Four Rivers Sanitation Authority
Rockford, Illinois

Bidding Requirements and Contract Forms for
Primary Filtration Project Phase I

Capital Project No. 2022

IEPA Project No. L17-5882

November 23, 2021
Bid Set

Volume 3 of 3

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Four Rivers Sanitation Authority
Rockford, Illinois

Bidding Requirements and Contract Forms
and
General Provisions and Technical Specifications

for

Primary Filtration Project Phase I

Capital Project No. 2022
IEPA Project No. L17-5882

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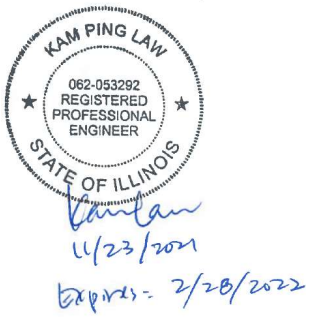
PROJECT MANUAL

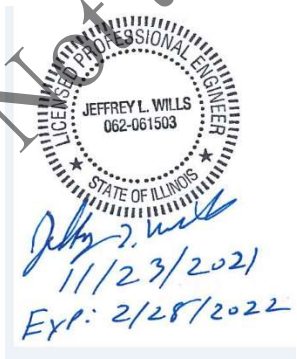
FOUR RIVERS SANITATION AUTHORITY
WASTEWATER TREATMENT PLANT

PRIMARY FILTRATION PROJECT (PHASE I)
CAPITAL PROJECT NO. 2022
IEPA LOAN NO. L17-5882

ROCKFORD, ILLINOIS

Seals and Signatures

Civil	Structural	Architectural	Process
			

HVAC/Plumbing	Electrical	Instrumentation and Controls
	 Date:11/23/2021 Exp:02/28/2022	

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CAPITAL PROJECT NO. 2022
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ROCKFORD, ILLINOIS

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WASTEWATER TREATMENT PLANT

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DIVISION 31

EARTHWORK

SECTION 31 10 00
SITE CLEARING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Protection of existing surface features
2. Removal of miscellaneous surface features.
3. Clearing and grubbing of site.
4. Stripping topsoil.
5. Locating existing pipes and electrical conduits.
6. Removal from site and disposal of stockpiled landfill material.

1.02 SUBMITTALS

A. Submit coordinates and elevation of each located underground pipe.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 PREPARATION

A. Provide a minimum of 3 working days advance notice, prior to construction, to owners of existing utilities and surface features in the work area.

B. Protect existing utilities and surface features indicated to remain. Restore damaged existing utilities and surface features to condition equal to condition prior to construction.

C. Protect trees, shrubs, and other land resources, where indicated to remain. Provide fencing no closer than "drip line" of trees and shrubs and of sufficient height so features will not be damaged. Comply with requirements of Section 01 57 19.

D. Do not remove or cut down trees unless identified for removal on drawings, or located within limits of excavation, proposed structures or paving as indicated on Drawings.

E. Do not trim trees unless shown on Drawings.

F. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

G. Maintain access to site.

H. Install erosion control measures prior to start of any earth-disturbing activities.

3.02 REMOVALS

A. Remove obstructions such as mounds of dirt, stones, or debris located within construction limits.

B. Remove surface features including pavements, curb and gutter, signs, posts, fences, shrubs, landscaping features, and other miscellaneous items. Items to be removed temporarily shall be replaced to original condition.

C. Full depth saw cut all pavement, sidewalk and curbing to be removed.

D. Conform to requirements of Section 01 35 16.

3.03 CLEARING AND GRUBBING

A. Clearing and grubbing shall include cutting and disposal of trees, shrubs, brush, windfalls, logs, and other vegetation, and removal and disposal of grass, roots, stumps, stubs, grubs, logs and other timber, and other perishable or objectionable matter.

B. Clear and grub area within limits to be covered with tanks, buildings, walks, parking areas, drives, and where grade is to be adjusted. Clearing and grubbing limits shall be 20 feet from building or tank lines.

C. Existing trees, shrubs, and other vegetation may not be shown on the Drawings.

D. Grub stumps and roots to a depth of at least 12 inches below existing ground surface or subgrade, whichever is lower.

E. Cut interfering tree roots and branches 1 inch or greater in diameter perpendicular to direction of growth on tree side of trench.

F. Remove cleared and grubbed material from site and dispose of in accordance with applicable regulations.

3.04 STRIPPING TOPSOIL

A. After area has been cleared of vegetation, remove existing grass and topsoil to entire depth in areas where grade is to be adjusted and in areas to be covered by structures or paving.

B. Remove and dispose of stripped topsoil.

3.05 DISPOSAL

A. Remove brush, grass, roots, trash, and other material from site preparation operations from site.

B. Do not store or permit debris to accumulate on the job site.

C. Do not burn debris at the site.

D. Dispose of materials removed by clearing and grubbing in accordance with applicable regulations.

3.06 DEMOLITION

A. Conform to Section 01 35 16.

3.07 EXPLORATION FOR EXISTING UNDERGROUND PIPING AND ELECTRICAL CONDUITS

A. Prior to initiating work, Contractor shall determine exact location and elevation of underground piping and conduits at locations specified.

1. Excavate and expose top and sides of piping or conduit.
2. Locate top and outer edges of piping or conduit by surveying with equipment capable of locating each point to within 0.1 ft. accuracy.
3. Tie survey coordinate information to state plane coordinate system shown on drawings.
4. Probing to locate outer edges of piping may be permissible if exposing sides of piping would compromise the structural integrity of the piping, provided the size and invert elevation can be determined from the information available.
5. Each point to be surveyed shall consist of a set of three (3) survey points. One set of points shall consist of coordinates on each side of the pipe or conduit and the top center elevation of pipe or conduit.

B. The Contractor shall vacuum excavate a pilot trench along the entire alignment of the following proposed piping systems as shown on the Drawings. Should additional location information be needed, contact the Engineer.

1. Storm sewer
2. Primary Filter Thickened Sludge (PFTS)
3. Gravity Thickener Overflow (GTO)
4. Primary Scum (PSM)
5. Existing Waste Activated Sludge (WAS) to be removed and replaced

C. The Contractor shall spot excavate ("pothole") the following locations.

1. Existing 54-inch diameter Primary Influent pipe at proposed influent structure.
2. Existing 54-inch diameter Primary Effluent pipe (from northeast corner of Primary Settling Tanks 1 & 2 to existing Primary Tank Outlet Structure) at all crossings with new piping as shown on the Drawings.
3. All existing utility crossings along new natural gas line piping.
4. All existing utility crossings along the existing 60-inch diameter Primary Effluent pipe from Primary Filtration Facility 1 to the Primary Tank Outlet Structure.

D. Additional buried utilities may exist that are not shown on the Drawings. The Contractor shall exercise care during all excavation activities and shall document all utilities discovered that are not indicated on the drawings.

E. Submit location survey information in hard copy and electronic form to Engineer. Engineer will evaluate information for its impact on proposed structures and will revise the design as required to avoid impacting the existing piping and conduits.

F. Contractor shall backfill and compact the backfill over the exposed piping and conduits in accordance with the requirements of Section 31 23 00 – Excavation and Backfill and/or 31 23 33 Trenching and Backfill as appropriate for the location.

G. Disposal of excess soil material shall be in accordance with Section 31 22 00.

3.08 PRELIMINARY SITE SURVEY

A. When required on the Drawings or specified in this or other sections, Contractor shall perform a preliminary site survey of surface features to ascertain their locations and elevations to an accuracy of 0.01 ft in all axis.

B. In areas where pavements, driveways or sidewalks are removed and no adjoining fixed features are available to reference (curb gutter, sidewalks, remaining pavement, etc) the Contractor shall provide a survey for the entire area to be disturbed which will establish the grades and locations of the existing features which can be staked for restoration efforts. Grades shall be determined at no more than 25 ft intervals. It is the intent of the contract documents to restore the project area to existing conditions or better.

C. In all areas where road or driveway centerlines or edges are removed the Contractor shall survey the centerline and edges to allow them to be accurately restored. Survey will not be required if existing curbing is present and is not disturbed on the pavement edge.

D. Inlets or other structures which are removed for construction and are to be replaced shall have their rim elevation and all inverts surveyed prior to removal.

E. Contractor shall photograph all landscape restoration areas including, but not limited to retaining walls, fences, shrubs, and trees.

END OF SECTION

SECTION 31 22 00
GRADING

PART 1 – GENERAL

1.01 SUMMARY

A. Excavation, filling, and rough and finish grading the site to the elevations shown on the Drawings and as needed to meet the requirements of the Contract Documents.

1.02 DEFINITIONS

A. Influence Zone Under Foundations, Pavements, or Sidewalks: Area below foundation or pavement or sidewalk subbase bounded by 1 horizontal to 2 vertical (1H:2V) slope extending outward from 1-ft beyond outer edge of foundation or pavement or sidewalk subbase.

B. Influence Zone Under Piping or Electrical Ducts: Area below limits bounded by line 6 inches below pipe or electrical duct and by 1 horizontal to 2 vertical slope (1H:2V) extending outward from that line 1-foot beyond outer edge of pipe or duct.

C. Unsuitable Material: Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble or soil with less than required bearing capacity as determined by Engineer.

D. IDOT: Illinois Department of Transportation

1.03 REFERENCES

A. ASTM: American Society for Testing and Materials

B. Illinois Department of Transportation (IDOT):

1. Standard Specifications for Road and Bridge Construction, Current Edition

1.04 SUBMITTALS

A. Test Results

1. Compaction test results.
2. Proctor test results.

B. Miscellaneous Submittals.

1. Test results to verify fill materials meet Specifications.

C. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Testing shall be provided by Contractor in accordance with Section 01 45 29 and this section.

1.05 PROJECT / SITE CONDITIONS

A. Notify owners of above or below ground utilities encountered during grading operations.

B. Cap and remove or relocate services in accordance with instructions of owners of such utilities.

C. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in accordance with requirements of owners of such utilities.

D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

E. Maintain access to adjacent areas at all times.

PART 2 – PRODUCTS

2.01 FILL MATERIALS

A. Structural Fill: Conform to requirements of Section 31 23 00.

B. Controlled Fill:

1. Silt, clay, clayey sand, clayey gravel or other approved material free from organic matter and deleterious substances, containing no rocks or lumps over 6 in., and with not more than 15% of the rocks larger than 2 inches.
2. Liquid Limit, ASTM D423: 50 maximum.
3. Unified Soil Classification: CL, ML, SC, or GC.

C. Earth Fill: Natural soils free of topsoil, wood, peat, cinders, organic and deleterious matter or other rubbish.

D. Subgrade Stabilizing Aggregate:

1. IDOT Gradation CA-1
2. IDOT Gradation CS-01
3. IDOT Gradation CS-02
4. IDOT Gradation RR-1
5. IDOT Gradation CA-6 (for top 6 inches of subgrade stabilizing aggregate material)

2.02 TOPSOIL

A. Friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and free from subsoil, roots, heavy or stiff clay, sand and gravel, stones larger than 1/2 inch, noxious weeds, sticks, brush, litter, and other deleterious matter.

B. Acidity Range: pH 5.0 minimum, 7.0 maximum.

C. Obtain topsoil from source stockpiled under Section 31 10 00, or provide imported topsoil obtained from sources outside the project limits, or from both sources. Stockpiled topsoil shall be screened to meet specified requirements.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work such as areas loosened by frost action or softened by flooding or weather, or existence of unsuitable material. Do not proceed until unsatisfactory conditions are corrected.

B. Fill settled areas where excavations or trenches were backfilled and holes made by demolition, tree removal, and site preparation.

C. Natural soils or fill softened by frost, flooding or weather shall be removed and replaced.

D. Remove unsuitable material within influence zone under foundations, pavements, sidewalks, piping or electrical ducts.

E. Remove frozen soils within influence zone.

3.02 PREPARATION

A. Areas to receive fill material and within the influence zone under foundations, pavements, and sidewalks shall be proofrolled to detect soft or loose zones.

B. Proofrolling may be accomplished with a fully loaded single axle dump truck or other pneumatic tire equipment which provides similar loading. Make multiple passes to test entire area.

C. Areas where displacement in base (yielding, rutting, pumping, heaving, cracking, or other signs of instability), in the opinion of the Engineer, is more than 1 inch under a fully-loaded tandem-axle dump truck shall be improved by one of the following methods:

1. Disk, dry, and recompact the subgrade.
2. Remove and replace. Undercut the excessively wet or soft soils a minimum of 18 inches below the limit of excavation. Replace soil with subgrade stabilizing aggregate in maximum lifts of 1 foot, and cap with a minimum of 6 inches of IDOT CA-6 stone. Place geogrid beneath each lift of subgrade stabilizing aggregate.

D. Where sensitive soils are encountered, requirement for proof rolling shall be waived, and Contractor shall perform alternative field testing to determine existence of soft areas. Method of alternative testing shall be approved by Engineer.

E. Keep construction site free draining.

F. Plow, step, or bench slopes steeper than 1 vertical to 4 horizontal. Disc level surfaces.

3.03 EXCAVATION

A. Perform excavation to the lines, grades, and elevations indicated and specified herein.

B. Method of excavation shall be consistent with soil types encountered and result in undisturbed subgrade. Loosened soils shall be recompacted or removed and replaced.

C. Excavation of Rock:

1. Where rock, boulders, or similar material is encountered, and where such material cannot be removed or excavated by conventional earth moving or ripping equipment, remove or

excavate such material by means which will neither cause additional cost to the Owner endanger buildings or structures on or off the site.

2. Do not use explosives without written permission from the Engineer.

D. Cut ditches and gutters accurately to the cross sections, grades, and elevations shown.

3.04 FILL USAGE

A. Structural: Within influence zone under foundations, pavements, sidewalks, piping or electrical ducts.

B. Earth: Other areas not previously specified.

3.05 PLACING FILL

A. Notify Engineer before placing fill material.

B. Do not use frozen material or place fill on frozen subgrade.

C. Do not operate power-operated earth moving equipment closer to foundation walls or other structures than distance equal to 1/2 height of fill above footing.

D. Place and compact fill materials in lift thickness and to densities listed.

1. Degree of compaction: ASTM D1557, Modified Proctor.
2. Moisture Content: Within 2% of optimum.

Location	Maximum Lift Thickness (in.)	Modified Proctor (%)
Footing, Foundation Slab, or Floor Slab Influence Zone	8 inches	95 minimum
Sidewalk, Crushed Aggregate Base Course, Pavement, Piping, or Electrical Duct Influence Zone	8 inches	95 minimum
Lawn and Landscaped Areas	12 inches	80 minimum, 90 maximum

3.06 ROUGH GRADING

A. Grade to 6 inches below finished grade in areas to receive topsoil.

B. Grade to bottom of base course in areas to receive sidewalk or paving.

C. Rough grading, including excavated or filled sections and adjacent transition areas, shall be reasonably smooth, compacted, and free from irregular surface changes.

3.07 FINISH GRADING

A. Uniformly grade the areas within limits of grading, including adjacent transition areas, with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades.

B. Where a change of slope is indicated on the Drawings, construct a rolled transition section having a minimum radius of approximately 8 ft, unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage.

C. Grade areas adjacent to buildings or structures to achieve drainage away from the structures, and to prevent ponding.

D. Maximum allowable variation from design elevation is 1 inch in 10 feet.

3.08 FIELD QUALITY CONTROL

A. Testing:

1. One field density test for each 100 cubic yards of structural fill, minimum one each lift.
2. One field density test for each 200 cubic yards of controlled fill, minimum one each lift.
3. One field density test for each 1000 cubic yards of earth fill.
4. Determine in-place density of fill at maximum intervals specified in accordance with ASTM D1556, D2167, D2922 or D2937.

3.09 ADJUSTMENT AND CLEANING

A. Remove and dispose of all unsuitable excavated material.

B. Owner has first right to excess material suitable for backfilling or site grading, not used in Work. Place on site in location designated by Owner and grade to drain. Provide erosion control devices for spoils pile in accordance with Section 31 25 00.

C. Remove excess material not required by Owner, material not suitable for backfilling or site grading, and unsuitable materials from site. Conform to requirements of Section 01 57 19.

3.10 MAINTENANCE

A. Protection of Newly Graded Areas:

1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds.
2. Repair and reestablish grades in settled, eroded, and rutted areas to the specified tolerances.

B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

END OF SECTION

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SECTION 31 23 00
EXCAVATION AND FILL

PART 1 – GENERAL

1.01 SUMMARY

A. Excavation and backfilling for structures to elevations shown on Drawings and as needed to meet requirements of Contract Documents.

B. Change in Removal Quantity of Unsuitable Material:

1. Include in Base Bid, cost of removal and disposal of unsuitable material to limits shown on Drawings and provide backfill as specified herein.
2. Adjust Contract Price if actual limits of removal of unsuitable material differ from those shown on Drawings.
3. Pay limits for change in removal of unsuitable material shall be the influence zone as defined herein.
4. Unit cost for change in removal of unsuitable material shall include cost of excavation, hauling, disposal, backfill material, and backfilling.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

1.03 DEFINITIONS

A. Influence Zone Under Foundations, Pavements, or Sidewalks: Area below foundation or pavement or sidewalk subbase bounded by 1 horizontal to 2 vertical slope extending outward from 1-foot beyond outer edge of foundation or pavement or sidewalk subbase.

B. Influence Zone Under Piping or Electrical Ducts: Area below limits bounded by line 6 inches below pipe or electrical duct and by 1 horizontal to 2 vertical slope extending outward from that line 1-foot beyond outer edge of pipe or duct.

C. Unsuitable Material: Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble or soil with less than required bearing capacity as determined by Engineer.

1.04 SUBMITTALS

A. Test Results.

1. Compaction test results.

B. Miscellaneous Submittals.

1. Test results to verify fill materials meet Specifications.

C. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Testing shall be provided by Contractor in accordance with Section 01 45 29 and this Section.

B. Sheeting, Shoring, and Bracing:

1. Sheeting, shoring, and bracing shall conform to safety requirements of federal, state, and local agencies.
2. Sheeting, shoring, and bracing shall not affect structural integrity of new construction, water tightness or waterproofing of new construction, and shall allow for sufficient clearances necessary to install associated appurtenances adjacent to new construction.
3. Sheeting, shoring, and bracing shall not penetrate walls or slabs of new construction unless approved by Engineer.

1.06 PROJECT / SITE CONDITIONS

A. Notify Owners of above or below ground utilities encountered during excavation operations.

B. Cap and remove or relocate services in accordance with instructions of Owners of such utilities.

C. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in accordance with requirements of Owners of such utilities.

D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

E. Maintain access to adjacent areas at all times.

PART 2 – PRODUCTS

2.01 FILL MATERIALS

A. Structural Fill:

1. IDOT gradation CA-6.

B. Flowable Fill (Controlled Low Strength Material): Said material, when used, shall meet IDOT Standard Specifications, Section 1019, Mix 1 per Article 1019.05.

C. Earth Fill: Natural soils free of topsoil, wood, peat, cinders, organic and deleterious matter or other rubbish.

D. Free-Draining Fill:

1. ASTM C33, Size No. 67.
2. Washed crushed stone.
3. Maximum Fines: ASTM D422, 1% passing No. 200 sieve.

2.02 FILTER FABRIC

A. Porous non-woven fabric with multiple layers of randomly arranged fibers, min 4.0 ounce per square yard (typical).

B. Filter fabric shall meet IDOT Standard Specification Article 1080.02.

C. Manufacturers:

1. Mirafi 140N by Mirafi, Inc.

2. Typar 340I by DuPont.
3. Supac 5P by Phillips Fibers Corp.
4. Propex 4545 by Amoco Fabrics Co.
5. Or Equal.

2.03 SHEETING, SHORING, AND BRACING

A. Type, design, detail, and installation of sheeting, shoring, and bracing shall be determined by and sole responsibility of Contractor.

2.04 SOURCE QUALITY CONTROL

A. Testing:

1. One sieve analysis, plasticity index, and uniformity coefficient for each source of structural fill.
2. One sieve analysis for each source of free-draining fill.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Conform to requirements of Section 31 22 00.

3.02 PREPARATION

A. Conform to requirements of Section 31 22 00.

3.03 SHEETING, SHORING, AND BRACING

A. Whenever necessary to prevent caving during excavation and to protect adjacent piping, structures, property, workers, and the public; excavations shall be sheeted, shored, and braced.

B. When sheeting, shoring, and bracing is required, install to prevent soil from entering excavation below or through sheeting.

C. Keep sheeting, shoring, and bracing in place until structure is placed, tested, and backfilled.

D. Remove sheeting, shoring, and bracing in manner not damaging to structure or permitting voids within backfill.

E. Fill settled areas after sheeting, shoring, and bracing has been removed.

3.04 DEWATERING

A. Contractor shall dewater excavation site prior to starting excavation and shall maintain groundwater minimum of 12 inches below bottom of excavation.

B. Contractor is responsible for choosing method of groundwater control.

C. If Contractor chooses to use deep wells or well points, wells and well points shall be designed, installed, and operated to prevent removal of in-situ materials.

D. Keep construction site free-draining. Keep excavations free of water.

E. Remove soil disturbed by pressure or flow of groundwater.

F. Maintain dewatering system to prevent uplifting of or damage to structures.

G. Protect adjacent utilities, structures, and properties from damage resulting from dewatering operations.

H. Drill, maintain, and abandon dewatering wells in accordance with federal, state, and local ordinances.

I. Contractor shall provide all power for dewatering.

J. Contractor is responsible for any required permits for the dewatering system and its operation.

3.05 EXCAVATION

A. Excavate to the lines, grades, and elevations indicated and necessary to complete construction.

B. Method of excavation shall be consistent with soil types encountered and result in undisturbed subgrade. Loosened soils shall be recompacted or removed and replaced.

C. Excavation of Rock:

1. Where rock, boulders, or similar material is encountered, and where such material cannot be removed or excavated by conventional earth moving or ripping equipment, remove or excavate such material by means which will neither cause additional cost to Owner nor endanger buildings or structures on or off the site.
2. Do not use explosives without written permission from Engineer.

D. Over-excavate to limits noted on Drawings.

E. Protect excavated areas from freezing.

3.06 FILL USAGE

A. Structural: Within influence zone under footings and foundations, floor slabs, pavements, sidewalks, piping or electrical ducts. Provide a minimum 6-inch layer under floor slabs when subbase material is not granular in nature.

B. Flowable: Where noted.

C. Free-Draining: Where noted.

D. Earth: Other areas not previously specified.

3.07 PLACING FILL

A. Notify Engineer before placing fill material.

B. Do not use frozen material or place fill on frozen subgrade.

C. Place filter fabric where indicated in accordance with manufacturer’s recommendations.

D. Do not backfill until concrete is properly cured and has reached 85% of design strength, coatings approved, and required tests accepted.

E. Place fill against foundation walls enclosing interior spaces after construction such as cross-walls, beams, or slabs are in-place to brace wall and such construction has reached 85% of design strength.

F. Place fill simultaneously on both sides of free standing structures.

G. Do not operate power-operated earth moving equipment closer to foundation walls or other structures than distance equal to ½ height of fill above footing.

H. Begin compaction of each layer at structure wall to minimize lateral forces against structure due to wedging action of soil.

I. Stop backfill at specified grade to allow for placing topsoil or sidewalk or pavement subbase.

J. Place and compact fill materials in lift thickness and to densities listed.

1. Degree of compaction: ASTM D1557, Modified Proctor.
2. Moisture Content: Within 2% of optimum.

Location	Maximum Lift Thickness	Modified Proctor (%)
Footing, Foundation Slab, or Floor Slab Influence Zone	8 inches	95 minimum
Sidewalk, Pavement, Piping, or Electrical Duct Influence Zone	8 inches	95 minimum
Lawn and Landscaped Areas	12 inches	80 minimum, 90 maximum

K. Free-draining fill below tanks and foundations shall be compacted in max 8-in. lifts with min 10-ton smooth vibratory roller. Make a minimum of 3 passes in each direction. In areas not accessible to roller, compact with equipment acceptable to Engineer.

3.08 FIELD QUALITY CONTROL

A. Testing:

1. One field density test for each 100 cubic yards of structural fill, minimum one each lift.
2. One field density test for each 200 cubic yards of earth fill, minimum one each lift.
3. Determine in-place density of fill at maximum intervals specified in accordance with ASTM D1556, D2167, D2922 or D2937.

3.09 ADJUSTMENT AND CLEANING

A. Owner has first right to excess material suitable for backfilling or site grading, not used in Work. Place on site in location designated by Owner and grade to drain. Provide erosion control devices for spoils pile in accordance with Section 31 25 00.

B. Remove excess material not required by Owner, material not suitable for backfilling or site grading, and unsuitable materials from site. Conform to requirements of Section 01 57 19.

END OF SECTION

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SECTION 31 23 33
TRENCHING AND BACKFILL

PART 1 – GENERAL

1.01 SUMMARY

A. Trenching and backfilling to elevations shown on Drawings and as needed for installation of underground piping and utilities associated with Work and to meet requirements of Contract Documents.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. D1556: Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method
   2. D2167: Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
   3. D2937: Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method
   4. D6938: Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

B. Illinois Department of Transportation (IDOT):

   1. Standard Specifications for Road and Bridge Construction, Current Edition

1.03 DEFINITIONS

A. Influence Zone Under Foundations, Pavements, or Sidewalks: Area below foundation or pavement or sidewalk subbase bounded by 1 horizontal to 2 vertical slope extending outward from 1-foot beyond outer edge of foundation or pavement or sidewalk subbase.

B. Influence Zone Under Piping or Electrical Ducts: Area below limits bounded by line 6 in. below pipe or electrical duct and by 1 horizontal to 2 vertical slope extending outward from that line 1-foot beyond outer edge of pipe or duct.

C. Unsuitable Material: Topsoil, peat, organic soils, and materials containing slag, cinders, foundry sand, debris, and rubble or soil with less than required bearing capacity as determined by Engineer.

1.04 SUBMITTALS

A. Test Results.

   1. Compaction test results.
   2. Proctor test results.

B. Miscellaneous Submittals.

   1. Test results to verify fill materials and bedding and cover materials meet Specifications.

C. Submit in accordance with Section 01 33 00.

1.05 QUALITY ASSURANCE

A. Testing shall be provided by Contractor in accordance with Section 01 45 29 and this Section.

B. Where IDOT aggregate gradations are specified, aggregates shall be from IDOT approved sources.

C. Sheeting, shoring, and bracing shall conform to safety requirements of federal, state, and local agencies.

1.06 PROJECT / SITE CONDITIONS

A. Notify owners of above or below ground utilities encountered during trenching operations.

B. Cap and remove or relocate services in accordance with instructions of owners of such utilities.

C. Protect, support, and maintain conduits, wires, pipes or other utilities that are to remain in accordance with requirements of owners of such utilities.

D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

E. Maintain access to adjacent areas at all times.

PART 2 – PRODUCTS

2.01 SUBGRADE STABILIZING AGGREGATE

A. Subgrade stabilizing aggregate, if required shall be IDOT CA-1.

2.02 BEDDING MATERIALS

1. Plastic, Copper, Fiberglass or Reinforced Plastic Pipe, and Electrical Conduit or Ducts: IDOT gradation FA-1, FA-2, FA-5, FA-6, FA-10, or FA-21.
2. Other Pipe 18-inch diameter or less: IDOT gradation CA-11 or CA-13.
3. Other Pipe over 18-inch diameter: IDOT gradation CA-7.

2.03 COVER MATERIALS

A. Copper, Fiberglass or Reinforced Plastic Pipe and Electrical Conduit: IDOT gradation FA-1, FA-2, FA-5, FA-6, FA-10, or FA-21.
B. Other Piping: IDOT gradation CA-6 or CA-10.
C. Electrical Ducts: Structural Fill or Excavated Trench Material.
D. Bedding material may be substituted for cover material.

2.04 FILL MATERIALS

A. Structural Fill:
   1. IDOT gradation CA-6.
   2. IDOT gradation CA-2.

B. Excavated Trench Material:

1. Natural soils resulting from excavation of project trenches.
2. Free of topsoil, wood, peat, cinders, organic and deleterious matter or other rubbish.

C. Recycled Concrete Fill:
1. Obtained from existing concrete that will be removed during demolition.
2. Free of unsuitable materials (rebar, mesh, wood, etc.)
3. Crushed to meet IDOT CA-1, CA-6, or CA-7 gradations.

D. Flowable Fill (Controlled Low Strength Material): Said material, when used, shall meet IDOT Standard Specifications, Section 1019, Mix 1 per Article 1019.05.

2.05 GEOTEXTILE FABRIC

A. Porous non-woven fabric with multiple layers of randomly arranged fibers, min 4.0 ounce per square yard (typical).

B. Manufacturers:

1. Mirafi 140N by Mirafi, Inc.
2. Typar 340I by DuPont.
3. Supac 5P by Phillips Fibers Corp.
4. Propex 4545 by Amoco Fabrics Co.
5. Or Equal

C. Geotextile fabric shall conform to IDOT Standard Specifications Article 1080.02.

2.06 SHEETING, SHORING, AND BRACING

A. Type, design, detail, and installation of sheeting, shoring, and bracing shall be determined by and sole responsibility of Contractor.

2.07 SOURCE QUALITY CONTROL

A. Testing:

1. One sieve analysis, plasticity index, and uniformity coefficient for each source of structural fill.
2. One sieve analysis for each source of bedding material and cover material.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work such as areas loosened by frost action or softened by flooding or weather, or existence of unsuitable material. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Natural soils or fill softened by frost, flooding or weather shall be removed and replaced.

B. Remove unsuitable material from within trenches.

C. Stabilize trench bottom and replace unsuitable materials with subgrade stabilizing aggregate, if required.

D. If unsuitable materials or soft soils are encountered at the bottom of the trench, remove and replace with a foundation consisting of subgrade stabilizing aggregate. Unsuitable material removal and replacement shall extend the depth of the unsuitable material or 18 inches beneath the bedding layer, whichever is less. Install subgrade stabilizing aggregate in lifts no deeper than 12 inches.

E. Where placement of subgrade stabilizing aggregate will not provide an adequate foundation for laying pipe due to instability of existing materials and where ordered by Engineer, place geotextile fabric on top of unstable subgrade prior to placing subgrade stabilizing aggregate foundation. Geotextile fabric shall completely enclose foundation, bedding, and cover materials, and pipe.

3.03 SHEETING, SHORING, AND BRACING

A. Whenever necessary to prevent caving during excavation and to protect adjacent piping, structures, property, workers, and public, trenches shall be sheeted, shored, and braced.

B. When sheeting, shoring, and bracing is required, install to prevent soil from entering excavation below or through sheeting.

C. Remove sheeting, shoring, and bracing after backfilling, or when approved by Engineer as backfill is being placed.

D. Remove sheeting, shoring, and bracing in manner not damaging to facility or permitting voids within backfill.

E. Fill settled areas after sheeting, shoring, and bracing has been removed.

3.04 DEWATERING

A. Dewater excavation site prior to starting trenching and maintain groundwater minimum of 12 inches below bottom of trench. Dewatering system shall be of a sufficient size and capacity as required to control hydrostatic pressure on trench sides and bottom to allow material to be excavated, pipe installed and backfill placed, all in a dry condition.

B. Contactor is responsible for choosing method of groundwater control.

C. If Contactor chooses to use deep wells or well points, wells and well points shall be designed, installed, and operated to prevent removal of in-situ materials.

D. Drill, maintain, and abandon dewatering wells in accordance with federal, state, and local ordinances.

E. Contractor shall provide all power for dewatering.

F. Contractor is responsible for any required permits for the dewatering system and its operation.

G. Keep construction site free-draining. Keep trenches free of water.

H. Remove soil disturbed by pressure or flow of groundwater.

I. Maintain dewatering system to prevent uplifting of or damage to facilities.

J. Protect adjacent utilities, structures, and properties from damage resulting from dewatering operations.

K. Direct discharge of trench dewatering pumps to sediment traps before conveying to natural drainage channels or storm water drains.

3.05 EXCAVATION

A. Excavate to the lines, grades, and elevations indicated and necessary to complete construction.

B. Method of excavation shall be consistent with soil types encountered and result in undisturbed subgrade. Loosened soils shall be recompacted or removed and replaced.

C. Where possible, excavated materials shall be placed in areas that will not block existing vehicle and pedestrian traffic and drainageways.

D. Conduct excavating operations to carefully expose all in-place underground structures without damage. Wherever excavation extends under or approaches close to an existing structure, precautions and protective measures shall be taken as necessary to preserve the structure and provide temporary support. Use hand excavation methods to probe for and expose such critical or hazardous installations as gas pipe and power or communication cables.

E. Excavation of Rock:

1. Where rock, boulders, or similar material is encountered, and where such material cannot be removed or excavated by conventional earth moving or ripping equipment, remove or excavate such material by means which will neither cause additional cost to the Owner nor endanger buildings or structures on or off site.
2. Do not use explosives without written permission from Engineer.

F. Trench Tolerances:

1. Maximum width of trench at top of pipe shall be outside diameter of pipe plus 24 inches. When sheeting, shoring, and bracing required, width of trench may be increased to allow for their use, provided provisions for excess width of trench are met.
2. Where trench width below top of pipe exceeds specified limit, Contactor, at his expense, shall furnish pipe with strength adequate for actual trench width.
3. Minimum trench width shall be outside diameter of pipe plus 18 inches
4. Top of concrete encasement for electrical duct or top of conduit shall be minimum of 24-inches below final grade or as shown on Drawings.
5. Trench width at ground surface shall be the minimum allowable based on OSHA standards and soil types.

G. Do not advance excavation of trenches more than 300 feet ahead of completed pipe installation.

H. Do not excavate within influence zone of existing footings or foundations without prior approval of Engineer.

I. Excavation through Rigid Pavement:

1. Remove pavement a minimum of 1 foot beyond anticipated edge of excavation.
2. Saw cut pavement to ensure straight joint.
3. Pavement replacement shall match existing.

4. Removal of rigid pavements shall extend to the nearest existing joint and no partial panels will be allowed to remain (only full panels shall be removed and replaced).

J. Excavation, backfill, and pavement replacement of roadways shall conform to requirements of the Four Rivers Sanitation Authority. In no case shall the replacement pavement edges bear on less than 12 inches of undisturbed soil.

K. If unsuitable material is encountered within the excavated trench, remove and dispose of unsuitable material and replace with structural fill. Conform to the requirements of Section 01 57 19 for disposal of unsuitable materials.

3.06 FILL USAGE

A. Bedding Material Limits:

1. Electrical Ducts:

a. Hand grade bottom of trench to established uniform grade of not less than 4 inches / 100 feet.
b. Use bedding material to bring grade to desired elevation.

2. Bedding material shall be placed over entire width of trench bottom such that after pipe has been placed thereon, imbedded to grade and aligned, there remains a 6 inch minimum depth of material below pipe barrel and a minimum of 5 inches below the bell.
3. Bell holes shall be excavated so that entire pipe barrel rests on bedding.

B. Cover Material Limits:

1. Electrical Conduit: Minimum 6 inches above and 9 inches each side.
2. Piping: Minimum of 12 inches above top of pipe and 12 inches each side.

C. Structural Fill: Within trenches under pavements and sidewalks and within piping, electrical duct or structure influence zone.

D. Excavated Trench Material: Other areas not previously specified.

E. Flowable Fill: Where noted.

3.07 PLACING FILL

A. Notify Engineer before placing fill material.

B. Do not use frozen material or place fill on frozen subgrade.

C. Place filter fabric where indicated in accordance with manufacturer's recommendations.

D. Do not backfill until concrete is properly cured and has reached design strength, coatings approved, and required tests accepted.

E. Place fill simultaneously on both sides of freestanding structures.

F. Where pipes leave structures, protect by backfilling pipe influence zone down to undisturbed soil with bedding material.

G. Where pipes or electrical ducts cross, protect piping or ducts at higher elevation by backfilling trench within influence zone of higher pipe or duct with structural fill.

H. Where pipes or electrical ducts leave structures, protect by backfilling within influence zone of pipe or duct with structural fill.

I. Provide mechanical compaction. Jetting, flooding, puddling, or vibroflotaion methods shall not be used for compaction.

J. Place and compact bedding, cover and fill materials in lift thickness and to densities listed below:

1. Degree of compaction: ASTM D1557, Modified Proctor.
2. Moisture Content: Within 2% of optimum.

Location	Maximum Lift Thickness	Modified Proctor (%)
Bedding Material or Cover Material	6 inches	90 minimum
Fill material under Footing, Foundation Slab, or Floor Slab Influence Zone	8 inches	95 minimum
Fill material under Sidewalk, Pavement, Crushed Aggregate Base Course, Piping, or Electrical Duct Influence Zone	8 inches	95 minimum
Fill material under Lawn and Landscaped Areas	12 inches	80 minimum, 90 maximum

K. Backfill to 4 inches below finished grade in areas to receive topsoil.

L. Backfill to bottom of base course in areas to receive sidewalk or paving.

M. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

3.08 FIELD QUALITY CONTROL

A. Testing:

1. Bedding and cover material – Take one field density test per lift per 100 feet of trench.
2. Trench Backfill Material – Depth of Cover Less than 14 feet: Take two tests every 100 feet of trench. Test when trench has been backfilled halfway and when trench has been completely backfilled.
3. Trench Backfill Material – Depth of Cover Equal to or Greater than 14 feet: Take three tests every 100 feet of trench. Test when trench 1/3 and 2/3 backfilled and when completely backfilled.
4. Determine in-place density of fill at maximum intervals specified in accordance with ASTM D1556, D2167, D2937, or D6938.
5. Recompact and retest areas of backfill tested that did not meet minimum requirements.

3.09 ADJUSTMENT AND CLEANING

A. Stockpile material suitable for backfill where designated by Engineer. Place no fill where trenches for sewers, water line, or other utilities will be located.

B. Remove and dispose of all unsuitable excavated material.

C. Owner has first right to excess material suitable for backfilling or site grading, not used in Work. Place on site in location designated by Owner and grade to drain. Provide erosion control devices for spoils pile in accordance with Section 31 25 00.

D. Remove excess material not required by Owner, material not suitable for backfilling or site grading, and unsuitable materials from site. Conform to requirements of Section 01 57 19.

END OF SECTION

SECTION 31 25 00
EROSION CONTROL AND SITE STABILIZATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section describes requirements for control of erosion on construction sites. Contractor shall provide necessary materials, equipment, and labor to control erosion by methods specified herein. If no specific quantities are shown on Plans, Contractor shall use whatever quantities are necessary to prevent sediment transport into adjacent storm water conveyance systems or water bodies.

B. Section includes:

1. Silt Fence
2. Storm Sewer Inlet Protection
3. Mulching
4. Erosion Control Blanket
5. Temporary Seeding

1.02 REFERENCES

A. Illinois Department of Transportation (IDOT): Standard Specifications for Road and Bridge Construction, Current Edition

B. Illinois Urban Manual (IUM), Current Edition

1.03 PERMITS AND REGULATORY REQUIREMENTS

A. Prior to start of any earthwork, the following permits, authorizations, or approvals are required and will be obtained by Owner.

1. Notice of Coverage under the Illinois Environmental Protection Agency (IEPA) General NPDES Permit for Storm Water Discharges from Construction Site Activities

B. Comply with requirements of permits obtained by Owner.

C. Erosion control permits and place review approvals establish minimum erosion control measures required. Contractor shall implement additional erosion control measures as needed based on Contractor's work plan.

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

2.01 TOPSOIL

A. Friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and free from subsoil, roots, heavy or stiff clay, sand and gravel, stones larger than two inches in any dimension, noxious weeds, sticks, brush, litter, and other deleterious matter.

B. Acidity Range: pH 5.0 minimum, 7.0 maximum.

C. Reference IUM Material Specification 804.

2.02 FERTILIZER

A. Reference Section 32 92 00.

2.03 TEMPORARY SEEDING

A. Temporary seed shall conform to the requirements of Article 1081.15(g) of the IDOT Standard Specifications.

2.04 EROSION CONTROL MAT

A. Excelsior blanket conforming to the requirements of Article 1081.10(a) of the IDOT Standard Specifications.

2.05 STORM INLET PROTECTION

A. Inlet protection shall be a manufactured storm sewer insert such as Catch All by Marathon Materials, Dandy Bag by Dandy Products, or approved equal.

2.06 SILT FENCE

A. Geotextile fabric: meet the requirements of IUM Material Specification 592 – Geotextile, Table 1, Class 2.

B. Silt fence stakes and posts:
   1. Use either wooden stakes or steel posts for fence construction.
   2. Minimum length: 5 feet.
   3. Wooden posts: 2-inch x 2-inch nominal cross-sectional area.
   4. Steel posts: Standard U or T-section, minimum weight of 1.33 pounds per linear foot.
   5. Fasteners: staples, zip ties, or wire ties.

2.07 Water: Furnished in accordance with Section 01 52 00.

2.08 All other products shall be as specified in current version of Illinois Urban Manual.

PART 3 – EXECUTION

3.01 EROSION CONTROL REQUIREMENTS

A. All erosion control measures shall be implemented in accordance with IUM Practice Standards:

   1. Practice Standard 813: Dewatering
   2. Practice Standard 830: Erosion Control Blanket
   3. Practice Standard 861: Inlet Protection – Impervious Areas
   4. Practice Standard 862: Inlet Protection – Pervious Areas
   5. Practice Standard 875: Mulching for Seeding and Soil Stabilization

6. Practice Standard 920: Silt Fence
7. Practice Standard 927: Soil Stockpile
8. Practice Standard 965: Temporary Seeding

B. Post IEPA Notice of Permit Coverage on site and maintain until construction activities have ceased and the site is stabilized in the opinion of the Owner and Engineer. Keep a copy of the current erosion control plan on site throughout the duration of the project. Any revisions of to the erosion control plan shall be kept on site at all times.

