects in materials and workmanship.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

- A. Basis of Design: Scaletron Model 4040 Digital Scale System as manufactured by Scaletron Industries, Ltd.
- B. The basis-of-design product establishes the standard of quality, features, capacity, and performance required.
- C. Acceptable Manufacturers:
 - 1. Scaletron Industries, Ltd.
 - 2. Equal products by other manufacturers may be submitted in accordance with Division 01 requirements, provided they meet or exceed the specified performance and construction requirements.

2.02 GENERAL

- A. Each scale shall be sized for the specific tank, tote, drum, or cylinder load shown on the Drawings. Contractor shall verify:
 - 1. Full operating weight including tank, contents, and ancillary equipment.
 - 2. Minimum and maximum load conditions.
 - 3. Required resolution and accuracy.
 - 4. Environmental conditions (indoor/outdoor, corrosive atmosphere).

- B. Provide scales in capacities as required for the application, including but not limited to:
 - 1. Drum scales (up to approximately 1,000 pounds).
 - 2. Tote scales (up to approximately 4,000 pounds).
 - 3. Tank scales (custom capacities as required).

2.03 LOAD CELLS AND SCALE FRAME

- A. Load Cells:
 - 1. Strain gauge type, stainless steel or alloy steel construction.
 - 2. Hermetically sealed or environmentally protected.
 - 3. Overload protection minimum 150 percent of rated capacity.
 - 4. Accuracy: ± 0.1 percent of full scale or better.
 - 5. Provide minimum of three (3) or four (4) load cells per platform as required for stability.
- B. Mounting Assemblies:
 - 1. Corrosion-resistant hardware.
 - 2. Self-centering or rocker-pin type mounts to accommodate minor misalignment and thermal expansion.
 - 3. Integral leveling feet where required.
- C. Scale Frame/Platform:
 - 1. Fabricated steel with corrosion-resistant coating or stainless steel construction for corrosive environments.
 - 2. Designed to fully support vessel footprint without deflection affecting accuracy.
 - 3. Suitable for anchoring to concrete floor or pad.

2.04 DIGITAL INDICATOR / TRANSMITTER

- A. Microprocessor-based digital weight indicator with:
 - 1. LCD or LED display.
 - 2. User-configurable units (pounds, kilograms).
 - 3. Tare function.
 - 4. Zero tracking.
- B. Output Signals:
 - 1. 4-20 mA analog output proportional to weight.
 - 2. Optional digital communication (Modbus or equivalent) where indicated.
- C. Enclosure:
 - 1. NEMA 4X for washdown or corrosive areas.
 - 2. NEMA 4 minimum for indoor installations.
- D. Power Supply:
 - 1. 120 VAC, 60 Hz unless otherwise indicated.
 - 2. Provide integral surge protection.

2.05 ACCESSORIES

- A. Junction Boxes:
 - 1. NEMA 4X rated.
 - 2. Stainless steel or non-metallic corrosion-resistant construction.
- B. Cables:
 - 1. Shielded load cell cables.
 - 2. Suitable for installation environment.

- C. Calibration Weights:
 - 1. Provide test weights or certified calibration method suitable for field calibration.
- D. Anchors and Fasteners:
 - 1. Stainless steel in corrosive areas.
 - 2. Sized for load and seismic requirements where applicable.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify concrete pads or floor surfaces are level and capable of supporting imposed loads.
- B. Verify vessel dimensions and weights prior to installation.
- C. Confirm correct scale capacity and configuration prior to setting equipment.

3.02 INSTALLATION

- A. Install scales in accordance with manufacturer's written instructions.
- B. Isolate scales from piping loads.
 - 1. Provide flexible connections in piping to prevent transmission of dead or live loads to the scale assembly.
- C. Anchor scale frames to concrete pads where required.
- D. Route cables in conduit in accordance with Division 26.
- E. Provide drip loops and strain relief at all terminations.

3.03 FIELD QUALITY CONTROL

- A. Calibrate each scale after installation and prior to startup.
- B. Verify accuracy at minimum of three (3) points across operating range.
- C. Provide written calibration report.
- D. Demonstrate proper operation to Owner, including:

1. Tare function.
2. Signal output verification.
3. Alarm or setpoint functions if provided.

3.04 PROTECTION

- A. Protect installed scales from construction loads and damage.
- B. Do not place tanks or vessels on scales until installation is complete and approved.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL ALL CHEMICAL FEED SYSTEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 46 33 23

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes furnishing, installing, testing, and placing into operation a complete polymer blending units for the preparation of liquid polymer solutions from neat (liquid emulsion) polymer for use in water and wastewater treatment processes.
- B. Work includes, but is not limited to:
 - 1. Polymer feed and metering system.
 - 2. Automatic dilution water control system.
 - 3. Static or dynamic mixing assembly.
 - 4. Aging/maturation chamber, where applicable.
 - 5. Control panel with programmable controller and operator interface.
 - 6. Mounting skid or wall frame.
 - 7. Interconnecting piping, valves, and appurtenances internal to the unit.
- C. Polymer blending units shall be furnished as factory-assembled and factory-tested packaged systems.
- D. Contractor shall coordinate polymer blending unit capacities with the polymer type, concentration, and feed rates indicated on the Drawings.

1.02 RELATED SECTIONS

- A. Section 40 60 00 - Supervisory Control and Data Acquisition

1.03 REFERENCES

- A. ANSI/NSF 61 – Drinking Water System Components – Health Effects.
- B. UL 508A – Industrial Control Panels.
- C. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. ASTM A36 – Standard Specification for Carbon Structural Steel.
- E. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes.

1.04 SUBMITTALS

A. Product Data:

1. Manufacturer's literature describing polymer blending unit, components, materials of construction, and performance capabilities.
2. Certified dimensional drawings and weights.
3. Hydraulic and electrical requirements.

B. Shop Drawings:

1. Piping and instrumentation diagram (P&ID).
2. Control panel layout and wiring diagrams.
3. Skid layout showing overall dimensions and connection points.

C. Performance Data:

1. Minimum and maximum polymer feed rates.
2. Dilution range and turndown ratio.
3. Mixing energy and aging time provided.

D. Operation and Maintenance Manuals:

1. Installation instructions.
2. Start-up and calibration procedures.
3. Recommended spare parts list.

E. Certificates:

1. Certification of compliance with NSF 61 where used for potable water applications.
2. UL listing for control panel.

1.05 QUALITY ASSURANCE

- A. Polymer blending unit manufacturer shall have a minimum of five (5) years' experience in the design and manufacture of polymer feed and blending systems for municipal or industrial treatment facilities.

- B. Equipment shall be factory assembled, pre-wired, and factory tested prior to shipment.
- C. Control panels shall be UL 508A listed.
- D. Wetted components in potable water service shall comply with ANSI/NSF 61.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment fully assembled where practical and protected against damage.
- B. Store in a clean, dry location protected from weather and temperature extremes.
- C. Protect control panels and instrumentation from moisture and physical damage.

1.07 GUARANTEE

- A. Polymer blending unit shall be warranted against defects in materials and workmanship for a minimum period of one (1) year from date of Substantial Completion.
- B. Warranty shall include repair or replacement of defective components at no additional cost to the Owner

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

- A. Polymer blending unit shall be Velodyne VeloBlend VM-2P-300, or approved equal.
- B. The basis of design establishes the standard of quality, materials of construction, performance, and operational features required.
- C. Alternate equipment must comply with provisions for “or equal” equipment as specified in this Section.

2.02 GENERAL

- A. The polymer blending system shall be a factory-assembled, skid-mounted unit with all interconnecting piping and wiring complete within skid limits.
- B. System shall be designed to invert, disperse, and activate emulsion and dispersion polymers with viscosities ranging from 200 to 6,000 cps.

- C. Mixing device shall be dynamic and staged in mixing energy to provide flexibility for a wide range of polymers.
- D. Mixing intensity shall be quantified by defined “G” value based on measured applied water horsepower determined by torque or electrical load differential between empty and water-filled chamber.
- E. Mixing chamber shall:
 - 1. Be transparent. Opaque chambers are unacceptable.
 - 2. Be rated for minimum 100 psi working pressure.
 - 3. Utilize a stainless steel multi-bladed turbine.
 - 4. Have high-shear mixing zone occupying not more than 30 percent of total chamber volume.
- F. All metallic wetted materials shall be 304 stainless steel or nickel-plated brass.

2.03 COMPONENTS

- A. Dilution Water System
 - 1. Solenoid valve for on/off control.
 - 2. Rotameter-type flow indicator with integral rate adjusting valve.
 - 3. Adjustable flow range of 0.2 to 40 GPH.
 - 4. Water inlet connection: 1/2-inch FNPT.
 - 5. Stock solution outlet connection: 5/8-inch FNPT.
- B. Polymer Metering Pump
 - 1. Progressive cavity or positive displacement type suitable for emulsion polymers.
 - 2. Output range: 0.1 – 2 GPH GPH.
 - 3. Capable of handling viscosities up to 40,000 cps.
 - 4. Maximum discharge pressure: 50 psig.

C. Pump Controller

1. Manual and proportional control capability.
2. Proportional control via 4–20 mA input signal.
3. LCD display indicating operating parameters.
4. Stroke frequency adjustment control.
5. Internal/off/external mode selection.
6. Loss-of-flow sensor to stop polymer pump upon interruption of dilution water flow and automatically restart when flow is restored.

D. Electrical

1. 120V, 60 Hz, single-phase power.
2. Standard grounded male plug rated 11 amps.
3. Three-position on-off-remote selector switch.
4. Terminal blocks for:
 - a. 4–20 mA input.
 - b. Dry contact remote start.
 - c. Dry contact alarm output.
 - d. Dry contact run output.
 - e. Control switch status output.
5. Integral timer shall energize alarm contacts after 15 seconds of continuous loss of flow.

2.04 ACCESSORIES

- A. Calibration cylinder constructed of clear PVC with mL graduations, slip cap, and 1/2-inch NPT vent connection; mounted with PVC isolation ball valves.
- B. Pressure reducing valve, bronze construction, adjustable 25–75 psig, suitable for dilution water service.
- C. Stainless steel wall mounting brackets, 7-gauge 304 stainless steel.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify mounting surface is level and capable of supporting equipment weight.
- B. Verify electrical power and water supply are available and properly sized.
- C. Confirm polymer type and manufacturer's recommended dilution range prior to start-up.

3.02 INSTALLATION

- A. Install polymer blending unit in accordance with manufacturer's written instructions and approved shop drawings.
- B. Anchor skid securely to floor.
- C. Connect dilution water piping with isolation valve and backflow prevention as required.
- D. Connect neat polymer supply line with isolation valve and appropriate flexible tubing.
- E. Provide electrical connections in accordance with Electrical Specifications.
- F. Provide signal wiring to and from control system as shown on Drawings.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's representative shall inspect installation and supervise initial start-up.
- B. Calibrate polymer feed pump and verify dilution ratio.
- C. Demonstrate full operational capability including alarms and interlocks.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL ALL CHEMICAL FEED SYSTEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 46 33 33

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Furnishing, fabrication, factory testing, delivery, installation, and startup of skid-mounted chemical feed systems for the following process chemicals:
 - a. Pre-chlorination
 - b. Post-chlorination
 - c. Hydrated Lime
 - d. Fluorination
 - e. Phosphate
 - f. Cationic Polymer
 - g. Anionic Polymer
2. Each system shall include, but not be limited to:
 - a. Metering pumps
 - b. Skid structure
 - c. Calibration columns
 - d. Piping, valves, and fittings
 - e. Pressure relief valves
 - f. Electrical controls
 - g. PLC and SCADA interface
 - h. All wiring internal to skid
 - i. Appurtenances required for complete and operable systems
3. Systems shall be factory assembled and tested prior to shipment.

1.02 RELATED SECTIONS

- A. Section 40 60 00 - Supervisory Control and Data Acquisition
- B. Section 46 33 23 – Scales
- C. Section 46 33 33 - Polymer Blending Unit
- D. Section 46 33 44 – Peristaltic Metering Pumps
- E. Section 46 36 13 - Bulk Hydrated Lime System

1.03 REFERENCES

- A. Hydraulic Institute Standards – Allowable vibration limits for rotary equipment
- B. NEC – National Electrical Code
- C. ASTM Standards applicable to PVC, CPVC, and polypropylene materials

1.04 SUBMITTALS

- A. Product Data
 - 1. Manufacturer's literature for all pumps, valves, piping, calibration columns, and controls.
 - 2. Chemical compatibility data for all wetted components.
 - 3. PLC and SCADA interface documentation.
- B. Shop Drawings
 - 1. Dimensioned skid layout drawings.
 - 2. Piping and instrumentation diagram (P&ID).
 - 3. Electrical schematics.
 - 4. Control panel layout.
- C. Certifications
 - 1. Factory test reports.
 - 2. Vibration compliance certification per Hydraulic Institute standards.

3. Manufacturer's certification of materials compatibility.

D. Operation and Maintenance Manuals

1. Installation instructions.
2. Calibration procedures.
3. Recommended spare parts list.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Minimum five (5) years' experience in fabrication of skid-mounted chemical feed systems.
2. Demonstrated successful installations of similar systems.

B. Single-Source Responsibility

1. All tanks, mixers, pumps, valves, electrodes, controls, and accessories for each chemical system shall be supplied by a single vendor.
2. All chlorination-related regulators, ejectors, switchovers, and piping shall be provided by one vendor.

C. PLC Integration

1. Supplier shall have certified PLC integration programmers and field service technicians within 100 miles of the Project site.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Skids shall be fully assembled and factory tested prior to shipment.
- B. Protect all components from damage and contamination during shipment and storage.
- C. Store in dry, protected environment.

1.07 GUARANTEE

- A. Provide manufacturer's standard warranty of not less than one (1) year from date of startup or eighteen (18) months from shipment, whichever occurs first.
- B. Warranty shall cover defects in materials and workmanship.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

A. Acceptable Manufacturers

1. Heartland Pump and Process
2. VanDevanter Engineering
3. Engineer pre-approved equal

B. Metering Pumps

1. Peristaltic type, hose or tube design, positive displacement, motor-driven metering pumps.
2. Diaphragm pumps are not acceptable.
3. Basis of Design Pumps:
 - a. Blue-White Industries M1, M2, M3, M4, M5 Series
 - b. Velodyne VeloBlend VM-2P-300

C. Performance Requirements

1. Operate without excessive vibration or noise across full speed range.
2. Vibration shall not exceed Hydraulic Institute acceptable limits.
3. All wetted materials shall be suitable for continuous exposure to chemical handled.