C. Erosion control devices, disturbed areas of the site that have not achieved final stabilization, and locations where vehicles enter and exit the site shall be inspected by a qualified person at least once every seven (7) calendar days and following a storm event resulting in 0.5 inches or more of rain. Post-rain event inspections shall be completed within 24 hours of the end of the rain event, or by the end of the following work day.

D. Make needed repairs and document findings of inspections in a site erosion control log that includes the date of inspection, name of person conducting inspection, scope of the inspection, major observations relating to sediment and erosion control, and any actions taken.

E. Install perimeter erosion controls and stabilized construction entrance(s) prior to any land-disturbing activities, including clearing and grubbing.

F. Contractor shall not begin work until after initial erosion and sediment control devices are in place and approved by Engineer.

G. Contractor shall take all possible precautions to prevent sediment from being tracked onto public or private roadways. Any sediment reaching a public or private road shall be removed by street cleaning (not flushing) before end of each workday.

H. All activities on site shall be conducted in a logical sequence to minimize area of bare soil exposed at any one time.

I. Site stabilization measures shall be initiated whenever any clearing, grading, excavating, or other earth disturbing activities have permanently ceased on any portion of the site, or have temporarily ceased on any portion of the site and will not resume for a period exceeding 14 calendar days. Stabilization measures shall be initiated no later than one (1) working day after cessation of construction activities, except when stabilization is precluded by snow cover. Once initiated, stabilization measures shall be completed as soon as practicable, but no more than 14 days from the initiation of stabilization work in an area.

J. Immediately stabilize stockpiles and surround stockpiles as needed with silt fence or other perimeter control if stockpiles will remain inactive for 7 days or longer.

3.02 TEMPORARY SEEDING

A. All disturbed ground left inactive for 14 days or longer shall be stabilized by seeding or sodding (only prior to October 15) or by mulching or covering, or other equivalent control measure.

Between September 15 and October 15 stabilize with mulch, tackifier, and a perennial seed mixed with winter wheat, annual oats, or annual rye, as appropriate for region and soil type.

After October 15th, stabilize with a polymer and dormant seed mix, as appropriate for region and soil type.

B. Temporarily seed all areas of exposed soil that will not be brought to final grade or on which land-disturbing activities will not be performed for a period greater than 14 days.

C. Temporarily seed in accordance with IUM Practice Standard 965.

3.03 MULCHING

A. In accordance with IUM Practice Standard 875.

3.04 EROSION CONTROL BLANKET

A. Provide in accordance with IUM Practice Standard 830.

3.05 SILT FENCE

A. Silt fences shall be placed along all sideslope and downslope sides of site. If a channel or area of concentrated runoff passes through site, sediment control fences shall be placed along channel edges to reduce sediment reaching channel.

B. Install in accordance with IUM Practice Standard 920 and detail drawings.

C. Attach geotextile fabric to each post with a minimum of three (3) fasteners per post.

D. Remove sediment from behind silt fences and sediment barriers before sediment reaches a depth that is equal to one-third of the fence and/or barrier height.

3.06 STORM DRAIN INLET PROTECTION

A. Install inlet protection prior to land-disturbing activities in the contributing drainage area and/or immediately upon inlet installation.

B. Install device according to manufacturer's instructions.

C. The contributing drainage area to inlet protection device shall be one acre or less. In instances where a larger contributing drainage area exists, runoff shall be routed through a sediment trap or settling device upstream of inlet.

3.07 TEMPORARY SOIL STOKPILES

A. Erosion and sediment control measures are required for soil stockpiles to remain in place for more than 24 hours.

B. Soil stockpiles shall be located a minimum of 25 feet from any wetland, stream, creek, ditch, swale, water conveyance system, lake, pond, etc.

C. Perimeter sediment control, such as a silt fence, shall be installed on the down slope side of the stockpile prior to its creation. Perimeter protection shall be placed a minimum of 8 feet from the toe of the stockpile slope.

D. Provide erosion and sediment control measures in accordance with IUM Practice Standard 927.

3.08 DEWATERING

A. The Contractor shall make their own calculations and shall plan their work accordingly. Dewatering, surface water control, and temporary diversions shall be used to facilitate work "in the dry." Work shall not be allowed in wetlands, flowing water, or in standing water that can discharge directly to Waters of the U.S. or Isolated Waters of Lake County.

B. Contact owner or operator of municipal separate stormwater system if discharge is to municipal storm water conveyance system.

C. Select best management practice for sediment removal based on predominant soil texture encountered at dewatering site with consideration given to pumping or flow rates to prevent discharge of sediment to the maximum extent practical. General categories include:

1. Geotextile Bags
2. Gravity Based Settling Systems
3. Passive Filtration Systems
4. Pressurized Filtration Systems

D. Water pumped from site shall be treated by temporary sedimentation basins, grit chambers, sand filters, upslope chambers, hydro-cyclones, swirl concentrators, or other appropriate controls designed and used to remove particles of 100 microns or greater for highest dewatering pumping rate. If water is demonstrated to have no particles greater than 100 microns during dewatering operations, then no control is needed before discharge. Water may not be discharged in a manner that causes erosion of site or receiving channels.

E. In accordance with IUM Practice Standard 813.

END OF SECTION

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DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 – **GENERAL**

1.01 SUMMARY

A. Crushed aggregate base course as shown on the Drawings, as specified herein, and as needed for a complete and proper installation of paving items.

1.02 DEFINITIONS

A. IDOT Specifications: Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition.

B. ASTM: American Society for Testing and Materials

C. AASHTO: American Association of State Highway and Transportation Officials

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Source of Aggregates

C. Test Results of Quality Assurance Testing

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Aggregates shall be from IDOT approved sources.

B. Provide the following testing:

1. Aggregate Gradation in accordance with AASHTO T 27

PART 2 – **PRODUCTS**

2.01 AGGREGATE BASE COURSE

A. IDOT gradation CA-6

B. IDOT gradation CA-2
1. If IDOT gradation CA-2 is utilized, the aggregate base course layer shall be capped with a minimum 3-inch thick layer of IDOT gradation CA-6.

PART 3 – **EXECUTION**

3.01 PREPARATION

A. Conform to requirements of Section 31 22 00.

3.02 DELIVERY, STORAGE, AND HANDLING

A. Adjust weight, type, capacity, haul routes, and method of operation of hauling vehicles such that there is no damage to existing streets, subgrade, or base course.

B. Owner has final authority to designate haul routes, procedures, and operation times

3.03 INSTALLATION

A. Maximum compacted thickness of layer shall not exceed 6 inches.

B. Deposit material on foundation or previously placed layer to minimize segregation and facilitate spreading to uniform layer.

C. Compact after each layer has been placed and spread to thickness, width, and contour to 95% of maximum density (Standard Proctor), in accordance with ASTM D-1557, before succeeding layer is placed.

3.04 FIELD QUALITY CONTROL

A. Check in-place base course for surface irregularities and repair unacceptable areas.

END OF SECTION

SECTION 32 12 16
ASPHALT PAVING

PART 1- GENERAL

1.01 SUMMARY

A. Provide asphalt pavement where shown on Drawings, as specified herein, and as needed for a complete and proper installation.

B. Asphalt Pavement thickness:
   1. Binder Course: 4 inches
   2. Surface Course: 2 inches

1.02 DEFINITIONS

A. IDOT Specifications: Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, Current Edition, including Supplemental Specifications and Recurring Special Provisions and Highway Standards

B. ASTM: American Society for Testing and Materials

C. AASHTO: American Association of State Highway and Transportation Officials

1.03 SUBMITTALS

A. General:

   1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Source of Aggregates showing use on previous local Department of Transportation Projects.

C. Asphalt Mix Design, including aggregate gradation, showing use on previous local Department of Transportation Projects.

D. Test Results of Quality Assurance Testing

E. Submit in accordance with Section 01 33 00.

1.04 QUALITY CONTROL AND ASSURANCE

A. Quality Control shall be completed by the Contractor in accordance with IDOT Standard Specifications Article 1030.05(d). Quality Control is the responsibility of the Contractor.

B. Asphalt supplier shall have a minimum of 5 years of experience producing asphalt mixes for the Department of Transportation.

C. Do not commence placement of asphalt until mix design has been reviewed and approved by Engineer.

D. Perform the following testing during asphalt mix production and placement:

1. Aggregate Gradation in accordance with AASHTO T 27
2. Asphalt Content.
3. Air Voids by calculation in accordance with AASHTO T 269.
4. Voids in Mineral Aggregate (VMA) by calculation in accordance with AASHTO R 35.
5. Density testing in accordance with AASHTO T 99.

E. Frequency of testing for Aggregate Gradation, Asphalt Content, Air Voids, and VMA:

Total Daily Production per mix design for Contract (tons)	Samples per Day (minimum)
50 - 600	1
601 to 1500	2
Greater than 1501	3

F. Frequency for density testing:

Total Placement per Mix Design (tons)	Tests Required (minimum)
0 to 750	Not Required
Greater than 751	5 tests per 1500 tons or portion thereof.

1. At a minimum, one set of density tests must be completed per half-day of production.

2. Additional density testing may be ordered beyond these requirements by the Engineer.

G. Testing shall be provided by Contractor in accordance with Section 01 45 29 and this section.

PART 2 - PRODUCTS

2.01 PAVEMENT MATERIALS

A. Aggregate:

1. Furnish coarse aggregate from IDOT approved sources.

2. Aggregate for Bituminous Binder:

a. Sound, angular crushed stone, crushed gravel, or crushed slag, sand, stone or slag screenings.
b. Gradation: Well graded between limits specified and shall conform to IDOT Specifications Article 1004.03 for HMA Binder Course, IL-19.0, N50.

4. Aggregate for Bituminous Surface:

a. Crushed stone, crushed gravel, crushed slag, and sharp-edged natural sand.
b. Sand prepared from stone, blast-furnace slag, gravel, or combinations thereof may be used if required to suit local material availability.
c. Gradation: Well graded between limits specified and shall conform to IDOT Specifications Article 1004.03 for HMA Surface Course, IL-9.5.

5. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with ASTM D242.

B. Bituminous Materials:

1. Asphalt Binder: Penetration Grade PG 64-22 in accordance with ASTM D946.

C. Mix Design:

Mixture Use	Surface Course	Binder Course
Asphalt Binder	PG 64-22	PG 64-22
Design Air Voids	4.0 @ N50	4.0 @ N50
Mixture Composition (Gradation Mixture)	IL 9.5	IL 19.0
Friction Aggregate	Mix "C"	N/A
Unit Weight	112 lbs/square yard/inch	112 lbs/square yard/inch

D. Prime Coat and Tack Coat

1. Bituminous material meeting one of the types listed in IDOT Standard Specifications, Article 406.02.

E. Recycled Asphalt Pavement

1. Stockpile recycled asphalt pavement separately from virgin materials and list each as individual job mix formula components.

2. Conform to the following maximum allowable percent binder replacement (ratio of recovered binder to total binder):

a. Binder Course: 25%
b. Surface Course: 15%

PART 3 - EXECUTION

3.01 WEATHER LIMITATION

A. Apply prime and tack coats when ambient temperature is above 40 degrees Fahrenheit. Do not apply when base is wet or contains standing water.

B. Place asphalt material when atmospheric temperature is above 40 degrees Fahrenheit and rising, and when base is dry.

C. Do not place asphalt material on frozen subgrade or base.

3.02 PREPARATION

A. Check base course for soundness, outline, and contour. Prepare base course for areas to be paved by scraping down or filling irregularities. Compact base course prior to paving.

B. Proof roll prepared aggregate base course to check for unstable areas and areas requiring additional compaction. Make multiple passes to test entire area to be paved. Remove and

replace any area where displacement in base (yielding, heaving, cracking or other signs of stability), in opinion of Engineer, is more than 1 inch under a fully-loaded tandem-axle dump truck. Excavate and backfill displaced area with new base material, properly compacted and retested. Do not begin paving work until deficient areas have been corrected.

C. Prime Coat:

1. Apply at rate of 0.25 pounds per square foot over compacted aggregate base.
2. Apply material to penetrate and seal, but not flood, surface.
3. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

D. Tack Coat:

1. Apply to contact surfaces of previously paved surfaces abutting or projecting into areas to be paved.
2. Apply to surface free of loose dirt, dust or other foreign matter.
3. Apply at a rate of 0.025 pounds per square foot of surface.
4. Apply only to areas expected to be paved in the same day.
5. Allow to dry prior to paving.
6. Avoid tracking or smearing bituminous materials onto adjoining surfaces. Remove material tracked or smeared to adjoining surfaces.

3.03 DELIVERY, STORAGE, AND HANDLING

A. Transport asphalt materials in covered trucks during rainy weather and when air temperature falls below 65 degrees F.

B. Adjust weight, type, capacity, haul routes, and method of operation of hauling vehicles such that no damage results to existing streets, subgrade, or base course.

C. Owner has final authority to designate haul routes, procedures, and operation times.

3.04 PLACING ASPHALT MIX

A. Place asphalt mixture on prepared surface, spread, and strike-off. Spread mixture at a temperature within 20 degrees Fahrenheit of temperature the asphalt material supplier recommends.

B. Place using a self-propelled paver to ensure uniform spreading and strike-off of mix. Provide a smooth mixture free of tearing and segregation. Place mixture to required grade, cross-section, and compacted thickness.

C. Place inaccessible and small areas by hand. Place mixture to required grade, cross-section, and compacted thickness.

D. Joints: Place asphalt continuously to limit the number of joints. Make joints between old and new pavements and between successive days' work, to ensure continuous bond between adjoining work. Clean contact surfaces and apply tack coat. Construct joints to have same texture, density, and smoothness as other sections of asphalt pavement.

3.05 COMPACTION

A. Compact asphalt mix while still hot. Compact each layer by uniformly rolling.

B. In small areas not accessible by a roller, compact using mechanical tampers.

C. Compact until no further consolidation is visible under action of the compaction equipment.

D. Keep roller wheels moistened to avoid sticking.

E. Hot-mix asphalt shall be compacted to the Density Control Limits specified in IDOT Standard Specifications Article 1030.05(d)(4). Do not re-roll compacted mixtures falling below required densities. If densities fall below the required densities, stop placement and identify and correct problem.

3.06 FIELD QUALITY CONTROL

A. Pavement Testing:

1. General: Test in-place asphalt courses for compliance with requirements for surface smoothness and thickness. Repair or remove and replace unacceptable paving.

1. Thickness Tolerance: In-place compacted thickness will not be acceptable if actual thickness exceeds the following allowable variation from required thickness:

a. Binder Course: 1/4 inch.
b. Surface Course: 1/8 inch.

3. Surface Smoothness Tolerances: Test finished surface of each asphalt concrete course for smoothness, using 10 foot straight edge applied parallel with, and at right angles to, the centerline of paved area. Surfaces will not be acceptable if deviations exceed 1/8 inch.

END OF SECTION

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SECTION 32 13 13
CONCRETE PAVING

PART 1 – GENERAL

1.01 SUMMARY

A. Provide Portland cement concrete paving including form work and reinforcement, base materials with compaction, where shown on Drawings, as specified herein, and as needed for a complete and proper installation. Provide pavement markings where shown on the Drawings and specified herein.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. AASHTO: American Association of State Highway and Transportation Officials

C. CRSI: Concrete Reinforcing Steel Institute

D. NRMCA: National Ready Mixed Concrete Association

E. IDOT: Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, Current Edition including Supplemental Specifications and Recurring Special Provisions and Highway Standards

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this section.

B. Product Data:

1. Verification of concrete mix design.

C. Test Results:

1. Tests indicating compliance of reinforcement with referenced standards.
2. Concrete test results.
3. Base material test results.
4. Concrete delivery tickets: With each load of concrete delivered, provide duplicate tickets, one for Contractor, one for Engineer, with following information.

a. Serial number of ticket.
b. Date and truck number.
c. Name of supplier.
d. Class of concrete.
e. Type of cement and cement content in bags/cubic yard.
f. Admixture brand names.
g. Aggregate size.
h. Time loaded.
i. Amount of concrete in load.
j. Gallons of water added at site and slump of concrete after addition of water.

k. Temperature of concrete at delivery.
l. Time unloaded.

5. Certified reports of field tests and observations.

D. PCC Quality Control Plan.

E. Submit in accordance with Section 01 33 00.

1.04 QUALITY CONTROL AND ASSURANCE

A. Plant Certification: Plant or concrete supplier shall comply with requirements of NRMCA certification plan as regards material storage and handling, batching equipment, central mixer, truck mixers with counters, agitators, nonagitating units, and ticketing system.

B. PCC Quality Control Plan: A PCC Quality Control Plan shall be prepared by the Contractor and submitted to the Engineer for review and approval prior to any PCC pavement work. All Quality Control and Quality Assurance testing shall follow the requirements of IDOT Check Sheet #25, *Recurring Special Provision for Quality Control / Quality Assurance of Concrete Mixtures.*

C. Do not commence placement of concrete until mix designs have been reviewed and approved by Engineer.

D. Concrete Testing: Testing shall be provided by Contractor in accordance with Section 01 45 29 and this Section.

1. Conduct tests on sample material in accordance with methods listed below:

a. Slump: ASTM C143.
b. Air-Entrainment: ASTM C231.
c. Compressive Strength: ASTM C31 and ASTM C39.

E. Quality Control is the responsibility of the Contractor.

PART 2 – **PRODUCTS**

2.01 BASE MATERIAL

A. Aggregate Base Courses in accordance with Section 32 11 23.

2.02 FORMS

A. Construct forms to exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, and level and plumb work in finished concrete. All forms must be inspected and approved by Engineer, prior to placement of concrete.

B. Forms shall be straight and of sufficient strength to resist pressure of concrete without bending, tipping, or other deformation. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

C. Forms shall not be removed from freshly placed concrete until it has hardened sufficiently to resist spalling, cracking or any other damage.

D. Slip form machines may be used provided sidewalk can be constructed to the requirements of specifications.

2.03 REINFORCEMENT

A. Welded Wire Reinforcement and Tie Bars: Comply with IDOT Standard Specifications Article 1006.10.

B. Dowel Bars and Dowel Bar Assemblies: Comply with IDOT Standard Specifications Article 1006.11.

2.04 CONCRETE

A. Class PV per IDOT Standard Specifications Article 1020.

2.05 OTHER MATERIALS

A. Curing Compounds: Comply with IDOT Standard Specifications Article 1022.

B. Preformed Expansion Joint Material: Comply with IDOT Standard Specifications Article 1051.09.

C. Joint Sealer: Hot-poured joint sealer per IDOT Standard Specifications Article 1050.02.

D. Pavement Markings: Epoxy or preformed thermoplastic per IDOT Standard Specifications Article 1095.

PART 3 – EXECUTION

3.01 PREPARATION

A. Place base material in accordance with Section 32 11 23.

B. Check base course outline, and contour. Scrape down or fill irregularities.

C. Compact base course prior to paving.

D. Set castings and frames of manholes, catch basins, etc. to required alignment and grade. Hand vibrate concrete adjacent to structures.

E. Remove foreign matter accumulated in formwork. Forms may be oiled, if necessary.

F. Dispose of excavated material as specified in Section 31 22 00.

3.02 JOINTS

A. Type, location, and spacing:
   1. Install pavement joints as indicated on the Drawings and in accordance with IDOT Highway Standard *420101-06 24' Jointed PCC Pavement*.
   2. Provide expansion joints where new concrete abuts rigid structures.
   3. Provide roundouts at manholes and other castings within pavement limites in accordance with IDOT Highway Stadard *420111-04: PCC Pavement Roundouts.*

B. Install in accordance with IDOT Standard Specifications Article 420.05.

C. Seal all longitudinal joints with hot-poured joint sealer in accordance with Article 420.12 of the IDOT Standard Specifications. Prior to sealing, all joints shall be cleaned of foreign material, including curing compound.

3.03 MIXING AND DELIVERY

A. Use ready mixed concrete conforming to ASTM C94.

B. Deliver and complete discharge within 1-1/2 hours of commencing of mixing. Limitations may be waived by Engineer if concrete slump, after 1-1/2 hours, is sufficient so that concrete can be placed without addition of water. In hot weather, time criteria may be reduced by Engineer.

C. Do not use concrete that has stood for over 30 minutes after leaving the mixer.

3.04 CONVEYING CONCRETE

D. Perform concrete placement at such a rate that concrete which is being integrated with fresh concrete is still plastic.

E. Deposit concrete as nearly as practicable in its final location so as to avoid separation due to rehandling and flowing.

F. Do not use concrete which becomes non-plastic and unworkable, does not meet required quality control limits, or has been contaminated by foreign materials.

G. Remove rejected concrete from job site.

3.05 CONCRETE PLACEMENT

A. Place in accordance with IDOT Standard Specifications Article 420. PCC pavement may be placed via form or slip form method.

B. Deposit concrete in a continuous operation, within limits of construction joints, until placing of a section is complete.

C. Consolidate concrete immediately after placing by use of internal concrete vibrators supplemented by hand spading, rodding, or tamping.

D. Do not vibrate forms or reinforcement.

E. Do not use vibrators to transport concrete inside the forms.

F. Bring surfaces to correct level with straightedge, and then strike off.

G. Use bullfloats or darbies to smooth surface, leaving surface free from bumps and hollows.

3.06 REINFORCEMENT

A. Irregular pavement panels that are within intersections and/or along curves shall be reinforced with welded wire reinforcement. Provide welded wire reinforcement in accordance with IDOT Highway Standard *42701-03: Pavement Welded Wire Reinforcement* (Type A) and Article 420.08 of the IDOT Standard Specifications.

3.07 CONCRETE FINISHING

A. Check concrete pavement with 10-foot straight edge. For areas showing irregularities of 0.25 inches or more cut down high areas or fill depressions with freshly mixed concrete and strike off, consolidate and refinish concrete Do not add water to correct surface deficiencies.

B. Final finish shall be Type B according to Article 420.09(e)(2) of the IDOT Standard Specifications.

C. Apply curing compound to all exposed surfaces immediately after finishing operations have been completed and surface water has disappeared.

3.08 PROTECTION FROM FREEZING

A. These provisions shall be followed when the atmospheric temperature is 35°F, or is expected to drop below 35°F during the curing period.

B. Heating of aggregates and water:

1. Concrete temperature shall be at least 50°F and not more than 80°F at the time of placing.
2. Heating equipment or methods which alter or prevent the entrainment of the required amount of air in the concrete shall not be used.
3. The equipment shall be capable of heating the materials uniformly.
4. Neither aggregates nor water used for mixing shall be heated to a temperature exceeding 150°F.
5. Materials containing frost or lumps of frozen material shall not be used.
6. When either aggregates or water are heated to 100°F, they shall be combined first in the mixer before cement is added.

C. Immediately after a pour is completed, the freshly placed concrete and forms shall be covered so as to form a protective enclosure and the air in the enclosure kept at a temperature above 50°F for at least 72 hours.

3.09 PAVEMENT MARKINGS

A. Install in accordance with IDOT Standard Specifications Article 780.

3.10 FIELD QUALITY CONTROL

A. All Quality Control and Quality Assurance testing shall follow the requirements of IDOT Check Sheet #25, *Recurring Special Provision for Quality Control / Quality Assurance of Concrete Mixtures.*

B. If tests verify work in-place is not in conformance with Specifications, Engineer will determine if work in-place is adequate for intended use. If work in-place is determined to be inadequate, Contractor shall follow such remedial or replacement measures which Engineer may require. Contractor shall bear costs associated with testing, engineering analysis, remedial work, and replacement required under terms of this paragraph.

END OF SECTION

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SECTION 32 16 13
CURBS AND GUTTERS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide portland cement concrete curb and gutter, including form work and reinforcement, base materials with compaction, where shown on the Drawings, as specified herein, and as needed for a complete and proper installation of curb or curb turnouts, combination curb and gutter, combined curb and gutter turnouts, or resetting curb and gutter.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. AASHTO: American Association of State Highway and Transportation Officials

C. CRSI: Concrete Reinforcing Steel Institute

D. NRMCA: National Ready Mixed Concrete Association

E. IDOT: Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, Current Edition, including Supplemental Specifications and Recurring Special Provisions and Highway Standards

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this section.

B. Product Data:

1. Verification of concrete mix design.

C. Test Results:

1. Tests indicating compliance of reinforcement with referenced standards.
2. Concrete test results.
3. Concrete delivery tickets: With each load of concrete delivered, provide duplicate tickets, one for Contractor, one for Engineer, with following information.

a. Serial number of ticket.
b. Date and truck number.
c. Name of supplier.
d. Class of concrete.
e. Type of cement and cement content in bags/cubic yard.
f. Admixture brand names.
g. Aggregate size.
h. Time loaded.
i. Amount of concrete in load.
j. Gallons of water added at site and slump of concrete after addition of water.
k. Temperature of concrete at delivery.

l. Time unloaded.

4. Certified reports of field tests and observations.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Plant Certification: Plant or concrete supplier shall comply with requirements of NRMCA certification plan as regards material storage and handling, batching equipment, central mixer, truck mixers with counters, agitators, nonagitating units, and ticketing system.

B. Do not commence placement of concrete until mix designs have been reviewed and approved by Engineer.

C. Concrete Testing: Testing shall be provided by Contractor in accordance with Section 01 45 29 and this Section.

1. Conduct tests on sample material in accordance with methods listed below:

a. Slump: ASTM C143.
b. Air-Entrainment: ASTM C231.
c. Compressive Strength: ASTM C31 and ASTM C39.

PART 2 – PRODUCTS

2.01 BASE MATERIAL

A. Crushed Aggregate Base Course in accordance with Section 32 11 23.

2.02 FORMS

A. Construct forms to the exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, and level and plumb work in the finished concrete. All forms must be inspected and approved by the Engineer or his authorized representative, prior to placement of concrete.

B. Forms shall be straight and of sufficient strength to resist the pressure of the concrete without bending, tipping, and other deformation. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

C. Forms shall not be removed from freshly placed concrete until it has hardened sufficiently to resist spalling, cracking or any other damage.

D. Curb Machines may be used to construct curb provided the curb can be constructed to the requirements of the specifications.

2.03 REINFORCEMENT

A. Comply with the following as minimums:

1. Tie Bars: AASHTO M31M, Grade 300 or 400.

B. Do not use reinforcement having any of the following defects:

1. Bar lengths, depths, or bends exceeding the specified fabricating tolerances.
2. Bends or kinks not indicated on the Drawings or required for this Work.
3. Bars with cross-section reduced due to excessive rust or other causes.

2.04 CONCRETE

A. Class SI per IDOT Standard Specifications Article 1020.04.

2.05 OTHER MATERIALS

A. Curing Compounds:

1. Membrane Curing Compounds shall be in accordance with AASHTO M148, Type 2.

B. Preformed Expansion Joint Material:

1. Shall meet the requirements of ASTM D 1751.
2. Shall be 1/2 inch thick and premolded.
3. Shall be in accordance with the cross-section of the curb and gutter on the plans.

PART 3 – **EXECUTION**

3.01 PREPARATION

A. Place base aggregate in accordance with Section 32 11 23.

B. Check base course outline, and contour. Scrape down or fill irregularities.

C. Compact base course prior toconstructing curb.

D. Remove foreign matter accumulated in formwork. Forms may be oiled, if necessary.

E. Where new curb abuts existing curb, place two (2) 12-inch tie bars, 6 inches into existing curb. Do not place tie bars in curb head.

3.02 MIXING CONCRETE

A. Transit mix the concrete in accordance with provisions of ASTM C 94.

B. Deliver and complete discharge within 1-1/2 hours of commencing of mixing. Limitations may be waived by Engineer if concrete slump, after 1-1/2 hours, is sufficient so that concrete can be placed without addition of water. In hot weather, time criteria may be reduced by Engineer.

C. Do not use concrete that has stood for over 30 minutes after leaving the mixer.

3.03 CONVEYING CONCRETE

A. Perform concrete placement at such a rate that concrete which is being integrated with fresh concrete is still plastic.

B. Deposit concrete as nearly as practicable in its final location so as to avoid separation due to rehandling and flowing.

C. Do not use concrete which becomes non-plastic and unworkable, does not meet required quality control limits, or has been contaminated by foreign materials.

D. Remove rejected concrete from job site.

3.04 CONCRETE PLACEMENT

A. Deposit concrete in a continuous operation, within limits of construction joints, until placing of a section is complete.

B. Consolidate concrete immediately after placing, by use of internal concrete vibrators supplemented by hand spading, rodding, or tamping.

C. Do not vibrate forms or reinforcement.

D. Do not use vibrators to transport concrete inside the forms.

E. Bring surfaces to correct level with straightedge, and then strike off.

F. Use bullfloats or darbies to smooth surface, leaving surface free from bumps and hollows.

3.05 CONCRETE FINISHING

A. While concrete is still plastic, check curb and gutter with 10-foot straight edge. For areas showing irregularities of 0.25 inches or more cut down high areas or fill depressions with freshly mixed concrete and strike off, consolidate and refinish concrete. Do not add water to correct surface deficiencies.

B. Provide a light broom finish perpendicular to direction of travel.

C. Expansion and control joints:

1. Expansion Joints shall extend the entire width of the curb and gutter, at intervals not to exceed 300 feet. Expansion joints shall be installed the full depth of concrete curb and gutter at all construction joints and where the curb and gutter abuts castings, begins a curve, or abuts other rigid structures. Expansion joints shall be placed perpendicular to the face and top of curb.

2. Control Joints:

a. Except as otherwise directed, control joint spacing to be at maximum intervals of 16 feet.
b. Make formed control joints not less in depth than 1/4 the curb height, using a 0.25 inch radius jointing tool.
c. Make sawed control joints not less than 2 inches deep within 24 hours after concrete placement.

D. All edges shall be finished with a 0.25 inch radius edging tool.

E. Curing Compound shall be applied to all exposed surfaces immediately after finishing operations have been completed and surface water has disappeared.

3.06 PROTECTION FROM FREEZING

A. These provisions shall be followed when the atmospheric temperature is 35°F, or is expected to drop below 35°F during the curing period.

B. Heating of aggregates and water:

1. Concrete temperature shall be at least 50°F and not more than 80°F at the time of placing.

2. Heating equipment or methods which alter or prevent the entrainment of the required amount of air in the concrete shall not be used.
3. The equipment shall be capable of heating the materials uniformly.
4. Neither aggregates nor water used for mixing shall be heated to a temperature exceeding 150°F.
5. Materials containing frost or lumps of frozen material shall not be used.
6. When either aggregates or water are heated to 100°F, they shall be combined first in the mixer before cement is added.

C. Immediately after a pour is completed, the freshly placed concrete and forms shall be covered so as to form a protective enclosure and the air in the enclosure kept at a temperature above 50°F for at least 72 hours.

3.07 FIELD QUALITY CONTROL

A. All Quality Control and Quality Assurance testing shall follow the requirements of IDOT Check Sheet #24, *Recurring Special Provision for Quality Control / Quality Assurance of Concrete Mixtures.*

B. If tests verify Work in-place is not in conformance with Specifications, Engineer will determine if Work in-place is adequate for intended use. If Work in-place is determined to be inadequate, Contractor shall follow such remedial or replacement measures which Engineer may require. Contractor shall bear costs associated with testing, engineering analysis, remedial work, and replacement required under terms of this paragraph.

END OF SECTION

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SECTION 32 16 23
SIDEWALKS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide Portland cement concrete sidewalk including form work and reinforcement, base materials with compaction, where shown on Drawings, as specified herein, and as needed for a complete and proper installation.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. CRSI: Concrete Reinforcing Steel Institute

C. NRMCA: National Ready Mixed Concrete Association

A. IDOT: Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, Current Edition, including Supplemental Specifications and Recurring Special Provisions and Highway Standards

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this section.

B. Product Data:

1. Verification of concrete mix design.

C. Test Results:

1. Tests indicating compliance of reinforcement with referenced standards.
2. Concrete test results.
3. Base material test results.
4. Concrete delivery tickets: With each load of concrete delivered, provide duplicate tickets, one for Contractor, one for Engineer, with following information.

a. Serial number of ticket.
b. Date and truck number.
c. Name of supplier.
d. Class of concrete.
e. Type of cement and cement content in bags/cubic yard.
f. Admixture brand names.
g. Aggregate size.
h. Time loaded.
i. Amount of concrete in load.
j. Gallons of water added at site and slump of concrete after addition of water.
k. Temperature of concrete at delivery.
l. Time unloaded.

5. Certified reports of field tests and observations.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Plant Certification: Plant or concrete supplier shall comply with requirements of NRMCA certification plan as regards material storage and handling, batching equipment, central mixer, truck mixers with counters, agitators, nonagitating units, and ticketing system.

B. Do not commence placement of concrete until mix designs have been reviewed and approved by Engineer.

C. Concrete Testing: Testing shall be provided by Contractor in accordance with Section 01 45 29 and this Section.

1. Conduct tests on sample material in accordance with methods listed below:

a. Slump: ASTM C143.
b. Air-Entrainment: ASTM C231.
c. Compressive Strength: ASTM C31 and ASTM C39.

PART 2 – **PRODUCTS**

2.01 BASE MATERIAL

A. Aggregate Base Course in accordance with Section 32 11 23. Base course beneath sidewalks shall be 2 inches thick.

2.02 FORMS

A. Construct forms to exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, and level and plumb work in finished concrete. All forms must be inspected and approved by Engineer, prior to placement of concrete.

B. Forms shall be straight and of sufficient strength to resist pressure of concrete without bending, tipping, or other deformation. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

C. Forms shall not be removed from freshly placed concrete until it has hardened sufficiently to resist spalling, cracking or any other damage.

D. Slip form machines may be used provided sidewalk can be constructed to the requirements of specifications.

2.03 CONCRETE

A. Class SI mix per Article 1020.04 of the IDOT Standard Specifications.

2.04 OTHER MATERIALS

A. Curing Compounds:

1. AASHTO M148, Type 2.

B. Preformed Expansion Joint Material:

1. Meet requirements of ASTM D 1751.
2. One-half (1/2) inch thick and premolded.

PART 3 – EXECUTION

3.01 PREPARATION

A. Place base material in accordance with Section 32 11 23.

B. Check base course outline, and contour. Scrape down or fill irregularities.

C. Compact base course prior to paving.

D. Set castings and frames of manholes, catch basins, etc. to required alignment and grade. Hand vibrate concrete adjacent to structures.

E. Remove foreign matter accumulated in formwork. Forms may be oiled, if necessary.

F. Dispose of excavated material as specified in Section 31 22 00.

3.02 MIXING AND DELIVERY

A. Use ready mixed concrete conforming to ASTM C94.

B. Deliver and complete discharge within 1-1/2 hours of commencing of mixing. Limitations may be waived by Engineer if concrete slump, after 1-1/2 hours, is sufficient so that concrete can be placed without addition of water. In hot weather, time criteria may be reduced by Engineer.

C. Do not use concrete that has stood for over 30 minutes after leaving the mixer.

3.03 CONVEYING CONCRETE

A. Perform concrete placement at such a rate that concrete which is being integrated with fresh concrete is still plastic.

B. Deposit concrete as nearly as practicable in its final location so as to avoid separation due to rehandling and flowing.

C. Do not use concrete which becomes non-plastic and unworkable, does not meet required quality control limits, or has been contaminated by foreign materials.

D. Remove rejected concrete from job site.

3.04 CONCRETE PLACEMENT

A. Deposit concrete in a continuous operation, within limits of construction joints, until placing of a section is complete.

B. Consolidate concrete immediately after placing by use of internal concrete vibrators supplemented by hand spading, rodding, or tamping.

C. Do not vibrate forms or reinforcement.

D. Do not use vibrators to transport concrete inside the forms.

E. Bring surfaces to correct level with straightedge, and then strike off.

F. Use bullfloats or darbies to smooth surface, leaving surface free from bumps and hollows.

3.05 CONCRETE FINISHING

A. Check sidewalk with 10-foot straight edge. For areas showing irregularities of 0.25 inches or more cut down high areas or fill depressions with freshly mixed concrete and strike off, consolidate and refinish concrete Do not add water to correct surface deficiencies.

B. Provide a light broom finish perpendicular to direction of travel.

C. Expansion joints:

1. Extend entire width of sidewalk, at intervals not to exceed 50 feet.
2. Install full depth of sidewalk.
3. Install at all construction joints and where sidewalk abuts castings or other rigid structures.
4. Place expansion joints perpendicular to sidewalk.

D. Control Joints:

1. Spacing:
   a. Typical intervals of 5 feet.
   b. Maximum intervals of 8 feet.

2. Formed control joints:

   a. Depth of not less than 1/4 the sidewalk depth
   b. Use 0.25 inch radius jointing tool.

3. Sawed joints:

   a. Not less than 2 inches deep
   b. Make within 24 hours after concrete placement.

E. Finish all edges with 0.25 inch radius edging tool.

F. Apply curing compound to all exposed surfaces immediately after finishing operations have been completed and surface water has disappeared.

3.06 PROTECTION FROM FREEZING

A. These provisions shall be followed when the atmospheric temperature is 35°F, or is expected to drop below 35°F during the curing period.

B. Heating of aggregates and water:

1. Concrete temperature shall be at least 50°F and not more than 80°F at the time of placing.
2. Heating equipment or methods which alter or prevent the entrainment of the required amount of air in the concrete shall not be used.
3. The equipment shall be capable of heating the materials uniformly.
4. Neither aggregates nor water used for mixing shall be heated to a temperature exceeding 150°F.
5. Materials containing frost or lumps of frozen material shall not be used.
6. When either aggregates or water are heated to 100°F, they shall be combined first in the mixer before cement is added.

C. Immediately after a pour is completed, the freshly placed concrete and forms shall be covered so as to form a protective enclosure and the air in the enclosure kept at a temperature above 50°F for at least 72 hours.

3.07 FIELD QUALITY CONTROL

A. All Quality Control and Quality Assurance testing shall follow the requirements of IDOT Check Sheet #25, *Recurring Special Provision for Quality Control / Quality Assurances of Concrete Mixtures.*

B. If tests verify Work in-place is not in conformance with Specifications, Engineer will determine if Work in-place is adequate for intended use. If Work in-place is determined to be inadequate, Contractor shall follow such remedial or replacement measures which Engineer may require. Contractor shall bear costs associated with testing, engineering analysis, remedial work, and replacement required under terms of this paragraph

END OF SECTION

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SECTION 32 92 00
TURF AND GRASSES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Preparing ground surface.
2. Seed.
3. Fertilizer.
4. Maintenance.

B. Except for paved, riprapped, or built-up areas, all areas of site which are disturbed and areas noted on Drawings shall be seeded or sodded.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.
2. Mix analysis and names of seed mixes.

B. Test Results:

1. Topsoil test results including fertilizer and lime requirements.

C. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Meet or exceed specifications of Federal, State, and local laws requiring inspection for plant disease and insect control.

B. Seed shall conform to U.S. Department of Agriculture Rules and Regulations under Federal Seed Act and requirements of state seed laws.

C. Contractor shall engage certified soils testing laboratory to perform a soils evaluation of existing and/or imported topsoil to determine fertilizer and lime requirements.Provide a minimum of 1 composite soil sample, consisting of 5 test borings, for every 5 acres to be seeded or sodded.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide seed mixture in sealed containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

B. Deliver fertilizer to site in waterproof bags showing weight, chemical analysis, and name of manufacturer.

1.06 WARRANTY

A. Warranty lawn areas for period of 1 year after acceptance of seeding and sodding to be alive and in satisfactory growth at end of warranty period.

1. For purpose of establishing acceptable standard, scattered bare spots, none larger than 1 square foot, will be allowed up to a maximum of 3% of lawn area.

PART 2 – PRODUCTS

2.01 TOPSOIL

A. Friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and free from subsoil, roots, heavy or stiff clay, sand and gravel, stones larger than two inches in any dimension, noxious weeds, sticks, brush, litter, and other deleterious matter.

B. Acidity Range: pH 5.0 minimum, 7.0 maximum.

C. Provide imported topsoil obtained from off-site source.

2.01 SEED

A. Fresh, recleaned, new crop seed in specified varieties and proportions indicated.

B. Weed content shall not exceed 0.25%.

Common Name	Weight (%)	Minimum Germination (%)
Kentucky Bluegrass	50	85
Perennial Ryegrass	30	85
Creeping Red Fescue	20	95

2.02 FERTILIZER

A. Commercial balanced, uniform in composition, free flowing, conforming to state and federal laws.

B. Contain percentage by weight as follows, or as modified by topsoil test recommendations.

1. Prior to seeding or sodding: 6-24-24.
2. After seeding or sodding: 18-5-9.

C. 50% of elements shall be derived from organic sources.

2.04 ACCESSORIES

A. Mulch: Dry oat or wheat straw or wood cellulose fiber free of weeds and foreign matter detrimental to plant life. Hay or chopped corn stacks are not acceptable.

B. Water: Furnished by Owner from existing on-site source. Provide pumps, tankage, hose, piping, and attachments as required to bring water to point of use.

C. Erosion Control Blanket:

1. Short term duration, light duty, organic Erosion Control Revegetative Mat
2. Non-organic photodegradable or biodegradable netting allowed.
3. Manufacturers:

a. Curlex I, by American Excelsior
b. S75, DS75, or DS150, by North American Green
c. Excel SR-1, by Western Excelsior
d. ECS1, by East Coast Erosion Blankets
e. Or Equal

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PLANTING SEASONS

A. Spring Planting Season: From time soil can be satisfactorily worked until following dates.

1. Seed: April 1st to June 15th.
2. Sod: June 15th.

B. Fall Planting Season:

1. Seed: August 1st to November 15th.
2. Sod: September 1st to October 20th.

C. Dormant Seeding: October 21st to November 15th (Soil at 1"<50 degrees Fahrenheit), seed with cover crop of winter wheat at 100 pounds per acre.

D. Perform planting of seed or placement of sod only when weather conditions and soil conditions are acceptable.

E. Planting season limits may be changed when approved by Engineer.

3.03 PREPARATION

A. Uniformly grade areas disturbed by construction, including adjacent transition areas, with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points and existing grades. Where proposed elevations are not shown on the Drawings, match pre-construction elevations and drainage patterns.

B. Where a change of slope is indicated on the Drawings, construct a rolled transition section having a minimum radius of approximately 8 ft, unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage.

C. Grade areas adjacent to buildings or structures to achieve drainage away from the structures, and to prevent ponding.

D. Maximum allowable variation from design elevation is 1 inch in 10 feet.

E. Do not plant seed or place sod until trees, shrubs, and other landscaping completed.

F. Scarify existing topsoil where grade is not being raised, or where topsoil is over compacted, to depth of 2 inches.

G. For topsoil with high acidity, add lime as recommended in topsoil test report.

H. Grade, rake, and roll with roller weighing not more than 100 pounds per foot or less than 25 pounds per foot.

I. Protection of Newly Graded Areas:

1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds.
2. Repair and reestablish grades in settled, eroded, and rutted areas to the specified tolerances.

3.04 FERTILIZING

A. Before seeding or sodding, apply 6-24-24 fertilizer at uniform rate of 2.0 pounds/1000 square feet; make 2 passes at right angles. Incorporate fertilizer into soil to depth of at least 2 inches by discing, harrowing, or other approved method.

B. After completion of required interim mowings, apply 18-5-9 fertilizer at rate of 15 pounds per 1000 square feet; make 2 passes at right angles.

C. Adjust rate of application and type of fertilizer as recommended in topsoil test report.

D. Lightly water to aid dissipation of fertilizer.

3.05 SEEDING

A. Apply seed at a total rate of not less than 5 pounds/1000 square feet; make 2 passes at right angles.

B. Seeding method shall establish smooth, uniform turf.

C. Cover seed with 1/8 inches of soil by light raking.

D. Do not seed following rain, if soil has been compacted by rain, or if ground is too dry.

E. Do not seed when wind velocity exceeds 6 miles per hour.

F. Do not seed areas in excess of that which can be mulched on same day.

G. Immediately after seeding, apply mulch to flat areas and erosion control blanket to areas with greater than 3H to 1V slopes.

H. Place mulch loose to allow some sunlight to penetrate and air to circulate, but thick enough to shade ground, conserve soil moisture, and prevent erosion.

I. Butt ends and edges of erosion control blanket snugly and staple to ground surface with 6 inch staples.

J. Apply water with fine spray immediately after area has been mulched or application of erosion control blanket. Leave area thoroughly soaked at close of each working day.

3.06 PROTECTION

A. Protect turf areas by erecting temporary fences, barriers, signs, and similar protection as necessary to prevent trampling until acceptance by Owner.

B. Replace, repair, restake, or replant damaged seeding or sod.

C. Protect slopes and embankments against erosion until Work is accepted. Repair eroded areas by refilling, resodding, reseeding, and remulching as required.

3.07 FIELD QUALITY CONTROL

A. Acceptance:

1. Notify Engineer when lawn areas are ready for final inspection.
2. Substantial completion will be granted upon conformance with following;

a. Turf reasonable free from weeds, diseases or other visible imperfections.
b. Turf displays uniform color, quality and coverage.
c. Minimum 3 mowings performed.
d. Fertilizer application performed after mowing.

3. After substantial completion, Owner will be responsible for maintenance.

3.10 MAINTENANCE

A. Maintenance shall begin immediately following installation of each portion of lawn. Continue until substantial completion.

B. Maintain lawns by watering, mowing, and repairing or replanting as may be necessary to produce uniform stand of grass until Work accepted.

C. Perform first mowing when average height of grass reaches 3 inches. Perform interim mowings, 2 minimum, as needed to maintain grass height at 2 to 2-1/2 inches. Do not remove more than 1/3 of leaf blade by mowing.

D. After completion of required interim mowings, apply 18-5-9 fertilizer as specified herein.

E. Control weed growth; apply herbicide in accordance with manufacturer's instructions.

F. Top dress or resod excessive cracks appearing upon soil shrinkage.

END OF SECTION

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DIVISION 33

UTILITIES

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SECTION 33 01 10.58
DISINFECTION OF WATER UTILITY PIPING SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Disinfection of new water mains and existing water mains which have been relocated or contaminated by construction operations.

1.02 SUBMITTALS

A. Prior to starting disinfection work, furnish detailed outline of proposed sequence of operation, manner of filling and flushing units, source and quality of water to be used, and disposal of wasted water.

B. Submit in accordance with Section 01 33 00.

1.03 QUALITY ASSURANCE

A. Conform to requirements of this section and regulatory agencies. If requirements of this section are in conflict with requirements of regulatory agencies, the most stringent shall apply.

B. Disinfection shall be acceptable to Owner.

PART 2 – PRODUCTS

2.01 CHLORINE

A. Liquid hypochlorite solution is preferred for disinfection.

B. Use of high test calcium hypochlorite or tablet method of disinfection shall be approved by Engineer and in accordance with AWWA procedures.

C. Tablet form calcium hypochlorite may be used only for water mains up to 12 in. dia and less than 2,500 ft in length.

PART 3 – EXECUTION

3.01 GENERAL

A. Method of disinfection for water containment devices and piping systems shall conform to AWWA C651.

B. Contractor liable for damages arising from direct contact of granular calcium hypochlorite with solvent welding materials used to join PVC pipe.

3.02 CHLORINE PREPARATION

A. Liquid Chlorine:

1. Apply liquid hypochlorite solution by means of solution feed chlorinating device.

B. Calcium Hypochlorite:

1. Prepare granular calcium hypochlorite as water mixture before introduction into unit. Make dry powder into paste and thin to approximately 1% chlorine solution.
2. To prepare chlorine solution, add 1 lb of calcium hypochlorite (65% to 70% available Cl_2) to 7-1/2 gal water.

3.03 PIPELINE PREPARATION

A. After pressure and leakage tests complete, flush units thoroughly to remove foreign material.

B. Release entrapped air at high points and fill units with disinfecting agent and water to allow disinfecting agent to come in contact with interior surfaces.

C. If complete venting cannot be accomplished through available outlets, provide necessary corporation cocks and vent piping.

3.04 APPLICATION OF DISINFECTANT

A. Point of Application:

1. Apply chlorinating agent at supply end of unit.
2. For pipes, apply disinfectant through corporation cock installed in top of pipe.
3. Place tablets in accordance with AWWA C651.

B. Rate of Application:

1. Introduce water at controlled rate in order to regulate chlorine dosage.
2. Proportion rate of chlorine mixture flow to rate of water entering unit so chlorine dose applied produces at least 25mg/l chlorine residual after period of 24 hrs.
3. Method of determining rate of flow of water into unit shall be approved by Engineer.

C. Keep chlorine disinfecting solution and contaminated water from flowing into units previously disinfected and flushed.

D. Retain chlorinated water in unit long enough to destroy nonspore-forming bacteria. Minimum retention period shall be 24hrs. Minimum chlorine residual shall not be less than 25 mg/l.

E. Operate valves and appurtenances while line or unit is being disinfected to ensure surfaces of valves are disinfected.

F. When approved by Engineer, flush and swab pipe, fittings or valves that must be placed in service immediately with 5% solution of calcium hypochlorite immediately prior to assembly.

3.05 FINAL FLUSHING AND TEST

A. Following chlorination, flush unit or system until replacement water in system is proven to be comparable in quality to water which will enter unit or system.

B. Condition of water delivered by each unit or system shall continue for at least 2 days, as demonstrated by laboratory examination of samples.

C. If initial treatment results in unsatisfactory bacterial test, repeat disinfection until satisfactory results obtained.

D. Laboratory tests shall show chlorine residual, after final flushing, of less than 1 mg/l.

E. Prevent entry of contaminated water into previously disinfected units or systems.

END OF SECTION

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SECTION 33 05 05
SITE UTILITIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes Site Piping for:

1. Water piping
2. Sanitary Sewer
3. Plumbing piping
4. Process piping
5. Storm sewer
6. Gas piping

1.02 REFERENCES

A. AWWA: American Waterworks Association

1.03 SYSTEM DESCRIPTION

A. Systems include yard piping between buildings or structures.

B. Systems are further described and specified in:

1. Exposed Piping Installation: Section 40 05 05
2. Plumbing Systems: Section 22 00 05
3. Facilities Natural Gas Piping: Section 23 11 23

1.04 SUBMITTALS

A. Manufacturer's specifications, data sheets, and installation instructions for piping, equipment, and accessories.

B. Include other data as necessary to show compliance with these Specifications.

C. Submit in accordance with Section 01 33 00.

D. Provide certification reports attesting that materials supplied meet referenced specifications

PART 2 - PRODUCTS

2.01 PROCESS MECHANICAL PIPING SYSTEMS

A. Piping

1. Provide piping material for exterior, buried process mechanical piping (yard piping) as indicated on the Process-Mechanical Piping Schedule in Section 40 05 05. Comply with indicated material specification.
   a. Cement Lined Ductile Iron Piping: Section 40 05 19.
   b. Glass Lined Ductile Iron Piping: Section 40 05 19.

B. Valves

1. Comply with Section 40 05 53.

2.02 NATURAL GAS PIPING SYSTEMS

A. Piping and Fittings

1. Comply with Section 23 11 23.

B. Valves

1. Comply with Section 23 11 23 and Section 40 05 53.

2.03 WATER (W1 AND W4) PIPE AND FITTINGS:

A. Water Piping 2 inches and less: Comply with Section 22 00 05.

B. Water Main Piping 4 inches and larger: Comply with Section 40 05 19.

C. Tapping Service Connections:

1. Stainless steel, double bolt saddles with skirted gasket as manufactured by:
   a. Romac Model No. 306-9.05 x 1 inch C.C.
   b. Ford Model No. FS-303-905-OS-CC4

D. Corporation Stops:

1. In accordance with AWWA C-800 and ASTM B-62.

2. ½ inch to 2 inches inch ball valve type with compression or flared end connections.

3. Manufacturers:
   a. A.Y. McDonald No. 4101BCAP-22
   b. Mueller H-15008
   c. Ford FB1000
   d. Or Equal

E. Curb Stop:

1. Manufacturers:
   a. A.Y. McDonald No. 6104-22
   b. A.Y. McDonald No. 6004-22
   c. Or Equal.

F. Curb Box:

1. Cast iron conforming to ASTM Designation A-48, Class 20
2. Castings shall be thoroughly coated with a 1-mil thick bituminous coating.
3. 1-1/4 inch diameter
4. Length: 7 to 8 feet without extension sections
5. Manufacturers:
   a. A.Y. McDonald No. 5614
   b. Or Equal.

G. Yard Hydrants

1. Manufacturer:
   a. John C. Kupferle Foundry Company, #80WD Mainguard Washdown hydrant.
   b. No substitutions.

2. Self-draining, non-freezing, compression type hydrant.

3. 2-inch FIP inlet and 2-1/2 inch NST nozzle.

4. Interior parts shall be of brass construction and removable without excavating the hydrant.

H. Valves

1. Buried valves for water piping:

   a. Resilient wedge gate valves in conformance with AWWA C509 with mechanical joints, cast iron body, bronze-mounted with bronze nonrising stems and O-ring seals. Mechanical joint bolts and nuts shall be high strength, low alloy steel with
   b. Operating nut 2 in., opening left.
   c. Internal and external surfaces of valve body shall be epoxy coated in accordance with AWWA C550.

2.04 VALVE BOXES

A. Provide for buried valves

B. Three-piece screw type, cast iron box and cover

C. Valve box diameter 5-1/4 inch, length as required for installation.

D. Provide extension stem to within 6-inches from top of cover and 2-inch operating nut.

E. Provide Valve Box Adaptor II by Adaptor Inc. or approved equal.

2.05 STORM SEWER

A. Comply with Section 33 42 11.

2.06 BACKFILL, COVER AND BEDDING MATERIALS

A. Comply with Section 31 23 33.

2.07 CONNECTING DISSIMILAR PIPE MATERIALS

A. Provide factory fabricated connecting piece meeting same structural and joint testing standards as adjacent new piping.

2.08 BURIED INSULATION

A. Manufacturers:

1. Dow Chemical Company, Styrofoam HI 60.
2. U.C. Industries, Inc., Foamular 600.
3. Or equal.

B. Rigid, closed-cell extruded polystyrene insulation, moisture-resistant and suitable for buried installations.

2.09 UNDERGROUND PIPE TRACE WIRE

A. Tracer Wire: 12 gauge AWG copper-clad steel wire with 30 mil HDPE jacketing for underground installation, as manufactured by Copperhead Industries. HDPE jacket color to conform to APWA uniform color code.

B. Connectors:

1. Buried tracer wire connections and splices shall be via moisture displacement connectors:
    a. Copperhead Industries SnakeBite Connectors
    b. 3M DBR Connectors
    c. 3M Direct Bury Splice Kit No. 09053
    d. Or equal.

2. Buried connections made by twisting wires together and taping them is not acceptable.

C. Access Points/Test Stations:
1. Paved Areas: Snakepit Roadway Access Point with single-terminal cast iron lid, as manufactured by Copperhead Industries
2. Unpaved Areas: Snakepit Lite Duty Access Point with adjustable single-terminal lid, as manufactured by Copperhead Industries.

PART 3 - EXECUTION

3.01 BURIED PIPING INSTALLATION

A. Comply with Section 31 23 33 and material and system specifications for piping being installed.

B. When new pipe is to be connected to existing pipe not terminating in manhole, uncover end of existing pipe to allow adjustments in line and grade before any pipe is laid.

C. Lay pipe to line and grade shown on Drawings.

D. For gravity piping, begin laying pipe from lowest point in proposed pipe line.

E. For pressure piping, lay pipe at continuous slope between invert elevations shown at building faces, unless otherwise noted.

F. Lay pipe with bell end of bell and spigot pipe pointing upgrade.

G. Lay gravity pipe uniformly to line and grade so finished pipe presents uniform bore.

H. Noticeable variations from true alignment and grade shall be considered sufficient cause for rejection of Work.

I. Record Northing, Easting, and Elevation of all bends and fittings. Provide data to Owner and Engineer as work progresses.

J. Take precautions to prevent foreign material from entering pipe during or after laying operations. If foreign material enters pipe, remove it completely before continuing.

K. Provide watertight plugs for open ends of pipe when laying not in progress.

L. Laying of Pipe in Cold Weather:

1. Heat pipe and jointing materials to prevent freezing of joints.
2. Do not lay pipe on frozen ground.
3. Pipes with rubber gaskets or resilient type joints: Warm gasket or joint material to facilitate making proper joint.
4. With solvent cemented joint: Remove ice and snow from jointed area prior to applying of solvent cement.

M. Wrap buried ductile iron pipe with polyethylene wrap as specified in Section 40 05 19.

N. Lay water main and process mechanical pressure pipe to line and grade so horizontal and vertical joint deflection will not be more than 50% maximum deflection as recommended by manufacturer. Where greater deflections are necessary, proper fittings shall be used.

O. Thrust Restraint:

1. Provide thrust restraint on pressure pipe tees, plugs, caps, bends, and other locations where unbalanced forces exist.

2. Restrain by one of the following means:

a. Thrust blocks conforming to details on drawings.
b. Mega-Lug by EBBA Iron, or equal.
c. Other restrained joint types as specified in Section 40 05 19.

3. Thrust blocks

a. Unless otherwise shown, place the base and thrust bearing sides of thrust blocking directly against undisturbed earth.
b. Sides of thrust blocking not subject to thrust may be placed against forms.
c. Place thrust blocking so the fitting joints will be accessible for repair.
d. Protect Steel rods and clamps by galvanizing or by coating with bituminous paint.

4. Valves located less than 30 feet from plugged end of dead-lines shall be restrained.

P. Connect dissimilar pipe materials using factory fabricated connecting pieces.

Q. Plug lines and provide necessary thrust restraint until connections to internal and building systems are made.

3.02 VALVE BOX INSTALLATION

A. Provide thrust blocking with solid concrete block or concrete.

B. Center valve boxes on the valves, setting plumb.

C. Tamp earth fill around each valve box to a distance of four feet on all sides, or to the undisturbed trench face if less than four feet.

D. Tighten stuffing boxes, and fully open and close each valve to assure that all parts are in working condition.

3.03 TRACE WIRE INSTALLATION

A. Install for all pipe and duct banks.

B. Tracer wire shall be placed approximately 6 inches above the top of the pipe or duct bank.

C. Provide access points as indicated on the FRSA Treatment Plan Tracer Wire & Access Points detail included in the drawings.

3.04 MANHOLE AND INLET INSTALLATION

A. Comply with Section 33 05 61 and Section 31 23 33.

B. Construct at locations and elevations shown on Drawings.

3.05 INSULATION INSTALLATION

A. Place at locations of water or drain (sanitary) and gas piping where less than 5 feet of cover exists.

1. Prior to placement of horizontal insulation, place bedding material 6 inches deep over top of pipe, level, and compact. Lightly scarify surface of cover material to depth of 1/2 inch.
2. Place horizontal insulation boards on scarified material with long side parallel to centerline of pipe.
3. Place boards in staggered arrangement to eliminate continuous joints. If 2 or more layers of insulation board are used to meet required thickness, place each layer to cover joints of layer immediately below.

B. Backfill First Lift:

1. Backfill with 6 inches of bedding material. End or side dump onto insulation board and spread so construction equipment does not operate directly on insulation.
2. Compact layer with equipment exerting contact stress of 70 to 80 pounds per square inch.

C. After first lift, compact to specified density.

3.06 FIELD QUALITY CONTROL

A. Disinfection:

1. Disinfect potable water lines (W1) in accordance Section 33 01 10.58.

B. Testing:

1. Test piping systems in accordance with Section 40 05 10 and requirements of applicable systems specifications.
2. Electrical Continuity: Test tracer wire for electrical continuity prior to acceptance of piping.

END OF SECTION

SECTION 33 05 61
MANHOLES, CATCH BASINS, AND INLETS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Precast concrete manholes and risers, catch basins and inlets.

1.02 REFERENCES

A. IDOT: Illinois Department of Transportation Standard Specifications for Road and Bridge Construction, Current Edition

B. ASTM: American Society for Testing and Materials

1.03 SUBMITTALS

A. Product data:

1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
2. Manufacturers recommended installation procedures.

B. Provide certification reports attesting that materials supplied meet referenced specifications.

C. Shop drawings for manholes showing all components to be installed.

D. If manufacturer’s test data is inadequate or unavailable, Engineer reserves right to require cores drilled for compressive strength tests.

E. A buoyancy calculation for each manhole catch basin, inlet, valve vault documenting the following buoyancy criteria is met:

1. Minimum safety factor 1.1
2. Surface friction with backfill materials shall not be included
3. Submerged soil weight of 55 pounds per cubic foot where soil weight is used to help hold down the manhole. Only soil directly above manhole or any anti-floatation devices may be included.
4. Water table to grade
5. No water weight to be included inside structure
6. Weights for castings, all precast components and any manufacturer supplied fillets in bottom of manhole may be included.

F. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer shall conform to requirements of ASTM C478.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE SECTIONS

A. Precast sections:

1. Provide reinforced precast concrete manhole, catch basin or inlet sections complying with ASTM C478.
2. No “see through” lift holes shall be allowed on precast concrete manholes and risers 48 inches in diameter or less.
3. All lift holes on structures greater than 48 inches in diameter shall be thoroughly wetted and completely filled with non-shrink mortar or epoxy grout; then smoothed and covered on the outside, with a trowelable grade butyl rubber base backplaster material to minimize leakage.
4. Provide integral anti-floatation collars (extended bases) with a minimum width of 6 inches around bottom of all manholes. Provide larger collars for manholes that calculations indicate have buoyancy safety factors less than 1.2 so that required factor of safety is achieved. Other methods of buoyancy control may also be acceptable upon Engineer’s approval.
5. Provide eccentric cone type precast or flat top slabs as shown on Drawings.
6. Wall Thickness in accordance with ASTM C443 and IDOT standards.

B. Joints:

1. Tongue and groove with butyl-rubber gaskets meeting requirements of ASTM C443.
2. Joints shall be watertight.

C. Pipe to Manhole Connections: All connections shall provide for a watertight seal between pipe and manhole.

1. Connect sanitary sewer pipe and flexible storm sewer pipe to manhole by means of boot-type or compression-type connector, meeting the requirements of ASTM C923.

a. Kor-N-Seal I, by Trelleborg
b. A-Lok, by A-Lok Products, Inc.
c. Z-Lok Cast in Boots, by A-Lok products, Inc.
d. PSX Direct Drive, by Press-Seal Gasket Corporation
e. Or equal.

2. Connect concrete pipe to precast concrete manholes and inlets by means of brick and mortar connection.

D. Mark each precast section with name or trademark of manufacturer and date of manufacture. Marking shall be indented into manhole section or shall be painted thereon with waterproof paint.

E. Source Quality Control:

1. Test risers and tops in accordance with ASTM C497 for compressive strength compliance by compression tests on cores drilled from 5% of lot.
2. Number of compression tests may be reduced to 1% of lot, with minimum of two cores per lot, for manhole sections fabricated on sewer pipe machine.
3. Manufacturer's core drilling machine shall conform to ASTM C497. Operator shall take test cores as directed by testing laboratory.
4. Stamp base sections, risers and tops, meeting strength requirements, with appropriate monogram.

2.02 STEPS

A. Conform to requirements of ASTM C478 and U.S. Department of Labor Occupational Safety and Health Standards.

B. Steel Reinforced Plastic:

1. Approved plastic such as copolymer polypropylene meeting with requirements of ASTM D4101, Type II, Grade 49108, reinforced with deformed 3/8 inch diameter reinforcing bar which conforms to requirements of ASTM A615, Grade 60.

C. Equally space steps in true vertical alignment to form continuous ladder at distance of 16 in oc. Place steps within allowable tolerance of +/- 1 inch.

D. Manufacturer shall install steps. Embed steps into wall minimum of 3 inches.

2.03 CONCRETE

A. Conform to Section 03 33 00.

1. Class B2.

2.04 MORTAR

A. Comply with ASTM C270, type M.

2.05 ADJUSTING RINGS

A. Precast concrete with one line of steel reinforcements, centered in normal handling and use, or injection molded high density polyethylene (HDPE) meeting the requirements of ASTM D-148 as manufactured by Ladtech Inc, or equal.

B. Mating Faces: Smooth, parallel, and free from cracks, chips, spalls, or casting irregularities.

C. Minimum thickness: 2 inches

D. Maximum thickness: 6 inches.

E. Adjusting rings not allowed on above grade frames and covers.

2.06 FRAMES AND COVERS

A. ASTM A48, Class 30-B minimum.

B. Free from cracks, holes, swells, and cold shuts.

C. Provide all frames, gratings and covers from the same manufacturer unless approved by Engineer.

D. Provide standard finish, supplied as a total unit.

1. Storm manhole:

a. Wording “Storm” in 2-inch high letters cast into cover.
b. IDOT Type 1 frame and cover

c. Or equal

2. Storm curb casting:

a. IDOT Type 3 frame and cover (where indicated on the Drawings).
b. IDOT District 2 Type 9 grate and cover (where indicated on the Drawings).
c. Or equal

3. Primary Filter Distribution Box and 54" Bypass Structure Castings

a. Upper Frame and Cover
   i. Neenah R-1558 frame and cover
      1. Solid lid with Type "B" indented pattern
      2. Type "F" concealed, watertight pick hole
      3. Self-sealing (gasketed) lid
      4. Wording to be determined by Owner in 2-inch high letters cast into cover.
   ii. Or equal

b. Lower Frame and Cover
   i. Watertight, pressure rated cover to be cast in to Primary Influent Distribution Box top slab.
   ii. Frame and cover shall provide a minimum clear opening diameter of 21 inches.
   iii. Cover shall be of a size to fit completely through clear opening of upper frame and cover.
   iv. Neenah R-1915-H2 Type P, or equal.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements in the field to assure precise fit of items in accordance with the approved design.

3.03 INSTALLATION

A. Trench, backfill, and compact for work of this Section in accordance with pertinent provisions of Section 31 23 33.

B. Standard Precast Manhole with Integral Base:

1. Excavate deep enough so bottom manhole barrel section with integral base rests on 6 inches minimum of bedding material.
2. Bedding material shall conform to requirements of adjacent pipe.
3. Set manholes plumb with orientation of cast-in items as shown on Drawings.

3.04 BACKFILL

A. Backfill with pipe bedding and cover material to spring line of incoming pipe in accordance with Section 31 23 33.

3.05 MANHOLE BENCH (CONSTRUCTED IN FIELD)

A. Shape invert channels to be smooth and semicircular, conforming to inside of adjacent sewer sections.

B. Make changes in direction of flow with a smooth curve of as large a radius as size of manhole will permit.

C. Make changes in size and grade of channels smoothly and evenly.

D. Form invert channels directly manhole base, with concrete. On manholes with straight through pipe invert may be formed by laying full section sewer pipe through manhole and cleanly breaking out top half after surrounding concrete has hardened.

E. Smooth floor of manhole outside channels, and slope toward channels at not less than 1 inch per foot or more than 2 inches per foot.

F. Construct outside drop at sanitary manholes whenever free drop inside manhole exceeds 24 inches measured from invert of inlet pipe to top of floor of manhole outside channels.

3.06 PIPE TO MANHOLE CONNECTION

A. Support pipe entering manhole above manhole base from wall of manhole back to face of first pipe joint bell with wall of backfill concrete, brick or solid concrete block columns.

B. Connect by means of an approved flexible watertight pipe to manhole seal.

3.07 SETTING CASTINGS

A. Set at elevation shown on Drawings.

B. Adjust castings to grade with adjusting rings. Do not use more than 8 inches of adjusting rings.

C. Sealing: Seal interior and exterior of adjusting rings and castings with trowelable mastic sealing material.

D. Provide external chimney seals for valve vaults, with extensions as necessary, on manholes. Install seals and extensions in accordance with manufacturer's instructions.

3.07 MANHOLE OVER EXISTING PIPE

A. Construct new manhole as specified, breaking upper half of existing pipe after base of manhole is completed so as not to obstruct flow of existing pipe.

3.08 TESTING AND INSPECTING

A. Do not allow or cause any of Work of this Section to be covered up or enclosed until after it has been inspected.

B. Precast reinforced concrete manholes, inlets, catch basins, risers and tops shall be subject to rejection on account of failure to conform to any specification requirements. In addition, individual sections may be rejected because of any of the following reasons:

1. Fractures or cracks passing through shell, except for single end crack not exceeding depth of joint.
2. Defects indicating imperfect proportioning, mixing, and molding.
3. Surface defects indicating honeycombed or open texture.
4. Damaged ends where such damage would prevent making satisfactory joint.
5. Manhole steps out of line, or not properly spaced.
6. Infiltration into sanitary sewer exceeding 0.0758 gal/vert ft/hr.
7. Internal diameter of section varying more than 1% from nominal diameter.
8. Any continuous crack having surface width of 0.01 in. or more and extending for length of 12 in or more, regardless of position.

C. Manhole seals shall be approved by inspecting Engineer after application and prior to backfilling.

3.09 VACUUM TESTING MANHOLES

A. General:

1. Test manholes as recommended by manufacturer. All manholes shall be tested for leakage/air tightness.
2. Provide equipment such as pumps, gauges, regulators, hoses, pipe plugs, manhole frame plugs, necessary to perform air tests of manholes. Equipment configuration shall be such that there are no valves on or along air line between measuring point at manhole and pressure transducer or sensing device located in control unit on surface. Amount of pressure being exerted on joint shall be readable above ground on pressure gauge.
3. Accuracy and calibration of pressure sensing/monitoring system shall have been certified by reliable testing firm within one-month period preceding use of equipment. Proof of certification shall be submitted.
4. Test valve vault manholes only.

B. Equipment:

1. Pressure meter device shall accurately show PSIG to nearest 1/10 of one pound and shall respond to and record any change in void pressure instantly.
2. Systems which incorporate bladders, hoses, or like for monitoring pressure and which have questionable accuracy will not be allowed.

C. Testing Procedure:

1. Test sanitary manholes prior to installation of chimney seals.
2. Test in accordance with ASTM C1244 and D3753.
3. Isolate manhole to be tested by temporarily plugging al pipes entering the manhole
4. Draw vacuum of 10 in. of mercury (5 PSIG or 0.03 Bar) within manhole.
5. If required vacuum pressure cannot be developed, manhole shall have failed test. Manhole being tested will also have failed if the time for the vacuum reading to drop from 10 in. of mercury to 9 in. of mercury meets or exceeds the values indicated in Table 1 or ASTM C1244.
6. Failure of manhole indicates need for sealing. Seal in accordance with manufacturer recommendations.
7. Retest until satisfactory results obtained.

END OF SECTION

SECTION 33 42 11
STORM WATER GRAVITY PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Provide sewer pipe materials and installation as shown on Drawings, specified herein, and as needed for a complete and proper installation of storm systems.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. AASHTO: American Association of State Highway and Transportation Officials

C. AWWA: American Water Works Association

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product data:

1. Manufacturer's specifications and other data needed to prove compliance with specified requirements.
2. Manufacturer’s recommended installation procedures.

C. Provide certification reports attesting that materials supplied meet referenced specifications

D. Concrete Pipe:

1. Calculations verifying pipe class, ASTM C76, or pipe D-Load, ASTM C655 and pipe floatation (for depths less than 6 feet), shall be furnished to Engineer prior to pipe manufacture.

E. PVC Pipe:

1. Calculations verifying pipe stiffness class, installation conditions and floatation (for depths less than 6 feet).

F. Submit in accordance with Section 01 33 00.

G. Results of plant tests shall be included with shipment of materials, with two additional copies of each test result to be furnished to Engineer.

1.04 QUALITY ASSURANCE

A. Pipe manufacturer shall have minimum of five (5) years of experience manufacturing pipe in accordance with ASTM Standard Specifications.

B. Plant Testing for Concrete Pipe:

1. Three-edge bearing load test circular reinforced concrete sewer pipe (per ASTM C497) to 0.01 inch crack D-load specified in tables 1 through 5 of ASTM C76, on pipe manufactured for this project.

C. Plant Testing for Solid Wall PVC Pipe:

1. Testing shall consist of flatting, impact resistance, and pipe stiffness tests in accordance with ASTM D3034 and/or ASTM F679. Testing shall be performed on pipe manufactured for this project.
2. Pipe diameter, wall thickness and other dimensions shall be verified as per ASTM D2122.

D. Plant Testing for All Pipe Materials:

1. For pipe testing frequency, pipe lot shall be defined as pipe of same diameter and class or D-Load manufactured by same process in one plant, over period not to exceed approximately 2 weeks.
2. Engineer or Engineer's representative will randomly select test pipe from each lot as follows:

a. For lots of 100 or more pipe, 1% of number of pipe in lot with a minimum of 2 pipes selected.
b. For lots less than 100 pipe, 1 pipe will be selected.
c. For lots less than 10 pipes, testing may be waived by Engineer if manufacturing plant has satisfactory specification compliance on other pipe lots.

PART 2 - PRODUCTS

2.01 GRAVITY SEWER PIPE STRENGTH DESIGN

A. All sewer pipe materials provided shall be designed in accordance with the following criteria:

1. Traffic Loading = HS-20 per AASHTO, Traffic impact = 30% for depths less than 5 feet.
2. Soil loading based upon depth and unit weight of 125 pounds per cubic feet.
3. Trenching and Bedding as per details shown in plans for pipe types and per Section 31 23 33.
4. Ground water table assumed to be at the surface.
5. Saturated soil weight for bouyancy calculations = 62.5 pounds per cubic feet.
6. Safety factor for pipe buoyancy calculations = 1.3.

B. Flexible pipe (solid wall PVC) shall also comply with following design criteria:

1. Allowable Deflection < 5%
2. Deflection Lag Factor = 1.0 for design condition (1.5 for 1 year post construction monitoring
3. Maximum E=1000 for depths less than 25 feet to top of pipe, maximum E=1500 for depths from 25 to 35 feet to top of pipe. (Lessor values may be used at manufacturer's option.)
4. Safety factor for buckling = 2.5
5. Safety factor for wall crush = 2. 0

C. Reinforced Concrete pipe shall meet following additional design criteria:

1. Concrete pipe ultimate strength = 1.5 times design strength for design strengths under 2000 psf, 1.25 times design strength for design strengths over 3000 psf, and varying linearly between 1.5 and 1.25 for strengths between 2000 and 3000 psf respectively.
2. K*u*= factor = .11
3. Bedding Angle = 90^0; Bedding Constant = 0.096

2.02 REINFORCED CONCRETE PIPE

A. Reinforced Concrete Pipe:
1. Conforming to ASTM C76
2. Class IV.
3. Producer shall be on the IDOT Certified Precast Concrete Producers list, latest edition.

A. Pipe joints:
1. Conform to ASTM C-443.
2. All joints shall be certified by pipe manufacturer to perform at thirty (30) feet of hydrostatic head.

B. Gaskets:
1. O-ring type conforming to ASTM C433.
2. Flexible, watertight, rubber.
3. ASTM C1619 Class A.

C. Fittings:
1. Conform to strength, watertightness, and other requirements of pipe to which they are joined.
2. Pipe reinforcement shall not be interrupted beyond radial distance of 3 inches outside of fitting.

D. Handling holes not permitted.

2.03 SOLID WALL PVC PIPE

A. Pipe shall conform to ASTM D3034. Pipe and fittings shall have a minimum cell classification of 12364 or 12454 as per ASTM D1784. PVC compounds shall meet or exceed requirements of listed cell classification.

B. 115 psii minimum pipe stiffness and dimension ratio (SDR) 26 per ASTM D3034.

C. Bell and spigot joint with flexible rubber gaskets conforming to ASTM D3212 and ASTM F477.

D. Pipe shall be green or white.

2.04 DUCTILE IRON PIPE

A. Comply with Section 40 05 19.

PART 3 - EXECUTION

3.01 SURFACE CONDITIONS

A. Examine areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements in the field to assure precise fit of items in accordance with approved design.

3.03 INSTALLATION

A. Trenching and backfill for Work of this Section shall conform to Section 31 23 33 and pipe manufacturer's recommendations.

B. Separation of Sewers and Potable Water Lines:

1. Horizontal Separation
    a. Locate sewer at least 10 feet away, horizontally, from water supply main or service line, as measured from outside edges of pipe.
    b. Water mains may be laid closer than ten feet to a sewer line when local conditions prevent separation of 10 feet, provided that the water main invert is at least 18 inches above the crown of the sewer, and the water main is either in a separate trench or in the same trench on an undisturbed earth shelf located to one side of the sewer.
    c. If the above conditions cannot be met, the sewer shall be constructed with water main quality pipe.

2. Vertical Separation
    a. Water Main Crossing Over Sewer: Water mains shall be laid so that its invert is 18 inches above the crown of the sewer whenever water mains cross storm sewers, sanitary sewers, or sewer service connections. The vertical separation shall be maintained for a distance of 10 feet. If a separation of 18 inches cannot be met, the sewer shall be constructed with water main quality pipe.
    b. Water Main Crossing Under Sewer: A vertical separation of 18 inches between the invert of the sewer and the crown of the water main shall be maintained where a water main crosses under a sewer. Sewers crossing over water mains shall be constructed with water main quality pipe.

3. Where sewers cross water mains, a length of sewer pipe water main pipe shall be centered at the water main to be crossed with joints equidistant from water main.

C. Pipe laying:

1. Protect pipe during handling against shocks and free fall. Remove extraneous material from pipe interior.
2. Between manholes all gravity pipe shall be of same strength class and as shown on layout/installation guide.
3. Lay pipe by proceeding upgrade with spigot ends of bell-and-spigot pipe pointing in direction of flow.
4. Lay each pipe accurately to indicated line and grade, aligning so sewer has a uniform invert. Noticeable variations from true alignment and grade shall be considered sufficient cause for rejection of Work.
5. Continually maintain interior of pipe free from foreign material. Provide watertight plugs for open ends of pipe when laying not in progress.
6. Before making pipe joints, clean and dry all surfaces of pipe to be joined.
7. Use lubricants recommended by pipe manufacturer.

8. Place, fit, join, and adjust joints to obtain water tight seal.
9. Lay pipe to line and grade so horizontal and vertical joint deflection will not be more than 50% maximum deflection as recommended by manufacturer.
10. Laying of Pipe in Cold Weather:

    a. Heat pipe and jointing material to prevent freezing of joints, as recommended by manufacturer.
    b. Do not lay pipe on frozen ground.
    c. Pipes with rubber gaskets or resilient type joints: Warm gasket or joint material to facilitate making proper joint.

3.04 TESTING AND INSPECTING

A. Do not allow or cause any work of this Section to be covered until after it has been inspected.

B. Test and inspect sewer installation in accordance with Section 40 05 10.

1. Televise sewer installation.

2. Leakage Test

    a. Low Pressure Air Test, or
    b. Infiltration Test, if top surface of ground water is at least 2 feet above top of pipe for entire test length

END OF SECTION

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DIVISION 40

PROCESS INTERCONNECTIONS

SECTION 40 05 05
EXPOSED PIPING INSTALLATION

PART 1 – GENERAL

1.01 SUMMARY

A. This section identifies process-mechanical piping systems to be provided, specifies unique requirements for each system identified, and references other sections where detailed requirements of piping components are specified.

B. Process-mechanical piping systems are shown on Process-Mechanical Drawings and on Civil Site Piping Drawings. Civil Site Piping Drawings may also show site utility, plumbing, fire protection, and HVAC piping systems that are specified in other sections.

C. Process-Mechanical Piping Schedule included with this section identifies process-mechanical piping systems to be provided. Schedule includes application information and specifies unique system requirements.

1.02 SUBMITTALS

A. Shop Drawings:

1. Layout drawings for each process-mechanical piping system drawn to scale. Identify each piping system with same flow stream identifier as shown on Drawings.

    a. Double-line layout for each piping system 3-inch pipe size and larger. Minimum scale of ¼-inch = 1 foot.
    b. Single-line or double-line layout for each piping system smaller than 3-inch pipe size. Minimum scale of ¼-inch = 1 foot.
    c. For each piping system include:
        1) Size for each pipe and fitting.
        2) Material, lining type, and system number for coating to be provided for each pipe and fitting.
        3) Pipe class, thickness or schedule for each pipe and fitting.
        4) Pipe end connections (joint type) and couplings.
        5) Location and type of supports, hangers, anchors, and expansion joints.
        6) Pipe couplings, saddles, sleeves, clamps, adapters, and other piping products.
        7) Pipe mounted equipment and instrumentation identified by tag number assigned on Drawings.
        8) Insulation to be provided.

B. American Iron and Steel Compliance Certification:

1. This project is being funded by the Clean Water State Revolving Fund that requires that all of the iron and steel products used in the project to be produced in the United States (“American Iron and Steel Requirement”). The Contractor and his/her suppliers shall comply with Section 436 of federal H.R. 3547. These requirements apply to and are binding to the Manufacturer of the products specified in this Section unless variance or De Minimums documentation has been submitted by the Contractor.
2. The Manufacturer shall provide with the shop drawing submittal one signed and dated Certification Letter (a sample copies of which are provided in the Appendix). The Certification Letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

C. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

2.01 PIPE AND FITTINGS

A. Provide pipe and fittings as shown on Drawings and as specified in sections identified in Process-Mechanical Piping Schedule presented at end of this section.

2.02 PRODUCTS FOR PIPING SUPPORT, FLEXIBILITY, THERMAL EXPANSION, ANCHORAGE, AND VIBRATION ISOLATION

A. Provide support system for each non-buried process-mechanical piping system in accordance with Section 40 05 07.

B. Provide anchors, restraints, and concrete blocks as required to resist hydraulic thrust and forces due to thermal expansion.

C. Piping system, including support and anchorage system, shall allow for thermal expansion and contraction due to differences in operating temperature and temperature piping is exposed to during construction. Provide piping system products to allow for and control movement of piping due to thermal expansion and contraction.

D. No attempt has been made to show all pipe supports, hangers, anchors, expansion joints, and other piping products required for piping support, thermal expansion, and anchorage. Absence of these products on Drawings does not relieve Contractor of his responsibility for providing them in accordance with these Specifications.

E. Provide joints, couplings, and expansion joints as shown on Drawings and as required for piping flexibility and vibration isolation. No attempt has been made to show all joints, couplings, expansion joints, and other piping products required for piping flexibility and vibration isolation.

2.03 OTHER PIPING PRODUCTS

A. For buried piping, furnish fill material and install piping in accordance with Section 31 23 33.

B. Provide insulation for piping systems identified to be insulated in REMARKS column of Process-Mechanical Piping Schedule. Provide piping insulation in accordance with Section 40 42 13.

C. Provide products for pipe penetrations in accordance with Section 40 05 09.

D. Provide couplings, flanged coupling adapters, and service saddles in accordance with Section 40 05 06.

E. Provide rubber expansion joints in accordance with Section 40 05 06.

2.04 COATINGS

A. Coat exterior surfaces of non-insulated piping products with coating system numbers specified in Specifications sections identified in Part 3 of this section and in accordance with Section 09 96 00.