D. Pump Quantities and Capacities

E. Each skidded chemical feed system shall include a minimum of two (2) pumps unless otherwise noted. Pumps shall be sized as follows:

1. Pre-chlorination – Two (2) pumps: 0.0019 – 19.02 GPH – 10 psi
2. Post-chlorination – Two (2) pumps: 0.01 – 28.5 GPH – 6 psi
3. Hydrated Lime – See Section 46 36 13 - Bulk Hydrated Lime System – 8 psi

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Section 46 33 41- Skidded Chemical Feed Systems

4. Fluoride – Two (2) pumps: 0.0001 – 1.35 GPH – 6 psi
5. Phosphate – Two (2) pumps: 0.0004 – 4.76 GPH – 6 psi
6. Cationic Polymer – One (1) blending system: 0.1 – 2 GPH (See Section 46 33 33 - Polymer Blending Unit) – 8 psi
7. Anionic Polymer – One (1) blending system: 0.1 – 2 GPH (See Section 46 33 33 - Polymer Blending Unit) – 8 psi

2.02 GENERAL

A. Skid Construction

1. Skid base shall be minimum 1/2-inch thick black textured polypropylene.
2. All components shall be mounted on a single skid.
3. Piping shall terminate within 2 inches of skid edge.
4. Electrical wiring shall terminate inside skid junction box.

B. Calibration Chamber

1. One clear plastic calibration chamber with vent.
2. Direct GPH reading scale without need for calculations.
3. Valved to allow use by each pump independently.
4. Threaded vent connection for common vent piping.

C. Pressure Relief Valves

1. Adjustable-pressure, two-way diaphragm type.
2. Materials compatible with chemical service.
3. One per pump.

D. Piping and Valves

1. Schedule 80 PVC or CPVC skid piping.
2. Solvent-weld or flanged connections as appropriate.

3. Vented true-union ball valves.
4. Isolation valves at all equipment connections.
5. Seals compatible with chemical service.

E. Controls

1. Integrated control junction box mounted on skid.
2. Skid shall interface with PLC and SCADA system.
3. All internal wiring, junction boxes, and I/O included.
4. Manual and automatic control capability.

F. Chemical Compatibility

1. Supplier shall provide written confirmation of compatibility of all wetted parts with chemicals specified.

2.03 ACCESSORIES

- A. Strainers as required.
- B. Injection quills where indicated.
- C. Tubing, fittings, gaskets, and hardware required for complete operation.
- D. Labels identifying chemical service and flow direction.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify concrete pads, anchors, utilities, and chemical storage connections are properly installed prior to skid placement.
- B. Coordinate electrical power and control wiring requirements.

3.02 INSTALLATION

- A. Install skids level and secure to wall wherever possible. If wall mounting is not possible, level and secure to floor.
- B. Connect suction and discharge piping to process lines.

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Section 46 33 41- Skidded Chemical Feed Systems

- C. Connect vent piping from calibration columns to common vent system.
- D. Connect power and control wiring in accordance with manufacturer's instructions and NEC requirements.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's representative shall:

- 1. Inspect installation.
- 2. Supervise startup.
- 3. Calibrate pumps.
- 4. Provide operator training.

B. Demonstrate:

- 1. Manual operation.
- 2. Automatic control operation.
- 3. Calibration procedures.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL ALL CHEMICAL FEED SYSTEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 46 33 44

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. M1, M2, M3, M4, and M5 peristaltic metering pumps as scheduled.
2. Integral Tube Failure Detection (TFD) system.
3. Integral drive, controls, and touchscreen interface (M3, M4, M5).
4. Mounting brackets and hardware.
5. All accessories required for a complete and operational system.

B. Furnish and install Blue-White FLEXFLO® M Series peristaltic metering pumps as shown on the Drawings and specified herein.

C. Pumps shall be positive displacement, self-priming, peristaltic type chemical metering pumps suitable for municipal water and wastewater chemical feed systems.

1.02 RELATED SECTIONS

A. Section 40 60 00 - Supervisory Control and Data Acquisition

B. Section 46 33 41 - Skidded Chemical Feed System

1.03 REFERENCES

A. NSF/ANSI 61 – Drinking Water System Components.

B. UL 778 – Motor-Operated Water Pumps.

C. CSA C22.2 – Industrial Control Equipment.

D. CE Marking Requirements.

E. RoHS Compliance Requirements.

1.04 SUBMITTALS

A. Product Data:

1. Manufacturer's technical data sheets for each model specified.

2. Flow range, pressure ratings, and tube material selections.
 3. Electrical requirements and wiring diagrams.
 4. Dimensions and weight data.
- B. Shop Drawings:
1. Pump layout and mounting details.
 2. Control wiring and terminal identification.
 3. Communication protocol details (EtherNet/IP, Modbus TCP/IP, Profibus, if specified).
- C. Certificates:
1. NSF/ANSI 61 certification.
 2. cETLus listing.
 3. CE declaration of conformity.
- D. Operation and Maintenance Manuals.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications
1. Minimum five (5) years' experience in fabrication of skid-mounted chemical feed systems.
 2. Demonstrated successful installations of similar systems.
- B. Single-Source Responsibility
1. All tanks, mixers, pumps, valves, electrodes, controls, and accessories for each chemical system shall be supplied by a single vendor.
 2. All chlorination-related regulators, ejectors, switchovers, and piping shall be provided by one vendor.
- C. PLC Integration
1. Supplier shall have certified PLC integration programmers and field service technicians within 100 miles of the Project site.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in original manufacturer packaging.
- B. Store indoors, protected from moisture, freezing, and physical damage.
- C. Handle in accordance with manufacturer's written instructions.

1.07 GUARANTEE

- A. Provide manufacturer's five (5) year warranty.
- B. Warranty shall cover defects in materials and workmanship under normal service conditions.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

- A. Pumps shall be Blue-White FLEXFLO® M Series peristaltic metering pumps (Models M1, M2, M3, M4, or M5 as indicated on the Drawings).
- B. Pumps shall be positive displacement, peristaltic type tubing pumps with:
 - 1. Variable speed motor (DC or brushless DC depending on model).
 - 2. Non-spring-loaded roller assembly located in the pump head.
 - 3. Factory-set occlusion requiring no field adjustment.
 - 4. Integral Tube Failure Detection (TFD) system.
 - 5. Flexible tubing with factory-attached connection fittings.
- C. Substitutions shall not be permitted without prior written approval.

2.02 GENERAL

- A. Pump shall contain no valves, diaphragms, springs, or dynamic seals in the fluid path. Process fluid shall contact only the pump tubing and connection fittings.
- B. Pump shall be capable of:
 - 1. Continuous 24-hour operation.
 - 2. Self-priming operation.

3. Running dry without damage.
 4. Suction lift of up to 30 feet of water.
 5. Handling fluids up to 12,000 centipoise viscosity (model dependent).
- C. Performance Range (model dependent):
1. Flow range: approximately 0.0001 to 534 GPH.
 2. Maximum working pressure: up to 125 PSI for smaller models and up to 65 PSI for large-capacity models; tube selection shall govern final allowable pressure.
 3. Maximum fluid temperature: up to 185°F, depending on tube material.
- D. Turndown ratio shall be up to 10,000:1, with fine speed adjustment resolution for low-flow applications (model dependent).

2.03 PUMP HEAD

- A. Pump head shall incorporate a single continuous compression track and removable transparent cover.
- B. Tube Failure Detection (TFD) System:
1. Sensors shall be located within the pump head.
 2. Pump shall automatically stop upon detection of tube rupture or leak.
 3. Sensor materials shall be corrosion resistant (e.g., Hastelloy or equivalent).
 4. System shall not rely solely on external drip trays or float switches.
- C. Roller Assembly:
1. Non-spring-loaded design.
 2. Rollers constructed of engineered polymer with sealed bearings.
 3. Rotor shall be directly coupled to motor shaft.
 4. Rotor shall be removable without special tools.

D. Safety:

1. Magnetic or equivalent safety interlock shall stop or limit pump operation when cover is removed (model dependent).

2.04 PUMP TUBE ASSEMBLY

A. Only manufacturer-supplied tubing assemblies shall be acceptable.

B. Tubing shall be factory assembled with permanently attached adapter fittings.

C. Tube Materials (model dependent):

1. Flex-A-Prene®.
2. Flex-A-Thane®.
3. Other manufacturer-approved materials compatible with the chemical service.

D. Fittings shall be polypropylene, PVDF, or equivalent corrosion-resistant material with Aflas or EPDM O-rings as specified.

E. Tube size shall determine maximum flow rate and pressure rating.

2.05 DRIVE SYSTEM AND CONTROLS

A. Enclosure

1. NEMA 4X, IP66 rated for washdown environments (model dependent).
2. Constructed of corrosion-resistant engineered thermoplastic, Kydex, or powder-coated aluminum with stainless steel hardware.

B. Motor:

1. DC or brushless DC gear motor.
2. Continuous duty rated.
3. Overload protected.

C. Power Supply (model dependent):

1. 115–240 VAC, 50/60 Hz, single phase.
2. Detachable power cord with region-specific plug configuration.

D. Control Interface:

1. LCD display with membrane keypad or touchscreen, depending on model.
2. Adjustable motor speed from minimum setting to 100 percent.
3. Multi-language support on advanced models.
4. Password protection on models with touchscreen interface.

E. Control Modes (model dependent):

1. Manual speed control.
2. 4–20 mA analog input.
3. Pulse or frequency input.
4. Remote start/stop.
5. Batch or timed dosing functions.
6. Industrial communication protocols such as EtherNet/IP, Modbus TCP/IP, or Profibus on advanced models.

F. Outputs and Alarms (model dependent):

1. Scalable 4–20 mA output.
2. Frequency output.
3. Multiple configurable alarm relays.

2.06 MATERIALS OF CONSTRUCTION

A. Non-Wetted Components:

1. Pump head: glass-filled engineered thermoplastic (e.g., Noryl or Valox).
2. Cover: clear acrylic or polycarbonate.
3. Rotor: glass-filled engineered polymer.
4. Rollers: nylon or engineered polymer with stainless steel bearings.
5. Mounting brackets and hardware: 316 stainless steel.

B. Wetted Components:

1. Pump tubing: chemical-resistant elastomer as specified.
2. Adapter fittings: polypropylene or equivalent.
3. O-rings: Aflas, EPDM, or equivalent.

2.07 ACCESSORIES

- A. Mounting brackets and hardware.
- B. Power cords, communication cables, and interface cables as required.
- C. Optional flow verification devices, injection fittings, foot valves, strainers, and quick-disconnect assemblies as specified.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify installation location, power supply, and piping connections prior to installation.

3.02 INSTALLATION

- A. Install pumps on chemical feed skid in accordance with manufacturer's written instructions.
- B. Provide electrical connections in compliance with NEC and local codes.
- C. Provide process piping connections as shown on the Drawings.
- D. Configure control mode, scaling, and alarm settings as required for process operation.
- E. Demonstrate proper operation, including TFD functionality and remote control features where provided.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL ALL CHEMICAL FEED SYSTEMS related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 46 33 44

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish all labor, materials, equipment, and incidentals required to provide one (1) complete bulk hydrated lime storage, batching, slurry preparation, and metering system as shown on the Drawings and specified herein.
- B. The system shall be capable of producing and feeding 25 to 40 percent lime slurry and shall include, but not be limited to:
 - 1. Bulk storage silo.
 - 2. Bin vent filter and fill system.
 - 3. Bin activator and discharge equipment.
 - 4. Volumetric feeder.
 - 5. Slurry mix tank and mixer.
 - 6. Slurry transfer pumps.
 - 7. Lime bulk day tank with mixer and containment.
 - 8. Lime slurry metering pump system.
 - 9. Mass flow density meter.
 - 10. Water supply panel.
 - 11. Silo control panel and truck unloading control panel.
 - 12. All interconnecting piping, wiring, and appurtenances within the system boundary.
- C. The system shall be shop assembled to the greatest extent possible and delivered ready for field installation and start-up.

1.02 RELATED SECTIONS

- A. Section 09 96 00 - High-Performance Coatings
- B. Section 40 60 00 - Supervisory Control and Data Acquisition
- C. Section 40 72 23 - Guided Wave Radar Transmitters

D. Section 46 33 44 - Skidded Chemical Feed System

E. Section 46 33 23 - Scales

1.03 REFERENCES

A. ASTM A36 – Standard Specification for Carbon Structural Steel.

B. SSPC-SP6 – Commercial Blast Cleaning.

C. International Building Code (IBC).

D. ASCE 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

E. OSHA – Occupational Safety and Health Standards.

F. NEMA – Enclosures for Electrical Equipment.

1.04 SUBMITTALS

A. Product Data:

1. Complete system description.
2. Storage silo structural calculations sealed by a Professional Engineer licensed in the state of the project.
3. Mechanical and electrical equipment data sheets.
4. Control panel schematics and PLC architecture.
5. Piping and instrumentation diagram (P&ID).

B. Shop Drawings:

1. Plan, elevation, and section views.
2. Anchor bolt layout and loading data.
3. Electrical interconnection diagrams.
4. Skid layout drawings.

C. Operation and Maintenance Manuals.

D. Factory test reports.

1.05 QUALITY ASSURANCE

- A. The lime system supplier shall be regularly engaged in the design and manufacture of bulk lime handling and slurry systems for a minimum of five (5) years.
- B. Major components of the bulk hydrated lime system shall be furnished by a single supplier to provide single-source responsibility.
- C. Supplier shall maintain certified PLC integration programmers and field service technicians within 100 miles of the project site.
- D. All structural components shall be designed in accordance with IBC and ASCE 7.
- E. Equipment shall be factory assembled, wired, and tested prior to shipment.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment properly protected to prevent damage.
- B. Store materials off the ground and protect from weather and contamination.
- C. Provide lifting lugs and handling instructions.

1.07 GUARANTEE

- A. Provide a minimum 12-month warranty from date of Owner acceptance.
- B. Provide 72-hour performance test prior to final acceptance. Supplier shall be onsite for entire duration.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

- A. Basis of Design: Cogent Company, Inc.
- B. The specification is based on a Cogent integrated lime handling system consisting of a welded steel storage silo, bin vent filter, bin activator, volumetric feeder, slurry mix tank, slurry transfer pumps, lime bulk day tank, metering pump skid, density metering system, and PLC-based control system.
- C. All major components of the lime system shall be supplied by a single system supplier to ensure compatibility, coordinated controls, and single-source responsibility.

- D. Alternate equipment must be submitted in accordance with Division 1 of these specifications.

2.02 GENERAL

- A. System shall be a complete, integrated bulk hydrated lime storage, batching, slurry preparation, and metering system capable of producing and feeding 25% to 40% lime slurry.
- B. The system shall be factory assembled and pre-wired to the greatest extent possible.
- C. Structural components shall be designed for all dead loads, live loads, vibration loads, and seismic forces per current IBC and ASCE 7 requirements.
- D. All welded steel fabrication shall be in accordance with applicable ASTM standards.
- E. All flanged connections shall be minimum Class 150 unless otherwise noted.
- F. All wetted components in contact with lime slurry shall be constructed of 304 stainless steel, Schedule 80 PVC, HDPE, polypropylene, or other corrosion-resistant materials suitable for lime service.
- G. The nominal overall silo height shall be approximately 40 feet (not including bin vent filter / dust collector), and 12 feet diameter.