PART 3 – EXECUTION

3.01 PREPARATION

A. Use implements, tools, and facilities for handling and protection of piping products to avoid damage prior to installation.

B. Inspect piping products before installation. Provide new or repair or recondition damaged piping products. Repair or reconditioning is subject to Engineer's approval. Patch damaged interior linings and exterior coatings or replace damaged product with new product. Patching is subject to Engineer's approval.

C. Clean ends of piping products before installation. Remove foreign matter and dirt from inside of piping products and keep products clean until Work has been accepted.

3.02 INSTALLATION

A. Location:

1. Install piping parallel to structure lines unless shown otherwise on Drawings.
2. Do not install piping through beams, columns, or other structural members unless shown on Drawings.
3. Locate valves in piping system in accordance with manufacturer's instructions. In horizontal piping runs, do not orient valves so operating stem is below horizontal centerline.

B. Assembly:

1. Install piping without springing or forcing in manner which would cause stress in piping, valves, or connected equipment.
2. Set pipe flanges level, plumb, and aligned. Set flanged fittings so flange is true and perpendicular to pipe axis. Set flanges so bolt holes straddle vertical centerline of pipes.
3. For flanged connections, match bolt holes and obtain uniform contact over entire flange area prior to installation of flange bolts. Tighten bolts to uniformly compress gaskets and minimize flange stress. Tighten bolts to torque recommended by gasket manufacturer. Coat nuts and bolts with anti-seize thread compound.
4. Machine off raised-face of steel flange when mating with flat-faced flange.

C. Pump, Blower and Equipment Connections:

1. Align pipe, equipment, pumps, and blowers so stresses are not transmitted to connections. Support piping independently from pumps, blowers, and equipment. Do not support piping from equipment, blowers, and pumps. Anchor piping to prevent transmission of hydraulic thrust load to pumps, blowers, and equipment.
2. Install couplings, adapters, expansion joints, flanges, and unions so pumps, equipment, valves, and in-line instruments can be removed from service without disruption to other portions of piping system.
3. Install couplings, expansion joints and other vibration isolation components to isolate piping from pump, blower, and equipment vibration.
4. For welded nozzle connections, allow for shrinkage during welding to prevent excessive stresses on pumps and equipment.
5. Provide drain piping from pump and equipment drains and overflows to floor drain system.
6. Provide control lines such as air and bubbler level system piping necessary for operation of pumps, equipment, valves, and in-line instruments.

D. Install insulating flange, insulating coupling or dielectric union at each connection between ferrous and non-ferrous metal piping.

3.03 FIELD QUALITY CONTROL

A. Inspect installed piping products for dents, kinks, abrupt changes of curvature, damage to lining, and other damage. Repair or recondition damaged products as approved by Engineer or replace damaged products with new products.

B. Inspect installed, unlined piping products for corrosion and scale on interior surfaces. Clean products to remove corrosion and scale or replace with new products.

C. Test system in accordance with Section 40 05 10 and as specified in Process-Mechanical Piping Schedule.

3.04 CLEANING

A. After installation and before testing, remove dirt, rocks, debris and other foreign matter from interior of each piping system.

B. Water flush each hydrostatically tested piping system unless specified otherwise.

1. Flushing velocities of 2.5 feet per second shall be maintained until accumulated debris has been removed.
2. Insert cone strainers at equipment connections prior to flushing. Remove cone strainers after flushing is complete.
3. Remove accumulated debris through drains not less than 2 inch in diameter or by temporarily removing pipe spools, fittings, or valves.
4. Drain piping after flushing and immediately dry piping with compressed air.

C. Blow clean each pneumatically tested piping system with compressed air unless specified otherwise.

3.05 PROCESS-MECHANICAL PIPING SCHEDULE

A. **SERVICE** column: Presents Flow Stream Identifiers for process-mechanical piping systems shown on Process-Mechanical Drawings and on Civil Drawings.

1. Civil Drawings may also show site utility, plumbing, fire protection, and HVAC piping systems which are not included in Process-Mechanical Piping Schedule. Site utility, plumbing, fire protection, and HVAC piping systems are specified in other sections.

B. **SIZE** column: Presents nominal pipe diameter(s) for each piping system shown on Process-Mechanical Drawings and continuation of piping system on Civil Drawings.

C. **PIPE MATL** column: Identifies material type to be provided for piping system. Piping material shall conform to requirements of referenced sections:

Pipe Material	Section	Abbreviation in Piping Schedule
Cement Lined Ductile Iron Piping	40 05 19	CLDI
Glass Lined Ductile Iron Piping	40 05 19	GLDI
Polyvinyl Chloride Piping	40 05 31.13	PVC
Unlined Ductile Iron Piping	40 05 19	ULDI
316L Stainless Steel Piping	40 05 23	316SS
304L Stainless Steel Piping	40 05 23	304SS

D. **LOCATION** Column: Identifies installation location of piping system. Piping system components shall be suitable for condition specified.

E. **MIN/MAX TEMP** column: Presents minimum and maximum operating temperature of piping system. Piping system components shall be suitable for operating temperatures shown.

F. **MAX PRESSURE** column: Presents maximum operating pressure of piping system and type of test to be provided. Piping system components shall be suitable for maximum operating pressure shown and test pressure specified.

1. Provide hydrostatic testing in accordance with Section 40 05 10 where maximum operating pressure value is followed by "-H".
2. Provide low pressure air testing in accordance with Section 40 05 10 where "-A" is specified.
3. Test pressure for hydrostatic and high pressure air testing shall be 1.5 times maximum operating pressure, minimum, unless specified otherwise in REMARKS column. Test pressure for low pressure air testing shall be as specified in Section 40 05 10.

G. **COLOR** column: Specifies color coding and banding to be provided for non-buried piping systems. Provide color coding, banding, and labeling in accordance with Section 40 05 97.

H. **REMARKS** column: Provides further description of piping system and specifies additional requirements.

PROCESS-MECHANICAL PIPING SCHEDULE

Service	Size (in.)	Pipe Matl	Location	Min/Max Temp (ºF)	Max Press (psig)	Color	Remarks
Primary Filter Distribution Structure							
PI, PFI	42	CLDI	Buried	-20/110	10-H	None	
Primary Settlings Tanks 1 & 2							
PI	42	CLDI	Buried	-20/110	10-H	None	
Primary Tank Outlet Structure							
PFE	60	CLDI	Buried	-20/110	10-H	None	
Gravity Belt Thickening Building							
PSM	4	GLDI	Interior Exposed, Embedded	40/95	100-H	ANSI Gray #70	
PFTS	3	316SS	Interior Exposed, Embedded	40/95	100-H	ANSI Gray #70	
PFTS	6	GLDI	Interior Exposed, Embedded	40/95	100-H	ANSI Gray #70	Salvaged 6" GLDI Centrate Pipe can be used where possible.
PSD	8	GLDI	Interior Exposed	30/110	100-H	ANSI Gray #70	
Digester Control Building							
PFTS	4, 6	GLDI	Interior Exposed, Embedded	40/95	100-H	ANSI Gray #70	Salvaged 6" GLDI Centrate Pipe can be used where possible.

PROCESS-MECHANICAL PIPING SCHEDULE							
Service	**Size (in.)**	**Pipe Matl**	**Location**	**Min/Max Temp (°F)**	**Max Press (psig)**	**Color**	**Remarks**
Primary Filtration Facility 1							
BWW	6	CLDI	Inside Exposed, Embedded	40/95	35-H	ANSI Gray #70	
BYP	6	GLDI	Inside Exposed, Embedded	40/95	35-H	ANSI Gray #70	PFTS bypass between thickened sludge pumps
BYP	12	CLDI	Inside Exposed, Embedded	40/95	35-H	ANSI Gray #70	GTO bypass to PFE Channel, PFS bypass to GTO Box, PFTS to GTO Box
BYP	42	CLDI	Submerged, Embedded, Buried	40/95	10-H	ANSI Gray #70	PFE bypass to future AGS
D	6, 8	CLDI	Inside Exposed, Embedded, Buried	40/95	5-H	ANSI Gray #70	
GTO	14	CLDI	Submerged, Embedded, Buried	-20/110	10-H	ANSI Gray #70	
PI	42	CLDI	Submerged, Embedded, Buried	-20/110	5-H	ANSI Gray #70	
PFI	18	CLDI	Submerged, Embedded, Exterior	-20/110	10-H	Dark Bronze	Dark bronze to match building.
PFI	42	CLDI	Submerged, Embedded, Buried	-20/110	10-H	ANSI Gray #70	
PFE	48, 60	CLDI	Submerged, Embedded, Buried	-20/110	10-H	ANSI Gray #70	
PFS	10, 12	CLDI	Inside Exposed, Embedded	40/95	35-H	ANSI Gray #70	
PFTS	4, 6	GLDI	Inside Exposed, Embedded	-20/110	100-H	ANSI Gray #70	Salvaged 6” GLDI Centrate Pipe can be used where possible.
PSM	4	GLDI	Inside Exposed, Embedded, Submerged, Buried	-20/110	35-H	ANSI Gray #70	
PSM	10	GLDI	Inside Exposed, Embedded, Submerged	40/95	35-H	ANSI Gray #70	
RCC	1/4	PVC	Inside Exposed, Embedded, Outside Exposed	-20/110	35-H	-	
RCC	6	CLDI	Inside Exposed, Embedded	40/95	35-H	ANSI Gray #70	
SLD	6	CLDI	Inside Exposed, Embedded	40/95	35-H	ANSI Gray #70	
V	1, 2, 6, 8	316SS	Inside Exposed, Embedded, Exterior Exposed	-20/110	5-A	-	
Primary Sludge Manhole							
PSD	8	CLDI	Outside Exposed	-20/110	35-H	ANSI Gray #70	

PROCESS-MECHANICAL PIPING SCHEDULE							
Service	**Size (in.)**	**Pipe Matl**	**Location**	**Min/Max Temp (ºF)**	**Max Press (psig)**	**Color**	**Remarks**
YARD PIPING							
BYP	42	CLDI	Buried	-20/110	10-H	None	
D	6, 8	CLDI	Buried	-20/110	5-H	None	
GTO	14, 24	CLDI	Buried	-20/110	10-H	None	
PI	42	CLDI	Buried	-20/110	10-H	None	
PFI	42	CLDI	Buried	-20/110	10-H	None	
PFE	48, 60	CLDI	Buried	-20/110	10-H	None	
PSM	4	GLDI	Buried	-20/110	100-H	None	
PFTS	4, 6	GLDI	Buried	-20/110	100-H	None	
WAS	8	CLDI	Buried	-20/110	100-H	None	

END SECTION

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SECTION 40 05 06
COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Couplings, flanged coupling adapters, and service saddles required for piping connections. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular products to be provided under this Contract.

1.02 REFERENCES

A. ANSI: American National Standards Institute

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for couplings and service saddles specified.
2. Catalog cuts and product specifications for couplings, flanged coupling adapters, and service saddles.

C. American Iron and Steel Compliance Certification:

1. This project is being funded by the Clean Water State Revolving Fund that requires that all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement"). The Contractor and his/her suppliers shall comply with Section 436 of federal H.R. 3547. These requirements apply to and are binding to the Manufacturer of the products specified in this Section unless variance or De Minimums documentation has been submitted by the Contractor.
2. The Manufacturer shall provide with the shop drawing submittal one signed and dated Certification Letter (a sample copies of which are provided in the Appendix). The Certification Letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain couplings and service saddles from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as a unit as evidenced by records of prototype testing.

PART 2 – PRODUCTS

2.01 COUPLINGS

A. Couplings for connecting plain-end steel or ductile iron pipe of same outside diameter:

1. Dresser Style 38.
2. Smith-Blair Product No. 411.

B. Transition couplings for connecting plain-end steel or ductile iron pipe of different outside diameter:

1. Dresser Style 162.
2. Smith-Blair Product No. 413.

C. Insulating couplings for connecting plain-end steel or ductile iron pipe and stopping flow of electrical current:

1. Dresser Style 39.
2. Smith-Blair Product No. 416.

D. Pressure rating shall be greater than test pressure of piping system.

E. Materials:

1. Middle Ring and Gaskets: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.
2. Followers: Ductile iron or steel.
3. Bolts and Nuts: Stainless steel.

2.02 FLANGED COUPLING ADAPTERS

A. Flanged coupling adapters for connecting plain-end steel or ductile iron pipe to flanged pipe, fitting, valve, instrument, or equipment item:

1. Romac FCG (3" to 12") and FC400 (>12")
2. Dresser Style 128.
3. Smith-Blair Product No. 913.

B. Pressure rating shall be greater than test pressure of piping system.

C. Materials:

1. Flange: Steel, faced and drilled to 150-pound class in conformance with ANSI B16.5.
2. Body: Steel.
3. Follower: Ductile iron or steel.
4. Gasket: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.
5. Bolts and Nuts: Stainless steel.

2.03 DISMANTLING JOINTS

A. Dismantling joint for valve, pump, meter, or other fitting installations with heavy duty joint restraint:

1. Romac DJ400.
2. Style 975, by Smith Blair, Inc.
3. Or equal.

B. Pressure and Service: Same as connected piping.

C. Body: ASTM A53, ASTM A283 Gr C or carbon steel with a minimum yield of 30,000 psi.

D. Follower Flange: Ductile iron per ASTM A536, Steel section per ASTM A576GR1020HR, or carbon steel having a minimum yield stress of 30,000 psi.

E. Gasket: Recommended by the manufacturer.

F. Bolts and Nuts: Stainless steel bolts complete with washers complying with ASTM F593, AISI Type 316 and nitrided stainless nuts.

G. Type 316 stainless steel anchor studs installed in pressure-tight anchor boss for restraint. For buried or submerged applications, provide external bolting and other hardware of Type 316 stainless steel, including tie bolts, bolt plates, lugs, nuts, and washers. Provide number of studs required to restrain test pressure and service conditions. Harness shall be as designed and recommended by manufacturer.

2.04 SERVICE SADDLES

A. Service saddles for tapping pipe sizes 18 inches and smaller shall be double strap design.

1. Dresser Style 91.
2. Smith-Blair Product No. 317.

B. Service saddles for tapping pipe sizes larger than 18 inches shall be triple strap design.

1. Smith-Blair Product No. 366.

C. Materials:

1. Body: Malleable iron or ductile iron.
2. Straps: 304 Stainless Steel.
3. Nuts and Washers: 304 Stainless Steel.
4. Gasket: As selected by manufacturer. Suitable for fluid service and maximum operating temperature of piping system.

2.05 RUBBER EXPANSION JOINTS

A. Rubber expansion joints rubber designed to absorb all-directional movements and reduce noise and vibration manufactured by:

1. General Rubber.
2. Garlock.
3. Mercer.
4. Or equal.

B. Rubber Expansion Joints:

1. Cover, body, seamless tube, and integral full-faced flanges. Standard 125-pound flange drilling.
2. Materials and construction shall be suitable for fluid service, maximum operating temperature, maximum operating pressure and test pressure of piping system.
3. Single arch.

   a. Filled for wastewater, sludge and other fluids with suspended solids.
   b. Unfilled for air, clean water and other fluids without suspended solids.

4. Split stainless steel retaining rings coated in accordance with Section 09 96 00.
5. Provide control unit for each expansion joint:

   a. Gusset plates, washers, bolts, and elastomeric bushings.
   b. No metal-to-metal contact to eliminate transmission of noise and vibration.
   c. Size control units for maximum operating pressure and test pressure of piping system.
   d. Control unit hardware shall be stainless steel.

6. Minimum movement capability for single, unfilled arch joints:

Joint Size (inch)	Axial Compression (inch)	Axial Extension (inch)	Lateral Deflection (inch)
≤ 6	7/16	1/4	1/2
8 to 18	11/16	3/8	1/2
20 to 24	13/16	7/16	1/2
26 to 40	15/16	1/2	1/2
≥ 42	1-1/16	9/16	1/2

7. Minimum movement capability for single, filled arch joints shall be at least 50 percent of movement specified above for unfilled arch joints.

2.06 ANCHORS

A. Provide anchors including, but not limited to, tie rods, lugs, harness assemblies, flanged spool pieces, friction collars and hardware for each coupling, and flanged coupling adapter. Anchors shall restrain pipe to prevent movement out of each coupling and flanged coupling adapter.

B. Design each anchor to sustain force developed by test pressure of piping system.

C. Anchor studs placed perpendicular to longitudinal axis of pipe is unacceptable.

D. Anchorage with welded attachments to ductile iron piping is unacceptable.

2.07 COATINGS

A. Coatings for couplings, flanged coupling adapters, and service saddles shall be same material as coatings for connected pipe.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install couplings, adapters, and specials for process piping in accordance with manufacturer's written instructions.

B. Provide expansion joints where indicated on Drawings and elsewhere as determined by Contractor for adequate expansion compensation and vibration isolation of piping systems.

3.02 FIXED SUPPORTS

A. Provide fixed supports for each expansion joint. Fixed supports shall restrain pipe to prevent movement of fixed end of the expansion joint.

B. Fixed support shall be located on the same end of pipe as the “restraining ring” is welded.

C. Design each support to sustain force developed by test pressure of piping system.

D. Fixed supports with welded attachments to stainless steel piping are unacceptable.

E. Provide fixed supports in accordance with pipe hangars, supports, and anchors in accordance with Section 40 05 07.

3.03 ADJUSTABLE SUPPORTS

A. Provide adjustable supports for each expansion joint. Adjustable supports shall restrain pipe to prevent movement out of each expansion joint.

B. Fixed support shall be located on the same end of pipe as the “restraining ring” is welded.

C. Design each support to sustain force developed by test pressure of piping system.

D. Adjustable supports with welded attachments to stainless steel piping are unacceptable.

E. Provide adjustable supports in accordance with pipe hangars, supports, and anchors in accordance with Section 40 05 07.

END OF SECTION

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SECTION 40 05 07
PIPE HANGERS AND SUPPORTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. System of pipe supports and anchors with necessary inserts, bolts, nuts, restraining and hanger rods, washers, miscellaneous steel, and other accessories.

1.02 DEFINITIONS

A. Submerged: At or below point 1 foot 6 inches above peak (maximum) water surface elevations in water holding structure.

1.03 REFERENCES

A. MSS: Manufacturers Standardization Society

B. ASTM: American Society for Testing and Materials

C. ANSI: American National Standards Institute

1.04 SYSTEM DESCRIPTION

A. Design Requirements:

1. Design, detail, and installation of pipe support system shall be responsibility of Contractor.
2. Pipe support system components shall withstand dead loads imposed by weight of pipes filled with water plus insulation, plus live loads due to thermal expansion, vibration, internal test pressures, and have minimum safety factor of 5.
3. Absence of pipe supports and details on Drawings shall not relieve Contractor of responsibility for providing them throughout plant.
4. Supply design loading criteria to precast concrete manufacturer for piping supported from precast members.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for pipe hangers, supports, and anchors specified.

C. Shop Drawings:

1. Pipe supporting system, including manufacturer's product data, dimensions, sizes, types, location, maximum loadings, thrust anchorage, and installation instructions.
2. Shop Drawing shall be stamped by a Structural Engineer registered in the State of Illinois.

D. American Iron and Steel Compliance Certification:

1. This project is being funded by the Clean Water State Revolving Fund that requires that all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement"). The Contractor and his/her suppliers shall comply with Section 436 of federal H.R. 3547. These requirements apply to and are binding to the Manufacturer of the products specified in this Section unless variance or De Minimums documentation has been submitted by the Contractor.
2. The Manufacturer shall provide with the shop drawing submittal one signed and dated Certification Letter (a sample copies of which are provided in the Appendix). The Certification Letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

E. Submit in accordance with Section 01 33 00.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain pipe hangers, supports, and anchor components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipe hangers, supports, and anchors to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store pipe hangers, supports, and anchors in clean, dry location.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. B-Line.

B. Grinnell.

C. Carpenter-Patterson.

D. Unistrut.

E. Superstrut.

2.02 GENERAL

A. MSS types indicated are typical of types and quality of standard pipe supports and hangers to be employed. Special support and hanger details are shown to cover locations where standard catalog supports are inapplicable.

B. Provide factory fabricated piping hangers and supports, clamps, hanger rod attachments, building attachments, saddles, shields, thrust anchorage, and other miscellaneous products of MSS SP69 type indicated or shop fabricated supports; comply with MSS SP58 and manufacturer's published product information. Where MSS type not indicated, provide proper selection for installation requirements and comply with MSS SP69, MSS SP89 and manufacturer's published product information.

2.03 MATERIALS

A. Hangers, rods, clamps, protective shields, metal framing, support components, and hanger accessories shall be hot dipped galvanized or of stainless steel construction unless otherwise noted.

B. Hangers, rods, clamps, protective shields, metal framing, support components, and hanger accessories in submerged or non-submerged location in wet wells, tanks, channels, or tank covers and in the Gravity Belt Thickener Room 2 shall be Type 316 stainless steel.

2.04 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. General:

1. Unless otherwise shown or specified, hangers for 2 1/2 inches and smaller pipe shall be split-ring, adjustable swivel, clevis or roller type, hangers for 3 inch pipe or greater shall be clevis or roller type.
2. Hangers for use with spring supports shall be split-ring or clamp type.
3. Hangers for fiberglass reinforced pipe shall be saddle type.
4. Each hanger shall be designed to permit at least 1/2 inch vertical adjustment after installation.

B. Adjustable Swivel Split Ring Hanger: MSS Type 6.

C. Adjustable Clevis Hanger: MSS Type 1, fabricated from steel.

D. Adjustable Band Hanger: MSS Type 7, fabricated from steel.

E. Adjustable Swivel-Band Hanger: MSS Type 10.

F. Clamp: MSS Type 4.

G. Single Roll Support: MSS Type 41, including axle roller and threaded sockets.

H. Adjustable Roller Hanger: MSS Type 43, including axle roller and clevis.

I. Roll/Stand: MSS Type 44, including roller, stand, and axle.

J. Adjustable Roller/Base: MSS Type 46, including roller, adjustable base, and stand.

K. Steel Brackets: Welded structural steel shapes complying with following:

1. Light Duty: MSS Type 31.
2. Medium Duty: MSS Type 32.
3. Heavy Duty: MSS Type 33.

L. Adjustable Saddle Support:

1. MSS Type 38, including saddle, pipe and reducer.
2. Fabricate base support from steel pipe and include cast iron flange or welded steel plate. Use of threaded rod for pedestal support stanchions is not acceptable.

M. Stanchion Saddle Support:

1. MSS Type 37, including saddle and U-bolt.
2. Fabricate base support from steel pipe and include cast iron flange or welded steel plate. Use of threaded rod for pedestal support stanchions is not acceptable.

N. Strap or wire hangers not acceptable.

2.05 VERTICAL PIPING CLAMPS

A. 2-Bolt Riser Clamp: MSS Type 8, galvanized or plastic coated.

B. 4-Bolt Riser Clamp: MSS Type 42, include pipe spacers at inner bolt holes, galvanized or plastic coated.

2.06 HANGER RODS AND ATTACHMENTS

A. Hanger Rods:

1. ASTM A36, threaded both ends or continuous thread.
2. Rods shall conform to following sizes.

Pipe Size (inches)	Minimum Rod Diameter (inches)
Up to 2	3/8
2 1/2 and 3	1/2
4	5/8
6	3/4
8 to 12	7/8
14 and Up	1
Trapeze Hangers	As Required

B. Turnbuckles: MSS Type 13.

C. Weldless Eye Nut: MSS Type 17.

D. Eye Socket: MSS Type 16.

E. Clevis: MSS Type 14.

2.07 BUILDING ATTACHMENTS

A. Individual Concrete Inserts:

1. MSS Type 18, malleable iron.
2. MSS Type 19, steel.
3. Minimum Safe Load: 1,100 pounds.

B. Continuous Concrete Inserts:

1. Unistrut, P-3200 Series.
2. B-Line.
3. Grinnel.
4. Superstrut.
5. Or equal.

C. Top Beam C-Clamp: MSS Type 19.

D. C-Clamps: MSS Type 23, steel.

E. Single-Side Clamp: MSS Type 25.

F. Top I-Beam Clamp: MSS Type 25.

G. Side Beam Clamp: MSS Type 20.

H. Concrete Anchors:

1. Provide in accordance with Section 05 50 00.
2. Minimum Safety Factor: 5.

2.08 SADDLES AND SHIELDS

A. Protection Saddles: MSS Type 39.

B. Protection Shields: MSS Type 40.

C. Wood Insulation Saddle:

1. Elcen Metal Products Company.
2. Or equal.

2.09 MISCELLANEOUS MATERIALS

A. Metal Framing Systems:

1. Unistrut, galvanized.
2. B-Line, galvanized.
3. Grinnell, galvanized.
4. Or equal.

B. Shop-Fabricated Anchors and Supports:

1. Steel Plates, Shapes, and Bars: ASTM A36.
2. Restraining Rods: ASTM A307.

C. Concrete: Minimum 28 day compressive strength of concrete – 3,000 pounds per square inch.

PART 3 – **EXECUTION**

3.01 GENERAL

A. Proceed with installation of hangers, supports, and anchors after required building structural work is complete and concrete support structure has reached 28-day compressive strength as 3,000 pounds per square inch.

B. Install hangers, supports, clamps, and attachments from building structure. Comply with MSS SP-69. Group parallel runs of horizontal piping to be supported together on trapeze type hangers where possible.

C. Install supports to provide indicated pipe slopes and maximum pipe deflections allowed by ANSI B31.1 are not exceeded.

D. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

E. Do not support piping from other piping.

F. Prevent contact between dissimilar metals. Where concrete or metal pipe support is used, place 1/8 inch thick Teflon, neoprene rubber or plastic strip under piping at point of bearing. Cut to fit entire area of contact between pipe and support.

G. Prevent electrolysis in support of copper tubing by use of hangers and supports where are copper plated, plastic coated or by other recognized industry methods. Electrician's tape not acceptable isolation method.

H. Apply anti-seize compound to nuts and bolts.

3.02 INSTALLATION OF BUILDING ATTACHMENTS

A. Support piping from structural framing, unless otherwise noted.

B. Concrete Inserts:

1. Locate inserts so total load on insert does not exceed manufacturer's recommended maximum load. Location of inserts shall be approved by Engineer.
2. Where necessary to anchor supports to hardened concrete or completed masonry, use concrete anchors.

C. Attach to structural steel with beam clamps.

3.03 THRUST ANCHORS AND GUIDES

A. Thrust Anchors:

1. For suspended piping, center thrust anchors as closely as possible between expansion joints and between elbows and expansion joints. Anchors shall hold pipe securely and be sufficiently rigid to force expansion and contraction movement to take place at expansion joints or elbows and preclude separation of joints.
2. Provide thrust anchors as required to resist thrust due to changes in diameter or direction or dead ending pipe lines. Anchorage shall be required wherever bending stresses exceed allowable for pipe. Wall pipes may be used as thrust anchors.

B. Pipe guides shall be provided adjacent to sliding expansion joints in accordance with recommendations of National Association of Expansion Joint Manufacturers.

3.04 PIPE SUPPORT

A. Spacing:

Type of Pipe (inches)	Maximum Pipe Support Spacing (feet)
Steel	
10 and larger	22
8	19
6	17
5	16
4	14
3 1/2	13
3	12
2 1/2	11
2	10
1 1/2	9
1	7
3/4	6
1/2	5
Copper	
4	12
3 1/2	11
3	10
2 1/2	9
2	8
1 1/2	8
1 1/4	7
1	5
3/4	5
1/2	5
Plastic (Schedule 80 at 100 degrees Fahrenheit, F)	
8	9-1/2
6	9
4	7-1/2
3	7
2	6
1 1/2	5-1/2
1	5
3/4	4-1/2
1/2	4-1/2
(For plumbing or chemical applications, plastic piping shall be supported at maximum of 4 ft-0 in. spacing.)	
Stainless Steel	
1 and smaller	6
1 1/2 through 4	8
6	8
8 and 10	10
12	10
14	12
16	12
18 and larger	14

Type of Pipe (inches)	Maximum Pipe Support Spacing (feet)
Cast Iron and Ductile Iron	
1 and smaller	6
1 1/4 through 2 1/2	8
3 and 4	10
6	12
8	12
10 and 12	14
14	16
16 and 18	16
20	18
24 and larger	18
(For cast iron soil pipe plumbing applications, support as 5 ft-0 in. spacing.)	

B. Where piping of various sizes is to be supported together, space supports for smallest pipe size or install intermediate supports for smaller diameter pipe.

C. Provide minimum of 2 pipe supports for each pipe run.

D. Where piping connects to equipment, support by pipe support and not by equipment, unless approved by equipment manufacturer.

E. Unless otherwise shown or authorized by Engineer, place piping running parallel to walls approximately 1 1/2 inches out from face of wall and at least 3 inches below ceiling.

F. Pedestal pipe supports shall be adjustable with stanchion, saddle, and anchoring flange. Use of threaded rod for pedestal support stanchions is not acceptable.

G. Piping supports for vertical piping passing through floor sleeves shall be galvanized steel riser clamps.

H. Piping passing through sleeves or openings in interior wall sleeves shall be carried by supports or hangers. Do not rest on wall.

I. Support piping in manner preventing undue strain on valve, fitting or equipment. Provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise shown. Do not install pipe supports and hangers in equipment access areas.

J. Install supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Piping shall be free to move when expands or contracts, except where fixed anchors are indicated. Where specified hanger rod swing length cannot be provided or where pipe movement based on expansion of 1 inch per 100 feet for each 100 degrees F change in temperature exceed 1/2 inch, provide approved roller supports.

L. Piping 6 inches and larger supported by trapeze hangers shall be supported with rollers.

M. Stacked horizontal runs of piping along walls may be supported by metal framing systems. Metal framing systems shall be attached to concrete insert channels.

N. Coat hangers, clamps, protective shields, metal framing support components, and hanger accessories in accordance with Section 09 96 00.

3.05 GALLERY AND TUNNEL PIPING

A. Support piping by metal framing system. Where possible, extend each insert channel continuously over gallery or tunnel ceiling and down both walls to floor.

3.06 INSULATED PIPING

A. Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed allowable pipe stresses.

B. Where low compressive strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. For pipe 8 inches and larger, install wood insulation saddles.

C. Where insulation without vapor barrier is indicated, install protection saddles on piping 2 inches and larger.

3.07 BURIED PIPING

A. Provide unlugged bell and spigot or bell tees, Y-branches, and bends deflecting 11 1/4 degrees or more and plugs with reaction blocking, anchors, joint harness or other acceptable means for preventing movement of pipe and joints caused by internal pressure.

B. Concrete Blocking:

1. Extend from fitting to solid undisturbed earth and installed so joints accessible for repair.
2. Bearing area of concrete reaction blocking shall be as shown on Drawings.
3. If adequate support against undisturbed ground cannot be obtained, install metal harness anchorages consisting of steel rods across joint and securely anchored to pipe and fitting or other adequate anchorage facilities to provide necessary support.
4. Should lack of solid vertical excavation face be due to improper trench excavation, cost of furnishing and installing metal harness anchorage in excess of Contract value of concrete blocking replaced by such anchorages shall be borne by Contractor.

C. Provide reaction blocking, anchorages or other supports for fittings installed in fills or other unstable ground or above grade as shown on Drawings.

END OF SECTION

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SECTION 40 05 09
WALL PIPES, FLOOR PIPES, AND PIPE SLEEVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Modular mechanical seals.
2. High density polyethylene (HDPE) sleeves.

1.02 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for sleeves and seals specified.

C. Submit in accordance with Section 01 33 00.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

C. Single-Source Responsibility: Obtain sleeve and seals from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. GPT Industries, LINK-SEAL.

B. Advance Products & Systems (APS), Innerlynx.

2.02 MODULAR MECHANICAL SEALS

A. Modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill annular space between pipe and opening.

B. Seal Element: Ethylene propylene diene monomer (EPDM). Provide low-durometer EPDM elements for thin or soft walled pipes of HDPE, PVC, tubing, or others with a wall thickness less than 3/8-inches as recommended by manufacturer.

C. Pressure Plates: Composite.

D. Bolts and Nuts: 316 stainless steel.

2.03 FIRE RATED MODULAR MECHANICAL SEALS (LINK SEAL)

A. Modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill annular space between pipe and opening.

B. Seal Element: Silicone.

C. Pressure Plates: Zinc plated carbon steel.

D. Bolts and Nuts: Zinc plated carbon steel.

E. UL approved for 3-hour fire wall penetrations.

2.04 HDPE SLEEVES

A. Material: HDPE.

B. Integrally molded water stop / anchor at least 4-inches larger than outside diameter of sleeve.

C. Textured surface to increase concrete bond strength.

D. Designed for use with modular mechanical seals.

PART 3 – **EXECUTION**

3.01 INSTALLATION

A. Install sleeves and seals in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 40 05 10
TESTING PIPING SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Hydrostatic pressure testing, low pressure air testing, and high pressure air testing of piping systems.

B. Systems to be tested, type of test to be performed, and test pressure shall be as specified in other sections of Specifications.

1.02 SUBMITTALS

A. Test report for each piping system tested. Include following:

1. Date of test.
2. Description and identification of piping system tested.
3. Type of test performed.
4. Test fluid.
5. Test pressure.
6. Type and location of leaks detected.
7. Corrective action taken to repair leaks.
8. Results of retesting.

B. Submit in accordance with Section 01 33 00.

PART 2 – PRODUCTS

(NOT USED)

PART 3 – EXECUTION

3.01 GENERAL

A. Test in presence of Engineer.

B. Owner will provide on-site source of water for testing specified herein.

C. Provide pumps and piping required to bring water to point of use.

D. Provide air supply.

E. Provide test pressure equipment, meters, pressure gauges, and other equipment, materials, and facilities necessary to perform specified tests.

F. Provide bulkheads, flanges, valves, bracing, blocking, or other temporary sectionalizing devices that may be required.

G. Remove temporary devices after tests complete.

H. Perform tests on exposed piping after completely installed, including supports, hangers, and anchors.

I. Perform tests on piping before insulation installed.

J. Perform tests on piping that is clean and free of dirt, sand or other foreign material.

K. Plug pipe outlets with test plugs. Brace each plug securely to prevent blowouts.

L. Add test fluid slowly.

M. Include regulator set to avoid overpressurizing and damaging piping.

N. Perform pressure testing in accordance with local, state, and federal requirements.

O. Correct leaks or defects and retest at no additional cost to Owner.

3.02 HYDROSTATIC PRESSURE TESTING

A. Perform hydrostatic pressure testing for piping systems identified in other sections. Test pressure shall be as specified in other sections.

B. Open vents at high points to purge air pockets while piping system is filling. Venting may also be provided by loosening flanges or with equipment vents.

C. Testing:

1. After section of piping to be tested has been filled with water, apply test pressure by means of force pump of such design and capacity that required pressure can be applied and maintained without interruption for duration of test.
2. Measure test pressure by means of tested and properly calibrated pressure gauge acceptable to Engineer.
3. Maintain test pressure for sufficient length of time to permit Engineer to observe piping under test but not less than 2 hours.

D. With exception of buried piping with mechanical joints or push-on joints, piping systems shall show no visual evidence of weeping or leaking. If leakage is evident, make appropriate repairs and retest.

E. Maximum allowable leakage for buried piping with mechanical joints or push-on joints is as follows. If leakage is excessive, make appropriate repairs and retest.

$$L = \frac{NDP^{1/2}}{7{,}400}$$

Where:
L = Leakage, gallons per hr
N = Number of joints under test
D = Nominal diameter of piping, in.
P = Average pressure during test, lbs per sq in.

3.03 LOW PRESSURE AIR TESTING

A. General:

1. Perform low pressure air testing for gravity sewer and drainage piping systems identified in other sections.

2. Test pipes between adjacent manholes. Test time for air pressure to drop 1.0 psi.

    a. For pipes 4 in. through 36 in. dia comply with Table 40 05 10.
    b. Pipe over 36 in. dia shall not be tested by the low pressure air method.
    c. Ignore length of laterals.

B. Preparation:

1. Isolate pipe section to be tested by plugging each end with air tight plugs. Plug ends of branches, laterals and wyes which are to be included in test section.
2. Brace plugs to prevent slippage and blowout due to internal pressure.
3. One plug shall have inlet tap or other provision for connecting air supply.
4. Air control equipment shall consist of valves and pressure gauges to control rate at which air flows into test section and gauges to monitor air pressure inside pipe.

C. Testing:

1. If pipe to be tested is submerged in water, determine height of water above spring line of pipe at each end of test section and compute average. For each foot of water above pipe's spring line, increase test pressure by 0.43 psi.
2. Add air slowly to test section until pressure inside pipe is raised to 4.0 psi greater than average back pressure of water that may be over pipe.
3. After pressure of 4.0 psi obtained, control supply of air so internal pressure maintained between 3.5 and 4.0 psi (above average water back pressure) for minimum of 2 minutes to allow temperature of air to come into equilibrium with temperature of pipe.
4. Determine rate of air lost by time pressure drop method.

    a. After temperature stabilized for 2 minute period, disconnect air supply. Allow pressure to decrease to 3.6 psi. At this pressure, start stopwatch to determine time required for pressure to drop 1.0 psi. Time required for loss of 1.0 psi is then compared to Table 40 05 10.
    b. If time is equal to or greater than time indicated in table, test shall be acceptable.
    c. If time is less than time indicated in table, make appropriate repairs and retest.

TABLE 40 05 10
LOW PRESSURE AIR TEST

Test time required for loss of air pressure of
1.0 psi for size and length of pipe indicated.

A	B	C	D	E	F
Pipe Dia (in.)	**Time/Ft Up To Length In Column C (sec)**	**Length Time In Column B Applies (ft)**	**Test Time For Length Between Columns C & E (min:sec)**	**Length Time In Column F Applies (ft)**	**Time/Ft Over Length In Column E (sec)**
4	0.18	636	1:54	1,432	0.08
6	0.40	424	2:50	955	0.18
8	0.71	318	3:47	716	0.32
10	1.11	255	4:43	573	0.49
12	1.60	212	5:40	477	0.71
15	2.50	170	7:05	382	1.11
18	3.62	141	8:30	318	1.61
21	4.92	121	9:55	273	2.19
24	6.42	106	11:20	239	2.85
27	8.14	94	12:45	212	3.62
30	10.00	85	14:10	191	4.44
33	12.14	77	15:35	174	5.40
36	14.37	71	17:00	159	6.39

END OF SECTION

SECTION 40 05 19
DUCTILE IRON PROCESS PIPE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Detailed requirements for various ductile iron piping products. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular ductile iron piping products to be provided under this Contract.

1.02 REFERENCES

A. AWWA: American Water Works Association

B. ANSI: American National Standards Institute

C. ASTM: American Society for Testing and Materials

D. AWS: American Welding Society

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for ductile iron piping specified.
2. Manufacturer's specifications, catalog cuts, and literature for the following:

a. Pipe.
b. Inside linings.
c. Restrained push-on joints.
d. Mechanical joints.
e. Flange joints.
f. Grooved joints.
g. Standard fittings.
h. Special fittings.
i. Wall pipe and floor pipe.
j. Polyethylene encasement.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for ductile iron piping.
2. Submit outside coating system for buried, interior, exterior, and submerged piping locations. Include submittal information in accordance with Section 09 96 00.
3. Submit all product data and coating system information specified above in one complete

submittal.

4. Shop drawings showing layout for ductile iron piping systems shall be submitted in accordance with and transmitted under appropriate piping system Specification section.
5. Submit in accordance with Section 01 33 00.

D. American Iron and Steel Compliance Certification:

1. This project is being funded by the Clean Water State Revolving Fund that requires that all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement"). The Contractor and his/her suppliers shall comply with Section 436 of federal H.R. 3547. These requirements apply to and are binding to the Manufacturer of the products specified in this Section unless variance or De Minimums documentation has been submitted by the Contractor.
2. The Manufacturer shall provide with the shop drawing submittal one signed and dated Certification Letter (a sample copies of which are provided in the Appendix). The Certification Letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

E. Lining Reports:

1. Submit layout drawing showing location of each pipe spool and fitting identification number.
2. Submit notarized certification report for each pipe spool and fitting for approval prior to shipment.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing materials of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain ductile iron piping from single supplier with responsibility for entire system.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. American Cast Iron Pipe Company.

B. U.S. Pipe and Foundry Company.

C. McWane Ductile - Clow Water Systems Co. (Less than 48-inch pipe)

2.02 PIPE

A. Liquid and air service pipe: AWWA C151, ductile iron.

B. Minimum Thickness/Pressure Class:

1. Buried Piping: Restrained push-on joint pipe and mechanical joint pipe, Pressure Class 250 unless specified otherwise in Section 40 05 05**.**
2. Flanged joint pipe: Special Thickness Class 53.
3. Grooved joint pipe: Special Thickness Class 53.

2.03 INSIDE LINING

A. Pipe and fittings shall be provided unlined or with inside lining as specified in Section 40 05 05.

B. Cement lining shall be in accordance with AWWA C104.

C. Glass Lining:

1. Glass-lined products shall be furnished to Contractor by glass lining manufacturer. Glass lining manufacturer shall supply pipe, fittings, fabrication, glass lining and outside coating.

2. Glass lining shall be in accordance with ASTM B 1000-15.

3. Manufacturers:

a. Fast Fabricators; Remington, VA.
b. C&B Piping; Leeds, AL.
c. U.S. Pipe Fabrication.

4. Special glasses and inorganic materials applied in minimum of two coats. Apply base coat and fire to temperature above 1,400 degrees Fahrenheit (F) to fuse glass to metal. Process subsequent coats in similar manner to form integral molecular bond with base coat. Finished lining shall be as follows:

a. Thickness: 0.008 to 0.012 inches.
b. Hardness: 5 to 6 on Mohs Scale.
c. Density: 2.5 to 3.0 grams per cubic centimeter.
d. Sufficiently bonded to metal surface to withstand strain of 0.001 inch per inch without damage to glass lining.
e. Resistant to corrosion by solutions of between pH-3 and pH-10 at 125 degrees F.
f. Withstand thermal shock of 350 degrees F without crazing, blistering or spalling.
g. No visible loss of surface glass after immersion in 8 percent sulfuric acid solution at 148 degrees F for 10 minutes.
h. Weight loss not more than 3 milligrams per square inch when tested according to ASTM C283.
i. Visually free of pinholes, crazing, or fish scales that expose metal.

5. Fabrication of glass lined pipe shall be performed by glass lining manufacturer. Fabrication of pipe outside of glass lining manufacturer's shop is unacceptable. Cutting of pipe outside of manufacturer's shop is only allowed on buried piping 10" and smaller, maximum of one piece per pipe run at locations to be approved by Engineer. Field cutting shall be performed in accordance with manufacturer's recommendations and Engineer shall inspect field cut prior to installation.

6. In Factory Glass Lining Testing:

a. Each pipe spool and fitting shall be marked, inspected, and certified that glass lining meets specified requirements.
b. For each pipe spool and fitting, perform low voltage, wet sponge, non-destructive holiday detection testing in accordance with ASTM D 5162-01 and manufacturer's recommendations.

1) Acceptable fittings pinhole criteria:

Pipe Size (in.)	Number of Pinholes per Fitting
3 - 8	5
10 - 18	8
20 and larger	10

2) Acceptable pipe spool pinhole criteria:

Pipe Size (in.)	Number of Pinholes per 20' Length of Pipe
3 - 8	12
10 - 18	20
20 and larger	28

c. Provide certification report including, but is not be limited to, the following information:

1) Pipe or fitting identification name/number
2) Date of manufacturer
3) Date of inspection
4) Name of inspector
5) Inspection performed

Holiday detection for pinholes, crazing, scaling, any exposed metal, or end damage
Glass thickness
Other (as recorded)

d. Upon delivery, each pipe and fitting may be inspected by Engineer in presence of Contractor. If, in the opinion of Engineer, pipe does not meet Contract Specifications, pipe or fitting will be retested on by a mutually-agreed upon by a third party company. If the third party company verifies that the pipe does not meet contract Specifications, pipe or fitting will be rejected and the Contractor shall pay for the third-party testing. New pipe or fitting shall be provided to replace rejected product at no additional cost to Owner.

2.04 JOINTS

A. Joint Type:

1. Liquid and air services in buried locations shall be mechanical or push-on joint unless otherwise noted or specified in system Specification section.

a. Provide restrained mechanical joints or restrained push-on joints for piping systems with a maximum operating pressure greater than 5 pounds per square inch.

2. Liquid and air service in locations other than buried shall be flanged or grooved end joint. As noted on Drawings or as specified in system Specification section if different than specified above for services and locations.

B. Mechanical and Push-On Joints:

1. AWWA C111.

2. Gasket material:

    a. Suitable for service and maximum operating temperature of piping system as specified in Section 40 05 05.
    b. Selected by pipe manufacturer.

3. Restrained Mechanical Joints:

    a. Incorporate restraint into follower gland with individually actuated wedges.
    b. Full mechanical joint deflection during assembly and after burial.
    c. Ductile iron components.
    d. Series 1100 Megalug as manufactured by EBBA Iron, Inc.

4. Restrained Push-On Joints:

    a. Retainer Ring Type:

        1) American Cast Iron Pipe Company, Flex-Ring and Lok-Ring.
        2) U.S. Pipe and Foundry Company, TR-Flex, HDSS or HP LOK
        3) Clow, TR-Flex.

5. Restrained joints shall be mechanical locking type to provide positive restraint from joint separation without use of restraining rods, straps, or clamps.
6. Minimum pressure rating of restrained joints: 250 pounds per square inch except 30-36" TR Flex has a 100 psi reduction in joint rating for a given parent pipe pressure class.
7. For all buried applications use Cor-Blue T-bolts or equal, which have a ceramic filled, baked on fluorocarbon resin developed to handle highly corrosive conditions. Cor-Blue or equal T-Bolts and nuts shall comply with current version of ANSI/AWWA C111/A21.11.

C. Flanged Joints:

1. Flanged pipe for liquid and air service shall be in accordance with AWWA C115.
2. Fabrication of flanged pipe, including assembly of flange on pipe shall be performed by pipe manufacturer in accordance with AWWA C115. Assembly of flange on pipe outside of manufacturer's shop is unacceptable.
3. Flange material for flanged pipe shall be ductile iron. Flanged pipe with gray iron flanges is not acceptable.
4. Gasket material shall be suitable for service and maximum operating temperature of piping system as specified in Section 40 05 05. Torque requirement of gaskets shall be less than torque rating of flange, bolt, and nuts.
5. Gaskets shall be ring or full face, 1/8-inch thick, and conform to dimensions shown in Appendices to AWWA C110 and AWWA C115. Provide pipe manufacturer proprietary gasket with flanges.
6. Bolts:

    a. Size, length, and number as shown in AWWA C110 and AWWA C115.
    b. Material:
    c. Carbon steel, ASTM A307, Grade B.
        1) Carbon steel, ASTM A307, Grade B for all locations unless otherwise noted.
        2) Type 316 stainless steel for all locations submerged, within wetwells, tanks, channels or tank covers. Provide locking washers for wetwells and channels. Provide bolt insulating sleeves to protect against dissimilar materials.

    d. Dimensions: ANSI B18.2.1, heavy hex.

7. Nuts:

    a. Size, length, and number as shown in AWWA C110 and AWWA C115.
    b. Material:

        1) Carbon steel, ASTM A307, Grade B for all locations unless otherwise noted.
        2) Type 316 stainless steel for all locations submerged, within wetwells, tanks, channels or tank covers. Provide bolt insulation sleeves for to protect against dissimilar materials.

    c. Dimensions: ANSI B18.2.2, heavy hex.

D. Grooved Joints:

1. AWWA C606.
2. Rigid joint. Pipe ends radius cut grooved to rigid groove specifications.
3. Grooved couplings shall be Victaulic Style 31, or equal.
4. Grooved joint adapter flanges shall be Victaulic Styles 341 or 342, or equal.
5. Gasket material:

    a. Suitable for service and maximum operating temperature of piping system as specified in Section 40 05 05.
    b. Selected by grooved coupling manufacturer.

6. Coatings for grooved couplings and adapter flanges shall be same products as coatings for pipe.
7. Materials for Bolts and Nuts:

    a. Cadmium coated, Grade B for all locations unless otherwise noted.
    b. Type 316 stainless steel for all locations submerged, within wetwells, tanks, channels or tank covers. Provide locking washers for wetwells and channels. Provide bolt isolation sleeves for to protect against dissimilar materials

2.05 FITTINGS

A. Pressure rating shall be 250 pounds per square inch, minimum.

B. Standard fittings for liquid and air service:

1. Restrained push-on and restrained mechanical joint fittings:

    a. Ductile iron.
    b. AWWA C110 or AWWA C153.

2. Flanged joint fittings:

    a. Ductile iron.
    b. AWWA C110.
    c. Flange dimensions in accordance with AWWA C115.

3. Grooved joint fittings:

    a. Ductile iron.
    b. AWWA C110 except end preparation.
    c. End preparation in accordance with AWWA C606, rigid radius groove.

d. Minimum wall thickness in accordance with AWWA C110/ANSI A21.10 and AWWA C153.

C. Special fittings for liquid and air service, not included in AWWA standards, shall be manufacturer's standard, based on AWWA design principles, and in compliance with applicable requirements of AWWA standards.

D. Wall Pipe and Floor Pipe:

1. Ductile iron.
2. Wall thickness of body equal to or greater than wall thickness of connecting pipe.
3. Flanges set flush with face of concrete shall be tapped for stud bolts.
4. Collar dimensions as shown on Drawings.
5. Collar cast integral with pipe or fabricated by welded attachment of collar to pipe.
6. Fabricated wall pipe and floor pipe shall be as follows:

a. Rated for dead end thrust due to 250 pounds per square inch internal pressure.
b. Steel collar welded continuously around pipe on both sides of collar.
c. Weld in pipe manufacturer's shop by qualified welder.
d. Electrodes: AWS A5.15, Class ENiFe-CI or AWS 5.6, Class ECuAl-2.

E. Miscellaneous Fittings:

1. Provide miscellaneous fittings, such as cutting in sleeves, tapping sleeves, caps, plugs, and other fittings, as required for a complete system.
2. Manufacturer of miscellaneous fittings shall be same manufacturer as pipe.
3. Miscellaneous fittings shall be suitable for service.

2.06 COATINGS

A. Provide buried piping with 1 mil thick asphaltic coating in accordance with applicable AWWA and ANSI standards.

B. Surface preparation, priming, and finish coating of non-buried piping shall be compatible and in accordance with Section 09 96 00.

C. Finish color for interior and exterior piping shall be as specified in Section 40 05 05.

D. Coating for piping embedded in concrete is not required.

2.07 POLYETHYLENE ENCASEMENT

A. Provide V-Bio Enhanced Polyethylene Encasement for buried piping in accordance with AWWA C105.

PART 3 – EXECUTION

3.01 INSTALLATION

A. In accordance with Section 40 05 05.

B. Buried Piping: In accordance with Section 33 05 05.

C. Pipes to be cut in the field shall be gauged and within acceptable tolerances to ensure fit of connections.

3.02 JOINT ASSEMBLY

A. Restrained push-on, mechanical, and grooved joint in accordance with manufacturer's written instructions.
B. Flanged joint in accordance with Section 40 05 05, flanged pipe manufacturer's written instructions, and gasket manufacturer's written instructions.

3.03 WALL PIPE

A. Support by formwork to prevent contact with reinforcing steel.

B. Install in accordance with Section 03 30 00.

3.04 POLYETHYLENE ENCASEMENT

A. Install V-Bio Enhanced Polyethylene Encasement on all buried piping in accordance with AWWA C105.

3.05 TAPPING

A. Do not tap polyethylene-lined and glass-lined pipe.

B. Taps for cement-lined and unlined pipe shall be in accordance with pipe manufacturer's instructions.

C. Provide service saddles for tap sizes greater than 1-inch. Service saddles are not required for tap sizes 1-inch and smaller.

3.06 TESTING

A. Test pipe and pipe products in accordance with Section 40 05 10.

3.07 IDENTIFICATION

A. Provide pipe identification in accordance with Section 40 05 97.

END OF SECTION

SECTION 40 05 23
STAINLESS STEEL PROCESS PIPE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Detailed requirements for various 304L and 316L stainless steel pipe and fittings. Some products specified in this Section may not be required for this Project. Refer to piping system Specification section(s) and Drawings to determine stainless steel piping products to be provided under this Contract.

1.02 REFERENCES

A. ASME: American Society of Mechanical Engineers.

B. ASTM: American Society of Testing and Materials.

C. ANSI: American National Standards Institute.

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for piping system specified.
2. Submit for pipe, fittings, flanges, face rings, and bolting.
3. Submit proposed gasket material for each service. Submit documentation confirming gasket material selection is appropriate for fluid carried in system.
4. Coating system for carbon steel surfaces. Include coating system submittal information specified in Section 09 96 00.

C. Shop Drawings:

1. Shop Drawings showing layout for stainless steel piping shall be submitted in accordance with and transmitted under appropriate piping system specification sections.

D. American Iron and Steel Compliance Certification:

1. This project is being funded by the Clean Water State Revolving Fund that requires that all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement"). The Contractor and his/her suppliers shall comply with Section 436 of federal H.R. 3547. These requirements apply to and are binding to the Manufacturer of the products specified in this Section unless variance or De Minimums documentation has been submitted by the Contractor.
2. The Manufacturer shall provide with the shop drawing submittal one signed and dated Certification Letter (a sample copies of which are provided in the Appendix). The Certification Letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

E. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Welding Qualifications:

1. Contractor shall be responsible for qualifying welders as required by ANSI B31.3 and ASME Boiler and Pressure Vessel Code, Section IX.

C. Contractor shall maintain record of welding procedures used and welders or welding operators assigned to this Project and their symbols. Records shall show date and results of procedure and performance qualifications. Records shall be certified by Contractor and kept at job site and shall be available to Owner or Engineer on request for duration of Project.

D. Single-Source Responsibility: Obtain stainless steel products from single manufacturer with responsibility for entire system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Shipping:

1. Sections with field welded ends shall have wooden plug securely installed at each end to prevent pipes from being bent out of round.
2. Flanged connections shall have plywood blind wired over end and through bolt holes to hold flange against face ring or clip-on type flange protectors.
3. Ship protected from damage and contact with carbon steel.
4. Tarp sections during shipment to avoid contact with road dust and salt spray.

C. Storage:

1. Store stainless steel products in clean, dry location.
2. Store protected from damage and contact with carbon steel.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Felker Brothers Corporation

B. Or equal.

2.02 GENERAL

A. Grade of stainless steel (304 or 316) shall be as indicated in Section 40 05 05 or elsewhere.

B. All piping, fittings and miscellaneous components installed on welded piping systems shall be provided in low carbon (L) variant of specified stainless steel alloy.

C. When cast materials are used, systems specified for:

1. 304 stainless steel shall be cast from CF-8 materials.
2. 304L stainless steel shall be cast from CF-3 materials.
3. 316 stainless steel shall be cast from CF-8M materials.
4. 316L stainless steel shall be cast from CF-3M materials.

D. At Contractor's option, thicker materials than specified are acceptable.

E. At Contractor's option, 316 stainless steel will be accepted in lieu of 304 stainless steel.

2.03 PIPE

A. Unless indicated otherwise, provide piping as follows:

1. 1/2-inch to 3/4-inch:

a. ASTM A312.
b. Dimensions: Conform to ANSI B36.19.
c. Schedule 10 for socket welded piping, Schedule 40 for socket welded piping utilizing Class 3000 fittings, Schedule 80 for threaded.
d. Fittings: Unless indicated otherwise in Section 40 05 05 or elsewhere for specific service, use the following:

1) 150-lb fittings meeting pressure/temperature requirements of MSS-SP-114 Class 150 fittings (300-psi CWP)
2) Threaded end connections shall conform to ASME B1.20.1.
3) Dimensions: Conform to MSS-SP-114.
4) ASTM A351, cast stainless steel.

2. 1-inch to 2-inch:

a. ASTM A312.
b. Dimensions: Conform to ANSI B36.19.
c. Schedule 10 for socket welded piping, Schedule 40 for threaded and for socket welded piping utilizing Class 3000 fittings.
d. Fittings: Unless indicated otherwise in Section 40 05 05 or elsewhere for specific service, use the following:

1) 150-lb fittings meeting pressure/temperature requirements of MSS-SP-114 Class 150 fittings (300-psi CWP)
2) Threaded end connections conforming to ASME B1.20.1.
3) Dimensions: Conform to MSS-SP-114.
4) ASTM A351, cast stainless steel.

3. 2-1/2-inch:

a. ASTM A312.
b. Dimensions: Conform to ANSI B36.19.
c. Schedule 10 for butt welded piping.
d. Fittings: Unless indicated otherwise in Section 40 05 05 or elsewhere for specific service, use the following:

1) Butt Weld Fittings:
2) ASTM A403, Class WP.
3) Dimensions: Conform to ANSI B16.9, Buttwelded.
4) Elbows shall be long radius unless otherwise indicated on Drawings.
5) Wall Thickness: match connecting pipe.

4. 3-inch to 24-inch:

    a. ASTM A312 or ASTM A778.
    b. Dimensions: Conform to ANSI B36.19.
    c. Schedule 10 for butt welded piping.
    d. Fittings: Unless indicated otherwise in Section 40 05 05 or elsewhere for specific service, use the following:

        1) Butt Weld Fittings:
        2) ASTM A403 or ASTM A774, Class WP.
        3) Dimensions: Conform to ANSI B16.9, Buttwelded.
        4) Elbows shall be long radius unless otherwise indicated on Drawings.
        5) Wall Thickness: match connecting pipe.

2.04 FITTINGS

A. Class 150 Cast Threaded Fittings:

1. Fittings shall be 150-lb fittings meeting pressure/temperature requirements of MSS-SP-114 Class 150 fittings (300-psi CWP)
2. Threaded end connections conforming to ASME B1.20.1.
3. Dimensions: Conform to MSS-SP-114.
4. ASTM A351, cast stainless steel.

B. Class 150 Cast Socket Welded Fittings:

1. Meeting pressure/temperature requirements of MSS-SP-114 Class 150 fittings (300-psi CWP).
2. Socket welded end connections shall be bored to match mating pipe Outside Diameter.
3. Dimensions: Conform to MSS-SP-114. ASTM A351, cast stainless steel.

C. Forged Class 3000 Fittings:

1. Forged stainless steel materials conforming to ASME A182.
2. All fittings shall be socket welded fittings.
3. Dimensions: Conform to ASME B16.11.

D. Butt Weld Fittings:

1. ASTM A403, Class WP when ASTM A312 pipe materials provided.
2. ASTM A774, Class WP when ASTM A778 pipe materials provided.
3. Dimensions: Conform to ANSI B16.9, Buttwelded.
4. Elbows shall be long radius unless otherwise indicated on Drawings.
5. Wall Thickness: match connecting pipe.

2.05 JOINTS

A. Threaded Joints:

1. Size: ½-inch to 2-inch.
2. Non-flanged equipment connections and valves shall be threaded, all other connections are Contractors choice of threaded or socket welded.
3. Thread Sealant: Teflon tape or Teflon paste.

B. Socket Welded Joints:

1. Size: ½-inch to 2-inch.
2. Socket welded joints shall be performed in the shop in accordance with Shop Fabrication paragraph or in the field in accordance with Field Welded Joints paragraph.

C. Butt Welded Joints:

1. Size: 2-1/2-inch and Larger.
2. Butt welded joints shall be performed in the shop in accordance with Shop Fabrication paragraph or in the field in accordance with Field Welded Joints paragraph.

D. Flanged Joints:

1. Flange:

a. Unless specifically indicated on Drawings or Remarks of Process Mechanical Piping Schedule of Section 40 05 05, type of flange to be used in Contractor's choice from the list below:

1) 304L stainless steel or 316L stainless steel matching pipe, back-up (lap joint) type.
2) Weld-neck style matching specified pipe material.
3) Slip-on flanges matching specified pipe material.

b. Flanges shall be raised face except where attaching to flat faced equipment or valves, then flat faced flanges shall be provided.
c. Faced and drilled to 150 or 300 pound class in conformance with ANSI B16.5.

2. Face Ring: Type 304L or 316L (match material type of pipe) stainless steel angle ring or flat plate. Flat plate thickness to suit pipe wall thickness and welding procedure to avoid warpage.
3. Bolting: ASTM F593-02 Type 304 stainless steel bolts, nuts and washers. Provide anti-galling compound on all mating threads of nuts and bolts.
4. Gaskets:

a. Biogas Service:

1) Ring-type. Provide full faced gaskets when connecting to Class 125 flanges.
2) PTFE composition, non-asbestos
3) Garlock "Gylon" style, or equal.

b. All other Services:

1) Material and facing as recommended as suitable for service by gasket Manufacturer.

2.06 FLANGE ISOLATION KITS

A. Manufacturers:

1. Pipeline Seal and Insulator, Inc.

B. Flange Isolation Kit:

1. Provide at all locations where stainless steel piping contacts ductile iron, carbon steel, cast iron, or copper piping to prevent galvanic reaction created from dissimilar metals.
2. Isolating and Sealing Gasket:

a. Provide one full faced isolating and sealing gasket, 1/8" thick, G-10 retainer containing precision tapered groove to accommodate controlled compression of a Teflon or Viton quad-ring sealing element.
b. Sealing element placement shall accommodate either flat, raised face, or RTJ flanges.
c. Quad-ring seal shall be pressure energized.
d. G-10 retainer shall have 550 volts/mil dielectric strength and minimum 50,000 psi compressive strength.
e. Full faced flange isolating gasket shall be 1/8-inch less in inner diameter than the inner diameter of flange in which it is installed.

3. Full Length Bolt Isolating Sleeves:

a. Provide one full length G-10 sleeve (extending half way into both steel washers) for each flange bolt.
b. G-10 shall be 1/32 inch thick tube with 400 volts/mil dielectric strength and water absorption of 0.10 percent or less.

4. Flange isolating kits shall be manufactured at a facility that has a registered ISO 9001:2000 Quality Management System.

2.07 SHOP FABRICATION

A. Dimensions:

1. Piping dimensions of fabricated sections shall conform to dimensions for manufactured pipe in ANSI B36.19.
2. For purpose of shop fabrication, dimensions shown on Drawings shall be considered approximate only. Field verification is responsibility of Contractor. Where possible, use field welds in each direction with adequate allowance for trim and fit, but not less than 2-inch in each direction. Loose flanged shall be provided for fit up at equipment connections.

B. Branch Connections:

1. Nozzle welds may be used in lieu of buttwelded reducing tees when permitted by ANSI B31.3. Buttwelded tees shall be used when branch is same size or one pipe size smaller than header. Nozzle welds shall be reinforced in conformance with ANSI B31.3.
2. Threaded or welded full couplings (O-lets) may be used for branch connections of 1-inch or smaller pipe size. Coupling shall comply with Fittings Paragraph of this Section.

C. Shop Welded Joints:

1. Preparation: Equipment used in welding preparation shall be covered or faced to prevent mild steel contamination of stainless steel. Items shall be marked "STAINLESS STEEL", and shall be used for no other purpose.
2. Cleaning: Clean metal to be fused of lubricants, grease, paint, filings, and cuttings. Cleaning with alcohol or acetone. Do not use chlorinated solvents.
3. MIG and TIG Welding: Metal Inert Gas (MIG) welding may be used with automatic or semi-automatic machine welding. Tungsten Inert Gas (TIG) welding shall be used for manual welding of pressure joints. Apply shielding gas protection to underside of weld. Filler metal rods shall be AWS A5.9 Type ER308L or ER316L.
4. SMA Welding: Shielded Metal Arc (SMA) welding may be used at noncritical non-pressure connections and for joining stainless to carbon steel. Welding electrodes shall be stored in dry atmosphere to avoid moisture pick-up. Filler metal rods shall be AWS A5.4 Type E308L or E316L.
5. Dissimilar Metals: Do not weld carbon steel directly to stainless steel piping. Weld "poison pads" of equal thickness and same material of pipe to pipe and attach carbon steel to poison

pad. SMA welding may be used to attach carbon steel to stainless pad. Filler metal rods shall be AWS A5.4 Type E309, or ASW A5.9 Type ER309 if TIG welding is used.

6. Shielding Gas: Use welding grade argon or helium-argon mixture.
7. Penetration: Buttweld joints shall have 100 percent penetration.
8. Tack Welding: Make tack welds with same grade of filler metal as finished weld. Tack welds shall be small enough to be absorbed into following weld beads and have slag and oxides removed prior to finishing weld or shall be completely removed.
9. Weld Finish: Inside of weld shall be smooth and free from projections and depressions. Grind with iron free grinding wheels labeled “STAINLESS STEEL” used for nothing else. Use 160 grit grinding wheels. Remove scale, oxides, and discolorations from pipes and welds. Products and procedures shall be as recommended by manufacturer.

2.08 COATING

A. Surface preparation, priming, and finish coating of carbon steel surfaces shall be compatible and in accordance with Section 09 96 00.

B. Stainless steel components shall not be coated.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install piping systems in accordance with manufacturer's written instructions.

B. Install in accordance with appropriate piping system Specification section.

C. Non-flanged equipment or skid connections shall be provided a union upstream of connection point between isolation valve and equipment.

D. Interconnections between stainless steel piping systems and copper, steel, or iron piping systems shall be made with a flanged connection, utilizing a Flange Isolation Kit.

3.02 IDENTIFICATION

A. Identification: pipe identification shall be in accordance with Section 40 05 97.

3.03 FIELD WELDED JOINTS

A. Branched connections:

1. Nozzle welds may be used in lieu of buttwelded reducing tees when permitted by ANSI B31.3. Use buttwelded tees when branch is same size or one pipe size smaller than header. Reinforced nozzle welds in conformance with ANSI B31.3.
2. Threaded full couplings may be used for branch connections of 1-inch or smaller pipe size. Couplings shall comply with Paragraph 2.03.A.

B. Joint Preparation:

1. Equipment used in welding preparation shall be covered or faced to prevent mild steel contamination of stainless steel.
2. Prepare buttwelded joints in conformance ANSI A16.25.
3. Cleaning: Clean metal to be fused of lubricants, grease, paint, filings, and cuttings. Cleaning with alcohol or acetone. Do not use chlorinated solvents.

C. Welding:

1. Protect weld area from wind or draft while welding with gas back-up.
2. Preheat weld area if work piece temperature is less than 60 degrees Fahrenheit (F).
3. TIG Welding: Use Tungsten Inert Gas (TIG) welding for welding of critical pressure pipe joints. Apply shielding gas protection to underside of weld. Filler metal rods shall be AWS A5.9 Type ER316L.
4. SMA Welding: Shielded Metal Arc (SMA) welding may be used at noncritical pressure pipe joints and for joining stainless steel to carbon steel. Welding electrodes shall be stored in dry atmosphere to avoid moisture pick-up. Filler metal rods shall be AWS A5.4 Type E316L.
5. Dissimilar Metals: Carbon steel shall not be welded directly to stainless steel piping. Weld "poison pads" of equal thickness and same material of pipe to pipe and attach carbon steel to poison pad. SMA welding may be used to attach carbon steel to stainless pad. Filler metal rods shall be AWS A5.4 Type E309, or ASW A5.9 Type ER309 if TIG welding is used.
6. Shielding Gas: Use welding grade argon or helium-argon mixture.
7. Penetration: Buttweld joints shall have 100 percent penetration.
8. Tack Welding: Make tack welds with same grade of filler metal as finished weld. Tack welds shall be small enough to be absorbed into following weld beads and have slag and oxides removed prior to finishing weld or be completely removed.
9. Weld Finish: Inside of weld shall be smooth and free from projections and depressions. Grind with iron free grinding wheels labeled "STAINLESS STEEL" used for nothing else. Use 160 grit grinding wheels. Remove scale, oxides, and discolorations from pipes and welds. Products and procedures shall be as recommended by manufacturer.

3.04 FIELD QUALITY CONTROL

A. Any appearance of rusting from embedded iron on exterior surfaces of installed piping systems prior to issuance of Substantial Completion for associated system shall be corrected by Contractor by means of pickling affected surface with an appropriate solution, scrubbing with stainless steel brushes, and rinsing clean with deionized / distilled water.

3.05 WALL PIPES, WALL SLEEVES, AND SEALS FOR WALL PENETRATIONS

A. Support wall pipe by form work to prevent contact with reinforcing steel.

B. Install wall pipe in accordance with Section 03 30 00.

END OF SECTION

SECTION 40 05 31.13
POLYVINYL CHLORIDE PROCESS PIPE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Detailed requirements for various PVC piping products. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular PVC piping products to be provided under this Contract.

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

B. ANSI: American National Standards Institute

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for PVC components specified.
2. Submit product data for pipe, fittings, flanges, gaskets, and bolting.
3. Submit proposed gasket material for each service. Submit document confirming gasket material selection is appropriate for fluid carried in system.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for PVC components.
2. Submit layout for PVC piping systems in accordance with and transmitted under appropriate piping system Specification section.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain PVC components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

PART 2 – PRODUCTS

2.01 PVC MATERIAL

A. Type 1, Grade 1 conforming to ASTM D1784.

2.02 PIPE

A. Schedule 80 PVC conforming to ASTM D1785.

2.03 PERFORATIONS

A. Provide perforations where perforated pipe called for on Drawings or in other Specification section(s).

B. Perforation requirements: 5/8-inch diameter holes on 5-inch centers 120 degrees apart.

2.04 FITTINGS

A. Schedule 40 or 80 PVC to match piping system.

1. ASTM D2464 for threaded joint type.
2. ASTM D2467 for socket joint type.

2.05 JOINTS

A. Provide socket type at all locations except unions, valves, and equipment with threaded or flanged end connections.

B. Threaded connections are not acceptable for nominal piping size greater than 2 inches.

C. Do not provide threaded joints for piping systems identified on Drawings or in other sections to be provided without threaded joints.

2.06 FLANGES

A. PVC, 1-piece socket type, flat faced, conforming to ANSI B16.5 150-pound bolt-hole drilling pattern.

2.07 GASKETS

A. Full-face, 1/8-inch thick flat type.

B. When mating flange has raised face, use flat ring gasket and provide filler gasket between outside diameter of raised face and flange outside diameter to protect flange from bolting moment.

C. Material compatible with fluid carried in system.

2.08 BOLTING

A. Type 316 Stainless Steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts.

B. Bolts shall conform to ANSI B.1.20.1.

C. Provide washers same material as bolts.

2.09 SOLVENT CEMENT

A. Join socket connections with PVC solvent cement conforming to ASTM D2564.

B. As recommended by pipe and fitting manufacturer to assure compatibility fluid in piping system.

2.10 THREAD LUBRICANT

A. Teflon tape.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install PVC components in accordance with manufacturer's written instructions.

B. Install products as shown on Drawings, and as specified in applicable piping system Specification section(s).

3.02 IDENTIFICATION

A. Identification: pipe identification shall be in accordance with Section 40 05 97.

END OF SECTION

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SECTION 40 05 53
PROCESS VALVES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plug Valves.
2. Check Valves.
3. Ball Valves.
4. Gate Valves.
5. Mechanical Regulating Valves.
6. Miscellaneous Valves.
7. Valve Accessories.

B. Some products specified in this Section may not be required for this Contract. Refer to piping system Specification section(s) and Drawings to determine particular products to be provided under this Contract.

1.02 DEFINITIONS

A. psi – pounds per square inch

B. w.c. – water column

C. FOG – fats-oils-grease

D. Deg F – Degree Fahrenheit

E. CWP – cold working pressure

F. SWP – steam working pressure

G. NPT – National Pipe Thread

1.03 REFERENCES

A. ANSI: American National Standards Institute

B. ASTM: American Society for Testing and Materials

C. ASME: American Society of Mechanical Engineers

D. AWWA: American Water Works Association

E. ISO: International Organization for Standardization

F. NEMA: National Electrical Manufacture's Association

G. NSF: National Sanitation Foundation

1.04 SUBMITTALS

A. Product Data and Shop Drawings:

1. Submit in accordance with Section 01 33 00 in sufficient detail to confirm compliance with the Drawings and this Section.
2. Submittal shall, at a minimum, include the items listed below.

a. Manufacturer's product data for each type of valve.
b. Motor data. Submit in accordance with Section 26 05 84.
c. Coating systems. Submit in accordance with Section 09 96 00.
d. Valve schedule. Identify all valves by type number, pipeline, location, joint type, manufacturer, and model or catalog number.

B. American Iron and Steel Compliance Certification:

1. This project is being funded by the Clean Water State Revolving Fund that requires that all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement"). The Contractor and his/her suppliers shall comply with Section 436 of federal H.R. 3547. These requirements apply to and are binding to the Manufacturer of the products specified in this Section unless variance or De Minimums documentation has been submitted by the Contractor.
2. The Manufacturer shall provide with the shop drawing submittal one signed and dated Certification Letter (a sample copies of which are provided in the Appendix). The Certification Letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

C. Instructional Services Documentation:

1. Submit in accordance with Section 01 61 00.

D. Operation and Maintenance (O&M) Data:

1. Submit in accordance with Section 01 78 23.

1.05 QUALITY ASSURANCE

A. Manufacturer shall be responsible for all components identified for each valve type, accessory, and actuator specified in this Section.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All equipment and parts shipped to the job site shall be properly protected from the elements so that no damage or deterioration occurs from the time of delivery to the time when the installation is complete and the units are placed into operation.

B. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

PART 2 – PRODUCTS

2.01 GENERAL

A. All valves shall be complete with all necessary operating hand wheels, chain wheels, extension stems, worm and gear operators, operating nuts, chains, wrenches, and other accessories that are required for proper completion of Work included under this section.

B. Valves installed in insulated piping systems shall be furnished with extended stem as required to allow operation of valve without damage to, or interference with, insulation system.

C. Unless otherwise shown, valves shall be same size as adjoining pipe.

D. All units shall have name of manufacturer and size of valve cast on body or bonnet or shown on permanently attached plate in raised letters.

E. Service for all items specified herein are shown on Drawings or in Specifications. Note, this is a general specification; some types listed herein may not be part of the Work.

2.02 PLUG VALVES

A. Type V005: Eccentric Plug Valve

1. Manufacturers:

   a. DeZurik.
   b. Henry Pratt.
   c. Val-Matic.

2. Non-lubricated, resilient seated eccentric plug valve in compliance with AWWA C517-09.
3. Drip-tight shut-off up to full pressure rating of valve with pressure in either direction.
4. Provide grease zerk fittings in upper bonnet and lower body bearing.
5. Provide 100 percent Full Port valve with port area of 100 percent of the connection pipe area.
6. Pressure rating for valves 12-inch and smaller: 175-psig.
7. Pressure rating for valves 14-inch and larger: 150-psig.
8. Cast iron body, ASTM A126, Grade B.
9. Bonnet shall be ASTM A126 Grade B cast iron or nickel aluminum bronze alloy C95500.
10. Buna-N, V packing, U-cup, or O-ring seals.
11. Nickel seats.
12. Balanced plug coated with Hycar.
13. Valves for thickened sludge (flowstream PFTS) and primary scum (flowstream PSM) shall be provided glass lined.
14. Mechanical joint ends for buried piping.
15. Flanged ends (125-pound ANSI Standards) for interior piping 3” and greater.
16. Threaded for interior piping 2” and smaller.
17. Stainless steel bearings.
18. Valves 4-inch and smaller, maximum operating pressure 25 psig and less: lever actuator.
19. Valves 4-inch and smaller, maximum operating pressure greater than 25 psig: gear actuator.
20. Valves 6-inch and larger: gear actuator.

B. Type V025: Use for Natural Gas service.

1. Manufacturers:

   a. Milliken 625 Series.
   b. Key Port Figure 425.
   c. Or equal.

2. Non-lubricated, resilient seated eccentric plug valve.
3. UL Listed for natural gas service.
4. Drip-tight shut-off up to full pressure rating of valve with pressure in either direction.
5. Pressure rating: 175-psig.
6. Cast iron body and plug.
7. Flanged end connections
8. Wrench nut operator.
9. Buna-N plug and stem seals.
10. Secondary seal of plug metal to metal seat interface.
11. Corrosion resistant bearings.

2.03 CHECK VALVES

A. Type V205: Swing Check Valve

1. Manufacturers:

a. DeZurik, APCO.
b. G.A. Industries, Inc.
c. Henry Pratt, 8501 Series
d. Val-Matic

2. 2-1/2-in through 12-inch
3. Swing check with outside lever and spring.
4. Suitable for flow direction horizontal or vertical up.
5. Cast or ductile iron body, disc, and cover.
6. Glassed lined.
7. Stainless steel hinge shafts.
8. Flanged ends meeting 125-lb ANSI standards.
9. Rated 200-lb water-oil-gas (WOG).
10. Stainless steel body seat, resilient field replaceable seat ring on disc.

B. Type V206: Flanged Swing Flex Check Valve

1. Manufacturers:

a. DeZurik, APCO.
b. Val Matic
c. Henry Pratt, RD Series

2. Design:

a. Valve body shall be full-flow equal to nominal pipe diameter at all points through valve. Exception is 4-inch valve shall be capable of passing a 3-inch solid.
b. Seating surface shall be 45-degree angle to reduce travel of disc to full open position.
c. Provide threaded port with plug on bottom of valve. Provide manual backflow actuator to allow back flushing and drainage through valve.
d. Top access port shall be full-size, allowing removal of disc without removing valve from line. Access cover shall be domed in shape to provide flushing action over disc for operating in lines containing high solids content.
e. Provide threaded port in access cover with mechanical indicator to provide disc position indication. Indicator shall have continuous contact with disc under all operating conditions to assure accurate disc position indication. Position of indicator shall allow reading from the east side of the valve when installed, not from the side adjacent to the structural beam.

f. Disc shall be one-piece construction, molded with integral O-ring type sealing surface and reinforced with alloy steel. Flex portion of disc shall contain nylon reinforcement and shall be warranted for 25-yrs.
g. Non-slam closing characteristics shall be provided through short 35-degree disc stroke and memory disc return action to provide cracking pressure of 0.25-psig.
h. Valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508 and show no signs of wear, cracking or distortion to valve disc or seat, and shall remain drip tight at both high and low pressures.

3. Materials:

a. Valve body and cover: ASTM A546 Grade 65-45-12 ductile iron.
b. Disc shall be molded Buna-N (NBR), ASTM D2000-BG.

C. Type V255: PVC Ball Check Valve

1. Manufacturers:

a. Spears Manufacturing.
b. Hayward Industrial Products, Inc.
c. Or equal.

2. Ball check valve.
3. Provide sizes as indicated on Drawings.
4. PVC construction, ASTM D1784.
5. Valve shall be true union type.
6. Provide with socket weld joints.
7. Viton seats and seals.
8. O-rings shall be EPDM.
9. All valve unions and nuts shall have Buttress threads.
10. Valve shall be suitable for installation in the vertical or horizontal position.
11. Rated for 150-psi at 73°F.

D. Type V274: PVC Swing Check Valve

1. Manufacturers:

a. Spears, Quiet Check Valve.
b. Or equal.

2. Designed to provide quiet operation in sump pump or sewage ejector pump systems.
3. 2-inch and smaller.
4. PVC construction.
5. True Union Socket Connection.
6. Spring assisted swing check style valve. Spring shall control rate of closure to prevent slamming.
7. Pressure rating 150 psi when open and 75 psi when closed at 73°F.

2.04 BALL VALVES

A. Type V330: Stainless Steel, Threaded Vented Ball Valve

1. Manufacturers:

a. Apollo.

b. Watts.
c. Or equal.

2. 2-inch and smaller.
3. Provide sizes as indicated on Drawings.
4. Stainless steel body and ball.
5. Vented ball.
6. Blowout proof stem.
7. Reinforced Teflon seats and seals.
8. Full port design.
9. Threaded ends.
10. Hand lever actuator.
11. Rated at 1,000-lb WOG minimum, 250-psi SWP.

B. Type V336: Stainless Steel, Threaded Water Service Ball Valve

1. Manufacturers:

a. Apollo, Figure 76-100.
b. Or Equal.

2. Comply with MSS-SP-110.
3. Conventional port, two-piece stainless steel body for threaded valves.
4. Conventional port, three-piece stainless steel body for socket weld valves.
5. Stainless steel ball and stem.
6. Reinforced TFE Seats.
7. 1,000 psi CWP.

C. Type V355: PVC, Socket-Weld Ball Valve

1. Manufacturers:

a. Spears Manufacturing.
b. Nibco.
c. Hayward Industrial Products, Inc.
d. Or equal.

2. 3-inch and smaller.
3. Provide sizes as indicated on Drawings.
4. PVC construction, ASTM D1784.
5. Valve shall be true union type.
6. Provide with socket weld joints.
7. Full-port.
8. PTFE ball seats.
9. O-rings shall be EPDM.
10. All valve unions and nuts shall have Buttress threads.
11. Rated for 150-psi at 73 deg F.
12. Unless indicated otherwise, provide with double-stop polypropylene handle operator.

D. Type V360: CPVC, Socket-Weld Vented Ball Valve

1. Manufacturers:

a. Spears.
b. Nibco.
c. Or equal.

2. 3-inch and smaller.
3. Provide sizes as indicated on Drawings.
4. CPVC construction, ASTM D1784.
5. Full-port.
6. Valve shall be true union type.
7. Provide with socket weld joints.
8. PTFE ball seats.
9. O-rings shall be EPDM.
10. All valve unions and nuts shall have Buttress threads.
11. Rated for 150-psi at 73 deg F.
12. Unless indicated otherwise, provide with double-stop polypropylene handle operator.

E. Type V370: Buried Natural Gas Isolation Valve

1. Manufacturers:

a. Andronaco Industries- Polyvalve, Poly-Gas.
b. Or Equal.

2. Non-metallic ball valve for buried natural gas piping isolation.
3. Design and fabricated in accordance with ANSI B16.40 and ASTM-2513.
4. Approved by US DOT 49 CFR, Part 192 to installation on buried natural gas distribution systems.
5. High density polyethylene body, ASTM PE4710/3408.
6. Acetal or Polypropylene ball, seat retainer, and wrench adapter.
7. Stainless steel or acetal stem.
8. Buna N seat and stem seal.
9. Neoprene ground water seal.
10. Full port ball when available for proposed size, else shall be standard port.
11. Butt fusion welded end connections dimensioned to SDR 11 sizes.
12. Minimum design operating pressure: 125 psig.
13. Provide with 2 inch square operating nut.
14. All valves shall be installed below a cast iron valve box with cover text of “GAS”.

F. Type V382: Natural Gas Isolation Valve, 1-1/2 inch and smaller

15. Manufacturers:

a. Apollo, 77FLF-100 Series.
b. Or Equal.