2.03 STORAGE SILO

- A. Construction:
 - 1. All welded mild steel construction.
 - 2. Fabricated from ASTM A36 steel.
 - 3. Dust-tight and watertight
 - 4. Connections to the storage compartments shall be neoprene gasketed connections.
 - 5. Designed for bulk density of 35 pounds per cubic foot (minimum 75,000-pound) live load.
 - 6. Usable storage capacity approximately 2,450 cubic feet.
 - 7. Designed for seismic and wind loads per IBC and ASCE 7.

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Section 46 36 13 – Bulk Hydrated Lime System

8. Smooth interior with no inward projecting elements (plates to protect the bin sensors excepted)
 9. Angle Rings shall be provided at the cone intersect and silo roof intersect.
- B. Wall Penetrations:
1. Minimum thickness of 1/4-inch for all square or rectangular shapes
 2. Minimum schedule 40 round penetrations
 3. All penetrations shall be completely seal welded.
- C. Bin Level Switches:
1. High, intermediate, and low-level sensors
 2. Stainless steel rotating paddle type, electrically operated
 3. Include opening accessible to the operators
 4. Pitched plates positioned above the level sensor to protect the sensor from falling material during silo filling
- D. Silo equipment room:
1. (1) Heavy duty set of double doors
 2. (1) 20: x 20" vent louver mounted in the side wall of the skirt
 3. (1) 1/20hp exhaust fan
 4. (2) Convenience receptacles 20 amp.
 5. (2) fluorescent lights
 6. (1) Light Switch
 7. (1) 10KW Heater with thermostat
- E. Hopper:
1. Cone bottom, 60 degrees from horizontal.
 2. Flanged discharge connection.

F. Roof:

1. Minimum 1:12 pitch.
2. 50 psf live load capacity.
3. 20-inch minimum manway with hinged cover.
4. Flanged nozzles for vent filter, PRV, and fill target box.

G. Coatings:

1. SSPC-SP6 surface prep.
2. Interior epoxy system.
3. Exterior primer and polyurethane topcoat.

H. Accessories:

1. OSHA-compliant ladder, cage, and railings.
2. Level switches – high, intermediate, and low (rotary paddle type).
3. Audible and visual alarms.

2.04 BIN ACTIVATOR AND DISCHARGE

- A. Heavy-duty motor-driven bin activator, minimum 6-foot diameter.
- B. 460V, 3-phase motor.
- C. Manual slide gate with chain wheel operator.
- D. Flexible transition to feeder.
- E. Bin activator shall be Kenergy or equal.

2.05 MAINTENANCE / KNIFE GATE:

- A. Manually chain wheel operated, slide type maintenance gate shall be provided between the cone and flexible connection.
- B. Arrangement for ease of operation from the equipment room floor
- C. Minimum clear opening of 144 square inches

- D. Manufacturer: Dezurik or equal.

2.06 BIN VENT FILTER AND FILL SYSTEM

- A. Housing shall be of one-piece construction, minimum 12-gauge carbon steel, continuously welded.
- B. Two (2) totally removable access doors
- C. Mechanical shaker type dust collector.
- D. 1,500 CFM capacity.
- E. 300 square feet cloth area.
- F. Filter bags shall be cylindrical and removable without the use of any tooling.
- G. Envelope type bags or bags without self-tensioning shall not be acceptable.
- H. Bag shaker assembly shall be operated by a 1/3 HP, 230/460, 1725 RPM, TEFC motor.
- I. Integral exhaust fan, 3 HP TEFC motor.
- J. 4-inch Schedule 40 carbon steel fill pipe with long-radius elbows.
- K. Bronze camlock adapter and dust cap.
- L. Truck unloading control panel:
 - 1. NEMA 4X stainless steel.
 - 2. High/low level lights
 - 3. Alarm horn
 - 4. HOA switches
 - 5. Terminal strips
 - 6. Integrated PLC communication

2.07 VOLUMETRIC FEEDER

- A. Capacity: 120 cubic feet per hour maximum.
- B. Accuracy: ± 2 percent.

- C. Solid flight 5-inch minimum stainless steel auger.
- D. 304 stainless steel construction.
- E. 1 HP TENV motor with VFD control.
- F. Digital speed indication on HMI.
- G. PVC downspout with removable cap.
- H. Flexible transition to silo discharge.

2.08 SLURRY MIX TANK

- A. 200-gallon, 10-gauge 304 stainless steel.
- B. Platform scale with 4-20 mA output to PLC.
- C. 1/2 HP mixer with dual 12-inch impellers.
- D. Water panel including:
 - 1. 1-1/2 inch solenoid valve.
 - 2. 0-100 psi pressure gauge.
 - 3. 0-25 GPM rotometer.

2.09 SLURRY TRANSFER PUMPS

- A. Two (2) Verderflex Dura 35 peristaltic pumps.
- B. Capacity: 24.2 GPM at 230 psi each.
- C. 1/2 HP TEFC motors.
- D. VFD controlled.
- E. Discharge pressure gauges.

2.10 MASS FLOW DENSITY METER

- A. Installed on transfer pump discharge.
- B. 4-20 mA output proportional to concentration.

- C. Compatible with PLC system.

2.11 LIME BULK DAY TANK

- A. 500-gallon HDPE vertical cone bottom tank.
- B. Spill containment basin.
- C. Mixer bridge (304 stainless steel).
- D. Ultrasonic level transmitter with local and PLC indication.
- E. Direct 28 percent liquid lime fill nozzle.

2.12 LIME SLURRY METERING PUMP SYSTEM

- A. Three (3) Verderflex Dura 15 peristaltic pumps.
- B. Capacity: 24.2 GPM at 230 psi each.
- C. Skid-mounted polypropylene base.
- D. Calibration column and pressure relief valves.
- E. NEMA 4X FRP local control panel with PLC/SCADA interface.

2.13 SILO CONTROL PANEL

- A. NEMA 4X stainless steel enclosure.
- B. PLC-based control system with Ethernet SCADA interface.
- C. HMI touchscreen with programmable setpoints and displays.
- D. 480 VAC, 3-phase power.
- E. VFDs coordinated with project integrator.
- F. Full running and overload indication for all equipment.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify foundation and anchor bolt locations prior to delivery.
- B. Coordinate electrical and water service availability.

3.02 INSTALLATION

- A. Install complete lime system in accordance with manufacturer's instructions.
- B. Provide all field piping, supports, and wiring external to factory skid boundaries.
- C. Align, level, and anchor all equipment.
- D. Terminate all control wiring at designated panels.

3.03 FIELD SERVICES

- A. Manufacturer's Representative shall provide:
 - 1. Fifteen (15) person-days installation oversight.
 - 2. Two (2) person-days start-up assistance.
 - 3. Minimum five (5) site trips.
- B. Conduct 72-hour performance test.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL LIME SILO AND LIME FEED EQUIPMENT related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 46 36 13

PART 1 GENERAL

1.01 SUMMARY

- A. Work under this Section includes furnishing, fabrication, delivery, installation, and field services for in-line static mixers complete with injection ports, gaskets, and appurtenances as shown on the Drawings and specified herein.
- B. Static mixers shall be designed for rapid and uniform blending of chemical solutions into a pressurized water stream in potable water treatment service.
- C. Equipment shall include, but not be limited to:
 - 1. Static mixer body assembly.
 - 2. Mixing element plate.
 - 3. Injection ports with corporation stops and solution tubes.
 - 4. Gaskets and sealing components.
 - 5. Manufacturer's field services for start-up and adjustment.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittals.
- B. Section 01 43 33 – Manufacturer's Field Services.
- C. Section 33 05 19 – Ductile Iron Pipe.

1.03 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A36 – Standard Specification for Carbon Structural Steel.
 - 2. ASTM D1784 – Rigid Poly(Vinyl Chloride) (PVC) Compounds.
 - 3. ASTM D2466 – Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- B. American Water Works Association (AWWA):
 - 1. AWWA C110 – Ductile-Iron and Gray-Iron Fittings.

2. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

C. American National Standards Institute (ANSI):

1. ANSI B16.5 – Pipe Flanges and Flanged Fittings.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

B. Product Data:

1. Manufacturer's catalog data and technical specifications.
2. Materials of construction for mixer body, mixing element, and injection components.
3. Pressure rating and temperature limitations.
4. Headloss versus flow curves.
5. Mixing performance data demonstrating compliance with specified uniformity.

C. Shop Drawings:

1. Dimensional drawings showing flange compatibility.
2. Injection port configuration and location.
3. Installation requirements and clearances.

D. Certificates:

1. Certification of materials compliance.
2. Factory testing documentation, if applicable.

E. Operation and Maintenance Data:

1. Installation instructions.
2. Maintenance procedures.
3. Recommended spare parts list.

1.05 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of five (5) years documented experience in the design and manufacture of static mixers for municipal water or wastewater treatment applications.
- B. Static mixers shall be the product of a single manufacturer regularly engaged in production of similar equipment.
- C. Equal products will be considered in accordance with Division 01 requirements, provided performance and materials are equal to or better than those specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment fully assembled where practical and properly protected to prevent damage during shipment.
- B. Store mixers off the ground, protected from sunlight, dirt, and physical damage.
- C. Handle equipment in accordance with manufacturer's written instructions.

1.07 GUARANTEE

- A. Provide a one-year warranty from date of Owner acceptance.
- B. During the warranty period, replace defective materials or workmanship at no additional cost to the Owner.
- C. Provide manufacturer's authorized representative for start-up services as specified in Section 01 43 33.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Static mixers as manufactured by Westfall Manufacturing Company.
- B. Acceptable Manufacturers:
 - 1. Westfall Manufacturing Company.
 - 2. Approved equal meeting all specified performance and material requirements.
- C. Requests for substitution shall comply with Division 01 requirements and shall include complete technical documentation demonstrating equivalency.

2.02 GENERAL

- A. Static mixers shall be compact wafer-style units designed to mount between standard 150-pound ANSI flanges.
- B. Mixer shall be designed to provide thorough mixing of injected chemicals within a short downstream distance while minimizing headloss.
- C. Each mixer shall be sized as indicated on the Drawings and coordinated with the associated piping system.

2.03 STATIC MIXER ASSEMBLY

- A. Configuration
 - 1. Compact ring-body wafer design.
 - 2. Designed for installation between ANSI Class 150 flanges in horizontal or vertical piping.
- B. Ring Body
 - 1. Minimum thickness: 3.0 inches.
 - 2. Material: PVC conforming to ASTM D1784.
 - 3. Body shall be machined to accept mixing plate in a recessed upstream cavity.
- C. Mixing Plate
 - 1. Minimum thickness: 0.625 inches.
 - 2. Material: PVC.
 - 3. Plate geometry shall be computer-designed to generate controlled vortices for effective radial and axial mixing.
 - 4. Plate shall be rigidly mounted within the mixer body to prevent vibration or displacement.
- D. Performance Requirements
 - 1. Mixer shall achieve a concentration variation of not more than ± 1 percent of the mean value at a distance of ten (10) pipe diameters downstream under design flow conditions.

2. Manufacturer shall provide performance data validating mixing efficiency.

E. Injection Ports

1. Provide two (2) 3/4-inch injection ports.
2. Ports shall be fitted with 3/4-inch CPVC corporation stops.
3. Provide CPVC solution injection tubes extending into the process stream as recommended by manufacturer.
4. Materials shall be compatible with process water and injected chemicals.

F. Gaskets

1. Provide ring-type EPDM gaskets adhered to both sides of mixer body.
2. Gaskets shall be suitable for potable water service.

G. Pressure Rating

1. Mixer assembly shall be suitable for not less than 150 psi working pressure unless otherwise indicated.

H. Corrosion Resistance

1. All wetted components shall be non-metallic and corrosion resistant.
2. Materials shall be suitable for continuous exposure to potable water and specified chemical solutions.

2.04 ACCESSORIES

- A. Provide identification tag with manufacturer name, model number, serial number, and flow direction.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify pipe alignment, flange condition, and spacing prior to installation.
- B. Ensure mating flanges are clean and free of debris or damage.
- C. Confirm injection quills and chemical feed lines are properly supported and aligned.

3.02 INSTALLATION

- A. Install static mixers at locations shown on the Drawings.
- B. Orient mixer in accordance with manufacturer's flow direction markings.
- C. Install between flanges using furnished EPDM gaskets.
- D. Tighten flange bolts in a star pattern to uniform torque to ensure proper sealing.
- E. Support adjacent piping independently to prevent loads from being transmitted to the mixer body.
- F. Connect chemical feed tubing to injection ports in accordance with manufacturer's recommendations.

3.03 FIELD QUALITY CONTROL

- A. Inspect installation for alignment and leakage.
- B. Assist Owner during initial chemical feed start-up to verify proper mixing and system operation.
- C. Manufacturer's representative shall be present for start-up as specified.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL ALL PROCESS PIPING, VALVES, FITTINGS AND RELATED APPURTANANCES related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 46 41 17

PART 1 GENERAL

1.01 SUMMARY

A. Scope of Work:

1. Work includes furnishing, fabricating, delivering, erecting, coating, and placing into service two (2) welded steel ClariCone Solids Contact Clarifiers complete with internals, nozzles, bridge, appurtenances, and controls as shown on the Drawings and specified herein.
2. The ClariCone clarifier shall accomplish:
 - a. Mixing of treatment chemicals with raw water in a mixing and reaction zone.
 - b. Solids contact and agglomeration within a flocculation zone.
 - c. Solids separation within a clarification zone.
 - d. Slurry concentration and compaction within a centrally located slurry concentrator.
3. All treatment processes shall occur within a single vessel.
4. The clarifier shall:
 - a. Operate without mixers, scrapers, or continuously moving mechanical equipment.
 - b. Rely solely on hydraulic energy supplied by influent flow through tangential inlet nozzles.
 - c. Maintain a helical upflow pattern to sustain solids suspension and contact.
5. The tank shall be shop-fabricated and field-erected welded steel designed in accordance with AWWA and applicable structural codes.

1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete.
- B. Section 09 96 00 - High-Performance Coatings
- C. Section 40 05 57 - Actuators for Process Valves and Gates

- D. Section 40 05 64 - Valves for Actuator Control
- E. Section 43 10 00 – Recarbonation Tank
- F. Section 43 41 13 - Pillar-Type Steel Water Storage Tank (Head Tank)

1.03 REFERENCES

- A. AISC American Institute of Steel Construction, Allowable Stress Design
- B. ASME IX American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Welding and Brazing Qualifications
- C. ASTM American Society for Testing and Materials
- D. AWS D1.1 American Welding Society, Structural Welding Code, Steel
- E. AWWA D100 American Water Works Association, Standard for Welded Steel Tanks for Water Storage
- F. NEMA National Electrical Manufacturers Association
- G. OSHA Occupational Safety and Health Standards
- H. SSPC-PA1 Steel Structures Painting Council, Paint Application Specification

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Plan, elevation, and sectional drawings.
 - 2. Shell thickness and structural calculations.
 - 3. Wind and seismic design calculations.
 - 4. Nozzle schedule.
 - 5. Anchor bolt layout and loads.
 - 6. Welding procedures and welder certifications.
 - 7. Radiographic inspection procedures.
 - 8. Coating system data sheets.
 - 9. Installation and operation instructions.