16. Listed shut-off valve for natural gas with operating temperatures as low as -30°F.
17. ASME B16.33
18. Bronze body.
19. Chrome plated ball.
20. RPTFE seats and seals.
21. Blow-out proof stem.
22. Threaded end connections.
23. Lever handle.
24. 150-SWP.

2.05 GATE VALVES

A. Type V405: Resilient Wedge Gate Valve

1. Manufacturers:

   a. American Flow Control.
   b. Mueller.
   c. Or equal.

2. Resilient wedge design, AWWA C515.
3. Ductile iron body.
4. Mechanical joint bolts and nuts shall be high strength, low alloy steel.
5. Ductile iron or bronze encapsulated with EPDM rubber wedge.
6. Gate valve stem and wedge nut shall be copper alloy, AWWA C515.
7. 2-inch ductile iron operating nut, opening left.
8. Epoxy coating on internal and external surfaces of valve body, AWWA C550.
9. Cor-Blue, or equal T-bolts and nuts, ANSI/AWWA C111/A21.11.

B. Type V410: Knife Gate Valves

1. Manufacturers:

   a. DeZurik.
   b. Henry Pratt, Figure 77

2. Wafer body, round port.
3. Wetted parts 304 stainless steel.
4. Flanged drilled to ANSI 125/150 pound standard.
5. Rated 150 psi CWP.
6. Resilient seat for drip tight shutoff.
7. Bevel gear actuator with handwheel.

C. Type V415: Iron Body Gate Valves

1. Manufacturers:

   a. Nibco, Figure F-619.
   b. Or Equal.

2. Class 125 iron body gate valve.
3. Bolted Bonnet.
4. Non-rising stem.
5. Solid wedge.
6. Bronze mounted.
7. Rated for 125-psi to 400 deg F.

D. Type V420: Knife Gate Valves for shut-off isolation of differential pressure level sensing

1. Manufacturers:

   a. Wey Valve, Model TI3.
   b. Or Equal.

2. Body: 316 Stainless Steel.
3. Gate: 316 Stainless Steel.
4. Seal: Aflas.
5. Topwork: 316 Stainless Steel
6. Stem / Piston Rod: 430F Stainless Steel

2.06 MECHANICAL REGULATING VALVES

A. Type V707: Natural Gas Pressure Reducing Valve

1. Manufacturers:

a. Sensus, Model 143 series.
b. Fisher, Model CS200 series.
c. Or equal.

2. Utilize for pressure control of equipment with natural gas input rate between 150 and 1,000 SCFH.
3. Valve Manufacturer to recommend valve size based on scheduled flow rates and pressures.
4. Direct sensing pressure reducing valve with internal relief valve.
5. Suitable for inlet pressures up to 25-psig.
6. Adjustable outlet pressure range from 7 to 14-inch W.C.
7. Internal relief shall be capable of preventing outlet pressure of the valve from rising greater than 7-in. w.c. above outlet pressure setpoint.
8. Cast iron body with threaded end connections.
9. Die cast aluminum alloy diaphragm case.
10. Diaphragm shall be of Buna-N construction with nylon fabric insert or Nitrile (NBR).
11. Stainless steel or aluminum orifice and stem.

2.07 MISCELLANEOUS VALVES

A. Type V901: Air Release Valve for Wastewater

1. Manufacturers:

a. ARI
b. Dezurik
c. Valmatic

2. Air release valves shall confirm to AWWA C512
3. Body, cover and baffle shall be cast 316 stainless steel. Fasteners, internal linkage, internal pats, floats, and float guide shall be 316 stainless steel. Elastomers shall be Buna-N.
4. Confirm to design requirements in AIR RELEASE VALVE SIZING CRITERIA - SCHEDULE 1 at the end of this section.

B. Type V980: Mud Valves

1. Manufacturers:

a. Troy Valve
b. Clow Valve Co.

2. Heavy duty flange type designed to provide a positive seal under both seating and unseating head conditions.
3. Frame, plug (cover), yoke, stem and stem extension (operating nut) shall be 316 Stainless Steel.
4. Valve stem shall be rolled and not cast as rolled.
5. Plug stem shall have hydraulic relief slots to prevent sediment from building up in plug stem area.
6. Rising Stem.
7. Buna-N seating surface.
8. Flange drilling on frame ANSI standard, 125lb.
9. Stem guides per manufacturer's recommendations.

2.08 ACCESSORIES

A. Valve Actuators:

1. Open by turning counter-clockwise.
2. Valves with centerline 5-feet 6-inch or less above operating floor: Handwheel for gear-actuated valves, lever for lever-actuated valves. Shall require no more than 40-pound effort to unseat valve.
3. Valves 4-inch and larger, unless otherwise noted on drawings, with centerline greater than 5-feet 6-inch above operating floor: Chainwheel.
4. Valves 4-inch and smaller and 6-inch butterfly valves, maximum operating pressure 25 psig and less: Lever.
5. Valves 4-inch and smaller, maximum operating pressure greater than 25 psig: Gear.
6. Valves 6-inch and larger: Gear.

B. Tee Wrenches:

1. Provide for buried and submerged valves.
2. Provide wrenches of varying lengths as needed so that when in operation the handle is 36-40 inches above the operating floor for each valve application.
3. Provide dual Type 316 stainless steel wall hooks, one on each branch of tee, for hanging each wrench. Anchors and hardware shall be type 316 stainless steel. Coordinate location of tee wrench wall hooks with Owner.
4. Provide wrench compatible with connection to 2-inch nut.

C. Chain Wheels and Chain Levers:

1. Provide chain wheels with guides and chain having coil proof design.
2. Provide chain levers with chain having coil proof design.
3. Galvanized or cadmium plate chain wheels, chain levers, guides, and chain.
4. Chain size as recommended by valve manufacturer.
5. Extend chains to within 4-feet of operating floor.
6. Provide chain hooks and tieback anchors for chains. Install so chain does not interfere with personnel traffic.

D. Buried and Submerged Valves:

1. Provide seals on shafts and gaskets on valve and actuator covers to prevent water entry.
2. Provide totally enclosed actuator mounting brackets with gasket seals.

E. Valve Boxes:

1. Provide for buried valves.
2. Three-piece screw type, cast iron box and cover.
3. Valve box diameter 5 ¼-inch, length as required for installation.
4. Provide extension stem as required for installation and 2-inch operating nut located within 6-inches from top of cover.

F. Floor Boxes:

1. Provide for valves as shown on Drawings.
2. Cast iron box and cover.
3. Provide valves with extension stems, complete with operating nuts, as required to locate top of operating nuts 2-inches below top of floor box cover.
4. Provide floor box cover wrench.

G. Extension Stems for Submerged Valves or Valves Below Operating Floor or Walkway:

1. Provide for valves as shown on Drawings.
2. Provide with intermediate stem guides with maximum spacing not exceeding 10 feet or L/R not exceeding 200.
3. Stem guides, stem, and couplings: Type 316 stainless steel.
4. Provide stem ends with transition pieces to connect to valve actuator and operator above.

H. Operator (Floor) Stand:

1. Ductile iron or Type 316 stainless steel floor mounted operator stand to operate extended stem valves with handwheel or handcrank actuator as noted on Drawings.
2. Provide bevel gear operator with clear plastic stem cover.
3. Floorstand and handwheel shall be cast iron.
4. Provide valve position indicator.
5. Provide rising stem, unless otherwise noted on Drawings.

I. Locking Devices:

1. Provide for valves as shown on Drawings.
2. Locking device shall be integral to the valve/operator and shall accept a normal padlock. Locking devices using chains and cables are not acceptable.
3. Provide two padlocks (one duty and one spare) for each pad-lockable valve.
4. Provide one key for each pad-lockable valve.
5. All padlocks provided shall be compatible with all keys provided. Different keys for each padlock are not acceptable.

J. Worm and Gear Actuators:

1. Totally enclosed design.
2. Sized for valve operation under valve rated pressure with pull of 40-pounds on handwheel or chain wheel.
3. Self-locking to prevent valve position creep.
4. Hardened alloy steel worm.
5. Reduction gearing runs in lubricant.
6. Orient operators to avoid interference with adjacent piping, equipment, and structures.
7. Include valve position indication.

2.09 ELECTRIC ACTUATORS

A. General:

1. Actuators shall be furnished and sized by valve manufacturer.

B. General:

1. Actuators shall be furnished and sized by valve manufacturer.

C. Type EA-1:

1. Manufacturers:

   a. Rotork

2. Design Requirements:
   a. Furnished and sized by valve manufacturer.
   b. Self-contained, packaged-unit designed for a valve requiring multi-turn actuation.
   c. Electric motor double-reduction gear type consisting of motor controls, gearbox, geared limit switches, torque switches, and manual override with de-clutching level.
   d. Torque output no less than 1.5 times the required operating torque.
   e. Self-locking.
   f. Removable from valve without taking valve out of service.
   g. Designed for mounting and running in any position.
   h. Suitable for indoor or outdoor service with ambient temperatures from -40 to 150 deg F. Provide enclosure heater as required.
   i. Where noted on Drawings, provide Explosion Proof actuators suitable for Class I, Division 1 Group C and D Hazardous.

3. Construction:

   a. Motor speed reduction shall be by means of gear train.
   b. Gearbox totally enclosed and sealed, constructed of Ductile Iron. No other materials of construction will be acceptable.
   c. Gearbox shall have oil or grease lubricated hardened steel spur gears and self-locking worm and worm gear set. Worm shall be heat treated alloy steel and have worm threaded surface rolled or ground. Worm gear shall be bronze. Non-metallic gears in power train are not acceptable.
   d. Shafts shall be heat-treated alloy steel supported throughout by anti-friction ball or roller bearings and permanently lubricated at the factory.
   e. All thrust components shall be supported by use of tapered roller bearings.
   f. Electrical components factory wired, except devices located remote from actuator.
   g. Integral terminal strips for field wiring connections.
   h. Separately sealed terminal compartment for remote control connections.
   i. Heater and thermostat for humid and low temperature environments.
   j. NEMA 4X enclosure for motor, gearing, switches, and wiring terminals unless located in a hazardous area as noted on Drawings. Actuators in hazardous areas shall be NEMA 7 rated.
   k. Enclosure shall have a bonded O-ring seal and a hinged cover.
   l. Aluminum Electrical Compartment Cover with Stainless Steel hinges and captivated hex head screws.

4. Manual Operation:

   a. Engageable manual override.
   b. Padlockable in manual or motor mode.
   c. Manual operation possible by both handwheel and portable electric operator. Handwheel rim pull at 40 pound maximum.
   d. Safety interlock feature to prevent motor operating when manual override engaged.
   e. Failure of the motorized gearing shall not prevent manual operation.

5. Motor:

    a. 460 Volt, 3-phase, 60 Hertz
    b. Unless approved by Engineer, maximum horsepower 1.
    c. Constant speed.
    d. Reversing.
    e. Continuous duty cycle for modulating electric actuators.
    f. Standard duty cycle for Open-Close electric actuators.
    g. Provide motor in accordance with Section 26 05 84.
    h. Permanently lubricated ball bearings.
    i. Entirely enclosed and nonventilated

6. Control:

    a. Reversing motor controller (solid-state for continuous modulation)
    b. Control power transformer.
    c. Automatic reset thermal overload relay.
    d. Current-sensing motor overload relay or automatic phase correction single phase protection.
    e. OPEN/STOP/CLOSE local control pushbuttons. 120Vac
    f. Remote 4-20mAdc position control for modulating actuators.
    g. Timer to Inhibit/Limit the Motion/Duty Cycle for modulating actuators.
    h. Deadband adjustment of Process/Feedback signal deviation for modulating actuators.
    i. OPEN/CLOSE position indicating lights or LEDs.
    j. Pad-lockable STOP/LOCAL/REMOTE switch.
    k. Automatic double acting geared limit switches.
    l. Limit switches geared directly to the operating gear train, independently adjustable, and capable of being adjusted to trip at any point between full open and full closed.
    m. Adjustable travel limit switches factory set to full open and full closed positions.
    n. Automatic double-acting torque switches.
    o. Torque switches or torque sensing operate during the complete gate cycle to protect the valve from excessive loads in either travel direction.
    p. Unpowered contacts for indication of REMOTE, FAIL, OPEN and CLOSED status, rated at 5 amps at 120 vac.
    q. Internally supplied 120 vac control power for OPEN/STOP/CLOSE commands.

7. Remote Position Indication (see P&ID for requirements):

    a. Integral position transmitter, internally powered, producing a 4-20 mA output in direct proportion to valve position for connection to an external instrument loop. Position transmitter shall use a multi-turn, conductive plastic potentiometer rated for 10-20 million cycles.
    b. Full closed position shall correspond to 4 mA.
    c. Capable of driving a minimum external load impedance of 350 ohms.

2.10 COATINGS

A. Provide in accordance with Section 09 96 00 unless specified otherwise in this Section.

B. Manufacturer is responsible for surface preparation, prime coat, and second coat of equipment in the factory prior to shipment unless otherwise noted.

C. Manufacturer is responsible for the surface preparation and all motor coatings in the factory

prior to shipment.

D. Contractor shall provide final third finish coat for equipment in the field and be responsible for touchup and any additional specified coatings.

E. Final color of exposed equipment and motors shall be selected by Owner.

F. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

G. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install valves in accordance with manufacturer's written recommendations and approved submittals.

B. Bolt holes of flanged valves shall straddle the vertical centerline of the pipe run. Before installing flanged valves, the flanged faces shall be thoroughly cleaned. After cleaning, insert gasket and bolts, and tighten the nuts progressively and uniformly. If flanges leak under pressure, loosen or remove the nuts and bolts, reseat or replace the gasket, retighten and/or reinstall the nuts and bolts, and retest the joints.

C. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.02 FIELD QUALITY CONTROL

A. Tests:

1. Pressure test valves at same time connected piping is tested.
2. Repair leaking joints.
3. Protect parts of valves and actuators that could be damaged by test.

SCHEDULE 1: AIR RELEASE VALVE SIZING CRITERIA

Service	Pipe Material	Design Flow Range gpm	Pressure Range psi	Inlet Connection	Remarks
6" PFTS	GLDI	0-350	0-100	2-inch NPT	For thickened primary sludge (up to 5% solids) application. Quantity: (1) Primary Filtration Thickened Sludge Pump 1 (1) Primary Filtration Thickened Sludge Pump 2
10" PFS	CLDI	0-1,157	0-20	2-inch NPT	For primary filter backwash (0.15% TSS) and waste solids removal (1% TSS) application. Quantity: (1) Primary Filter 1 PFS (1) Primary Filter 2 PFS

SCHEDULE 2: ACTUATED VALVE SCHEDULE

Tag No.	Valve Type	Valve Size (inch)	Service	Actuator Type	Operating Mode	Maximum Stroke Time (seconds)	Failure Mode	Position Switches / Transmitter	NEMA Rating	Comments
BWV-1 thru 6	V005	6	BWW	EA-1	O/C	-	CLOSED	N/A	4X	Provided under Section 46 61 41
BWDV-1 & 2	V005	6	BWW	EA-1	O/C	-	CLOSED	N/A	4X	Provided under Section 46 61 41
SWV-1 thru 6	V005	6	SLD	EA-1	O/C	-	CLOSED	N/A	4X	Provided under Section 46 61 41
SWDV-1 & 2	V005	6	SLD	EA-1	O/C	-	CLOSED	N/A	4X	Provided under Section 46 61 41
RCV-1 thru 6	V005	6	RCC	EA-1	O/C	-	CLOSED	N/A	4X	Provided under Section 46 61 41
BKV-1 thru 4	V005	6	Varies	EA-1	O/C	-	CLOSED	N/A	4X	Provided under Section 46 61 41
PSMV-1 & 2	V005	10	PSM	EA-1	O/C	-	CLOSED	N/A	4X	Provided under Section 46 61 41

END OF SECTION

SECTION 40 05 59.23
STAINLESS STEEL SLIDE GATES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Downward Opening Weir Gates
2. Slide Gates
3. Gate Operators
4. Gate Accessories.

B. Provide gates as specified in Stainless Steel Gate Schedule.

1.02 DEFINITIONS

A. EPDM: Ethylene Propylene Diene Monomer

B. GPM: Gallons per Minute

C. UHMWPE: Ultra High Molecular Weight Polyethylene

1.03 REFERENCES

A. ASTM: American Society of Testing and Materials

B. AWWA: American Water Works Association

1.04 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Conform to latest revision of AWWA C561.
2. Proportion for stresses occurring during continuous operation and for additional stresses occurring during fabrication or installation.

B. Field Leakage Criteria:

1. Seating Head: Leakage shall not exceed 0.05 gallon per minute per foot of periphery under design head conditions.
2. Unseating Head: Leakage shall not exceed 0.1 gallon per minute per foot of periphery under design head condition.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for gates specified.
2. Motor data. Submit in accordance with Section 26 05 84.
3. Coating systems. Submit in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for gates. General arrangement drawings and catalog cuts are not considered acceptable installation and assembly drawings.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.
3. Stainless Steel Gate Schedule. Identify all gates by type number, pipeline, location, joint type, manufacturer, and model or catalog number.
4. Slide gate calculations demonstrating compliance with performance data.
5. Stem and operator calculations.
6. Slide gate yoke calculations.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of gates with referenced standards.
2. Certified reports of field tests and observations.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of gates in service.
3. Submit in accordance with Section 01 78 23.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Single-Source Responsibility: Obtain gate components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver gates and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store equipment in clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

1.08 MAINTENANCE

A. Provide spare parts necessary to maintain the equipment in service for a period of two years.

B. Provide special tools required for checking, testing, parts replacement, and maintenance.

C. Spare parts shall be suitably packaged and labeled with the name and number of the equipment to which they belong.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Whipps, Inc.

B. RW Gate Company

2.02 STAINLESS STEEL GATES

A. General:

1. This Section includes design, materials of construction, fabrication, and supply of downward opening weir gates and slide gates as shown on Drawings and as indicated in the Stainless Steel Gate Schedule.
2. Slide gates shall be either self-contained or non self-contained of the rising stem configuration as shown on Drawings and as indicated in the Stainless Steel Gate Schedule.
3. Downward opening weir type gates shall be self-contained or non self-contained weir type with disc arranged to lower to open with guides designed to mount on face of concrete wall as shown on Drawings and as indicated in the Stainless Steel Gate Schedule. All downward opening gates shall be provided with self-adjusting type seals, utilizing a cup shaped UHMWPE seal with twin contact surfaces and compression cord.
4. Gates shall be provided with four-sided or three-sided seal system as shown on Drawings and as indicated in the Stainless Steel Gate Schedule. All upward opening gates shall be provided with a resilient seal made of neoprene set into the bottom frame member to seal the bottom portion of the gate and form a flush-bottom. The top and side seals shall be the self-adjusting type, utilizing a cup shaped UHMWPE seal with twin contact surfaces and compression cord.
5. Except as modified or supplemented herein, all gates and operators shall conform to applicable requirements of AWWA C561, latest edition.

B. Materials:

1. Disc Skin Plate:	ASTM A240, Type 316L Stainless Steel
2. Frame and Guides:	ASTM A240, Type 316L Stainless Steel
3. Seals:	UHMWPE ASTM D4020
4. Invert seal (upward opening gates)	EPDM or Buna-N ASTM D-2000
5. Seats:	UHMWPE ASTM D4020
6. Retainer Bars and Fasteners:	ASTM A276, Type 316L Stainless Steel
7. Stems:	ASTM A276, Type 316L Stainless Steel
8. Stem Couplings:	ASTM A276, Type 316L Stainless Steel
9. Stem Guides:	ASTM A240, Type 316L Stainless Steel
10. Frame, Yoke, Stem Guides, Pedestal, Wall Brackets, Slide:	ASTM A240 and A276, Type 316L Stainless Steel
11. Guides, Side & Bottom Seals, Stem Guide Liner:	UHMWPE ASTM D-4020
12. Compression Cord or Pad:	Silicon or Nitrile, ASTM D2000 or

		EPDM ASTM D 1056
13.	Gasket:	EPDM ASTM D 1056
14.	Stem Cover:	Opaque-UV protected/enhanced Lexan or Butyrate ASTM D-707
15.	Lift Nut:	Manganese bronze ASTM B584 UNS-C86500
16.	Anchor bolts:	minimum diameter of 1/2-inch

C. Performance:

1. Design Head: Gates shall be designed to withstand design head (maximum design head shall be taken as height of slide unless otherwise shown in Stainless Steel Gate Schedule).
2. Seal Performance Test: Gate's sealing system shall be tested through a cycle test in an abrasive environment and shall show leakage requirements are still obtained after 25,000 cycles with minimum deterioration.

D. Disc / Slide:

1. Flat plate reinforced with structural or formed members welded to plate.
2. Limit deflection of gate to 1/720 of span or 1/16-inch, whichever is less.
3. Working design stresses shall not exceed lesser of 40 percent yield strength or 25 percent ultimate strength of material.
4. Disc components shall have minimum material thickness of 1/4-inch. When the width of the gate opening in feet multiplied by the maximum design head in feet is greater than 80 square feet the portion of the slide member that engages the guide shall be 1/2-inch thick. When the width of the gate opening in feet multiplied by the maximum design head in feet is greater than 120 square feet, the portion of the slide that engages the guide members shall be of a "thick edge" design. The thick edge portion of the slide shall have a minimum thickness of 2.5 inches.
5. Slide shall consist of flat plate reinforced with formed plates or structural members to limit its deflection.

E. Guides and Frame:

1. The structural portion of the frame that incorporates the seat/seals shall be formed into a one-piece shape for rigidity. Guide members that consist of two or more bolted structural members are not acceptable. Guide member designs where water loads are transferred through the assembly bolts are specifically not acceptable.
2. Frame shall be a rigid, one-piece assembly with a flanged frame arrangement.
3. Flat frames shall only be provided on gates with frames that will be embedded or mounted in existing channels or openings.
4. Guides shall have a minimum weight of 13 lbs/ft. Guide extensions shall have a minimum weight of 6.5 lbs/ft. Angles are not acceptable for guide extensions.
5. Lifting lugs shall be provided on all frame styles.
6. On self-contained gates, the side frame shall extend above the operating floor and the operating mechanism shall be mounted to the yoke. When shown, the frame may extend to the operating floor and a floorstand may be mounted to the yoke.
7. Yoke members shall be designed for output of gate hoist and shall be arranged to permit removing disc from frame.
8. Guide slot shall engage disc plate a minimum of 1-inch on each side.
9. Guides extending above operating floor shall be sufficiently strong so further reinforcing not required.

F. Seals:

1. The seal system shall consist of self-adjusting UHMWPE seals with a rubber compression cord.
2. The UHMWPE seals shall be arranged to ensure that there is no metal-to-metal contact between the slide and the frame.
3. Continuous compression cord shall ensure contact between UHMWPE guide and gate in all positions.
4. Sealing system shall maintain efficient sealing in any position of slide and let water flow only in open part of gate. Vertical face of seal shall contact seating surface of guides to properly seal corners. Shape seal to produce seating surface ¾-in. wide, minimum.
5. All seals shall be secured with assembly bolts. All seals shall be field removable and field replaceable without the need to remove the gate frame from the wall or to remove concrete or grout to access the attachment bolts.
6. The compression cord shall be contained by the UHMWPE seal so that it shall not be in contact with the slide.
7. Seal system shall be self-adjusting for the life of the gate. Adjustable wedging devices such as wedges, wedge bars and pressure pads are not acceptable.
8. Rubber J-type seals or similar are not acceptable.

G. Stems:

1. Stem threads shall be of the machine cut or machine rolled, full depth Acme type polished to a 16 microinch finish or better. Stems shall be designed to transmit in compression a minimum of 2 times the rated output of hoist at 40 pounds effort on crank or handwheel.
2. Stems shall have a minimum diameter of 1½-inches and shall be constructed of solid round bar.
3. Stem shall have slenderness ration (L/r) less than 200.
4. Stem guides, where required to limit unsupported stem length, shall be 316 stainless steel with bronze or UHMWPE bushings. Stem guides shall be a one piece design with four anchor bolts and shall be constructed of minimum 3/8-inch 316L stainless steel plate.
5. Dual Operators: Gates having widths in excess of 48 inches and equal to or greater than 2 times their height shall be provided with two gear boxes connected by a tandem shaft for simultaneous operation. All gates with gate openings of 84 inches wide or wider and with widths twice the height shall be provided with two gearboxes and a tandem shaft. Tandem shaft shall be of 316L stainless steel.
6. Operating stem shall be of 316L stainless steel designed to transmit in compression at least two times rated output of operating manual mechanism with 40 pounds effort on crank or handwheel.
7. Where electric operator is used, stem design force shall not be less than 1.25 times output thrust of hydraulic or pneumatic cylinder, with pressure equal to maximum working pressure of supply or 1.25 times output thrust of electric motor in stalled condition.
8. For stems in more than one piece and with diameter or 2-inches and larger, different sections shall be joined together by 316L stainless steel or solid bronze couplings.
9. Couplings shall be internally threaded and keyed or bored and bolted and shall be of greater strength than the stem.
10. Guides shall be adjustable and shall be spaced in accordance with manufacturer's recommendation.

H. Stem Covers:

1. Transparent, lexan or butyrate plastic, vented pipe stem cover and cap to provide indication of gate position, permit inspection of stem threads, and protect stem from contamination.
2. Clear mylar indicating tape shall be provided for field application after the gate has been installed and positioned.

I. Operator:

1. Benchstand hoists shall be sized to permit operation of gate under full operating head with maximum effort of 40 pounds on crank or handwheel.
2. Hoist nut shall be manganese bronze conforming to ASTM B584 C86500.
3. Hoist nut shall be supported on ball or roller bearings.
4. Suitable seals shall be provided to prevent entry of foreign matter.
5. Direction of handwheel or crank rotation to open gate shall be clearly and permanently marked on hoist.
6. All bearings and gears shall be totally enclosed in weather tight housing. Pinion shaft of crank-operated mechanisms shall be constructed of 316L stainless steel and supported by ball, roller, or needle bearings.
7. Each manual operator shall be designed to operate gate under maximum specified seating and unseating heads by using maximum effort of 40 pounds on crank or handwheel, and shall be able to withstand, without damage, an effort of 80 pounds.
8. Pedestals shall be fabricated from 316L stainless steel and shall have a minimum 4-inch diameter tube and 1/2-inch minimum thick base plate and operator mounting plate.
9. Install pedestals using max. 1-in thick leveling grout pad.
10. Crank shall be removable and fitted with corrosion resistant rotating handle.
11. Maximum crank radius shall be 15 inches and maximum handwheel diameter shall be 24 inches.

2.03 ELECTRIC ACTUATOR (furnished by gate manufacturer)

A. Manufacturers:

1. Rotork

B. General:

1. Provide electric hoisting mechanism operation for gates as indicated in Stainless Steel Gate Schedule.
2. Requirements for Open/Close, Non-Continuous Modulating and Continuous Modulating electric actuators.
3. Provide Open/Close electric actuators as indicated in Stainless Steel Gate Schedule.

C. Design Requirements:

1. Furnished and sized by gate manufacturer.
2. Self-contained, packaged-unit.
3. For non-self-contained units provide 316L stainless steel or ductile iron pedestal to place input shaft approximately 36 inches above floor. Level pedestal with grout pad and fasten pedestal to surface.
4. Electric motor double-reduction gear type consisting of motor controls, gearbox, geared limit switches, torque switches, and manual override with de-clutching level.
5. Torque output no less than 1.5 times the required operating torque.
6. Self-locking.
7. Operate gate from full open to full closed, or the reverse, at a gate travel speed of 12 inches per minute. Modulating service gates shall not exceed travel speed of 6 inches per minute.
8. Removable from gate without taking gate out of service.
9. Designed for mounting and running in any position.
10. Ambient temperature rating: negative 40 degrees Fahrenheit to 150 degrees Fahrenheit.
11. Where noted in Stainless Steel Gate Schedule, provide Explosion Proof actuators suitable for Class I, Division 1 Group C and D Hazardous.

D. Construction:

1. Gearbox totally enclosed and sealed.
2. Gearbox shall have oil or grease lubricated gears and shafts of heat-treated alloy steel and bronze, supported throughout by anti-friction ball or roller bearings and permanently lubricated at the factory.
3. Electrical components factory wired, except devices located remote from actuator.
4. Integral terminal strips for field wiring connections.
5. Separately sealed terminal compartment for remote control connections.
6. Heater and thermostat for humid and low temperature environment.
7. NEMA 4X enclosure for motor, gearing, switches, and wiring terminals, NEMA 7 where indicated explosion proof.

E. Manual Operation:

1. Engageable manual override.
2. Manual operation possible by both handwheel and portable electric operator.
3. Safety interlock feature to prevent motor operating when manual override engaged.
4. Failure of the motorized gearing shall not prevent manual operation.

F. Motor:

1. Nameplate hp as required and defined by gate and actuator manufacturer shall not exceed maximum horsepower in Stainless Steel Gate Schedule unless approved by Engineer.
2. 460 volt, 3-phase, 60 hertz
3. Constant speed
4. Reversible
5. Continuous duty cycle for Modulating electric actuators.
6. Standard duty cycle for Open-Close electric actuators.
7. Where noted in Stainless Steel Gate Schedule, provide Explosion Proof actuator motor suitable for Class I, Division 1 Group C and D Hazardous.

G. Control:

1. Reversing motor controller (solid-state for continuous modulation).
2. Control power transformer.
3. Automatic reset thermal overload relay.
4. Current-sensing motor overload relay or automatic phase correction single phase protection.
5. OPEN/STOP/CLOSE local control pushbuttons
6. Remote OPEN/STOP/CLOSE position control (non-continuous modulation).
7. Remote 4-20mAdc position control (continuous modulation).
8. Timer to Inhibit/Limit the Motion/Duty Cycle (continuous modulation).
9. Deadband adjustment of Process/Feedback signal deviation (continuous modulation).
10. OPEN/CLOSE position indicating lights or LEDs.
11. Pad-lockable STOP/LOCAL/REMOTE switch.
12. Automatic double acting geared limit switches.
13. Limit switches geared directly to the operating gear train, independently adjustable, and capable of being adjusted to trip at any point between full open and full closed.
14. Adjustable travel limit switches factory set to full open and full closed positions.
15. Automatic double-acting torque switches.
16. Torque switches or torque sensing operate during the complete gate cycle to protect the gate from excessive loads in either travel direction.
17. Unpowered contacts for indication of REMOTE, OPEN and CLOSED status, rated at 5 amps at 120 vac.

H. Remote Position Indication (see P&ID for requirements):

1. Integral position transmitter, internally powered, producing a 4-20 mA output in direct proportion to gate position for connection to an external instrument loop. Position transmitter shall use a multi-turn, conductive plastic potentiometer rated for 10-20 million cycles.
2. Full closed position shall correspond to 4 mA.
3. Capable of driving a minimum external load impedance of 350 ohms.

I. Spare Parts:

1. Provide one (1) bronze operating nut of each size stem.
2. Provide one (1) stop collar of each size stem.

2.04 GATE ACCESSORIES

A. Manually Operated Floor Stands

1. Maximum effort of 40 pounds shall be required to unseat gate and maximum of 25 pounds to operate gate after it is unseated.
2. Enclosed gear type with crank capable of manual operation or by means of portable electric operator.
3. Provide single or double gear reduction, depending upon lifting capacity required.
4. Steel or cast iron gears with machine cut teeth designed for smooth operation.
5. Mount gearing and lift nut in a ductile iron housing and support with fabricated 304L stainless steel pedestal to place stainless steel input shaft approximately 36 inches above floor.
6. Provide lubrication fittings in gear housing to permit lubrication of gears and bearings.
7. Removable cast aluminum crank arm with revolving brass or nylon grip.
8. Handwheel shall be provided with face of handwheel in vertical orientation.
9. Provide rising stem gates with Butyrate or lexan cover, unless noted otherwise.

B. LIFTING MECHANISM

1. Provide gates for manual or hoisting mechanism operation as indicated in Stainless Steel Gate Schedule.

   a. Provisions for manual operation shall be, reinforced lifting clevis hole, single lift or lifting lug as indicated in Stainless Steel Gate Schedule. Reinforced lifting clevis hole shall consist of 1" dia lifting hole with extra thickness welded to gate before drilling hole in order to provide additional surface area clevis pin will contact.
   b. Hoisting Mechanism: Handcrank or handwheel.

      1) Handcrank: Capable of operation by crank or portable electric operator.
      2) Provide an internally threaded, adjustable bronze stop collar on stems of manually operated gates to set open and closing settings.
      3) Bottom of gate in full open position to be at or above top of gate elevation when fully closed.
      4) Hoist shall be sized to permit operation of gate under full operating load with a maximum effort of 40 pounds on the crank or handwheel.
      5) Handwheel or handcrank operator centerline shall be no more than 3 feet-6 inches above operating floor, unless otherwise noted. Provide remote drive on self-contained gates as indicated in Stainless Steel Gate Schedule.

   c. When in closed position, gates shall seat flush with bottom and be provided with compressible resilient seal mounted on disc or frame. Specially mold and design seal to produce wide sealing surface.

d. Provide 316L stainless steel operating stem attached to disc with stainless steel or bronze stem connector. Stem shall have minimum diameter of 1½-inches. Stem threads shall be machine rolled, full depth ACME threads with a 16 microinch finish or better.

e. Where gate width is in excess of 48 inches and equal to or greater than twice gate height, provide multiple operating stems. Mechanically interconnect multiple operating stems to provide uniform gate operation. Where electrically actuated, provide actuator installation bracket. Coordinate position of actuator, handwheel, and controls with Engineer.

1) For Dual Stem application, provide bevel gearboxes with electric actuator mounted to one of the gearboxes or mount the electric actuator and intermediate gearbox to drive bevel gearboxes. Actuator installed where any part of actuator extends beyond outside width of gate frame into walkway area is not acceptable.
2) Provide flexible couplings and a Type 316L stainless steel shaft with stainless steel connecting bolts.
3) Coat exposed portion of bevel gearbox shaft connecting to actuator gearbox to protect from corrosion. Coat shaft in accordance with Section 09 96 00. Protect bevel gear shaft seal from coating. Once connected, provide thin film of grease at shaft and seal interface to protect small area not covered by coating.
4) Provide removable corrosion resistant guard to prevent contact with rotating shaft assembly.
5) All fasteners and anchor bolts shall be Type 316 stainless steel. Anchor bolts shall be provided by the gate manufacturer and shall have a minimum diameter of 1/2-inch.

2.05 COATINGS

A. Provide in accordance with Section 09 96 00 unless specified otherwise in this Section.

B. Manufacturer is responsible for surface preparation and priming of the manual gearbox housing in the plant. Contractor is responsible for finish coating the gearboxes after installation of the equipment.

C. Prior to substantial completion, examine coated surfaces and retouch or refinish surfaces (with same coating material) to leave in condition acceptable to Engineer.

D. Final color of exposed equipment and motors shall be selected by Owner.

E. Stainless steel, bronze, and nonmetallic surfaces shall not be coated. All weld burn and slag shall be mechanically passivated in accordance with ASTM A380 to provide a uniform finish. If bead blasting is utilized, the entire slide and entire frame shall be bead blasted to provide a uniform finish.

F. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install gates in accordance with manufacturer's written instructions.

B. Installation of all parts shall be done by Contractor in a workmanlike manner and in accordance with detailed technical installation procedures supplied by gate manufacturer. It shall be Contractor's responsibility to handle, store, and install gate operating mechanism and accessories in strict accordance with manufacturer's drawings and recommendations.

C. Equipment provided under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions and recommendations of equipment manufacturer unless exceptions are noted by Engineer.

D. Gates and operators shall be supplied with all necessary parts and accessories indicated on Drawings, specified or otherwise required for a complete, properly operating installation.

E. Gates shall be shop inspected for operation before shipping.

F. Install gates in accordance with manufacturer's written recommendations and approved submittals.

G. Electric actuator orientation and positioning, or rotation of various component heads on actuator may be required to be adjusted in the field after, or during, installation. Contractor shall coordinate with Engineer in positioning actuator to allow best access to controls and allow handwheel to be in lowest position possible and accessible with portable actuator.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for workdays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

   a. 2 man-day, two separate trips for Installation Services.
   b. 1 man-day, one separate trip for Instructional Services and Startup Services.

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10

3.04 DEMONSTRATION

A. After installation is complete, test and demonstrate operation of equipment in accordance with Section 01 79 10. In addition to services specified above, provide Supplier's or Manufacturer's field services as required to successfully complete systems demonstrations in accordance with Section 01 79 10.

B. After installation has been completed, test sluice gates under normal operating conditions in presence of Engineer.

C. Repair leaks or other imperfections found upon testing.

STAINLESS STEEL SLIDE GATE SCHEDULE							
Name (Tag Number)	Opening Size (inches by inches)	Material	Design Head from Centerline (feet)	Operator	Installation	Max HP	Notes
Primary Filter Influent Gate 1 (PFIG-1) Primary Filter Influent Gate 2 (PFIG-2)	60" W X 54" H	Type 316L Stainless Steel	Seated 2.5 ft	Gate Mounted w/ Pedestal similar to Detail M353 Modulating Electric Actuator	Channel Mounted Self-Contained 3-side seal Flush Bottom	1	Opening Invert: 708.00 Operating Floor: 718.25 T/ yoke shall be positioned below proposed aluminum plate at elevation 718.25. Actuator shall be mounted minimum 36-inches above operating floor.
Primary Filter Influent Gate 3 (PFIG-3)	60" W X 54" H	Type 316L Stainless Steel	Seated & Unseated 2.5 ft	Gate Mounted w/ Pedestal similar to Detail M353 Modulating Electric Actuator	Channel Mounted Self-Contained 3-side seal Flush Bottom	1	Opening Invert: 708.00 Operating Floor: 718.25 T/ yoke shall be positioned below proposed aluminum plate at elevation 718.25. Actuator shall be mounted minimum 36-inches above operating floor.
Primary Settling Tank Control Gate 1 PTCG-1	42" Diameter	Type 316L Stainless Steel	Unseated 8.50 ft	Pedestal-Mounted similar to Detail M350 Modulating Electric Actuator	Surface Mounted Self-Contained	1	Opening Invert: 695.75 Operating Floor: 704.25± VIF
PFI Wet Well 1 Inlet Gate PFWG-1	42" Diameter	Type 316L Stainless Steel	Unseated 8.25 ft	Gate Mounted w/ Pedestal similar to Detail M352 Modulating Electric Actuator	Surface Mounted	1	Opening Invert: 696.00 Operating Floor: 708.00
Primary Filtration Effluent Control Gate 1 PFEG-1	42" Diameter	Type 316L Stainless Steel	Seated 20 ft	Pedestal-Mounted similar to Detail M351 Modulating Electric Actuator	Surface Mounted	1	Opening Invert: 688.00 Operating Floor: 709.50
Primary Filtration Effluent Control Gate 2 PFEG-2	84" Wide x 66" Tall	Type 316L Stainless Steel	Seated 7 ft	Gate-Mounted Modulating Electric Actuator	Dual Stem Self-Contained 3-side seal Surface Mounted	1	Opening Invert: 702.00 Operating Floor: 709.50 Downward opening weir gate modulates between weir elevation 702.00 to 707.50

STAINLESS STEEL SLIDE GATE SCHEDULE							
Name (Tag Number)	Opening Size (inches by inches)	Material	Design Head from Centerline (feet)	Operator	Installation	Max HP	Notes
Primary Filtration Scum Overflow Gate 1 SMOG-1	24" x 60"	Type 316L Stainless Steel	Unseated 5 ft	Pedestal-Mounted similar to Detail M352 Modulating Electric Actuator	Surface Mounted	1	Opening Invert: 701.00 Operating Floor: 708.13± Downward opening weir gate modulates between weir elevation 701.00 and 706.00
Existing VLV-14	54" Diameter	-	Seated 11 ft	Existing Pedestal-Mounted Modulating Electric Actuator	Surface Mounted	0.64 kW to match existing	Provide new actuator for existing gate to "Primary Tanks 1, 2, 3, 4". Existing stem to remain. Existing Rotork Actuator Serial: 33357201/01 Opening Invert: 692.00± Operating Floor: 708.25±
Existing VLV-56	36" Diameter	-	Seated 11 ft	Existing Pedestal-Mounted Existing Electric Actuator	Surface Mounted	existing	Provide Folomatic analogue control card for remote position control as shown on Process and Instrumentation Diagram. Existing actuator for existing gate to "Primary Tanks 5, 6" serial number: MD14680101 with wiring diagram 100B0000-6. Opening Invert: 692.00± Operating Floor: 708.25±
Existing VLV-710	54" Diameter	-	Seated 11 ft	Existing Pedestal-Mounted Modulating Electric Actuator	Surface Mounted	3.4 hp to match existing	Provide new actuator for existing gate to "Primary Tanks 7, 8, 9, 10". Existing stem to remain. Existing Rotork Actuator Serial: 8159540201 Opening Invert: 692.00± Operating Floor: 708.25±

END OF SECTION

SECTION 40 05 97
PIPING AND EQUIPMENT IDENTIFICATION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plastic pipe markers.
2. Underground type plastic line marker.
3. Engraved plastic laminate signs.
4. Plastic equipment markers.
5. Piping system color coding schedule.

B. Identification furnished as part of equipment is specified as part of equipment assembly in other sections and shall comply with requirements of this section.

C. Refer to Division 26 for identification requirements of electrical and instrumentation work, not Work of this Section.