10. Documentation of experience qualifications.

B. Fourteen (14) days prior to bid, supplier shall furnish written evidence demonstrating compliance with experience requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Clarifier shall be designed, fabricated, and erected by a single supplier regularly engaged in manufacturing similar solids contact clarifiers.
2. Supplier shall have successfully designed, fabricated, and erected a minimum of ten (10) similar vessels.
3. At least ten (10) installations shall have been in continuous satisfactory operation for a minimum of two (2) years.
4. Experience Modification Rate (EMR) shall be less than 0.80.
5. Fabrication and erection shall not be subcontracted without written approval of the Engineer.

B. Personnel Qualifications

1. Field supervision: Minimum fifteen (15) years' experience in welded conical steel structures.
2. Field erection personnel: Documented experience in welded steel tank construction.
3. Welders: Certified in accordance with ASME Section IX or AWS D1.1.

C. Design and Construction Standards

1. Tank design shall conform to AWWA D100 allowable stresses.
2. Structural members shall conform to AISC.
3. Welding procedures shall conform to ASME Section IX and AWS D1.1.
4. Field inspection of butt welds shall be performed by spot radiography in accordance with AWWA D100.
5. Radiographs shall become the property of the Owner.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect all materials from damage and corrosion.
- B. Store materials off the ground and protect flange faces and machined surfaces.
- C. Handle components in a manner that prevents distortion or coating damage.

1.07 GUARANTEE

- A. Provide a one (1) year warranty from date of Substantial Completion covering defects in materials and workmanship.

PART 2 PRODUCTS

2.01 BASIS OF DESIGN

- A. Basis of Design: ClariCone Solids Contact Clarifier as manufactured by CB&I.
- B. Approved equal manufacturers shall demonstrate strict compliance with:
 - 1. Hydraulic performance.
 - 2. Structural design.
 - 3. Fabrication tolerances.
 - 4. Operating history.

2.02 GENERAL

- A. Furnish and erect two (2) ClariCone solids contact clarifiers as shown on the Plans and as specified herein.

2.03 DESIGN CRITERIA

- A. Each clarifier shall be designed for the following operating conditions:
 - 1. Raw Water Source: Ground
 - 2. Treatment Application: Lime Softening
 - 3. Minimum Flow: 325 gpm
 - 4. Average Design Flow: 750 gpm
 - 5. Maximum Flow: 1,000 gpm

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6. Loading Rate – At Weir Elevation (gpm/ft²): <1.0 min
 7. Hydraulic Retention Time: Greater than 5 minutes
- B. Each clarifier shall be constructed to the following major dimensions:
1. Diameter – At Weir Elevation (feet) 26' – 0"
 2. Overall Height (feet) 21' – 11"
- C. The clarifier steel shell and bridge shall be designed for the following loading conditions:
1. Liquid Level Full to top angle
 2. Specific Gravity 1.0
 3. Burial (external soil pressure) 0 (constructed above grade)
 4. Wind Load AWWA D100
 - a. Design Category III
 - b. Wind Speed 115 MPH (3 sec burst)
 - c. Exposure Cat C
 - d. Importance Factor 1.15
 5. Seismic Design
 - a. Seismic Use Group III
 - b. Soil Classification Class D
 - c. Importance Factor 1.25
 - d. S_s 0.639g
 - e. S_1 0.21g
 - f. Bridge Live Load (lbs/ft²) 100
 - g. Bridge Dead Load (lbs/lf) – Piping Determined by manufacturer
 - h. Point Loads (lbs) Determined by manufacturer

D. Design Standards:

1. Shell: Design in accordance with the allowable stresses specified in the latest edition of AWWA D100, Welded Carbon Steel Tanks for Water Storage.
2. Other Structural Components: Design in accordance with the latest edition of AISC, Steel Construction Manual.

E. External Piping Support: All external piping shall be supported independently of the vessel to prevent transfer of dead loads, live loads, or thermal loads to the vessel shell or nozzles.

2.04 MATERIALS

A. Shell Plates: ASTM A36 steel plate.

B. Structural Members: ASTM A36 structural steel.

C. Internals, Weir Troughs, and Bridge Structural Components: ASTM A36 steel, unless otherwise specified.

D. Corrosion Allowance: No corrosion allowance is required.

E. Minimum Shell Thickness:

1. Shell Plates (Pressure Boundary): 1/4 inch.
2. Lower Cylinder Bottom Plate: 3/8 inch.

F. Minimum Internal Component Thickness:

G. Internals, Weir Troughs, Bridge Structural, and Other Components: 3/16 inch minimum thickness.

2.05 COMPONENTS

A. Inlet Distribution

1. The ClariCone shall be provided with two (2) tangential influent nozzles, located in the lower cylindrical section of the ClariCone, to direct the raw water into an expanding helical flow pattern.
2. The General Contractor shall furnish and install an electrically operated knife gate valve, designed to operate at an inlet side pressure of 50 psig, in the large influent line. The automatic valve assembly shall include a

slow acting electrical motor for valve actuation and a manual operator mounted on the valve with a local mechanical position indicator.

3. The General Contractor shall furnish and install a manually operated butterfly valve in the small influent line.

B. Water Jets

1. A minimum of two tangential water jet nozzles shall be provided. The water jets shall provide additional hydraulic energy for resuspending the slurry blanket following a shutdown.
2. The General Contractor shall furnish and install piping to each water jet nozzle complete with a manual ball valve to allow throttling of the water jet flowrate and with a slow acting, electrically operated ball or solenoid valve in the common manifold to the water jets to turn the water jets on and off.

C. Grit Blowdown

1. The lower cylinder shall include a grit discharge and tank drain nozzle.
2. The General Contractor shall supply and install grout in the lower cylinder that is sloped to the grit nozzle invert to the Clarifier Suppliers' specifications. The General Contractor shall also furnish and install a manually-operated plug valve in the grit blowdown line.

D. Flocculation and Clarification Zone

1. The ClariCone clarifier shall have a flocculation zone having the configuration of a truncated right circular cone. A rotating slurry blanket of flocculated particles shall be maintained by proper control of the hydraulic energy within the ClariCone. The blanket shall provide intimate contact between previously flocculated particles and the raw water, providing maximum chemical efficiency. The flocculation zone shall provide decreasing energy and rise rate, with the upward helical flow thereby promoting the growth of flocculated particles. The side walls of the flocculation zone shall form an angle of approximately 45 degrees with the horizontal to provide a properly decreasing rise rate and to prevent accumulation of slurry on the side walls or clarifier shell.
2. The clarification zone shall provide a decreasing rise rate as the water flows upwards through the conical area of the ClariCone, allowing flocculated particle subsidence as the particle settling velocity exceeds the rise rate. The relative depth allocated to both the flocculation and clarification zones shall be adjustable by the positioning of a centrally located, adjustable slurry concentrator.

E. Slurry Concentration and Blowdown

1. The ClariCone clarifier shall include a slurry concentrator centrally located on the vertical axis of the ClariCone. The concentrator shall have the configuration of a truncated right circular cone for slurry compaction. The slurry concentrator shall have the following characteristics.
 - a. Volume (gallons): 365
 - b. Overflow Weir Length (feet): 16.5
 - c. Vertical Travel Range (feet): 4
2. Solids shall be removed from the surface of the rotating slurry blanket by overflow into the concentrator. By varying the elevation of the concentrator, the level of the rotating slurry blanket shall be adjustable so that the solids inventory or blanket level can be varied to compensate for fluctuations in flow rate, turbidity or other conditions, necessitating additional solids contact time or increased clarification depth. The Clarifier Supplier shall select the minimum elevation for the concentrator based on the specific treatment application.
3. The concentrator operator shall be located on the access bridge. It shall consist of a manual handwheel jacking screw that is connected to the concentrator.
4. The concentrator shall be equipped with a bubble trap. The bubble trap shall have a diameter larger than the diameter of the lower cylinder to trap air bubbles rising from the inlet and reaction zone. The bubble trap shall be vented to the atmosphere. The bubble trap shall prevent disruption of the sludge blanket by entrained air and prevent the carryover of flocculated particles, with attached air bubbles, into the clarification zone.
5. The concentrator shall be equipped with a pressure relief device that allows water to enter or exit the concentrator cone to prevent excessive loading on the concentrator stem or support bridge.
6. A slurry discharge nozzle shall be provided in the lower cylinder and connected to the concentrator by a telescoping pipe arrangement.
7. The General Contractor shall furnish and install a manually operated plug valve in the slurry blowdown line. The General Contractor shall also furnish and install an electrically operated eccentric plug valve, designed to operate at an inlet side pressure of 50 psig, in the slurry blowdown line. The automatic valve assembly shall include a slow acting electric valve actuator with a manual operator mounted on the valve.

F. ELECTRICAL CONTROLS

1. All electrical controls shall be directed to the SCADA control system provided under Section 40 60 00 - Supervisory Control and Data Acquisition. The SCADA system shall control and indicate the position of the valve in the large inlet line and activate the slurry blowdown and water jet functions. No local controls shall be provided unless noted otherwise.
2. Large Inlet Valve Position Control
 - a. An Open/Stop/Close selector switch shall be provided to allow plant personnel to manually modulate the valve in the large inlet line to the ClariCone. A modulating valve actuator shall be provided by the General Contractor to allow the valve to be stopped at the fully opened and fully closed positions as well as at any intermediate position. An indicator shall be provided to show the position of the valve. The indicator shall accept a 4-20 mA position signal from the valve actuator.
3. Slurry Blowdown Valve Control
 - a. Automatic operation of the slurry blowdown valve shall be controlled by a repeat cycle timer or PLC, with separate settings for ON duration and OFF duration, that are adjustable from 1 second to 50 hours.
4. Water Jet Valve Control
 - a. Actuation of the water jet valves can be accomplished locally or remotely and manually or automatically. These options are described below.
 - b. An local H-O-A switch shall be provided to actuate the water jet valves. When the H-O-A switch is in the “Hand” position, operation of the water jet valves shall be controlled by a manual ON/OFF selector switch. The ON/OFF selector switch shall be provided to allow plant personnel to manually actuate the water jet valves.
 - c. When the H-O-A switch is in the “Automatic” position, operation of the water jet valves shall be controlled by SCADA. Automatic operation of the water jet valves will allow the water jet valves to be opened for a user selected time period, between 0 and 15 minutes, prior to startup of the ClariCone, and will allow the water jet valves to stay open for a user selected time period, between 0 and 15 minutes, after startup of the ClariCone.

- d. The General Contractor shall install the control panel, furnish and install all wiring, conduit and any remote-control systems or equipment.

G. Clarified Water Collection

1. The ClariCone shall include an adjustable radial weir trough, designed to handle the maximum flow rate, for clarified water collection. Adjustable, 3/16" thick, weir plates shall be provided on the radial trough.
2. The radial trough shall be sized by the Clarifier Supplier for the specified flowrates and shall consist of a single trough extending from the drop box across approximately ½ of the clarifier diameter.
3. The trough shall be designed so that they can be adjusted, through a range of level and out-of-level positions, so that the weir rate can be varied along the radius of the ClariCone. The trough position shall be quickly and easily adjustable with a manual, handwheel operated actuator, from one point on the bridge while the ClariCone is in operation, so that the operator can alter the distribution flow on an in-service basis. A position indicator shall be provided on the actuator.
4. The trough shall be supported by the ClariCone shell at its outer end. That support shall be hinged to allow the trough to pivot up and down. The trough shall be supported at its inner end, by the actuator, which shall be supported from the bridge of the ClariCone.
5. The trough shall discharge into a drop box welded to the ClariCone shell that is provided with a flanged nozzle. The drop box shall be designed to provide for free discharge so that the trough is not flooded.
6. Peripheral or inboard circular troughs shall only be allowed if walkways are provided, immediately above or adjacent to the troughs, along their entire length to provide safe access for weir plate adjustment and maintenance.
7. The General Contractor shall install and level the weir plates after final painting.

H. Adjustable Elevation Disinfection Header

1. The ClariCone shall be provided with an adjustable elevation disinfectant header that allows the slurry concentrator to be moved as required to maximize the solids contact treatment process within the ClariCone while minimizing trihalomethane formation and maximizing disinfectant contact time within the ClariCone.

2. The header shall be horizontal and oriented radially within the ClariCone. Orifices shall be spaced along the header to distribute the disinfectant across the radius of the ClariCone. The orifices shall be located on the downstream side of the header with respect to the rotating motion of the water within the ClariCone.
3. The disinfectant header shall be supported by brackets on the slurry concentrator. The header shall be mounted at a fixed distance above the slurry concentrator to ensure that the header is as low as possible within the clarification zone while still being above the sludge blanket. The disinfectant shall be fed into the header through a flexible conduit that allows the header to move up and down with the concentrator.
4. The General Contractor shall furnish and install all piping beyond the flexible conduit supplied by the Clarifier Supplier and all chemical feed equipment and controls.

I. Manway

1. The Clarifier Supplier shall furnish a 24" diameter access manway in the lower cylindrical section of the ClariCone. A davit supported, bolted manway cover shall be provided. A removable baffle plate shall be provided on the inside of the ClariCone to cover the entire manway opening and prevent any disturbance of the hydraulic flow pattern within the ClariCone. The baffle plate shall be curved to match the inside diameter of the ClariCone.

J. Access And Support Bridge

1. The Clarifier Supplier shall furnish an access and support bridge constructed of rigidly braced wide flange structural beam sections. The Clarifier Supplier shall provide a walkway and handrail across the full bridge length as specified herein and in accordance with the Metals Section:
 - a. Walkway Surface Alum. Grating, 1.5" deep, banded, mill finish
 - b. Handrail Alum., 2 rail, 1.5"Ø., Sch 40, anodized finish
 - c. Toe Plates Alum., 4" deep x ¼" thick, anodized finish
2. The bridge shall be designed to support a live load as specified. Deflection of the bridge shall be limited to $l/360$ of the span, considering the live load. The bridge shall be designed to support the live and all dead loads, including the weight of the radial trough full of water with the

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ClariCone empty, if that condition can occur, without exceeding AISC allowables. The dead load deflection shall be cambered out of the bridge.

K. Nozzles

1. The Clarifier Supplier shall furnish the following nozzles in the clarifier with flanged nozzles extending 12 inches beyond the shell or plate surface. Flanges for nozzles that will be connected to external piping shall be left loose for final alignment and welding in place by the General Contractor.

	Description	Quantity	Dia. (inches)	Type
a.	Small Inlet	1	4	Flanged
b.	Large Inlet	1	10	Flanged
c.	Slurry Blowdown	1	6	Flanged
d.	Grit Blowdown	1	6	Flanged
e.	Outlet	1	12	Flanged
f.	Water Jets	2	1.5	Coupling
g.	Manway	1	24	Flanged
h.	Samples	5	2	Coupling
i.	Chemical Feed	2	2	Coupling
j.	Overflow	1	12	Flanged

L. Anchorage

1. The Clarifier Supplier shall furnish hot dip galvanized A36 anchor bolts, nuts and washers.
2. The General Contractor shall install the anchor bolts in the concrete foundation in accordance with the Clarifier Suppliers' instructions.

M. Fasteners

1. The Clarifier Supplier shall furnish all permanent fasteners of 304 stainless steel.

N. Sample Lines

1. The Clarifier Supplier shall furnish and weld 1-inch diameter couplings and pipe support brackets to the ClariCone shell to allow for sample collection from the lower cylinder, sludge blanket and clarified water zones.
2. The General Contractor shall provide and install the pipe lines, valves, sample sink, insulation and heat tracing as required. All lines shall be located on the outside of the ClariCone and terminate four (4) feet above the finished floor with a valve. The sample lines shall be schedule 80 PVC piping, minimum.

PART 3 EXECUTION

3.01 INSPECTION

- A. Field inspection of butt welds shall be performed by the Clarifier Supplier by spot radiography in accordance with the latest edition of AWWA D100. All radiographs shall become the property of the Owner. Inspection of shell butt welds, by sectioning (cutting plugs), oil testing or vacuum testing, will not be permitted.

3.02 FOUNDATION

- A. The General Contractor shall construct the foundation in accordance with the applicable requirements of the Specifications and Plans specifying concrete, excavation and backfill. The foundation shall be designed in accordance with the soil bearing value established in the Geotechnical Report.
- B. Anchors shall be installed by the General Contractor to the Clarifier Suppliers' specifications. A minimum foundation thickness of 16 inches is required to provide sufficient depth for anchor bolt embedment.
- C. The poured concrete foundation shall be level to within $\pm 1/4$ inch within the total circumference of the foundation.

3.03 SAND CUSHION

- A. A sand cushion shall be furnished and installed under the ClariCone lower cylinder to provide for uniformity of bearing between the plate bottom and the foundation and as an insulator against galvanic corrosion. Cushion thickness shall be a minimum of 1 inch over flat concrete slabs. The outer circumference of the bottom plate shall be grouted full with either a non-shrink grout or a 1:1.5 cement-sand grout to contain the sand. See AWWA D100, Section 12.6, notes 1, 2 and 3.

- B. Alternatively, the bottom plate may be fully grouted under its entire surface with a non-shrink grout, a pumpable grout or a 1:1.5 cement-sand grout.
- C. The General Contractor shall furnish and install the sand cushion shall be in compliance with this General Specification and with the Plans which may specify sand and grout thicknesses in excess of the minimum.

3.04 FABRICATION AND ERECTION

- A. The Clarifier Supplier's welding procedures, welders and welding operators shall be qualified and certified in accordance with the requirements of the ASME Code Section IX or AWS Section D1.1, for all shop and field welding. All shop and field welders shall have their qualifications available for the Engineer's inspection.
- B. The edges or surfaces of the pieces to be joined by welding shall be prepared by flame cutting, plasma arc cutting, arc gouging, machining, shearing, grinding or chipping and shall be cleaned of detrimental oil, grease, scale and rust. The edges of the pieces may have a protective coating applied to them, which need not be removed before they are welded unless specifically prohibited by the WPS.
- C. All field welding shall be done by the shielded metal arc welding process, the gas metal arc welding process, the flux core arc welding process and the submerged arc welding process. Shop welding may be done by the shielded metal arc process, submerged arc welding process, gas metal arc welding process and flux core metal arc welding process.
- D. Plates and component members of the tank shall be assembled and welded following a procedure which will result in a minimum of distortion from weld shrinkage. The weld metal shall meet or exceed the minimum requirements for visual inspection as set out in AWWA D100 Section 11.4 and as set forth in the radiographic acceptance standards of AWWA D100 Section 11.6.10.
- E. All shell plate material for the conical portion of the ClariCone shall be shop formed into radial cone segments. Fabrication techniques which do not provide a uniform plate curvature, or which create butt joint misalignment shall not be allowed.
- F. During fabrication, after each segment is cut or burned, but before forming, both plate diagonals shall be measured. The difference shall not exceed 1/8 inch. After each conical segment is formed, 36-inch-long sweep boards shall be used to measure the horizontal contour at the upper and lower edges, and the approximate center of each conical segment. Gaps shall not appear between the sweep board and the fabricated conical segment in excess of 1/8 inch, in any 36 inches of arc.

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- G. Misalignment of butt joints shall not exceed 1/16 inch. Back-up bars are not permitted in butt joints.
- H. Banding and peaking, that occurs during shop fabrication or field erection, shall not exceed 1/2 inch in any 36-inch-long arc when measured with a 36 inch long sweep board.
- I. Weld spatter, burrs and slag shall be removed by chipping, grinding or brushing.
- J. All vessel boundary butt welds shall be full penetration welds.

3.05 EXTERNAL PIPING

- A. All external piping must be supported independently of the vessel to prevent the transfer of piping dead and live loads to the vessel nozzles or shell. All external piping, valves, and supports beyond the first vessel flange are by the General Contractor.

3.06 COATINGS & FINISHES

- A. All painting shall be in accordance with Section 09 96 00 - High-Performance Coatings

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL CLARICONES related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 46 43 53

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish, factory test, deliver, install, and place into satisfactory operation one (1) integrally-gear centrifugal air scour blower package complete with motor, lubrication system, enclosure, controls, bypass valve, accessories, and appurtenances as specified herein.
- B. Furnish and install air header piping for uniform distribution of air to each filter lateral.
- C. The blower system and header piping shall be designed for air scour service associated with filter backwash operations and shall be suitable for continuous and intermittent duty as required by the process.
- D. The blower package shall be factory assembled and tested and delivered as a complete system ready for installation.
- E. All equipment shall be manufactured in the United States and provided by a single manufacturer responsible for the complete blower package.

1.02 RELATED SECTIONS

- A. Section 40 05 57 - Actuators for Process Valves and Gates
- B. Section 40 05 64 - Valves for Actuator Control
- C. Section 40 60 00 – Supervisory Control and Data Acquisition
- D. Section 40 05 15 – Piping Support Systems
- E. Section 46 61 26 - High-Rate Sand Filters

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
- B. American Society of Mechanical Engineers (ASME)
- C. American Gear Manufacturers Association (AGMA)
- D. American Society of Testing and Materials (ASTM)
- E. Anti-Friction Bearing Manufacturers' Association (AFBMA)
- F. American Society for Metals (ASM)

- G. National Electrical Code (NEC)
- H. National Electrical Manufacturers Association (NEMA)
- I. National Fire Protection Association (NFPA)
- J. Occupational Safety and Health Administration (OSHA)
- K. Underwriters Laboratories (UL)

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Blower layout drawings including:
 - a. Dimensions and service clearances
 - b. Weights and anchor points
 - c. Piping connection points
 - d. Electrical interfaces
 - e. Lifting points
 - 2. Air header piping shop drawings including:
 - a. Routing and dimensions
 - b. Pipe sizes and schedule
 - c. Support locations
 - d. Anchor details
 - e. Connection details to blower discharge and laterals
 - 3. Certified blower performance curves and sizing calculations.
 - 4. Product data for stainless steel pipe, fittings, anchors, and hardware.
 - 5. Control panel wiring diagrams and UL 508 documentation.
 - 6. Operation and Maintenance Manuals.

1.05 QUALITY ASSURANCE

- A. The blower manufacturer shall have a minimum of ten (10) years of experience in the design and manufacture of integrally-gearred centrifugal blowers.
- B. The blower package shall be manufactured, assembled, and tested at a single U.S. facility.
- C. All gearing shall be designed in accordance with AGMA high-speed gearing standards and manufactured to AGMA 11 quality or better.
- D. Bearings shall be designed for a minimum L10 life of 90,000 hours.
- E. Each blower shall undergo factory functional testing for a minimum duration of two (2) hours prior to shipment.
- F. Factory testing shall include:
 - 1. Verification of vibration and shaft excursion levels.
 - 2. Testing of all start/stop sequences.
 - 3. Verification of safety alarms and shutdown systems.
 - 4. Recording of performance data at design conditions.
 - 5. Testing with filters installed and enclosure panels closed.
- G. Stainless steel piping materials shall conform to ASTM standards applicable to Type 304 stainless steel.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment fully assembled to the extent practical.
- B. Protect all openings from dirt, moisture, and damage.
- C. Store equipment in a dry, weather-protected location.
- D. Follow manufacturer's written storage recommendations for long-term storage.
- E. Store stainless steel piping off the ground and isolated from carbon steel to prevent contamination.

1.07 GUARANTEE

- A. Provide a minimum one (1) year warranty from date of startup or eighteen (18) months from shipment, whichever occurs first.
- B. Warranty shall cover defects in materials and workmanship, including gearbox, impeller, bearings, motor (manufacturer's standard warranty), and control components.

PART 2 PRODUCTS**2.01 GENERAL**

- A. Basis of Design
 - 1. The equipment specified is based on integrally-gearred centrifugal blowers manufactured by Inovair, Lenexa, Kansas.
 - 2. Alternate manufacturers will be considered only if:
 - a. Submitted in accordance with Section 01 25 00 - Substitution Procedures
 - b. Complete technical documentation is provided.
 - c. All performance, material, and design requirements are met or exceeded.
 - d. Contractor assumes all costs associated with redesign, including electrical, structural, and civil modifications.
- B. Performance Requirements
 - 1. The air scour blower shall meet the following design conditions:

Parameter	Value
Air Service	Filter Backwash
Quantity	1
Design Ambient Pressure	14.4 PSIA
Design Ambient Temperature	100°F
Site Elevation	518 ft ASL
Relative Humidity	70%
Design Discharge Pressure	8.0 PSI
Design Flow Capacity	1,000 SCFM

Parameter	Value
Head Rise to Surge	1.93 PSI
Motor Shaft Power	47.8 HP
Motor Size	50 HP
Power Consumption	39.5 kW
Sound Level @ 1 m	< 85 dBA

C. Blower Construction

1. Type: Single-stage integrally-gearred centrifugal blower.
2. Construction shall exceed maximum design pressure.
3. All major components manufactured in the USA.

D. Gear Case

1. Three-piece casing:
 - a. Cast iron center section.
 - b. CNC-machined steel end plates.
2. Line-bored for precise shaft alignment.
3. Internal oil galleys for pressurized lubrication.

E. Impeller

1. Machined from 7075-T6 billet aluminum.
2. Backswept 3-dimensional blade design.
3. Designed using Computational Fluid Dynamics (CFD).
4. sized to achieve the flow and pressure required for application.
5. Balanced to ISO G2.5 or better.
6. Structurally suitable for full operating range.

F. Gears and Shafts

1. Solid 8620 steel shafts and gearing.

2. Case hardened to 52–56 Rc “C”.
3. Fully ground shafts for fitment to the gears and bearings and to minimize run-out and imbalance.
4. Two-stage helical gear configuration.
5. Manufactured to AGMA 11 or better.
6. Balanced to ISO G6.3.
7. Minimum 10-year gear life.
8. Shaft operation at or above 120% of first lateral critical speed.

G. Bearings and Seals

1. Input/intermediate shafts: Rolling element bearings (90,000 hr L10 life).
2. Impeller shaft: Floating-ring oil film journal bearings.
3. Axial support: Tapered land thrust bearing.
4. Impeller seal: Aerospace carbon face lift-off oil seal with vented labyrinth.
5. Input shaft seal: Viton lip seal.
6. Air or magnetic bearings not permitted.

H. Lubrication System

1. ISO 32 synthetic turbine oil.
2. Shaft-mounted mechanical oil pump.
3. Integral air-to-oil cooler (no external coolers permitted).
4. 10-micron oil filtration.
5. Oil pressure regulation between 40–70 psig.
6. Maximum oil temperature: 180°F.

I. Frame and Enclosure

1. Structural steel base frame.

2. Powder coat finish:
 - a. Sand blast
 - b. Epoxy primer
 - c. White powder coat topcoat
 3. Noise-reducing enclosure:
 - a. Carbon steel construction
 - b. Internal acoustic insulation
 - c. No external silencers permitted
 4. Integral:
 - a. Process air filters
 - b. Cabinet cooling air filters
- J. Electric Motor
1. NEMA premium efficiency.
 2. TEFC or ODP, inverter duty rated.
 3. Class F insulation.
 4. Rated for 105°F ambient.
 5. 1.15 service factor across-the-line.
 6. 1.0 service factor with VFD.
- K. Bypass Valve
1. Integrated butterfly-style valve.
 2. Stainless steel/aluminum construction.
 3. Electric servo actuator.
 4. Automatically actuated during startup, shutdown, and surge avoidance.

L. Local Control Panel (LCP)

1. Integral NEMA 4 enclosure.
2. UL 508 listed.
3. Includes:
 - a. Machine Level Controller
 - b. HMI
 - c. VFD integration package
 - d. Pressure and temperature sensors
 - e. Oil monitoring instrumentation
 - f. Electrically actuated bypass valve control
 - g. Remote/Local selector
 - h. Stop button
4. Control Features:
 - a. Speed control via VFD only (no inlet/discharge vanes permitted).
 - b. Maintains mass airflow setpoint.
 - c. Surge protection logic.
 - d. Rapid bypass open (~1 sec) and controlled close (~15 sec).
 - e. Automatic shutdown on:
 - 1) Low oil pressure
 - 2) High oil temperature
 - 3) Multiple surge events
 - f. TCP/IP Modbus connectivity.
 - g. 4–20 mA or Modbus SCADA interface.
 - h. Remote monitoring of operating parameters and alarms.

5. VFD:
 - a. Wall, stand, or MCC mounted.
 - b. Not permitted within blower enclosure.

M. ACCESSORIES

1. Integral air filters.
2. Oil filtration system.
3. Acoustic enclosure.
4. Bypass valve and actuator.
5. All sensors required for complete operation.
6. Anchor bolts (by Contractor unless noted otherwise).

2.02 AIR HEADER PIPING

A. General

1. Provide complete air header piping system from blower discharge connection to distribution laterals as shown on the Drawings.
2. The air header system shall be designed to uniformly distribute air to each lateral during air scour operation.

B. Materials

1. Pipe:
 - a. 6-inch diameter.
 - b. Schedule 5.
 - c. Type 304 stainless steel.
 - d. Conforming to applicable ASTM standards for austenitic stainless steel pipe.
2. Fittings:
 - a. Type 304 stainless steel.

- b. Same alloy and corrosion resistance as pipe.
 - 3. Flanges:
 - a. Stainless steel, compatible with pipe material.
 - b. Drilled to ANSI standards.
 - 4. Anchors and Hardware:
 - a. Type 18-8 stainless steel.
 - b. All bolts, nuts, washers, threaded rods, and anchors shall be stainless steel.
 - c. No carbon steel hardware permitted in contact with stainless components.
- C. Fabrication
 - 1. Cut, fabricate, and weld in accordance with recognized stainless steel welding standards.
 - 2. Welds shall be continuous and ground smooth where required for proper fit-up.
 - 3. Prevent contamination from carbon steel tools during fabrication.
 - 4. Clean piping after fabrication to remove debris and contaminants.
- D. Supports and Anchoring
 - 1. Provide supports in accordance with Section 40 05 15.
 - 2. Anchors and supports shall:
 - a. Prevent vibration.
 - b. Allow for thermal expansion.
 - c. Maintain alignment with blower discharge and laterals.
 - 3. All anchors and fastening hardware shall be Type 18-8 stainless steel.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify foundation is level and properly cured.
- B. Confirm anchor bolt placement and electrical service availability.
- C. Inspect equipment upon delivery for damage.