D. Refer to Division 10 for identification and signage requirements of architectural work, not work of this Section.

1.02 REFERENCES

A. ANSI: American National Standards Institute.

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for piping and equipment identification specified.

C. Shop Drawings:

1. Submit piping system color coding schedule indicating flow stream identifier and proposed color. Submittal shall include color chart for reference. Schedule shall include all piping systems from Sections 40 05 05.

D. Submit in accordance with Section 01 33 00.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

B. Regulatory Requirements:

1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

C. Single-Source Responsibility: Obtain piping and equipment identification from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping and equipment identification to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store piping and equipment identification in clean, dry location.

1.06 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

a. Furnish minimum 5 percent extra stock of each mechanical identification material required for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Brady (W.H.) Company, Signmark Division.

B. Marking Services, Inc.

C. Seton Name Plate Corporation.

2.02 MECHANICAL IDENTIFICATION MATERIALS

A. Provide manufacturer's recommended products as specified for each application.

B. Where more than single type is specified for application, selection is installer's option, provide single selection for each product category.

C. Bands, markers, and identification materials used in mechanical rooms and process locations shall be rated for exterior application and suitable for withstanding occasional washdown.

2.03 LETTERING AND GRAPHICS

A. Coordinate names, abbreviations, and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or if not indicated, as recommended by manufacturers or required for proper identification and operation and maintenance of mechanical systems and equipment.

B. Multiple Systems: Where multiple systems of same generic name are shown or specified, provide identification indicating individual system number as well as service (i.e., Boiler No. 3, Air Supply Unit No. 10-ASU-2).

2.04 PLASTIC PIPE MARKERS

A. Snap-on Type: Provide preprinted, semi-rigid snap-on, color coded plastic pipe markers complying with ANSI A13.1.

B. Strap-on Type: Provide preprinted, strap-on, color coded, plastic pipe markers complying with ANSI A13.1.

C. Adhesive Type: Provide preprinted, color coded, strap-on vinyl pipe markers complying with ANSI A13.1.

D. Small Pipes: For external diameters less than 6 inch (including insulation, if any), provide full circumference pipe markers, extending 360 degrees around pipe at each location, fastened by one of following methods:

1. Snap-on type pipe marker.
2. Adhesive type pipe marker, taped to pipe (or insulation) with color coded plastic adhesive tape not less than 4 inch wide, full circle at both ends of pipe marker, and tape lapped 1-1/2 inch.
3. For plastic chemical tubing use only snap-on type.

E. Large Pipes: For external diameter 6 inch and larger (including insulation, if any), provide either full circumference or strip pipe markers not narrower than 3 times letter height (and of required length):

1. Strap-on type pipe marker strapped to pipe (or insulation) with manufacturer's standard nylon bands.
2. Adhesive type pipe marker taped to pipe (or insulation), not less than 4 inch wide, full circle at both ends of pipe marker, tape lapped 3 inch.

F. Lettering: Comply with piping system nomenclature as specified, scheduled or shown and abbreviate only as necessary for each application length, and only with approval of Engineer. Lettering height shall be as follows:

Outside Pipe Diameter (inches)	Minimum Letter Height (inches)	Minimum Length of Marker (inches)
¾ to 1-1/4	½	8
1-1/2 to 2	¾	8
2-1/2 to 6	1-1/4	12
8 to 10	2-1/2	24
Over 10	3-1/2	32

G. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

H. Label and band colors in accordance with ANSI A13.1-2015, Process-Mechanical Piping Schedule Section 40 05 05 and following:

1. Lettering and arrows:

    a. White on green background for potable, cooling, boiler feed, and other waters.
    b. White on red background for fire quenching fluids.
    c. Black on orange background for toxic and corrosive fluids.
    d. White on brown background for combustible fluids.
    e. Black on yellow background for flammable and oxidizing fluids
    f. White on blue background for compressed air
    g. Black on white background for wastewater, sludge, and other services.

2. Banding:

    a. Colors and band spacing as scheduled or as shown on Drawings.
    b. Pipe marker tape: 4-inch wide vinyl self-adhesive tape with gloss finish.

2.05 UNDERGROUND TYPE PLASTIC LINE MARKERS

A. Permanent, bright colored, continuous printed plastic tape, intended for direct burial service; not less than 6 inch wide by 4 mils thick. Provide tape with printing most accurately indicating type of service of buried pipe.

B. Provide multi-ply tape consisting of solid aluminum foil core between 2 layers of plastic tape.

2.06 ENGRAVED PLASTIC LAMINATE SIGNS

A. Engraving stock melamine plastic laminate complying with FS L-P-387A(1) in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, white with black core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting necessary because of substrate.

B. Thickness: 1/16-inch for units up to 20 square inches or 8-inch length, 1/8-inch for larger units.

C. Fasteners: Self-tapping stainless steel screws except contact type permanent adhesive where screws cannot or should not penetrate substrate.

2.07 PLASTIC EQUIPMENT MARKERS

A. 2-ply, 1/8-inch thick laminated engraved plastic.

1. Color: Black letters on white background.

B. Nomenclature: Marker shall use terminology in Contract Documents as closely as possible:

1. Equipment Name (e.g., Chilled Water Pump No. 1).
2. Equipment Tag No. (e.g., 30-P-1).

C. Size: Provide approximate 3-inch by 6-inch (minimum) for equipment.

1. 1-inch high letters for equipment tag number.
2. ½-inch high letters for descriptive equipment name.

2.08 FLOW CONTROL AND MEASUREMENT DEVICE TAGS

A. Provide tags for all flow control devices (e.g., valves) and flow measurement devices (e.g., flowmeters) installed in piping of 4-inch diameter or larger.

B. Provide tags for all flow control devices (e.g., gates) that control flow from/in basins or channels.

C. 2-ply, 1/8-inch thick laminated engraved plastic.

1. Color: Black letters on yellow background.

D. Size: Adequate to accommodate letter height below.

1. 1/2-inch high letters for nomenclature.

E. Fastening: Fasten to device using nylon zip tie through metal eyelet in tag.

F. Nomenclature:

1. For devices that are named and tagged (e.g., electrically-actuated devices) in the Contract Documents, use the nomenclature in the Contract Documents.

a. Equipment Name (e.g., Chilled Water Pump No. 1)
b. Equipment Tag No. (e.g., 30-P-1)

2. For devices that are not named or tagged in the Contract Documents, use the nomenclature below.

a. XXX-YYY-ZZZ where XXX = Structure Number, YYY = Device Type, ZZZ = Tag Number (e.g, 250-PV-001 represents plug valve 001 in Structure 250).
b. Device Types, YYY shall be defined as follows: G = gate, PV = plug valve, BFV = butterfly valve, CV = check valve, GV = gate valve, ARV = air release valve, BV = ball valve, KV = knife valve, PRV = pressure regulating valve, PIV = pinch valve, MV = mud valve, SPV = specialty valve.

G. Submittal:

1. Submit device inventory in format shown below. Notes: [1] – example shows device that is not tagged in Contract Documents, [2] – example shows device that is named and tagged in Contract Documents.

Structure	Description	Tag Nomenclature
230	Butterfly Valve[1]	230-BFV-001
250	Ball Valve[1]	250-BV-001
230	Ball Valve[1]	250-BV-002
220	WAS Diverter Valve No. 2[2]	220-FV-0652
230	MHS Flushing Valve[2]	230-FCV-0941

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install piping and equipment identification in accordance with manufacturer's written instructions.

B. Coordination: Where identification is to be applied to surfaces requiring insulation, painting or other covering or finish including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 IDENTIFICATION

A. Locate pipe markers with arrows and color bands as follows wherever piping exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exterior non-concealed locations.

1. Near each valve and control device.
2. Near locations where pipes pass through walls or floors, ceilings or enter non-accessible enclosures.
3. At access doors, manholes, and similar access points permitting view of concealed piping.
4. Near major equipment items and other points of origination and termination.
5. Spaced intermediately at maximum spacing of 30 feet along each piping run, except reduce spacing to 20 feet in congested area of piping and equipment.
6. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

B. Locate color bands at each marker and at intermediate spacing not to exceed 10 feet between bands, and at lesser spacing as indicated or as required by local codes.

C. Locate directional arrows at each marker. Provide 3 arrows at each tee or branch fitting.

D. Where piping is normally visible from more than 1 side, provide 2 or 3 labels and arrows spaced at 120 degree intervals around pipe in accordance with ANSI A13.1.

E. Painting or Coating:

1. Painting of piping, ductwork, and equipment is work of Section 09 96 00.
2. Colors listed are general. Colors shall match existing piping system color coding.
3. For piping scheduled to be color-coded, but not scheduled for complete painting (such as plastic piping, stainless steel piping, or aluminum insulation jacketing) provide pipe marking tape banding to represent piping color-code. At each banding location provide following sequence:

a. 8-inch wide tape of scheduled pipe color.
b. 4-inch wide tape of scheduled band color (if pipe color-code calls for banding).
c. 8-inch wide tape of scheduled pipe color (if pipe color-code calls for banding).

F. Underground Piping Identification:

1. During backfilling/top soil placement of each exterior underground piping system, install continuous underground type plastic line marker located directly over buried line at 6 to 8 inch below finished grade. Where multiple small lines buried in common trench and do not exceed overall width of 16 inch, install single line marker.

G. Process Valve Identification:

1. Install engraved plastic marker at each process valve, gate, or flow control device as identified by P&ID tag numbers on Drawings.

H. Mechanical Equipment Identification:

1. Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, if not otherwise specified for each item or device. Provide signs for each unit having equipment tag number on Drawings or in Specifications.

3.03 FIELD QUALITY CONTROL

A. Final Survey and Repairs:

1. 1-year after date of substantial completion, Contractor shall perform walk-through survey of mechanical identification systems and shall remove and replace any bands, labels, tags or markers that are loose, discolored, or defective.
2. Replacement materials shall be provided by Contractor, not drawn from Owner's extra material.

3.04 ADJUSTMENT AND CLEANING

A. Adjusting: Relocate any mechanical identification device visually blocked.

B. Cleaning: Clean face of identification devices.

END OF SECTION

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SECTION 40 42 13
MECHANICAL INSULATION AND JACKET

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Drawings and General Requirements of contract including General and Supplementary Conditions and Division 1 specification sections apply to work of this Section.

B. Extent of mechanical insulation specified in this section includes Piping and Ductwork Systems (where indicated).

1.02 QUALITY ASSURANCE

A. Installation shall meet the requirements local plumbing, mechanical, and energy codes.

B. Manufacturer - Subject to compliance with requirements, provide products of one of the following:

1. Armstrong World Industries, Inc.
2. Certainteed Corp.
3. Knauf Fiberglass
4. Manville Corp.
5. Owens-Corning Fiberglass Corp.
6. Pittsburg Corning Corp.
7. Rubatex Corp.

C. Installer - A firm with at least 3 years successful installation experience on projects with mechanical insulation similar to that required for this project.

D. Flame/Smoke Ratings - Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread rating of 25 or less, and smoke-developed rating of 50 or less, as tested by ANSI/ASTM E 84 (NFPA 255) method.

1.03 SUBMITTALS

A. Product Data - Submit manufacturer's specifications and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, thickness, and furnished accessories for each mechanical system requiring insulation in accordance with Section 01 33 00.

B. Maintenance Data - Submit maintenance data and replacement material lists for each type of mechanical insulation in accordance with Section 01 78 23.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or level, affixed showing fire hazard ratings of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged insulation; remove from project site.

PART 2 - PRODUCTS

2.01 FIBERGLASS PIPE INSULATION MATERIALS

A. Fiberglass Pipe Insulation: Knauf 1000° Pipe Insulation, Johns Manville Micro-lok, or equal. Preformed insulation designed for nominal pipe sizes indicated on the drawings.

B. Meeting requirements of ASTM C547, ASTM C585, and ASTM C795.

C. Rigid, molded, noncombustible construction.

D. Maximum k = 0.23 Btu in./hr sq ft °F at 75°F.

E. Jacketing as specified for intended use.

2.02 POLYISOCYANURATE INSULATION MATERIALS

A. Manufacturers:

1. Trymer.
2. Dyplast Products.
3. Or equal.

B. Polyisocyanurate Insulation: Product meets the requirements of ASTM C591, type IV.

C. Thermal conductivity of 0.19 btu-in/hr-ft2-°F or lower at 75°F mean temperature.

D. Minimum 4 lb/ft3 density.

E. Flame spread/smoke developed performance tested via method ASTM E-84, UL 723, or NFPA 255 of 25/50 or better at thicknesses of 1.0 inches or less.

F. Heat traced piping systems shall be provided oversized as required for installation of heat tracing.

2.03 CELLULAR GLASS INSULATION MATERIALS

A. Manufacturers:

1. Pittsburgh Corning Corporation, Foamglas.
2. Or equal.

B. Cellular Glass Insulation: ASTM C552, density 7.0 to 9.5 pcf, maximum ASTM E96 permeability = 0.005 perm in., maximum k = 0.32 Btu in./hr sq ft °F at 75°F, to 850°F (427°C).

C. Buried system jacketing:

1. Flexible polyvinyldene chloride (PVDC), Saran 560 CX or equal.
2. 6.0-mils thickness.
3. 0.01-perms permeance rating.

2.04 REMOVABLE/REUSABLE INSULATING BLANKETS

A. Manufacturers:

1. Auburn Manufacturing, Inc, Ever Green Cut ‘n Wrap

2. Or equal

B. Construction:

1. Fibrous Glass Wool Insulation:

a. Meeting requirements of ASTM C553 with:
b. Maximum ASTM C1104/1104M water sorption of 5% by weight.
c. Mass loss corrosion rate of unfaced insulation shall be less than that of a 5-ppm chloride solution per ASTM C1617.
d. Suitable for operating temperatures up to 500°F.

2. Glass Fabric:

a. Suitable for operating temperatures up to 500°F.
b. Minimum weight of 13.5 ounces per square yard.
c. Minimum breaking strength of 125 psi warp and 100 psi fill per ASTM D5587.
d. Minimum tear strength of 30 psi warp and 20 psi fill per ASTM D5587.

3. Sewing Thread:

a. PTFE coated.
b. Minimum 0.021 inch diameter
c. Minimum 20 pound breaking strength
d. No less than 7 stiches per inch with 1/2 inch spacing.

4. Water Vapor Retarder:

a. Provide in all applications where operating temperature of insulated component will be below ambient temperature.
b. Material and associated tape shall meet requirements of ASTM C1136, Type IX.
c. One layer of metallic foil with minimum thickness of 0.00095 inches.
d. Permeance less than 0.005 Perm per ASTM E96, Procedure B.
e. Burst strength great than 80 psi per STM D774.
f. Tensile strength greater than 9 psi warp and fill per ASTM D828.

5. Minimum average thickness: 1.125 inches
6. Maximum flame spread index / smoke developed index of 25/50 per ASTM E84
7. Maximum k-value of 0.21 Btu-in/hr-ft2-°F at 50°F.

2.05 JACKETING MATERIALS

A. Aluminum Piping Jacket Materials:

1. JRA, 0.016-in. aluminum, ASTM B209, with Pittsburgh seam, butt joint strips, matching fitting covers, stucco embossed finish and weather mastic.

B. PVC Piping Jacket Materials:

1. Heavy-duty UV resistant PVC jacketing, ASTM D1784, 30 mil thickness, solid color, Johns Manville Zeston 300 PVC, or equal.
2. Color to be as selected by Owner or Engineer.

PART 3 – EXECUTION

3.01 SYSTEM INSULATION

A. For all Exterior and Buried Piping systems identified on Drawings, Section 40 05 05, or herein, to be heat traced and/or insulated and jacketed:

1. Insulate exterior above grade heat traced piping system with the following types and thicknesses of insulation:

a. Insulation: Polyisocyanurate, 2-in. thickness for 2-in and larger pipes, 1-1/2-in thickness for 1-1/2-in and smaller pipes.
b. Cellular Glass, 2-in. thickness for 2-in and larger pipes, 1-1/2-in thickness for 1-1/2-in and smaller pipes.
c. Jacketing: Aluminum, stucco embossed.

2. Insulate exterior below grade heat traced piping system with the following types and thicknesses of insulation:

a. Cellular Glass, 2-in. thickness for 2-in and larger pipes, 1-1/2-in thickness for 1-1/2-in and smaller pipes.
b. Jacketing: Saran 560 CX, or equal.

B. For all Interior Process Piping systems identified on "M" Drawings, Section 40 05 05, or herein, to be insulated and jacketed unless specified otherwise:

1. Insulate interior piping system and blower piping with the following types and thicknesses of insulation:

a. Insulation: Fiberglass, 2-in. thickness.
b. Jacketing: PVC.
c. Insulate all valves on insulted piping systems with a removable/reusable insulating blanket.

C. Plumbing Piping:

1. Insulate all interior W4 piping:

a. Insulation: Fiberglass, 1-in. thickness.
b. Insulation for fittings shall be preformed with PVC jacketing.
c. Jacketing: PVC.
d. Insulate all valves on insulted piping systems with a removable/reusable insulating blanket.

3.02 INSTALLATION OF INSULATION

A. Install insulation products in accordance with manufacturer's written instructions.

B. Install insulation on pipe systems subsequent to testing and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run.

1. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
2. All valves shall be covered with a removable, custom fabricated, insulating cover.
3. Covers shall be fabricated to be removable without disturbing adjacent insulating systems and capable of reinstallation to associated component.

G. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

H. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

3.03 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

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SECTION 40 61 13
PROCESS CONTROL SYSTEM (PCS) GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section covers general provisions and requirements for all work necessary for Engineering, furnishing, installing, adjusting, testing, documenting, and starting-up the Process Control System, complete.

B. Unless otherwise noted, the System Integrator shall assume responsibility for specification sections as listed in sub-section 2.03.B within this Specification.

a. Application Engineering (Programming) is not part of this contract and will be completed by the Owner.

C. The Contract Documents including drawings and specifications are complementary parts and what is called for by one part shall be as binding as if called for by all parts.

1.02 REFERENCES

A. ANSI: American National Standards Institute

B. IEEE: Institute of Electrical and Electronics Engineers

C. ISA: Instrumentation, Systems and Automation Society

D. NEMA: National Electrical Manufacturers Association

E. NFPA: National Fire Protection Agency

F. UL: Underwriters Laboratory

1.03 ABBREVIATIONS

A. HMI: Human/Machine Interface

B. I&C: Instrumentation and Controls

C. I/O: Input / Output

D. LOS: Line of Sight

E. NEC: National Electrical Code

F. PC: Personal Computer

G. PCN: Process Control Network

H. PCS: Process Control System

I. PLC: Programmable Logic Controller

J. OIU: Operator Interface Unit

K. SCADA : Supervisory Control and Data Acquisition

L. UPS: Uninterruptible Power Supply

1.04 DEFINITIONS

A. Process Control System: a complete, integrated system of PLCs, PCs, Windows-based servers, instruments, devices, wireless and wired process control networks, software, application Engineering, and ancillary equipment for monitoring and control of wastewater treatment facilities included in this project.

B. Process Control Network: a complete, integrated and secured communication network consisting of equipment and cabling that provides communications between components of the Process Control System.

C. System Integrator: Organization whose principal function is to design, program, configure, manufacture, install, and service the PCS. An organization, under the direction of the Contractor, who shall assume complete responsibility for: detail design, manufacture, installation, configuration, technically advising on and certifying correctness of installation, testing and adjusting, documenting and starting-up, and training of the complete PCS.

1.05 SUBMITTALS

A. In addition to the requirements of Section 01 33 00, the following information shall be provided in tabbed, booklet format covering all Project work.

C. List of special tools (including software) required for instrument calibration, startup, checking, testing, parts replacement, troubleshooting, and maintenance of all components of the Process Control System. Identify any special tools specially designed or adapted for use on parts of this system.

D. Product Data:

1. Catalog Information - Provide catalog information and descriptive literature on all equipment associated with the PCS.
2. Product Data (Specification) Sheets – Provide product data sheets for each component provided under this Section. The purpose of the data sheets is to supplement the generalized catalog information provided by citing all specific features for each specific component (e.g., scale range, materials of construction, special options included). Product Data Sheets shall follow General ISA S20 format.

E. Test Outline and Procedure Submittal

1. A detailed description of each specified test procedure and demonstration shall be submitted for approval. The decision of Engineer upon the acceptability of the procedure shall be final.
2. It is required that this be a two-step submittal: outlines first followed, upon receipt of Engineer's approval, by specific test descriptions.
3. Test descriptions shall be in sufficient detail to fully describe the specific tests to be conducted to demonstrate conformance with these Specifications.
4. Provide detailed step-by-step in-factory and field test procedure in accordance with Section 40 61 21. Include proposed test documentation and sign-off sheets and punch list forms.
5. Identify complete inventory of equipment to be tested at factory including make, model, and serial number. Label each piece of equipment.

F. Spare and Expendable Items Submittal

1. Contractor shall provide a list of recommended spares and expendable items as recommended by System Integrator in sufficient quantities to sustain the Process Control System for a period of 3 years after acceptance.
2. A total purchase cost for the recommended list shall be provided in addition to the unit cost for each item. The cost of obtaining spare and expendable items selected by Owner will be addressed as a Change Order at the Owner's discretion.
3. In addition to the Spares and Expendables List, Contractor shall provide a Component Part List as recommended by Systems Integrator. The Component Part List shall be a complete parts list for the entire Process Control System, and shall have the following features:

    a. All components shall be grouped by component type, with the component types identified in a similar manner to the component identification code used in these Specifications.
    b. All components shall be listed with their exact and complete manufacturer's part number, including all options or accessories.
    c. All components shall be identified with their complete tag number as shown in these Specifications, or as modified or assigned by Contractor and approved by Engineer.
    d. All components without tag numbers shall be grouped within component types by manufacturer's part number. Exact quantities shall be listed for each part number.

G. Operation and Maintenance (O&M) Data:

1. Process Control System - Submit in accordance with Section 40 61 30.
2. Fully document copy of all application programs including PLC, PC and Server-based applications. See Section 40 61 30 for requirements
3. Network, server and workstation setup instructions. See Section 40 61 30 for requirements.

H. Record Drawings: Submit in accordance with Section 40 61 30.

1.06 QUALITY ASSURANCE

A. Contractor shall engage the services of a qualified System Integrator for the purposes of furnishing the Process Control System, providing technical assistance on the installation of System and certifying the correctness of said installation.

B. Equipment shall be latest and most modern design at time of Notice to Proceed.

C. All software and firmware used in this Project shall be the latest version that is compatible with each other, as of the Notice to Proceed.

D. Like items of Equipment shall be end products of single manufacturer to achieve standardization for maintenance, spare parts, operation, and service.

E. PCS components shall be grounded in accordance with NEC requirements.

F. Coordination - In order to ensure timely performance of the Contract and the System's conformance with Specifications, coordination meeting(s) shall be held during the course of the project.

1. Within 45 days of date of Contract Time commencement, submit Progress Meeting schedule for final coordination by Owner/Engineer, Contractor and Systems Integrator. Submit also the Submittal Schedule and Project Activity Schedule for final review.

2. Progress Meetings shall be held at the project site and designated by Owner with Owner/Engineer's, Contractor's and System Integrator's representatives in attendance.

3. Purpose of Progress Meetings is to obtain Owner/Engineer's clarification on intent of Contract Documents during Submittal preparation and prior to OIU/HMI and PLC software configuration at no additional cost to Owner. Progress Meeting(s) shall cover following:

    a. Review of functional descriptions describing equipment operation.
    b. Owner/Engineer selection of options.
    c. Owner/Engineer review documentation

4. Prepare and submit Startup Schedule, coordinated with overall Construction Schedule including the following:

    a. Factory Acceptance Test(s).
    b. Review of Wiring Sign-Off forms by Owner.
    c. I/O checkout by System Integrator.
    d. Plant startup.
    e. Training.
    f. Post-startup services.

1.07 SYSTEM INTEGRATOR RESPONSIBILITY

A. System Integrator shall inspect Equipment provided under this Section prior to shipment to Project sites.

B. System Integrator shall coordinate work with Contactor to ensure that:

    1. All components provided under this Section are properly installed.
    2. All components provided under this Section are properly configured.
    3. The proper type, size, and number of control wires with conduits are provided.
    4. Proper electric power circuits are provided for all components and systems.

C. System Integrator shall be responsible for coordination of voltage levels and signal types for signals connected to Process Control System with the Owner.

D. Systems Integrator shall be responsible for configuration and setup of Variable Frequency Drive parameters. The setup shall include data access via the Process Control Network.

    1. VFDs shall be programmed for auto-restart enabled.
    2. VFDs shall be programmed such that a voltage dip is not considered a fault.
    3. High temperature and/or leakage detection inputs wired to VFDs shall be programmed for "enable" and not "fault".

E. Systems Integrator shall be responsible for the configuration and setup of the Power Monitoring Devices provided as part of the process control system. The setup shall include data access via the Process Control Network.

F. System Integrator shall coordinate Process Control Network addressing schemes with Owner and incorporate agreed upon scheme for all equipment on the PCS including vendor supplied equipment.

G. All field located conduits, wiring and cables shall be provided in accordance with Division 26 – Electrical. Exceptions to this are copper Ethernet cable and fiber optic Ethernet cable which shall be provided in accordance with Division 40.

H. Modifications to existing control equipment.

1. Provide equipment necessary to affect changes to existing control equipment as shown on drawings and specified.
2. Provide interposing relays and current-to-current isolation relays only as required to affect signal interfacing with non-compatible devices.
3. Modify documents of existing control equipment to reflect new as-built conditions.

1.08 APPLICATION ENGINEERING SERVICES

A. Application Engineering Services shall be provided by Owner.

B. Application Engineering Services shall include the following:

1. Develop written loop descriptions from the Process Control Descriptions of Section 40 61 96. These loop descriptions will define the proposed operation and control of the plant equipment and treatment systems affected by the work on this project.
2. Develop sample Human Machine Interface (HMI) graphic screen layouts.
3. Develop PLC and HMI application software associated with the Project in accordance with Section 40 61 20. Application software will be based on the standards established with the Owner during the pre-programming phase of the construction of the project and will be integrated into the plant-wide process control system.
4. Install and test PLC and HMI application software developed by Application Engineer. Modify tested software to incorporate changes agreed to between the Owner and Application Engineer.
5. Develop the alarm notification feature of the HMI software to alert operations and maintenance personnel of critical alarms by means of their existing cell phones.
6. Develop standard trends and set up custom trend features.
7. Prepare an operation and maintenance manual for the new PLC and HMI application software. The manual will serve as the basis for training provided by Application Engineer.

1.09 WARRANTY

A. Provide warranty in accordance with General Conditions.

B. Furnish a copy of the warranty together with the operating instructions and maintenance data for the complete system.

C. System defects and deficiencies shall be corrected by Contractor within 24 hours of notification if Owner does not have necessary replacement parts in stock and within 4 hours of notification if Owner has necessary replacement parts in stock.

PART 2 – PRODUCTS

2.01 SYSTEM INTEGRATORS

A. Allan Integrated Control Systems, Inc., Milwaukee, WI.

B. Austgen Electric, Inc., Griffin, IN.

C. L.W. Allen, Inc./Altronex, Madison, WI.

D. Frakes Engineering, Indianapolis, IN.

E. Gasvoda & Associates, Inc., Calumet City, IL.

F. Toric Engineering, Inc., Danville, IN.

2.02 SYSTEM INTEGRATOR EXPERIENCE REQUIREMENT

A. The Contractor shall utilize a System Integrator having the experience and knowledge, as defined herein, to undertake the work specified in this Section. The System Integrator shall be an organization having the following organizational and individual experience, knowledge, and capability:

1. System Integrator shall be regularly engaged in the design, installation, and servicing of wastewater treatment PCS.
2. System Integrator shall demonstrate the ability to produce electrical and control logic diagrams in the level of detail required by this specification.
3. System Integrator shall have previously executed a minimum of five (5) wastewater treatment PCS projects of similar size and complexity to this Project and incorporating PLCs and HMI platforms included in this Project.
4. Systems Integrator shall have previously successfully executed Ethernet wireless and wired networked projects of comparable size and complexity to this Project.
5. The person(s) performing the field I&C work as required by the Contract Documents shall have a minimum of five (5) years experience on PLC-based systems.
6. System Integrator shall provide, on-site, a Control Systems Engineer to commission the functional testing, start-up and training as required by the Contract Documents. The individual shall have authored and commissioned control logic for no fewer than three (3) projects of similar or greater complexity, and shall have a demonstrated proficiency in authoring logic in PLC Function Block Language.
7. Upon request of Owner and in addition to other specified requirements, Contractor shall provide a minimum of five (5) System Integrator references to confirm compliance with these requirements.

2.03 EQUIPMENT, SYSTEMS AND SERVICES

A. Equipment, Systems and Services provided under this Section shall conform to the following requirements.

1. UL 508 - Standards for Safety, Industrial Control Equipment.
2. NEMA ICS 1 - General Standards for Industrial Control and Systems.
3. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.
4. NEMA ICS 3 - Industrial Systems.
5. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
6. NEMA ICS 250 - Enclosures for Electrical Equipment.
7. NFPA 79 - Electrical Standard for Industrial Machinery
8. UL 698A Intrinsic Safe Circuits.

B. Equipment, Systems and Services provided under this section include the following.

1.	Motor-Control Centers	Section 26 24 19.
2.	Variable Frequency Drive Equipment	Section 26 29 23.
3.	Process Control System – Testing	Section 40 61 21.
4.	Process Control System – Training	Section 40 61 26.
5.	Process Control System – O&M Data	Section 40 61 30.
6.	Process Control System I/O Listing	Section 40 61 93.
7.	Process Control Descriptions	Section 40 61 96.
8.	Network and Communication Equipment	Section 40 66 00.
9.	Instrumentation of Process Systems	Section 40 70 00.
10.	Flow Measurement	Section 40 71 00.
11.	Level measurement	Section 40 72 00.

12. Pressure, Strain, and Force Measurement — Section 40 73 00.
13. Temperature Measurement — Section 40 74 00.
14. Panel Mounted Instruments — Section 40 78 00.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Contractor shall install and wire Process Control System equipment in accordance with System Integrator's and Instrument Manufacturer's written instructions and approved submittals.

3.02 PLC INPUT/OUTPUT WIRING

A. Contractor shall provide and install control wiring and components as indicated and specified. The Owner will complete terminations in the PLC and Remote I/O panels. The Contractor will complete terminations to equipment, instruments, pump local control stations, motor control centers, and vendor-supplied control panels.

B. Each conductor or twisted pair cable shall be labeled near its termination point.

C. Color-coded multi-conductor cable or multi-pair cable shall be labeled on overall jacket near its point of fan-out. Each pair of a multi-pair cable, when not color-coded, shall be labeled at its termination point in addition to the overall jacket.

D. Labels shall be machine-printed wrap-around types with tag visible from front without removal of wire from termination.

E. Electrical wiring and controls shall conform to Division 26 – ELECTRICAL.

3.03 PLC INPUT/OUTPUT SIGNAL POWER SOURCE

F. Except for 4-wire instruments, all analog loops shall be powered from respective process control panel.

G. 120 volts alternating and direct current for Process Control System inputs shall be sourced from respective process control panel.

H. 120 volts alternating and direct current for Process Control System outputs shall be sourced from respective location receiving control signal.

3.04 FIELD QUALITY CONTROL

A. Protection During Construction.

1. Throughout Contract, Contractor shall provide protection for materials and equipment against loss or damage and the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Specific storage requirements shall be in accordance with the Engineer-reviewed System Integrator's recommendations.

B. Cleaning and Touch-up Painting.

1. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior

and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish.

C. Inspections.

1. System Integrator shall provide services of qualified service Engineer to supervise and inspect equipment installation to ensure system is installed in accordance with System Integrator's recommendations.
2. All materials, equipment, and workmanship shall be subject to observation at any time by Engineer's representatives. Correct any work, materials or equipment not in accordance with these Contract Documents or found to be deficient or defective. Make corrections in a manner satisfactory to Engineer at no additional cost to Owner.
3. The System Integrator shall supervise final power and signal connections by Contractor to all equipment provided under this Section. For all equipment provided under this Section and all other equipment interfaced by the system, the System Integrator shall verify and certify by written notice to Engineer, correctness of final signal connections and correctness of adjustment.
4. System Integrator shall field calibrate equipment at time of complete startup on loop-by-loop basis. Submit calibration certification to Engineer for each piece of equipment. Make adjustments necessary to place equipment in satisfactory operation.
5. During this startup period, Contractor's personnel are to thoroughly check all of the equipment and perform the on-site tests specified above.

3.05 SUBSTANTIAL COMPLETION

A. In addition to requirements identified in other parts of the Contract Documents, Substantial Completion shall require the following process instrumentation and control work is successfully completed:

1. Owner's receipt of required site documentation including required O&M material.
2. Completion of specified training associated with equipment provided.
3. Successful completion of the specified demonstration period.
4. Owner's receipt of required tools.

END OF SECTION

SECTION 40 61 21
PROCESS CONTROL SYSTEM (PCS) – TESTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes field testing requirements.

B. Testing of Process Control System (PCS) in conjunction with following Sections.

1. Section 40 61 93 Process Control System I/O List.
2. Section 40 61 96 Process Control Descriptions.

1.02 SUBMITTALS

A. In addition to submittal requirements of Section 40 61 13, provide the following:

1. Test Results:

a. Pass/fail status of all digital I/O.
b. Results of analog I/O testing.

2. Miscellaneous:

a. Detailed step-by-step in-factory and field test procedure at least 6 weeks in advance of scheduled test date. Include sign-off sheets and punch list forms and description of configurations to be tested.
b. Complete inventory of equipment to be tested at factory including make, model, and serial number. Label each piece of equipment.

3. Submit in accordance with Section 01 33 00.

PART 2 – SERVICES

2.01 PREPARATION

A. Meet following criteria prior to start of test.

1. Complete submittals and resolve disputes, if any.
2. Engineer review of test procedure.
3. Include PLC processor, PLC network interface, and HMI computer in testing.
4. Coordinate test date agreeable to each party.

B. Schedule:

1. At end of test, meet to review list of deficiencies. Engineer will indicate those items which must be corrected prior to shipment.
2. Confirm, in writing, times and dates 2 weeks before tests.

2.02 FIELD I/O AND SOFTWARE TESTING

A. General:

1. Field testing is intended to check installation of the Process Control System PLC's in addition to providing a diagnostic check of field equipment and wiring.

2. Testing shall begin after Process Control System PLC has been installed and all terminations are complete.
3. Test as follows:

    a. Run hardware diagnostics.
    b. Testing of all input and output (I/O) signals by activation or injection of signal at field device.

        1) Digital input signals:

            a) For all equipment run signals, test by on/off operation of equipment. If operation of equipment is deemed inadvisable by Owner or PLC supplier due to potential process upset, inaccessibility of generating device, hazard to personnel or other factors, test by jumpering of motor starter auxiliary contact or other source of run signal.
            b) For all alarm or status signals, test by activation of device generating alarm. If generation of alarm is deemed inadvisable by Owner or PLC supplier due to potential process upset, inaccessibility of generating device, hazard to personnel or other factors, test by jumpering of alarm contact at nearest accessible location to generating device.
            c) For signals designated as spare, test by jumpering of signal at Process Control System PLC panel field termination point.
            d) Demonstrate change of state in PLC data table.
            e) Demonstrate change of state at SCADA HMI.
            f) Demonstrate change of state at Operator Interface Terminal.

        2) Digital or Relay output signals:

            a) Manipulate PLC data table or use forces to test response of all discrete output signals.
            b) Verify proper response of other devices in loop to signals.
            c) For signals designated as spare, test by checking signal at Process Control System PLC panel field termination point.

        3) Analog input signals:

            a) Verify impedance capabilities of transmitting device has not been exceeded by installation of Process Control System PLC.
            b) Disconnect transmitting device and inject 0, 4, 12, and 20 mAdc into loop.
            c) Demonstrate proper response to various signals in PLC data table.
            d) Demonstrate change of value at SCADA HMI.
            e) Demonstrate change of value at Operator Interface Terminal.
            f) Verify proper response of other devices in analog loop to various signals.
            g) For signals designated as spare, test by injection of signal at Process Control System PLC panel field termination point.

        4) Analog output signals:

            a) Verify impedance capabilities of analog outputs are not exceeded.
            b) Generate 4, 12, and 20 mAdc signals for all analog outputs through PLC data table.
            c) Demonstrate change of value at SCADA HMI.
            d) Demonstrate change of value at Operator Interface Terminal.
            e) Verify proper response of other devices in analog loop to various signals. Verify proper loop current through measurement.
            f) For signals designated as spare, test by measuring of signal at Process Control

System PLC panel field termination point.

4. Documentation

   a. Prepare field testing sign-off document. Document shall include following as a minimum:

      1) Project description and number.
      2) Company name for Owner, PLC supplier, and Engineer.
      3) For each I/O point, include area for initials of PLC supplier, Owner, and Engineer representative indicating passing of inspection. Include separate line for I/O point to be tested.
      4) Include area for handwritten notes of any corrections required.

5. Problem field devices or wiring.

   a. Provide written documentation of any problems encountered with Owner's existing field devices or wiring during testing.

PART 3 – EXECUTION

3.01 PERFORMANCE

A. Test PLC's and Operator Interface Terminal consistent with Drawings and Specifications.

B. Refer to Section 40 61 93 for information on ranges, signal functions, set-points, initial values and activation points.

END OF SECTION

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SECTION 40 61 26
PROCESS CONTROL SYSTEM (PCS) – TRAINING

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes Training requirements.

B. Include Training on the following subjects:

1. Overview of equipment and how it interacts with equipment and processes.
2. Overview of equipment areas and how they interact with field panels and instruments and other area equipment.
3. Overview of plant communications hardware and equipment.

C. Comply with requirements of Section 01 79 30 Instructional Services.

1.02 ABBREVIATIONS AND REFERENCES

A. HMI Human Machine Interface

B. OIU Operator Interface Unit

C. PLC Programmable Logic Controller

D. SCADA Supervisory Control And Data Acquisition

1.03 SUBMITTALS

A. General:

1. Two weeks prior to training provide to Engineer a copy of the training documents to be presented to participants.
2. Material shall be arranged in a 3-ring tabbed binder separated by primary subjects as defined below.
3. Material shall be comprensive, yet arranged in a manner easy to find or reference key information.
4. Partial submittals are not acceptable.

PART 2 – PRODUCTS – Not Applicable

PART 3 – EXECUTION

3.01 MAINTENANCE TRAINING

A. Cover following areas as a minimum:

1. Testing programs which can isolate faults to functional area.
2. Theory, logic flow, physical hardware awareness, and interface connections and assembly of each equipment item.
3. Diagnostic procedures using special and general purpose test equipment. Theory, testing, and troubleshooting procedures given for special test equipment.
4. Operation of submersible pump monitoring systems.
5. Present short operator's course to ensure students understand operator functions and man/machine interfaces. Explain displays and printouts so students understand how

information is derived, when it is presented incorrectly, and use of guidelines to differentiate between software and hardware problems.

3.02 INSTRUMENT TRAINING

A. Cover following areas as a minimum:

1. General principle of operation.
2. Calibration schedule.
3. Calibration procedure.
4. Calibration equipment required (if needed).
5. Recommended spare parts.
6. Consumable part – recommended replacement schedule (e.g. Reagents, filters, probe tips) and procedure.
7. General care and maintenance with special consideration to all instruments that may require cleaning such as level elements, etc.

END OF SECTION

SECTION 40 61 30
PROCESS CONTROL SYSTEM (PCS) – O&M DATA

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes requirements for Operations and Maintenance (O&M) data for Process Control System.

B. Comply with requirements of:

1. Section 01 33 00 Submittal Procedures.
2. Section 01 78 23 Operation and Maintenance Data.

PART 2 – SERVICES

2.01 HARDWARE MANUALS

A. General:

1. Include equipment comprising system. Provide instructions for O&M of installed system and individual equipment units comprising system.
2. Provide level of comprehension so experienced electronics technician can understand them. Convey understanding of how system operates and provide sufficient procedures for O&M. Use abbreviated tabular data such as charts, tables, checklists, and diagrams whenever practical, in lieu of written text. Make Drawings and tables integral part of manuals.
3. Standard hardware manuals are acceptable, if errata sheets are included to reflect specific equipment provided.

B. Organization and Content:

1. Introduction Section: Brief explanation of function of equipment covered. Be concise and do not include detailed descriptions. Provide quick orientation to use and purpose of manual and its relationship to system and equipment.
2. Safety Precautions: Major hazards to personnel and equipment peculiar to equipment or jobs covered. Intersperse specific hazard information, cautions or warning notes at appropriate points throughout other sections of manual.
3. Physical Description: Physical description (size, dimension, weight, special attachments, and physical orientation or clearances) for installation and operation. Identify special environmental (cooling, exhausting or noise) constraints.
4. Functional Description: How various functions operate together to cause desired results. Include block diagrams and flow diagrams for clarification and understanding. Provide text and diagrams which mutually support each other.
5. Operating procedures: Include maintenance-oriented operating procedures for individual equipment so maintenance personnel will be able to verify proper operation.

a. Describe each equipment, unit, and assembly in detail with regard to technical or theoretical operation. Include information to component level. Describe each circuit and mechanical mechanism. Cross-reference descriptions so functions of each piece of equipment are covered. Use schematic diagrams, sketches, equivalent diagrams, tables, and graphs to supplement text.
b. Applicable checkout, troubleshooting, servicing, removal and replacement, and in-place repair procedures which are performed on system basis. Provide written procedures for every adjustment point of equipment.