3.02 INSTALLATION

A. Blower Installation

- 1. Install blower system in accordance with manufacturer's written instructions and approved shop drawings.
- 2. Provide all electrical protection including motor overload protection and 110 VAC circuit protection.
- 3. Connect air piping without imposing strain on blower flanges.
- 4. Install VFD in approved remote location.
- 5. Do not operate equipment until installation has been inspected by manufacturer's representative.

B. Air Header Piping Installation

- 1. Install 6-inch Schedule 5 Type 304 stainless steel header piping as shown.
- 2. Align piping to avoid imposing stress on blower discharge nozzle.
- 3. Install piping to provide uniform airflow distribution to each lateral.
- 4. Provide proper slope or drainage provisions where required.
- 5. Install stainless steel anchors and hardware.
- 6. Isolate stainless steel components from dissimilar metals to prevent galvanic corrosion.
- 7. Field welds shall be performed by qualified welders experienced in stainless steel fabrication.

3.03 FIELD QUALITY CONTROL

A. Prior to startup:

1. Inspect alignment.
2. Verify electrical connections.
3. Confirm proper motor rotation.

B. Manufacturer's Services:

1. Installation check and startup – 1/2 day.
2. Owner training – 1/2 day.

C. Post-startup:

1. Unit shall operate smoothly without abnormal vibration.
2. Operate continuously for minimum eight (8) hours.
3. Verify alarms, interlocks, and safety shutdowns.
4. Confirm operation at design performance conditions.

D. Provide complete documentation to Owner upon completion of startup.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL AIR SCOUR BLOWER AND ALL RELATED PIPING related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 46 61 17

PART 1 GENERAL

1.01 SUMMARY

A. Work Included

1. Furnish all labor, materials, equipment, and incidentals required to provide complete factory-fabricated, steel high-rate gravity filters with underdrain systems, air scour system, filter media, appurtenances, and accessories as specified herein and as shown on the Contract Drawings.
2. Filters shall be rectangular, 10 feet by 15 feet (150 square feet surface area).

B. Each filter shall include, but not be limited to:

1. Painted carbon steel tank.
2. Dual parallel lateral underdrain system with integral media retainers.
3. Air header distribution system.
4. Washwater troughs.
5. Anthracite cap media.
6. GreensandPlus™ manganese dioxide coated media.
7. All required nozzles, flanges, and connections.

C. The filter system shall be furnished by a single manufacturer regularly engaged in the design and fabrication of high-rate gravity filtration systems and underdrains for potable water treatment.

D. The General Contractor for Contract 1 shall provide and install the influent/effluent/drain piping, touch up paint, filter control panel, and air scour system to provide a complete and operational filter/backwash system.

E. All contractors shall coordinate deliveries, installation, and lay down areas. Contractors shall not take action preventing other contracts from completing their work in a timely and efficient manner.

1.02 RELATED SECTIONS

A. Section 09 96 00 - High-Performance Coatings

B. Section 33 05 19 - Ductile Iron Pipe

- C. Section 40 05 57 - Actuators for Process Valves and Gates
- D. Section 40 05 64 - Valves for Actuator Control
- E. Section 46 61 17 - Air Scour Equipment

1.03 REFERENCES

- A. AWWA B100 – Filtering Material.
- B. NSF/ANSI 61 – Drinking Water System Components – Health Effects.
- C. ASTM A36 – Structural Steel.
- D. ASTM C150 – Portland Cement.
- E. AWWA C504 – Rubber-Seated Butterfly Valves.
- F. AWS – American Welding Society Code.
- G. AISC – Specifications for Structural Steel Buildings.

1.04 SUBMITTALS

- A. Product Data
 - 1. Shop drawings showing tank dimensions, structural supports, connection sizes and locations, underdrain layout, air header details, and wash trough configuration.
 - 2. Hydraulic calculations demonstrating compliance with specified flow and headloss criteria.
 - 3. Coating system data sheets and application procedures.
 - 4. Media data sheets and certified gradation analyses.
- B. Media Submittals
 - 1. Certified gradation, effective size, and uniformity coefficient for each media type.
 - 2. Certified compliance with AWWA B100 and NSF/ANSI 61.
 - 3. Guaranteed analysis for anthracite and GreensandPlus™ media.

4. Manufacturer's Quality Control documentation.

C. Certificates

1. NSF/ANSI 61 certification for all wetted components.
2. Manufacturer's Certificate of Compliance.

1.05 QUALITY ASSURANCE

- A. Manufacturer shall have minimum fifteen (15) years experience in the design and manufacture of dual parallel lateral air/water underdrain systems.
- B. Underdrain and associated components shall be supplied by a single manufacturer to ensure system compatibility and performance responsibility.
- C. All materials in contact with potable water shall be certified to NSF/ANSI 61.
- D. Media shall comply with AWWA B100 latest revision.
- E. Manufacturer shall provide qualified field service representative for installation supervision and start-up assistance.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Media shall be delivered in manufacturer's original packaging.
- B. Anthracite shall be packaged in 1 cubic foot bags or 2,000-pound super-sack totes.
- C. GreensandPlus™ shall be packaged in 1/2 cubic foot bags or bulk sacks as supplied by manufacturer.
- D. Protect media from contamination and moisture.
- E. Store underdrain components off the ground and protected from ultraviolet exposure.

1.07 GUARANTEE

- A. Provide one-year warranty from date of Substantial Completion covering defects in materials and workmanship.

PART 2 PRODUCTS

2.01 GENERAL

- A. Basis of Design: Steel pre-engineered gravity filters with dual parallel lateral underdrain system as manufactured by F.B. Leopold Company or Engineer approved equal.
 - 1. Leopold Type XA underdrain with I.M.S® 200 media retainer
- B. Tanks shall be factory fabricated and shop painted prior to shipment.

2.02 STEEL FILTER TANK

- A. Construction
 - 1. Minimum 1/4-inch ASTM A36 structural steel plate.
 - 2. Fully seal welded watertight construction.
 - 3. Structural reinforcement as required by design loads.
 - 4. Integral dual wash water troughs and supports.
- B. Dimensions
 - 1. Filter Media area: 10 feet x 15 feet.
 - 2. Surface area: 150 square feet.
- C. Connections (Flanged)
 - 1. Influent: 12-inch.
 - 2. Effluent: 14-inch.
 - 3. Overflow: 12-inch.
 - 4. Backwash effluent: 16-inch.
 - 5. Media removal: 6-inch.
 - 6. Backwash supply: 14-inch.
 - 7. Filter to Waste: 6-inch.
 - 8. Air scour inlet: 4-inch.

D. Coatings

1. Interior and exterior coating system suitable for potable water service.
2. Surface preparation SSPC-SP10.
3. Minimum interior dry film thickness: 10 mils.

2.03 UNDERDRAIN SYSTEM

- A. Dual parallel lateral HDPE block system with integral primary and secondary chambers.
- B. Dispersion orifices integrally molded; no drilled orifices permitted.
- C. Minimum 20 inches headloss across orifices at 20 gpm/sf backwash rate.
- D. Designed for:
1. The filter underdrain system, when installed, shall be designed for a net internal loading during backwash of the greater of either 1400 psf or 200 percent of the maximum pressure at maximum backwash rates. No credit shall be taken for the weight of gravel or filter media.
 2. 2.800 psf downward loading minimum.
 3. The underdrain system shall have an integral grout pocket designed to provide uplift resistance as a result of internal pressurization of 30 PSI (2.068 Bar) without any external mechanical anchors.
 4. Underdrain blocks that do not have a grout pocket shall have external anchor rods embedded into the filter floor and shall extend above the underdrain and hold the underdrain down from the top.
 5. The external anchor system shall be designed for a minimum allowable load of 30 psi hold down across the filter.
 6. All anchors shall be tested prior to the placement of the underdrain block to 130% of the allowable load.
 7. All anchors shall be type 316 stainless steel.
- E. Capable of uniform air distribution at 1–5 scfm/sf and combined air/water backwash.

2.04 AIR HEADER

- A. Type 304 stainless steel Schedule 5 header.
- B. Designed to uniformly distribute air to each lateral.
- C. Anchors and hardware Type 18-8 stainless steel.

2.05 FILTER MEDIA

- A. Anthracite Media (Cap Layer)
 - 1. Product shall be clean of debris and foreign material.
 - 2. Only anthracite water filter media mined and manufactured in the United States shall be accepted.
 - 3. Media shall not contain compounds producing toxic effects in properly treated water.
 - 4. Certification
 - a. Certified to meet or exceed AWWA B100-01 and NSF/ANSI 61.
 - b. Bidder shall include guaranteed analysis with bid.
 - 5. Physical Properties
 - a. Bulk Density: 50 lb/cu ft.
 - b. Specific Gravity: 1.6 ± 0.05 .
 - c. Effective Size: 0.95 – 1.05 mm.
 - d. Uniformity Coefficient: 1.5 maximum.
 - e. Hardness: Moh's scale of hardness greater than 2.7.
 - 6. Depth
 - a. 12 inches finished depth after backwashing and leveling.
- B. Greensandplus™ Media
 - 1. Manganese dioxide coated silica media for removal of iron, manganese, hydrogen sulfide, arsenic, and radium.

2. Media shall be GreensandPlus™ as manufactured by Inversand Company or approved equal.
3. Certified NSF/ANSI 61 compliant.
4. Effective Size: 0.30 – 0.35 mm.
5. Uniformity Coefficient: Less than 1.60.
6. Specific Gravity: Approximately 2.4.
7. Minimum depth: 15 inches.

C. Silica Gravel

1. Silica gravel to be placed between IMS underdrain and GreensandPlus™ to prevent iron and manganese plugging of underdrain in the following ascending layers:
 - a. 2.5 inches – 1/8 inch × No. 12 silica gravel.
 - b. 2 inches – 1/4 inch × 1/8 inch silica gravel.
 - c. 2 inches – 3/4 inch × 1/2 inch silica gravel.
2. All gravel shall be hard, durable, rounded silica gravel conforming to AWWA B100.
3. Gravel shall be washed, free of clay, shale, mica, organic matter, and other deleterious materials.
4. Gravel shall be placed carefully to avoid disturbance of underlying layers and leveled to uniform thickness prior to placement of GreensandPlus™ media.

2.06 PERFORMANCE REQUIREMENTS

- A. Service Flow Rate: Up to 10 gpm/sf (1,500 gpm per filter).
- B. Backwash Water Rate: Up to 15 gpm/sf.
- C. Air Scour Rate: 4–6 scfm/sf.
- D. Combined Air/Water Backwash: 4 scfm/sf and 5 gpm/sf typical.
- E. Headloss through 40-ft lateral at 20 gpm/sf shall not exceed 45 inches water column.

2.07 ACCESSORIES

- A. Washwater troughs designed for 1,125 gpm carry-off with minimum 2-inch freeboard.
- B. Trough spacing such that maximum particle travel during backwash does not exceed 3 feet.
- C. All gaskets, bolts, anchors, and appurtenances required for complete installation.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify foundation elevations and anchor bolt locations prior to installation.
- B. Protect underdrain from debris and contamination.

3.02 APPLICATION

- A. Install tank, underdrain, and appurtenances per manufacturer's written instructions.
- B. Grout underdrain blocks with Portland cement grout, minimum 2,500 psi compressive strength.
- C. Allow minimum three (3) days curing prior to functional testing.
- D. Media Installation
 - 1. Install GreensandPlus™ first.
 - 2. Backwash and condition per manufacturer's recommendations prior to placing anthracite.
 - 3. Install anthracite cap and backwash to final grade.
- E. Perform visual air and water distribution tests prior to media placement.
- F. Disinfect filter prior to placing into service.

PART 4 PAYMENT

- 4.01 The above work shall include all equipment, material, and labor; and shall be incidental to the price for pay item PROVIDE AND INSTALL FILTERS WITH UNDERDRAINS, MEDIA, ETC. related to plans titled W2E WATER TREATMENT PLANT.

END OF SECTION 46 61 26

APPENDIX A

Applicant: Milano & Grunloh Engineers, LLC
Contact: Lee R. Beckman, P.E., P.L.S.
Address: 114 W Washington Ave
Effingham, IL 62401

IDNR Project Number: 2505132
Date: 10/16/2024
Alternate Number: 22228, 2300071

Project: W2E Water Treatment Plant
Address: Multiple, Grayville

Description: Construction of a ground water treatment plant and a ground storage tank utilizing aeration, detention, pressure filters, chemical feed, etc. Also, included is the installation of approximately 2,514 L.F. of 12" watermain.

Natural Resource Review Results

Consultation for Endangered Species Protection and Natural Areas Preservation (Part 1075)

The Illinois Natural Heritage Database contains no record of State-listed threatened or endangered species, Illinois Natural Area Inventory sites, dedicated Illinois Nature Preserves, or registered Land and Water Reserves in the vicinity of the project location. **Therefore, consultation under part 1075 is terminated.**

Wetland Review (Part 1090)

The Illinois Wetlands Inventory does not show wetlands within 250 feet of the project location. **Therefore, the wetland review under Part 1090 is terminated.**

This review is valid for two years unless new information becomes available that was not previously considered; the proposed action is modified; or additional species, essential habitat, Natural Areas, or wetlands are identified in the vicinity. If the project has not been implemented within two years of the date of this letter, or any of the above listed conditions develop, a new consultation is necessary. Termination does not imply IDNR's authorization or endorsement.

Location

The applicant is responsible for the accuracy of the location submitted for the project.

County: Edwards

Township, Range, Section:
3S, 14W, 9



IL Department of Natural Resources

Contact

Adam Rawe
217-785-5500
Division of Ecosystems & Environment

Government Jurisdiction

IL Environmental Protection Agency
Nidhan Singh
1021 N Grand Ave East
Springfield, Illinois 62794 -9276

Disclaimer

The Illinois Natural Heritage Database cannot provide a conclusive statement on the presence, absence, or condition of natural resources in Illinois. This review reflects the information existing in the Database at the time of this inquiry, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, compliance with applicable statutes and regulations is required.

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1. The IDNR EcoCAT website was developed so that units of local government, state agencies and the public could request information or begin natural resource consultations on-line for the Illinois Endangered Species Protection Act, Illinois Natural Areas Preservation Act, and Illinois Interagency Wetland Policy Act. EcoCAT uses databases, Geographic Information System mapping, and a set of programmed decision rules to determine if proposed actions are in the vicinity of protected natural resources. By indicating your agreement to the Terms of Use for this application, you warrant that you will not use this web site for any other purpose.
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Applicant: Milano & Grunloh Engineers, LLC
Contact: Lee R. Beckman, P.E., P.L.S.
Address: 114 W Washington Ave
Effingham, IL 62401

IDNR Project Number: 2505133
Date: 10/16/2024
Alternate Number: 22228, 2301434

Project: W2E Water Treatment Plant
Address: Multiple, Grayville

Description: Construction of a ground water treatment plant and a ground storage tank utilizing aeration, detention, pressure filters, chemical feeds, etc. Also included in this project is the installation of approximately 2,514 L.F. of 12" watermain.

Natural Resource Review Results

Consultation for Endangered Species Protection and Natural Areas Preservation (Part 1075)

The Illinois Natural Heritage Database shows the following protected resources may be in the vicinity of the project location:

Fat Pocketbook (*Potamilus capax*)
Monkeyface (*Quadrula metanevra*)

Wetland Review (Part 1090)

The Illinois Wetlands Inventory shows wetlands within 250 feet of the project location.

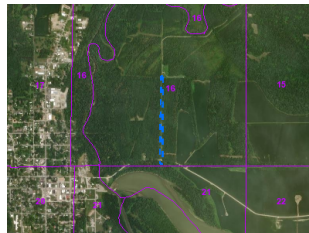
An IDNR staff member will evaluate this information and contact you to request additional information or to terminate consultation if adverse effects are unlikely.

Location

The applicant is responsible for the accuracy of the location submitted for the project.

County: Edwards

Township, Range, Section:
3S, 14W, 16



**IL Department of Natural Resources
Contact**
Adam Rawe
217-785-5500
Division of Ecosystems & Environment

Government Jurisdiction
IL Environmental Protection Agency
Nidhan Singh
1021 N Grand Ave East
Springfield, Illinois 62794 -9276

Disclaimer

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1. The IDNR EcoCAT website was developed so that units of local government, state agencies and the public could request information or begin natural resource consultations on-line for the Illinois Endangered Species Protection Act, Illinois Natural Areas Preservation Act, and Illinois Interagency Wetland Policy Act. EcoCAT uses databases, Geographic Information System mapping, and a set of programmed decision rules to determine if proposed actions are in the vicinity of protected natural resources. By indicating your agreement to the Terms of Use for this application, you warrant that you will not use this web site for any other purpose.

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Privacy

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Illinois Department of Natural Resources

One Natural Resources Way Springfield, Illinois 62702-1271
<http://dnr.state.il.us>

JB Pritzker, Governor

Colleen Callahan, Director

July 25, 2022

Lee R. Beckman, P.E., P.L.S.
Milano & Grunloh Engineers, LLC
114 W Washington Ave.
Effingham, IL 62401

RE: City of Albion/Grayville Water Treatment Plant Improvements
Project Number(s): 2301434 [22228]
County: Edwards

Dear Applicant:

This letter is in reference to the project you recently submitted for consultation. The natural resource review provided by EcoCAT identified protected resources that may be in the vicinity of the proposed action. The Department has evaluated this information and concluded that adverse effects are unlikely. Therefore, consultation under 17 Ill. Adm. Code Part 1075 and 1090 is terminated.

Consultation for Part 1075 is valid for two years unless new information becomes available that was not previously considered; the proposed action is modified; or additional species, essential habitat, or Natural Areas are identified in the vicinity. If the project has not been implemented within two years of the date of this letter, or any of the above listed conditions develop, a new consultation is necessary. Consultation for Part 1090 (Interagency Wetland Policy Act) is valid for three years.

The natural resource review reflects the information existing in the Illinois Natural Heritage Database and the Illinois Wetlands Inventory at the time of the project submittal, and should not be regarded as a final statement on the site being considered, nor should it be a substitute for detailed site surveys or field surveys required for environmental assessments. If additional protected resources are encountered during the project's implementation, you must comply with the applicable statutes and regulations. Also, note that termination does not imply IDNR's authorization or endorsement of the proposed action.

Please contact me if you have questions regarding this review.

Adam Rawe

Adam Rawe
Division of Ecosystems and Environment
217-785-5500



Illinois
Department of
Agriculture

JB Pritzker, Governor
Jerry Costello II, Director

Bureau of Land and Water Resources

State Fairgrounds • P.O. Box 19281 • Springfield, IL 62794-9281 • 217/782-6297 • TDD 866/287-2999 • Fax 217/557-0993

August 22, 2022

Milano & Grunloh Engineers, LLC
Lee R. Beckman, P.E., P.L.S.
114 West Washington Avenue
Effingham, IL 62401

Re: Cities of Albion & Grayville
Water Treatment Plant Improvements
Edwards County, Illinois
USDA Rural Development Funds
USDA NRCS Form AD-1006 - ±5 acres

Dear Mr. Beckman:

The Illinois Department of Agriculture (IDOA) has examined the above-referenced project for its potential impact to agricultural land in order to determine its compliance with the Illinois Farmland Preservation Act (505 ILCS 75/1 et seq.). Our analysis relates to the federal Farmland Protection Policy Act (7 USC 4201 et seq.) which specifies that federal actions affecting farmland conversion shall be consistent with state and local programs to protect farmland.

The Cities of Albion and Grayville is proposing to construct a ground water treatment plant and a ground storage tank that will utilize aeration, detention, pressure filters, chemical feed, etc. In addition to installing approximately 2,514 LF of 12" watermain. Construction of the water mains will utilize private easement and road right-of-way. The project will be completed in accordance with the *IDOA Water and Sewer Line Construction Standards and Policies*.

The ground water treatment plant site will ultimately convert ±5.0 acres of farmland outside of the corporate limits to a non ag use. The IDOA has determined the project is consistent with the federal Farmland Protection Policy Act and complies with the Illinois Farmland Preservation Act.

Enclosed are two copies of the USDA NRCS form AD-1006. One copy must be included in the project's environmental assessment; the other is for your files.

Sincerely,

Brian Rennecker, Chief
Bureau of Land and Water Resources

BR:JE
Enclosures-2

cc: Kari Handy, USDA-RD, Mt Vernon
Agency project file

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I (To be completed by Federal Agency) Date Of Land Evaluation Request 8/11/22

Name Of Project City of Albion-Grayville WTP Improv.

Federal Agency Involved Rural Development

Proposed Land Use Water Treatment Plant

County And State Edwards County, Illinois

PART II (To be completed by NRCS)

Date Request Received By NRCS 8/11/22

Does the site contain prime, unique, statewide or local important farmland?
(If no, the FPPA does not apply -- do not complete additional parts of this form).

Yes

No

☒

☐

Acres Irrigated

Average Farm Size

372

Major Crop(s) Corn, Soybeans, Wheat, Hay

Farmable Land In Govt. Jurisdiction

Acres: 29,633,500 % 97

Amount Of Farmland As Defined in FPPA

Acres: 27,695,900 % 91

Name Of Land Evaluation System Used
Illinois

Name Of Local Site Assessment System
Illinois

Date Land Evaluation Returned By NRCS
8/11/22

PART III (To be completed by Federal Agency)

Alternative Site Rating

Site A

Site B

Site C

Site D

A. Total Acres To Be Converted Directly

5.0000

B. Total Acres To Be Converted Indirectly

C. Total Acres In Site

5.0000

0.0000

0.0000

0.0000

PART IV (To be completed by NRCS) Land Evaluation Information

A. Total Acres Prime And Unique Farmland

2.5000

B. Total Acres Statewide And Local Important Farmland

2.5000

C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted

0.00000020

D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value

73.30

PART V (To be completed by NRCS) Land Evaluation Criterion

Relative Value Of Farmland To Be Converted (Scale of 0 to 100 Points)

74.50

0.0000

0.0000

0.0000

PART VI (To be completed by Federal Agency)

Site Assessment Criteria (These criteria are explained in 7 CFR 658.5(b))

Maximum
Points

1. Area In Nonurban Use

2. Perimeter In Nonurban Use

3. Percent Of Site Being Farmed

4. Protection Provided By State And Local Government

5. Distance From Urban Builtup Area

6. Distance To Urban Support Services

7. Size Of Present Farm Unit Compared To Average

8. Creation Of Nonfarmable Farmland

9. Availability Of Farm Support Services

10. On-Farm Investments

11. Effects Of Conversion On Farm Support Services

12. Compatibility With Existing Agricultural Use

TOTAL SITE ASSESSMENT POINTS

200 * 150

120

0

0

0

PART VII (To be completed by Federal Agency)

Relative Value Of Farmland (From Part V)

100 * 150

74.5

0.0000

0.0000

0.0000

Total Site Assessment (From Part VI above or a local
site assessment)

200 * 150

120

0

0

0

TOTAL POINTS (Total of above 2 lines)

*300

194.50

0

0

0

Site Selected:

Date Of Selection

Was A Local Site Assessment Used?

Yes ☐

No ☐

Reason For Selection:

See Attached
Illinois LESA Site Assessment
Site Specific Factors

**Cities of Albion-Grayville WTP Improvements
Edwards County, Illinois
USDA Rural Development**

PART VI-A Illinois Site Assessment Criteria	Maximum Points	Site A
1. Land Use on the Site	20	20
2. Adjacent Land Use	20	16
3. General Character of Area within 1.5 Miles of Site	20	10
4. Distance to City	20	0
5. Zoned Use of Proposed Site	20	20
6. Zoned Use of Land Adjacent to Proposed Site	20	16
7. Planned Land Use of Proposed Site	20	20
8. Compatibility of Proposed Use with Surrounding Land Uses	20	0
9. Alternative Sites Proposed on Less Productive Land	10	10
10. Availability of Central Water System	10	2
11. Availability of Central Waste Disposal System (Sewer)	10	2
12. Transportation	10	4
TOTAL SITE ASSESSMENT POINTS	200	120
PART VII		
Relative Value of Farmland	100	74.50
Total Site Assessment	200	120.00
TOTAL ILLINOIS LESA POINTS	300	194.50

* The Illinois LESA System applies the **225 point cutoff** when evaluating state and federally funded projects. Site or Corridor alternatives receiving **175 or fewer points** have a **low rating** for protection, and it is not necessary to evaluate additional alternatives. Those alternatives receiving **176 to 225 points** are in the **moderate range** for protection. In most cases, alternatives **exceeding the 225 point level should be retained for agricultural use**, and an alternate site should be utilized for the intended project. Selecting the alternative with the lowest total points will usually protect the best farmland located in the most agriculturally viable areas. LESA also serves to maintain and promote the agricultural industry in Illinois.



ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

1021 NORTH GRAND AVENUE EAST, P.O. BOX 19276, SPRINGFIELD, ILLINOIS 62794-9276 • (217) 782-3397

JB PRITZKER, GOVERNOR

JOHN J. KIM, DIRECTOR

July 20, 2022

JUL 25 2022

Lee R. Beckman, P.E.
Milano & Grunloh Engineers, LLC
114 West Washington Avenue
Effingham, IL 62401

RE: City of Albion/Grayville Water Treatment Plant Improvements
Edwards County

Dear Mr. Beckman,

The Agency has reviewed this submission and has no objections to the project. A construction permit is required from the Division of Public Water Supplies.

If one or more acres are disturbed during construction, a construction site activities NPDES will be required from the Division of Water Pollution Control. Additional information is provided on the following webpage: <https://www2.illinois.gov/epa/topics/forms/water-permits/storm-water/Pages/construction.aspx>

Please be advised that any solid or hazardous waste must be properly disposed of or recycled.

Sincerely,

A handwritten signature in black ink, appearing to read "John J. Kim", with a stylized flourish at the end.

John J. Kim
Director

2125 S. First Street, Champaign, IL 61820 (217) 278-5800
1101 Eastport Plaza Dr., Suite 100, Collinsville, IL 62234 (618) 346-5120
9511 Harrison Street, Des Plaines, IL 60016 (847) 294-4000
595 S. State Street, Elgin, IL 60123 (847) 608-3131

2309 W. Main Street, Suite 116, Marion, IL 62959 (618) 993-7200
412 SW Washington Street, Suite D, Peoria, IL 61602 (309) 671-3022
4302 N. Main Street, Rockford, IL 61103 (815) 987-7760



Illinois
Department of
**Natural
Resources**

JB Pritzker, Governor • Natalie Phelps Finnie, Director
One Natural Resources Way • Springfield, Illinois 62702-1271

www.dnr.illinois.gov

Various Counties

Grayville and Albion

New Construction of Ground Water Treatment Plant, Ground Storage Tank and Watermain Installation

**New Ground Water Treatment Plant - East side of County Road 050 East at East 150 North Road,
Watermain - Browns/Grayville Road North of North 200 Blvd., Grayville Water Treatment Plant - 401 S.
Water St., Grayville**

Albion Water Treatment Plant - 303 E. Cherry St., Albion

Site 11ED60

M-G-22228, UMA-708

SHPO Log #010070622

June 2, 2025

Rex Gower

Milano & Grunloh Engineers, LLC

114 W. Washington

Effingham, IL 62401

We have reviewed the documentation submitted for the referenced project(s) in accordance with 36 CFR Part 800.4. Based upon the information provided, no historic properties are affected. We, therefore, have no objection to the undertaking proceeding as planned.

Please retain this letter in your files as evidence of compliance with Section 106 of the National Historic Preservation Act of 1966, as amended. This clearance remains in effect for two years from date of issuance. It does not pertain to any discovery during construction, nor is it a clearance for purposes of the Illinois Human Remains Protection Act (20 ILCS 3440).

If you have any further questions, please contact Rita Baker, Cultural Resources Manager, at (217) 785-4998 or at Rita.E.Baker@illinois.gov.

Sincerely,

Carey L. Mayer, AIA

Deputy State Historic Preservation Officer



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
REGULATORY, SOUTH BRANCH
6855 SR 66
NEWBURGH, IN 47630

February 3, 2023

Regulatory Division
South Branch
ID No. LRL-2023-0073-jws

W2E, Inc
122 South Court St.
Grayville, IL 62844

To whom it may concern:

This is in response to your request dated November 21, 2022, concerning a proposal to for the W2E Cooperative (City of Albion/Grayville) proposal to construct a groundwater treatment plant, ground storage tank, and approximately 2,514 LF of watermain near Grayville, Edwards County, IL in the immediate vicinity of coordinates: Lat: 38.263335° N, Long: -87.983656° W.

The U.S. Army Corps of Engineers (USACE) exercises regulatory authority under Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403) and Section 404 of the Clean Water Act, 1972 (33 USC 1344) for certain activities in "waters of the United States (U.S.)." These waters include all waters that are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce. "Waters of the U.S." include hydrologically connected lakes, rivers, and stream channels exhibiting an Ordinary High Water Mark (OHWM); wetlands; sloughs; and wet meadows and wetlands adjacent to "waters of the U.S."

Based on the information provided by you in the above-referenced request, it appears a Department of the Army (DA) Permit may be required. The mapping you provided shows proposed work in or near what appears to be "waters of the U.S." These waters include wetlands abutting The Wabash River and Bonpas Creek. If the project would necessitate the discharge of dredged or fill material into any "waters of the U.S." including wetlands, then you should submit a DA permit application for review by this office. We will need a completed DA permit application along with additional details regarding the project's design, scope, construction methods, purpose and a delineation of all "waters of the U.S.," including the coordinates and locations of each "water" within the proposed project area and all impacts to waters (linear feet, width and acreage).

You are reminded that all drawings must be submitted on 8½ x 11-inch paper and be of reproducible quality, and if possible, please also submit the information in electronic format via CD (please note we cannot accept thumb drives).

Our comments on this project are limited to only those effects which may fall within our area of jurisdiction and thus does not obviate the need to obtain other permits from State or local agencies.

Further information on the Regulatory Program, including the DA Permit application, can be obtained from our website at <http://www.lrl.usace.army.mil/Missions/Regulatory.aspx>. Please

allow sufficient time in your preconstruction schedule for the processing of a DA permit application.

Your request has been assigned ID No. LRL-2023-0073. Please reference this number on all correspondence pertaining to this project. Please contact us by writing to the Newburgh Regulatory Office at 6855 State Road 66, Newburgh, IN 47630-9794, ATTN: CELRL-RDS, or contact me directly at 812-965-6439 or jason.w.saxton@usace.army.mil.

Sincerely,

Jason W. Saxton
Project Manager
South Branch

APPENDIX B

Storm Water Pollution Prevention Plan

W2E, Inc. Water Treatment Plant
Albion/Grayville, Illinois (Edwards/White County)

Job# 22228

This plan has been prepared to comply with the provisions of the NPDES Permit Number ILR10, issued by the Illinois Environmental Protection Agency for storm water discharges from Construction Site Activities.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. Signing a document on behalf of another person is subject to criminal, civil, administrative, or other lawful action.

Signature

Date

Engineer

Title

SWPPP ATTACHMENTS

- a. Site Map
- b. Wetland Map
- c. Floodplain Map
- d. EcoCAT / IDNR Letter
- e. SHPO Log No. 010070622
- f. NRCS Custom Soil Resource

ALL SIGNIFICANT SPILLS OR LEAKS DURING THE LAST THREE YEARS

- a. No significant spills or leaks have been reported in the last three years.

SITE DEVELOPMENT

- a. Activities: The proposed project will consist of constructing a 2.16 MGD lime softening water treatment plant consisting of a head tank with aerator, two (2) claricone upflow clarifiers, one (1) recarbonation tank, three (3) filters, clearwell, ground storage tank, chemical feeds, lime drying beds, SCADA, pre-engineered metal building and appurtenances. The project also includes the construction of watermain and offsite renovations regarding SCADA (Edwards/White County).
- b. Materials, Equipment, and Vehicle Maintenance practices employed to minimize contact of significant materials to storm water: See attachments a. and f.
- c. Existing structural and non-structural control measures are employed to reduce pollutants in storm water discharges: See attachments a. and f.
- d. Industrial storm water discharge treatment facilities: See attachments a. and f.
- e. Methods of on-site storage and disposal of significant materials: See attachments a. and f.

SEQUENCE OF MAJOR ACTIVITIES

- 1) Earth Excavation
 - 2) Construction of Water Treatment Plant
 - 3) 2,000 LF of 12" water main
 - 4) Seeding and Mulching
- a. Approximately 6.15 acres – of this total area, it is estimated that approximately 6.15 acres will be disturbed.
 - b. Existing drainage patterns will be retained.
 - c. The property is located in a Wetland & Floodplain. (See attached Maps)

EROSION AND SEDIMENT CONTROLS

- a. Stabilization practices include temporary seeding and permanent seeding and mulching. The stabilization process must be initiated within 1 working day of the cessation of construction activity for all areas where activities are ceased for 14 days. Naturally vegetated areas that have been disturbed by the construction operations will be temporarily seeded within 14 days of the last disturbance, or within one day if cessation of activities is known to be longer than 14 days. Agricultural areas will be exempt from this requirement. Permanent seeding and mulching and other landscaping will be completed as soon as all ground disturbing activities are completed. Temporary erosion control seeding shall be applied at the rate of 100#/acre.
- b. There shall not be any chemical containers over 55 gallons on site.
- c. Structural control measures include a detention basin, silt fence, and temporary straw bale ditch checks. Temporary straw bale ditch checks shall be used to prevent longitudinal erosion when the trench is in a swale or ditch. Silt fence shall be placed at these locations where runoff will transport silt beyond the easement limits.
- d. Storm Water Management. Temporary Erosion Control measures shall be left in place and properly maintained until permanent erosion control is in place and working properly and seeded areas have been established. Once permanent controls are functional and established, temporary measures shall be removed from the site. Temporary measures may be left if directed by the Engineer. This determination shall be made on a case-by-case basis
- e. Sediment track-out shall be minimized by sediment removal prior to site departure, or construction of vehicle tracking pad. Track-out that does occur shall be managed by means of shoveling or sweeping deposited sediment at the end of each working day.
- f. The site shall use IDOT Temporary Erosion Control Systems (Standard 280001-07). The erosion control system shall be installed prior to infrastructure construction to control water releasing into federal waters.
- g. Erosion and sediment control measures identified in the SWPPP must be observed to ensure that they are operating correctly. All locations where stabilization measures have been implemented must be observed to ensure that they are still stabilized.

OTHER CONTROLS

- a. Waste Disposal: No solid materials shall be discharged into waters of the State of Illinois.
- b. The contractor shall take precautions to prevent spillage of fuel and other petroleum products. Used oil containers, oil filters, grease cartridges, oily rags, and other contaminants shall be properly disposed of off-site.
- c. Sanitary Sewer shall follow EPA Regulations.
- d. Is off-site concrete/asphalt being used? ✓ Y N – If yes, controls and measures to reduce or eliminate discharges from these activities are: _____.
- e. Management practices, controls, and other provisions contained in this SWPPP must be at least as protective as the requirements contained in the Illinois Urban Manual. [<https://illinoisurbanmanual.org>]

TIMING OF CONTROLS/MEASURES

Structural and stabilization practices will be performed as work progresses. These measures will be completed within 14 days of the last construction activity.

CERTIFICATION OF COMPLIANCE WITH FEDERAL, STATE, AND LOCAL REGULATIONS

There are no other applicable requirements for sediment and erosion control affecting this project.

INSPECTION AND MAINTENANCE PROCEDURES

- a. Qualified Contractor Personnel shall inspect disturbed areas of the project on a weekly basis within 24 hours of the end of a storm that is 0.5 inches or greater.
- b. Areas inaccessible during inspections due to flooding or other unsafe conditions must be inspected within 72 hours of becoming accessible.
- c. Inspections may be reduced to once per month when construction activities have ceased due to frozen conditions. Weekly inspection must recommence when construction activities are conducted, if there is a 0.5 inches or greater rain event, or a discharge due to snowmelt occurs.
- d. Areas used for storage of materials and all areas where stormwater typically flows within the site must be inspected for evidence of, or the potential for, pollutants entering the drainage system. Where discharge locations or points are accessible, they must be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles enter or exit the site must be inspected for evidence of offsite sediment tracking.
- e. The Structural Control Measures implemented for this site are: Silt Fence and Temporary Straw Bale Ditch Checks.
- f. Qualified Contractor Personnel shall record damages or deficiencies in the control measures on the attached inspection report form. Corrective action shall be taken no later than 7 days after the inspection. Corrective actions are to be recorded and retained and maintained with the inspection report. If an inspection warrants modification, the modification must occur within 7 days following the inspection.
- g. Qualified Contractor Personnel shall retain and maintain records of the inspections and make these records available upon request of the Engineer or other State or Local official who has SWPPP approval authority.

- h. Annual Inspections shall be performed by the contractor, including a review of the storm water pollution prevention plan, as well as the facility to ensure all measures and controls are operating properly. This Annual Inspection shall be submitted to the Agency as outlined in the permit.
- i. If an area is inaccessible during inspection due to flooding or unsafe conditions, the site must be inspected within 72 hours of becoming accessible.
- j. Discharge locations shall be accessible and inspected for impacts to receiving water.
- k. Vehicle locations are shown on the site plan and shall be inspected for offsite sediment tracking.
- l. If the SWPPP must be modified based on the results of an inspection report, the modifications must be completed within 7 calendar days following the inspection.
- m. The permittee shall notify epa.swnoncomp@illinois.gov within 72 hours of any noncompliance and incidents of violation of the SWPPP. The permittee must complete and submit an ION Report within 5 days of the incident/violation. Corrective actions must be undertaken to address the noncompliant issues. The noncompliance report must be mailed to the EPA.

EMPLOYEE TRAINING

The contractor shall provide periodic training of all employees at all levels of responsibility and documented and retained as part of the Storm Water Pollution Prevention Plan. Topics shall include spill response, materials/equipment handling procedures, and good housekeeping strategies.

NON-STORM WATER DISCHARGES

Qualified Contractor Personnel shall conduct a visual inspection of storm water to ensure that non-storm water discharges are not entering into the storm water (i.e. oil sheen). An inspection of procedures/equipment for the discharge of non-storm water should be conducted when appropriate. Inspections shall be documented and made available on request of the Engineer or other State or Local official who has SWPPP approval authority.

INVENTORY FOR POLLUTION PREVENTION PLAN

• Sand	• Portland Cement Concrete
• Asphalt Pavement	• Fertilizer
• CA-6 Aggregate	• Seed
• Storm Sewer	• Mulch
• Manholes	• Straw Bales
• Castings	• Joint Lubricant
• Concrete Block	• Petroleum Based Products

SPILL PREVENTION

- a. Housekeeping
 - Products will be kept in their original container.
 - Substances will not be mixed with one another unless recommended by the manufacturer.
 - Use all of the products before disposing container.
 - Follow Manufacturers Recommendation.
 - Materials shall be stored properly.
 - Have on site only enough materials to do the job.
- b. Petroleum Products
 - Vehicles will be monitored for excessive leakage.
 - Vehicles and equipment shall be in good repair to reduce leakage.
 - Petroleum products shall be stored in approved containers.
- c. Fertilizers
 - Fertilizer used shall be applied at the recommended amount.
 - Fertilizer shall be stored out of the weather.
 - Empty fertilizer bags shall be properly disposed of.
- d. Spills
 - All spills shall be documented and cleaned up immediately.
 - Spills of toxic or hazardous materials will be reported to the appropriate agency.

REPORTING

- a. A report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the SWPPP, and actions taken in accordance with IV.D.4.b must be made and retained as part of the SWPPP for at least three years from the date that the permit coverage expires, or is terminated. All inspection reports must be retained at the construction site. Any flooding or other unsafe conditions that delay inspections must be documented in the inspection report.
- b. The permittee must notify the appropriate Agency Field Operations Section office by email at: epa.swnoncomp@illinois.gov, telephone, or fax (See Attachment A of the General NPDES Stormwater Permit for Construction Activities) within 24 hours of any incidence of noncompliance for any violation of the SWPPP observed during any inspection conducted, or for violations of any condition of this permit. The permittee must complete and submit within 5 days an "Incidence of Noncompliance" (ION) report for any violation of the SWPPP observed during any inspection conducted, or for violations of any condition of this permit. Submission must be on forms provided by the Agency and include specific information on the cause of noncompliance, actions which were taken to prevent any further causes of noncompliance, and a statement detailing any environmental impact which may have resulted from the noncompliance. Corrective actions must be undertaken immediately to address the identified non-compliance issue(s).
- c. All reports of noncompliance must be signed by a responsible authority.
- d. After the initial contact has been made with the appropriate Agency Field Operations Section Office, all reports of noncompliance must be mailed to the Agency at the address provided in the permit.
- e. Corrective action must be taken when the following conditions are identified: A stormwater control needs repair or replacement; A stormwater control necessary to comply with the requirements of this permit was never installed or was installed incorrectly; Discharges are causing an exceedance of applicable water quality standards;

and A prohibited discharge has occurred. Corrective actions must be completed as soon as possible and documented within 7 days in an Inspection Report or report of noncompliance. If it is infeasible to complete the installation or repair within 7 calendar days, it must be documented why it is infeasible to complete the installation or repair within the 7-day timeframe and document the schedule for installing the stormwater control(s) and making it operational as soon as feasible after the 7-day timeframe. If maintenance is required for the same stormwater control at the same location three or more times, the control must be repaired in a manner that prevents continued failure to the extent feasible, and the condition and how it was repaired must be documented. Alternatively, it must be documented why the specific reoccurrence of this same issue should continue to be addressed as a routine maintenance fix.

- f. This SWPPP and completed inspection reports/forms must be made available to the public within 30 days upon request. If the documents cannot be provided, a statement explaining why must be provided within 30 days upon request. The SWPPP report must be posted publicly on-site on wooden boards. The SWPPP and completed inspection reports/forms shall be posted at the job site for public viewing.

INSPECTION, MAINTENANCE, AND CORRECTIVE ACTION FORM

SITE INSPECTOR:	
SITE LOCATION:	
INSPECTOR QUALIFICATIONS:	
INSPECTION SCHEDULE: (Site inspections will be performed every 7 days and within 24 hours of one-half inch of rainfall.)	
Increased Frequency (if applicable):	
Reduced Frequency (if applicable)	
List any noncompliance issues and or violations:	
Are corrective actions required? ☐ Yes ☐ No List the corrective actions taken:	
List any flooding or other unsafe conditions that delay inspections:	
Stabilized: ☐ Y ☐ N Stabilization Method: Structural Control:	
Date of Major Grading: Date Stabilization Occurred: Condition:	
Date construction activities temporarily ☐ or permanently ☐ ceased:	
If temporarily ceased, indicate the date construction activities resumed:	
If corrective action is needed / taken, this shall be reported to:	
Date Reported: Further Action Required? ☐ Yes ☐ No	
Name(s) of Staff responsible for completing maintenance:	
Maintenance actions being implemented:	
Date range of corrective action: -	
Note: If corrective actions are required, is to be notified. will be responsible for initiating corrective actions within 24 hours of the report and completing maintenance as soon as possible or before the next storm event. For any corrective actions requiring a SWPPP amendment or change to a stormwater conveyance or control design, will notify as soon as possible, before initiating the corrective action.	
If any noncompliance or violation incident has occurred, it shall be recorded in this report. Permittee shall notify epa.swnoncomp@illinois.gov within 24 hours. Illinois EPA 2520 W. Iles Ave, P.O. Box 19276, Springfield, IL 62794.	
Signature of Inspector:	Date of Inspection:

CONTRACTOR CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. Signing a document on behalf of another person is subject to criminal, civil, administrative, or other lawful action. I certify under penalty of law that I understand the terms and conditions of the National Pollutant Discharge Elimination System (NPDES) Permit that authorizes storm water discharges associated with industrial activity from the construction site identified as part of this certification.

Signature

Date

Name of Firm

Title

Street Address

Telephone Number

Village

State

Zip Code

INSPECTION AND MAINTENANCE REPORT FORM

INSPECTOR:		DATE:		PROJECT:	

[illegible]