6. Checkout Procedures: Verify satisfactory operation of system, subsystem or unit as applicable. If checkout requires detailed step-by-step procedure include such procedures. Indicate why checkout is performed and what conditions are to be satisfied.
7. Troubleshooting Procedures: Isolate faulty components. Sequence troubleshooting procedures in logical progression from malfunction indication to location of faulty component(s). Indicate special connections or test equipment required for troubleshooting.
8. Servicing Requirements: Cleaning, lubricating, replenishing, and other housekeeping and preventive maintenance procedures applying to particular equipment. Make reference to applicable manuals which describe various servicing procedures.
9. Removal and Replacement Procedures: Step-by-step instructions for removal and replacement of items subject to frequent replacement. If special tools are required, identify by name and part number.
10. Diagrams: Schematic diagrams, logic diagrams, and associated data necessary for maintenance personnel to trace circuits, make continuity checks, and accomplish general and specific troubleshooting on inoperative or malfunctioning circuits. Provide pin wiring diagrams and cabling and plug tables showing to-and-from wiring information. Provide symbol chart where necessary to explain graphic symbols appearing on diagrams.
11. Tabular Listing: Special tools, equipment, and test equipment applicable to test, adjustment, and fault isolation procedures. Write systems maintenance instructions to enable correct use of test equipment.
12. Parts Lists: Provide clear traceability from equipment to replaceable component. Identify each component part with original manufacturer's name and part number. Identify component parts or assemblies modified for Project by part number. Parts lists may be tabulated or supplied in form of engineering or manufacturing drawings.

2.02 SOFTWARE AND CONFIGURATION MANUALS

A. General:

1. Manufacturer's standard PLC programming and software manuals.
2. Manufacturer's standard PLC data highway network programming and software manuals.

B. Provide complete, organized, and standardized documentation. Structure documentation so each level develops different degree of detail. Begin with broad approach (Systems Manual), focus on smaller pieces of overall system (Subsystem Documentation), and finally pinpoint finest detail (Program Documentation).

C. Systems Manual: Describe overall content of systems software. Describe what is included in software and not how components function. Provide global view of system and complete description of interaction of various software subsystems. Include following.

1. Table of contents.
2. Overall narrative of system including special techniques and general philosophies.
3. Block diagram showing subsystem interaction.
4. List of subsystems including brief discussion of purpose of each.
5. List of programs included, categorized by subsystem, to which each belongs.
6. Description of files or tables within system which are not unique to any particular subsystem. Files or tables used uniquely within subsystem may be defined therein.

D. Cold Boot Manual and Boot Disks: Provide detailed instructions and bootstrap software for restoring all configured equipment to normal operation in the event of an equipment crash. Document all soft and hard points used, both in programming code and in Excel format.

2.03 DRAWINGS

A. Provide following for Process Control System elements.

1. Block Diagram: Diagram showing major Process Control System components. Identify components by manufacturer and model number. Show interconnecting cables diagrammatically.
2. Power and Grounding Interconnection Diagrams:

    a. Power diagrams shall detail interconnections from power source through power conditioning equipment, to process control system equipment.
    b. Grounding diagram shall illustrate grounding philosophy and implementation.

3. Interconnecting Wiring Diagrams: Show Process Control System elements, interconnecting cables and wiring terminations, and terminations to interacting elements and subsystems. Number terminations. Label terminations for circuits extending outside PLC assemblies.

    a. Coordinate external circuit portion of diagram with Work specified under Division 26 and bear Contractor's mark showing Work is complete.
    b. Nomenclature for external connections shall be in accordance with I/O lists in these Contract Documents and on Drawings.

4. Shop Drawings for specifically assembled Process Control System equipment such as panels, consoles, and cabinets. Drawings shall include, but not be limited to, following.

    a. Complete connection diagram.
    b. Bill of materials listing each major item of assembly. Provide data sheets for each item, annotated as necessary to describe specific items/options furnished.
    c. Layout and fabrication drawings showing locations of components.
    d. Installation and mounting detail drawings.
    e. Anchor bolt size and location.
    f. Equipment weights.
    g. Cabinet details and location.

        1) Exterior dimensions.
        2) Cable ingress and egress areas.
        3) Cable routing.
        4) Power termination location.
        5) Ground lug location.
        6) Cable termination points.
        7) Nameplate schedules.

PART 3 – EXECUTION

NOT USED

END OF SECTION

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SECTION 40 61 93
PROCESS CONTROL SYSTEM (PCS) – INPUT/OUTPUT LIST

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this Section shall conform to general requirements of Section 40 61 13 - PCS General Provisions.

B. Section includes Process Control System hard-wired PLC I/O and programming parameters, and is to be used in conjunction with the following Sections:

1. Section 40 61 20 PCS Configuration Services.
2. Section 40 61 96 Process Control Descriptions.

C. This section includes:

1. Schedule 1 to Section 40 61 93, Input/Output List.

D. I/O List as shown in Schedule 1 of this Section contains information to configure I/O subsystem hardware and to indicate range conversion or signal function.

1.02 ABBREVIATIONS AND REFERENCES

A. I/O Inputs/Outputs

B. PLC Programmable Logic Controller

C. RTD Resistance Temperature Detector

PART 2 – SERVICES

2.01 I/O LIST DEFINITIONS

A. LOCATION is the tag number for the PLC/RIO/RTU panel the I/O point terminates at.

B. DRAWING is the Drawing number of Process and Instrumentation Diagram (P&ID) in which the I/O point is located.

C. TAG is the field tagname given to the I/O point as designated on the Drawings.

1. This list is not to be considered a comprehensive list of PLC tagnames.

D. EQUIPMENT describes the equipment associated with the I/O point.

1. Equipment in Schedule 1 table may be truncated and/or abbreviated due to space considerations.
2. Shop Submittals for PLC Drawings shall have Equipment tagnames as described on Process and Instrumentation Diagram (P&ID) Drawings.

E. FUNCTION describes associated process parameter or programmable controller action.

F. I/O TYPE is defined as one of following:

1. AI Designates Analog Input.

2. AO Designates Analog Output.
3. DI Designates Discrete Input.
4. DO Designates Discrete Output (non-relay)
5. RO Designates Relay Output; momentary, maintained or latched relay contact output.
6. RTD Designates RTD Input.

G. SIGNAL TYPE Description:

1. Analog Input (AI):

a. 4-20mA DC.
b. DATA 1: Process parameter range.
c. DATA 2: Process parameter engineering units.
d. POLL TIME: 0.25 second.

2. Analog Output (AO):

a. 4-20mA DC.
b. DATA 1: Process parameter range.
c. DATA 2: Process parameter engineering units.

3. Discrete Input (DI):

a. 120Vac.
b. DATA 1: Condition existing when field contact open.
c. DATA 2: Condition existing when field contact closed.
d. POLL TIME: Change-of-State, exception-based.

4. Discrete Output (DO):

a. 120Vac.
b. DATA 1: Contact open function.
c. DATA 2: Contact closed function.

5. Relay Output (RO):

a. 120Vac.
b. DATA 1: Contact open function.
c. DATA 2: Contact closed function.

H. DATA 1 and DATA 2 describe function or signal characteristics. These are further defined under SIGNAL TYPE above.

1. I/O point data fields are subject to review and modification by Engineer during Shop Drawing review phase. Incorporate modifications into entire system.

PART 3 – EXECUTION

3.01 I/O CONFIGURATION

A. I/O shall be configured such that any single I/O module failure shall not shut down all the equipment for a given process. The objective of this configuration is to avoid a process strategy failure because of a single I/O module failure.

1. For example, if a treatment system includes 4 pumps, the I/O for each pump should be

placed such that the failure of an I/O point or module will only affect one of the four pumps, with the remaining pumps operating normally.

B. I/O Point Spares Utilization.

1. Provide 25% prewired spare points per panel. Incorporate spare points into active point data base. Include changing point names, descriptions, ranges, or status from spare to new point. Include related documentation changes. Spares utilization will be subject to following limitations:

   a. Incorporation shall not significantly alter control software functions. Minor change is addition of device alarm input. Significant change is addition of control device.
   b. Incorporation shall not significantly alter local area panels or field wiring to device. Minor alterations include additions of signals to terminations. Significant alterations include addition of major equipment.
   c. Additions shall not increase size of reports beyond that specified elsewhere.
   d. Changes shall not be made subsequent to submittal approval for a given panel or process area loop drawings.
   e. Treat changing of active points to spare points in same manner as incorporation of spares.

(See following pages for Schedule 1 of this Section)

LOCATION	DRAWING	I/O TAG	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
PLC-ADM	1-N-01	EXISTING I/O	INFLUENT VALVE 14	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
PLC-ADM	1-N-01	EXISTING I/O	INFLUENT VALVE 710	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
PLC-ADM	1-N-01	EXISTING I/O	INFLUENT VALVE 56	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
PLC-ADM	1-N-01	EXISTING I/O	INFLUENT VALVE 14	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
PLC-ADM	1-N-01	EXISTING I/O	INFLUENT VALVE 710	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
PLC-ADM	1-N-01	EXISTING I/O	INFLUENT VALVE 56	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
PLC-ADM	1-N-01	EXISTING I/O	INFLUENT VALVE 14	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
PLC-ADM	1-N-01	EXISTING I/O	INFLUENT VALVE 710	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
PLC-ADM	1-N-01	EXISTING I/O	INFLUENT VALVE 56	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
RIO-PFS-1	1-N-01	PFS-LIT-111	PRIMARY FILTER EFFLUENT DIVERSION STRUCTURE	LEVEL	AI	4-20mA	0-20	FEET
RIO-PFS-1	1-N-01	PFS-PFEG1-ZI	PRIMARY FILTRATION EFFLUENT CONTROL GATE 1	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-01	PFS-PFEG2-ZI	PRIMARY FILTRATION EFFLUENT CONTROL GATE 2	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-02	PFS-PFWG1-ZI	PFI WET WELL 1 INLET GATE	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-02	PFS-PFIG1-ZI	PRIMARY FILTER INFLUENT GATE 1	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-02	PFS-PFIG2-ZI	PRIMARY FILTER INFLUENT GATE 2	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-02	PFS-PFIG3-ZI	PRIMARY FILTER INFLUENT GATE 3	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-02	PFS-FIT-121	PFIP 1 DISCHARGE FLOW METER	FLOW	AI	4-20mA	0-12	MGD
RIO-PFS-1	1-N-02	PFS-FIT-122	PFIP 2 DISCHARGE FLOW METER	FLOW	AI	4-20mA	0-12	MGD
RIO-PFS-1	1-N-02	PFS-FIT-123	PFIP 3 DISCHARGE FLOW METER	FLOW	AI	4-20mA	0-12	MGD
RIO-PFS-1	1-N-02	PFS-FIT-124	PFIP 4 DISCHARGE FLOW METER	FLOW	AI	4-20mA	0-12	MGD
RIO-PFS-1	1-N-02	PFS-LIT-121	PF. INFLUENT WET WELL RADAR LEVEL METER	LEVEL	AI	4-20mA	0-20	FEET
RIO-PFS-1	1-N-05	PFS-LIT-151	SCUM WET WELL 1 LEVEL SENSOR	LEVEL	AI	4-20mA	0-10	FEET
RIO-PFS-1	1-N-05	PFS-SMOG1-ZI	PRIMARY FILTRATION SCUM OVERFLOW GATE 1	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-06	PFS-LIT-161	GRAVITY THICKENER 1 LEVEL SENSOR	LEVEL	AI	4-20mA	0-20	FEET
RIO-PFS-1	1-N-07	PFS-FIT-171	PFTS PUMP 2 DISCHARGE FLOW METER	FLOW	AI	4-20mA	0-150	GPM
RIO-PFS-1	1-N-07	PFS-FIT-172	PFTS PUMP 1 DISCHARGE FLOW METER	FLOW	AI	4-20mA	0-300	GPM
RIO-PFS-1	1-N-07	PFS-TIT-173	PFTS PUMP 2	CASING TEMPERATURE	AI	4-20mA	40 to 300	ºF
RIO-PFS-1	1-N-01	PFS-PFEG1-ZC	PRIMARY FILTRATION EFFLUENT CONTROL GATE 1	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-01	PFS-PFEG2-ZC	PRIMARY FILTRATION EFFLUENT CONTROL GATE 2	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-02	PFS-PFWG1-ZC	PFI WET WELL 1 INLET GATE	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-02	PFS-PFIG1-ZC	PRIMARY FILTER INFLUENT GATE 1	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-02	PFS-PFIG2-ZC	PRIMARY FILTER INFLUENT GATE 2	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-02	PFS-PFIG3-ZC	PRIMARY FILTER INFLUENT GATE 3	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-03	PFS-SAM1-PACE	PFE SAMPLER	FLOW PACE	AO	4-20mA	0-100	% SPEED
RIO-PFS-1	1-N-05	PFS-SMOG1-ZC	PRIMARY FILTRATION SCUM OVERFLOW GATE 1	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
RIO-PFS-1	1-N-01	PFS-PFEG1-LR	PRIMARY FILTRATION EFFLUENT CONTROL GATE 1	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
RIO-PFS-1	1-N-01	PFS-PFEG2-LR	PRIMARY FILTRATION EFFLUENT CONTROL GATE 2	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
RIO-PFS-1	1-N-02	PFS-RIO1-UPS-FAIL	RIO 1 PANEL UPS	FAIL	DI	120Vac	NORMAL	FAIL
RIO-PFS-1	1-N-02	PFS-RIO1-UPS-BATT	RIO 1 PANEL UPS	LOW BATTERY	DI	120Vac	NORMAL	LOW BATTERY
RIO-PFS-1	1-N-02	PFS-RIO1-UPS-ON	RIO 1 PANEL UPS	ON UPS MODE	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-02	PFS-PFIG1-LR	PRIMARY FILTER INFLUENT GATE 1	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
RIO-PFS-1	1-N-02	PFS-PFIG2-LR	PRIMARY FILTER INFLUENT GATE 2	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
RIO-PFS-1	1-N-02	PFS-PFIG3-LR	PRIMARY FILTER INFLUENT GATE 3	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
RIO-PFS-1	1-N-02	PFS-PFIP1-SF	PRIMARY FILTRATION INFLUENT PUMP 1	SEAL FAIL	DI	120Vac	NORMAL	SEAL FAIL
RIO-PFS-1	1-N-02	PFS-PFIP1-TSH	PRIMARY FILTRATION INFLUENT PUMP 1	OVERTEMP	DI	120Vac	NORMAL	OVERTEMP
RIO-PFS-1	1-N-02	PFS-PFIP2-SF	PRIMARY FILTRATION INFLUENT PUMP 2	SEAL FAIL	DI	120Vac	NORMAL	SEAL FAIL
RIO-PFS-1	1-N-02	PFS-PFIP2-TSH	PRIMARY FILTRATION INFLUENT PUMP 2	OVERTEMP	DI	120Vac	NORMAL	OVERTEMP
RIO-PFS-1	1-N-02	PFS-PFIP3-SF	PRIMARY FILTRATION INFLUENT PUMP 3	SEAL FAIL	DI	120Vac	NORMAL	SEAL FAIL
RIO-PFS-1	1-N-02	PFS-PFIP3-TSH	PRIMARY FILTRATION INFLUENT PUMP 3	OVERTEMP	DI	120Vac	NORMAL	OVERTEMP
RIO-PFS-1	1-N-02	PFS-PFIP4-SF	PRIMARY FILTRATION INFLUENT PUMP 4	SEAL FAIL	DI	120Vac	NORMAL	SEAL FAIL
RIO-PFS-1	1-N-02	PFS-PFIP4-TSH	PRIMARY FILTRATION INFLUENT PUMP 4	OVERTEMP	DI	120Vac	NORMAL	OVERTEMP
RIO-PFS-1	1-N-02	PFS-PFWG1-LR	PFI WET WELL 1 INLET GATE	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE

LOCATION	DRAWING	I/O TAG	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
RIO-PFS-1	1-N-02	PFS-JS-PFIP1	PFIP 1 LOCAL DISCONNECT	ACTIVATED	DI	120Vac	NORMAL	ACTIVATED
RIO-PFS-1	1-N-02	PFS-JS-PFIP2	PFIP 2 LOCAL DISCONNECT	ACTIVATED	DI	120Vac	NORMAL	ACTIVATED
RIO-PFS-1	1-N-02	PFS-JS-PFIP3	PFIP 3 LOCAL DISCONNECT	ACTIVATED	DI	120Vac	NORMAL	ACTIVATED
RIO-PFS-1	1-N-02	PFS-JS-PFIP4	PFIP 4 LOCAL DISCONNECT	ACTIVATED	DI	120Vac	NORMAL	ACTIVATED
RIO-PFS-1	1-N-02	PFS-SPD-100	SURGE PROTECTION DEVICE	FAILURE	DI	120Vac	NORMAL	FAILURE
RIO-PFS-1	1-N-02	PFS-SPD-101	SURGE PROTECTION DEVICE	FAILURE	DI	120Vac	NORMAL	FAILURE
RIO-PFS-1	1-N-03	PFS-SAM1-ALM	PFE SAMPLER	COMMON ALARM	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-03	PFS-SAM1-FULL	PFE SAMPLER	BOTTLES FULL	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-05	PFS-LSHH-154	SUMP PUMP CONTROL PANEL	HIGH LEVEL ALARM	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-05	PFS-VCP100-FAIL	VENTILATION SYSTEM	FAILURE	DI	120Vac	NORMAL	FAILURE
RIO-PFS-1	1-N-05	PFS-VCP100-ALM1	HVAC	CRITICAL ALARM	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-05	PFS-VCP100-ALM2	HVAC	MAINTENANCE ALARM	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-05	PFS-VCP100-ALM3	HVAC	COMB. GAS ALARM	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-05	PFS-VCP100-ALM4	HVAC	GAS DETECTION FAULT	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-05	PFS-JS-SMP1	SCUM PUMP 1 LOCAL DISCONNECT	ACTIVATED	DI	120Vac	NORMAL	ACTIVATED
RIO-PFS-1	1-N-05	PFS-SMOG1-LR	PRIMARY FILTRATION SCUM OVERFLOW GATE 1	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
RIO-PFS-1	1-N-05	PFS-SMP1-SF	SCUM PUMP 1	SEAL FAIL	DI	120Vac	NORMAL	SEAL FAIL
RIO-PFS-1	1-N-05	PFS-SMP1-TSH	SCUM PUMP 1	OVERTEMP	DI	120Vac	NORMAL	OVERTEMP
RIO-PFS-1	1-N-06	PFS-GT1-WSH	GRAVITY THICKENER 1	HIGH TORQUE ALARM	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-06	PFS-LSHH-161	GRAVITY THICKENER 1 BALL FLOAT SWITCH	HIGH-HIGH LEVEL ALARM	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-06	PFS-LSHH-161	SCUM WW HIGH-HIGH BALL FLOAT SWITCH	HIGH-HIGH LEVEL ALARM	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-07	PFS-GRI1-OT	PFTS GRINDER 1	MOTOR OVERTEMP	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-07	PFS-GRI1-LR	PFTS GRINDER 1	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
RIO-PFS-1	1-N-07	PFS-GRI1-MS	PFTS GRINDER 1	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
RIO-PFS-1	1-N-07	PFS-GRI1-MF	PFTS GRINDER 1	FAIL	DI	120Vac	NORMAL	FAIL
RIO-PFS-1	1-N-07	PFS-GRI2-OT	PFTS GRINDER 2	MOTOR OVERTEMP	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-07	PFS-GRI2-LR	PFTS GRINDER 2	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
RIO-PFS-1	1-N-07	PFS-GRI2-MS	PFTS GRINDER 2	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
RIO-PFS-1	1-N-07	PFS-GRI2-MF	PFTS GRINDER 2	FAIL	DI	120Vac	NORMAL	FAIL
RIO-PFS-1	1-N-07	PFS-TSH-173	PFTS PUMP 1	MOTOR OVERTEMP	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-07	PFS-PSH-171	PFTS PUMP 1	HIGH DISCHARGE PRESSURE	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-07	PFS-PSL-172S	PFTS PUMP 2	LOW SUCTION PRESSURE	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-07	PFS-TSH-174	PFTS PUMP 2	MOTOR OVERTEMP	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-07	PFS-PSH-172D	PFTS PUMP 2	HIGH DISCHARGE PRESSURE	DI	120Vac	NORMAL	ALARM
RIO-PFS-1	1-N-07	PFS-JS-PFTSP1	PFTSP 1 LOCAL DISCONNECT	ACTIVATED	DI	120Vac	NORMAL	ACTIVATED
RIO-PFS-1	1-N-07	PFS-JS-PFTSP2	PFTSP 2 LOCAL DISCONNECT	ACTIVATED	DI	120Vac	NORMAL	ACTIVATED
RIO-PFS-1	1-N-03	PFS-SAM1-TAKE	PFE SAMPLER	TAKE SAMPLE	DO	120Vac	DO NOT SAMPLE	SAMPLE
RIO-PFS-1	1-N-07	PFS-GRI1-MC	PFTS GRINDER 1	START COMMAND	DO	120Vac		START
RIO-PFS-1	1-N-07	PFS-GRI2-MC	PFTS GRINDER 2	START COMMAND	DO	120Vac		START
PLC-PFS	1-N-01	PFS-PTCG1-ZI	PRIMARY SETTLING TANK CONTROL GATE 1	POSITION FEEDBACK	AI	4-20mA	0-100	% OPEN
PLC-PFS	1-N-02	PFS-PFIP1-SI	PRIMARY FILTRATION INFLUENT PUMP 1	SPEED FEEDBACK	AI	4-20mA	0-100	% SPEED
PLC-PFS	1-N-02	PFS-PFIP2-SI	PRIMARY FILTRATION INFLUENT PUMP 2	SPEED FEEDBACK	AI	4-20mA	0-100	% SPEED
PLC-PFS	1-N-02	PFS-PFIP3-SI	PRIMARY FILTRATION INFLUENT PUMP 3	SPEED FEEDBACK	AI	4-20mA	0-100	% SPEED
PLC-PFS	1-N-02	PFS-PFIP4-SI	PRIMARY FILTRATION INFLUENT PUMP 4	SPEED FEEDBACK	AI	4-20mA	0-100	% SPEED
PLC-PFS	1-N-05	PFS-SMP1-SI	SCUM PUMP 1	SPEED FEEDBACK	AI	4-20mA	0-100	% SPEED
PLC-PFS	1-N-07	PFS-PFTSP1-SI	PRIMARY FILTRATION THICKENED SLUDGE PUMP 1	SPEED FEEDBACK	AI	4-20mA	0-100	% SPEED
PLC-PFS	1-N-07	PFS-PFTSP2-SI	PRIMARY FILTRATION THICKENED SLUDGE PUMP 2	SPEED FEEDBACK	AI	4-20mA	0-100	% SPEED
PLC-PFS	1-N-01	PFS-PTCG1-ZC	PRIMARY SETTLING TANK CONTROL GATE 1	POSITION COMMAND	AO	4-20mA	0-100	% OPEN
PLC-PFS	1-N-02	PFS-PFIP1-SC	PRIMARY FILTRATION INFLUENT PUMP 1	SPEED COMMAND	AO	4-20mA	0-100	% SPEED
PLC-PFS	1-N-02	PFS-PFIP2-SC	PRIMARY FILTRATION INFLUENT PUMP 2	SPEED COMMAND	AO	4-20mA	0-100	% SPEED
PLC-PFS	1-N-02	PFS-PFIP3-SC	PRIMARY FILTRATION INFLUENT PUMP 3	SPEED COMMAND	AO	4-20mA	0-100	% SPEED
PLC-PFS	1-N-02	PFS-PFIP4-SC	PRIMARY FILTRATION INFLUENT PUMP 4	SPEED COMMAND	AO	4-20mA	0-100	% SPEED
PLC-PFS	1-N-05	PFS-SMP1-SC	SCUM PUMP 1	SPEED COMMAND	AO	4-20mA	0-100	% SPEED
PLC-PFS	1-N-07	PFS-PFTSP1-SC	PRIMARY FILTRATION THICKENED SLUDGE PUMP 1	SPEED COMMAND	AO	4-20mA	0-100	% SPEED
PLC-PFS	1-N-07	PFS-PFTSP2-SC	PRIMARY FILTRATION THICKENED SLUDGE PUMP 2	SPEED COMMAND	AO	4-20mA	0-100	% SPEED

LOCATION	DRAWING	I/O TAG	EQUIPMENT	FUNCTION	I/O TYPE	SIGNAL TYPE	DATA 1	DATA 2
PLC-PFS	1-N-01	PFS-PTCG1-LR	PRIMARY SETTLING TANK CONTROL GATE 1	IN REMOTE	DI	120Vac	NOT IN REMOTE	IN REMOTE
PLC-PFS	1-N-02	PFS-PFIP1-AUTO	PRIMARY FILTRATION INFLUENT PUMP 1	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
PLC-PFS	1-N-02	PFS-PFIP1-MS	PRIMARY FILTRATION INFLUENT PUMP 1	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PLC-PFS	1-N-02	PFS-PFIP1-VFD	PRIMARY FILTRATION INFLUENT PUMP 1	VFD FAIL	DI	120Vac	NORMAL	FAIL
PLC-PFS	1-N-02	PFS-PFIP2-AUTO	PRIMARY FILTRATION INFLUENT PUMP 2	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
PLC-PFS	1-N-02	PFS-PFIP2-MS	PRIMARY FILTRATION INFLUENT PUMP 2	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PLC-PFS	1-N-02	PFS-PFIP2-VFD	PRIMARY FILTRATION INFLUENT PUMP 2	VFD FAIL	DI	120Vac	NORMAL	FAIL
PLC-PFS	1-N-02	PFS-PFIP3-AUTO	PRIMARY FILTRATION INFLUENT PUMP 3	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
PLC-PFS	1-N-02	PFS-PFIP3-MS	PRIMARY FILTRATION INFLUENT PUMP 3	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PLC-PFS	1-N-02	PFS-PFIP3-VFD	PRIMARY FILTRATION INFLUENT PUMP 3	VFD FAIL	DI	120Vac	NORMAL	FAIL
PLC-PFS	1-N-02	PFS-PFIP4-AUTO	PRIMARY FILTRATION INFLUENT PUMP 4	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
PLC-PFS	1-N-02	PFS-PFIP4-MS	PRIMARY FILTRATION INFLUENT PUMP 4	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PLC-PFS	1-N-02	PFS-PFIP4-VFD	PRIMARY FILTRATION INFLUENT PUMP 4	VFD FAIL	DI	120Vac	NORMAL	FAIL
PLC-PFS	1-N-02	PFS-SPD-120	SURGE PROTECTION DEVICE	FAILURE	DI	120Vac	NORMAL	FAILURE
PLC-PFS	1-N-02	PFS-SPD-121	SURGE PROTECTION DEVICE	FAILURE	DI	120Vac	NORMAL	FAILURE
PLC-PFS	1-N-02	PFS-SPD-122	SURGE PROTECTION DEVICE	FAILURE	DI	120Vac	NORMAL	FAILURE
PLC-PFS	1-N-02	PFS-PLC-UPS-FAIL	PLC-PFS PANEL UPS	FAIL	DI	120Vac	NORMAL	FAIL
PLC-PFS	1-N-02	PFS-PLC-UPS-BATT	PLC-PFS PANEL UPS	LOW BATTERY	DI	120Vac	NORMAL	LOW BATTERY
PLC-PFS	1-N-02	PFS-PLC-UPS-ON	PLC-PFS PANEL UPS	ON UPS MODE	DI	120Vac	NORMAL	ALARM
PLC-PFS	1-N-05	PFS-SMP1-AUTO	SCUM PUMP 1	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
PLC-PFS	1-N-05	PFS-SMP1-FAIL	SCUM PUMP 1	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PLC-PFS	1-N-05	PFS-SMP1-VFD	SCUM PUMP 1	VFD FAIL	DI	120Vac	NORMAL	FAIL
PLC-PFS	1-N-06	PFS-FACP-MP2	FIRE ALARM CONTROL PANEL	MAIN PUMP II FIRE ALARM	DI	120Vac	NORMAL	ALARM
PLC-PFS	1-N-06	PFS-FACP-PF1	FIRE ALARM CONTROL PANEL	PRIMARY FILTRATION 1 FIRE ALARM	DI	120Vac	NORMAL	ALARM
PLC-PFS	1-N-06	PFS-FACP-ALM	FIRE ALARM CONTROL PANEL	TROUBLE	DI	120Vac	NORMAL	ALARM
PLC-PFS	1-N-06	PFS-GT1-MS	GRAVITY THICKENER 1	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PLC-PFS	1-N-06	PFS-GT1-FAIL	GRAVITY THICKENER 1	FAIL	DI	120Vac	NORMAL	FAIL
PLC-PFS	1-N-06	PFS-LSHH-165	SUMP PUMP CONTROL PANEL - MAIN PUMP II	HIGH LEVEL ALARM	DI	120Vac	NORMAL	ALARM
PLC-PFS	1-N-06	PFS-VCP120-ALM1	HVAC	CRITICAL ALARM	DI	120Vac	NORMAL	ALARM
PLC-PFS	1-N-06	PFS-VCP120-ALM2	HVAC	MAINTENANCE ALARM	DI	120Vac	NORMAL	ALARM
PLC-PFS	1-N-07	PFS-PFTSP1-AUTO	PRIMARY FILTRATION THICKENED SLUDGE PUMP 1	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
PLC-PFS	1-N-07	PFS-PFTSP1-MS	PRIMARY FILTRATION THICKENED SLUDGE PUMP 1	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PLC-PFS	1-N-07	PFS-PFTSP1-VFD	PRIMARY FILTRATION THICKENED SLUDGE PUMP 1	VFD FAIL	DI	120Vac	NORMAL	FAIL
PLC-PFS	1-N-07	PFS-PFTSP2-AUTO	PRIMARY FILTRATION THICKENED SLUDGE PUMP 2	IN AUTO	DI	120Vac	NOT IN AUTO	IN AUTO
PLC-PFS	1-N-07	PFS-PFTSP2-MS	PRIMARY FILTRATION THICKENED SLUDGE PUMP 2	RUNNING	DI	120Vac	NOT RUNNING	RUNNING
PLC-PFS	1-N-07	PFS-PFTSP2-VFD	PRIMARY FILTRATION THICKENED SLUDGE PUMP 2	VFD FAIL	DI	120Vac	NORMAL	FAIL
PLC-PFS	1-N-02	PFS-PFIP1-MC	PRIMARY FILTRATION INFLUENT PUMP 1	START COMMAND	DO	120Vac		START
PLC-PFS	1-N-02	PFS-PFIP2-MC	PRIMARY FILTRATION INFLUENT PUMP 2	START COMMAND	DO	120Vac		START
PLC-PFS	1-N-02	PFS-PFIP3-MC	PRIMARY FILTRATION INFLUENT PUMP 3	START COMMAND	DO	120Vac		START
PLC-PFS	1-N-02	PFS-PFIP4-MC	PRIMARY FILTRATION INFLUENT PUMP 4	START COMMAND	DO	120Vac		START
PLC-PFS	1-N-05	PFS-SMP1-MC	SCUM PUMP 1	START COMMAND	DO	120Vac		START
PLC-PFS	1-N-07	PFS-PFTSP1-MC	PRIMARY FILTRATION THICKENED SLUDGE PUMP 1	START COMMAND	DO	120Vac		START
PLC-PFS	1-N-07	PFS-PFTSP2-MC	PRIMARY FILTRATION THICKENED SLUDGE PUMP 2	START COMMAND	DO	120Vac		START
PLC-PSP	1-N-07	PSP-FIT-173	SCUM FROM PRIMARY FILTERS	SCUM FLOW	AI	4-20mA	0-200	GPM
PLC-PSP	*1-N-07*	*PSP-PIT-212*	*GBT-2 CAKE HOPPER*	*LEVEL*	*AI*	*4-20mA*	*0-10**	*FEET*
PLC-PSP	1-N-07	PSP-TIT-212	GBT-2 THICKENED SLUDGE PUMP	PUMP CASING TEMPERATURE	AI	4-20mA	40 to 300	ºF
PLC-PSP	1-N-07	PSP-TSH-212	GBT-2 THICKENED SLUDGE PUMP	MOTOR OVERTEMP	DI	120Vac	NORMAL	OVERTEMP
PLC-PSP	1-N-07	PSP-PSH-212	GBT-2 THICKENED SLUDGE PUMP	HIGH DISCHARGE PRESSURE	DI	120Vac	NORMAL	ALARM

** Note: I/O is existing and might need to be re-scaled with new instrument.*

General Note: For simplicity, soft I/Os transmitting over Ethernet and hard-wired I/Os wired to vendor-supplied control panels are not shown on Schedule 1.

SECTION 40 61 96
PROCESS CONTROL DESCRIPTIONS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes Process Control System in conjunction with P&IDs.

B. Items specified in this section shall conform to general requirements of Section 40 61 13.

1.02 REFERENCES

A. NEMA: National Electrical Manufacturer's Association

1.03 ABBREVATIONS

A. HMI: Human/Machine Interface

B. I/O: Input / Output

C. OIU: Operator Interface Unit

D. LOS: Line of Sight

E. NEC: National Electrical Code

F. PC: Personal Computer

G. PCS: Process Control System

H. P&IDs: Process and Instrumentation Diagrams

I. PLC: Programmable Logic Controller

J. SCADA : Supervisory Control and Data Acquisition

K. UPS: Uninterruptible Power Supply

L. I&C: Instrumentation and Controls

PART 2 – PROCESS CONTROL DESCRIPTIONS

2.01 SPDs – GENERAL

A. Surge Protection Devices (SPDs) are specified in Section 26 43 13.

B. The Surge Protective Device provides a degree of electrical protection to the 3-phase and 1-phase circuits located in any given building.

C. An alarm will alert the Operator if an internal failure is observed by the device, which can be further investigated locally at the SPD interface.

2.02 VFDs – GENERAL

A. VFDs are specified in Section 26 29 23, with the associated Harmonic Filters being specified in Section 26 35 26.

B. Some equipment wired to VFDs include local power disconnect switches that are specified under Division 26. The disconnect switches include an auxiliary contact that shall be wired to Plant PLC.

C. VFDs shall be programmed with the following operational features:

1. During functional testing, any frequencies throughout the speed range of the VFD exhibit pump/motor/equipment vibration characteristics above normal running conditions, then the VFD shall be programmed to skip these frequencies with an associated bandwidth above and below the skip frequency. Adjustable to 0.1Hz.
2. VFDs shall be programmed to not fault on loss of communications.
3. VFDs shall be programmed for auto-restart enabled.
4. VFDs shall be programmed with minimum and maximum speed clamps to protect equipment and processes from damage or disruption.

D. Multiple VFDs shall operate at the same speed when operating pumps simultaneously.

2.03 BALL FLOAT SWITCH – GENERAL

A. Floats shall employ de-bounce timers such that they are required to be continuously tripped for at least an adjustable amount of time (default to 1 minute) prior to starting/stopping pumps.

2.04 FLOW MEASURING INSTRUMENT – GENERAL

A. All flow measurements will be totalized hourly, daily, weekly, monthly, and yearly for the current data set, and also the previous data set for all data sets.

2.05 PLC-BASED CONTROL PANELS – GENERAL

A. PLC-Based Control Panel Functional Descriptions - General:

1. Functional Descriptions for PLC-based control panels that follow pertain to “Auto” modes requiring supervisory control with interactive logic.
2. PLC control of equipment shall require “Hand/Off/Auto” selector switches to be in the “Auto” position. Equipment not in “Auto” shall be considered to be in “Hand” mode and shall be controlled manually at the equipment. “Hand” mode shall be for maintenance purposes and may inhibit equipment safeguards such as seal fail or overtemp conditions.
3. Stop or emergency stops shall work as designed for all modes of operation.
4. All equipment fail signals shall be alert the Operator, alarm the equipment, and remove from equipment sequencer.
5. All adjustable set-points described in this Section shall be by the Operator. Hierarchy shall be defined with the Owner by the System Integrator.

2.06 ADMIN BUILDING I PLC PANEL, PLC-ADM

A. <u>Influent Valves (1-N-01)</u>

1. The purpose of Influent Valves (VLV14, VLV56, and VLV710) is to isolate and equally divert plant influent flow between all in-service Primary Settling Tanks. Three existing Influent Valves located at Primary Influent Splitter Box will be equipped with new or upgraded electric actuators to allow remote position control.

2. Plant influent flow is measured by an existing ultrasonic level sensor (FE/FIT-2601) mounted above Parshall Flume at the Primary Influent Splitter Box.
3. Control of the Influent Valves is initiated at the electric actuator via Local/Off/Remote selector switch.
4. Local – With the Local/Off/Remote selector switch in Local, the following control options are available at the electric actuator. *Local control is intended for maintenance purposes only*.

    a. Open – This selection runs the gate to the 100% open position.
    b. Stop – The gate motor shuts down and gate will hold last position.
    c. Close – This selection runs the gate to the 100% closed position.
    d. % Open – This selection runs the gate to the desired % open position.

5. Off – With the Local/Off/Remote selector switch in Off, operation of the gate is inhibited.
6. Remote – With the Local/Off/Remote selector switch in Remote, the following control options are available to the Operator from the HMI.

    a. Manual – With the Manual/Auto software selector switch at the HMI in Manual, the following control options are available from the HMI.

        - Open – This selection runs the gate to the 100% open position.
        - Stop – The gate motor shuts down and gate will hold last position.
        - Close – This selection runs the gate to the 100% closed position.
        - % Open – This selection runs the gate to the desired % open position.

    b. Auto – With the Manual/Auto selector switch at the HMI in Auto, the following control options are available from the HMI.

        - Plant Operator will input the number of Primary Settling Tanks (tanks) to be in service and desired flow to Primary Filters (either by % of total influent flow, or specific amount). PLC logic shall calculate flow split between Primary Filters and Primary Settling Tank accordingly. Refer to Operation Strategy of Primary Filtration influent Pumping below for more details.
        - Based on the calculated flow to each Primary Settling Tanks Plant Operator will choose percent open of each Influent Valves and Primary Settling Tank Control Gate 1 to equally split influent flow between the tanks.

7. Alarms - Equipment alarms to the Operator at the HMI are as follows:

    a. Valves fail to be in commanded position within an adjustable period of time with a dead-band of +/- 5%.

2.07 MAIN PUMP II PLC PANEL, PLC-PFS

A. Primary Settling Tank Control Gate (1-N-01)

1. Primary Settling Tank Control Gate 1 (PTCG-1) will be installed at the Primary Settling Tank 1 & 2 Influent Channel to maintain an equal flow split between Primary Settling Tanks.
2. Plant influent flow is measured by an existing ultrasonic level sensor (FE/FIT-2601) mounted above Parshall Flume at the Primary Influent Splitter Box.
3. Control of the Primary Settling Tank Control Gate 1 is initiated at the electric actuator via Local/Off/Remote selector switch.
4. Local – With the Local/Off/Remote selector switch in Local, the following control options are available at the electric actuator. *Local control is intended for maintenance purposes only*.

    a. Open – This selection runs the gate to the 100% open position.
    b. Stop – The gate motor shuts down and gate will hold last position.

c. Close – This selection runs the gate to the 100% closed position.
d. % Open – This selection runs the gate to the desired % open position.

5. Off – With the Local/Off/Remote selector switch in Off, operation of the gate is inhibited.
6. Remote – With the Local/Off/Remote selector switch in Remote, the following control options are available to the Operator from the HMI.

   a. Manual – With the Manual/Auto software selector switch at the HMI in Manual, the following control options are available from the HMI.

      - Open – This selection runs the gate to the 100% open position.
      - Stop – The gate motor shuts down and gate will hold last position.
      - Close – This selection runs the gate to the 100% closed position.
      - % Open – This selection runs the gate to the desired % open position.

   b. Auto – With the Manual/Auto selector switch at the HMI in Auto, the following control options are available from the HMI.

      - Plant Operator will input the number of Primary Settling Tanks (tanks) to be in service and desired flow to Primary Filters (either by % of total influent flow, or specific amount). PLC logic shall calculate flow split between Primary Filters and Primary Settling Tank accordingly. Refer to Operation Strategy of Primary Filtration influent Pumping below for more details.
      - Based on the calculated flow to each Primary Settling Tanks Plant Operator will choose percent open of each Influent Valves and Primary Settling Tank Control Gate 1 to equally split influent flow between the tanks.

7. Alarms - Equipment alarms to the Operator at the HMI are as follows:

   a. Valves/Gate fail to be in commanded position within an adjustable period of time with a dead-band of +/- 5%.

B. <u>Primary Filtration Effluent Control Gate 1 (1-N-01)</u>

1. The purpose of Primary Filtration Effluent (PFE) Control Gate 1 (PFEG-1) is to bypass PFE flow to future Aerobic Granular Sludge (AGS) treatment.
2. The gate will be normally closed to divert all PFE flow to secondary treatment. Control of PFE Control Gate 1 (PFEG-1) is an Operator-initiated operation.
3. Control of the PFE Control Gate 1 is initiated at the electric actuator via Local/Off/Remote selector switch.
4. Local – With the Local/Off/Remote selector switch in Local, the following control options are available at the electric actuator. *Local control is intended for maintenance purposes only*.

   a. Open – This selection runs the gate to the 100% open position.
   b. Stop – The gate motor shuts down and gate will hold last position.
   c. Close – This selection runs the gate to the 100% closed position.
   d. % Open – This selection runs the gate to the desired % open position.

5. Off – With the Local/Off/Remote selector switch in Off, operation of the gate is inhibited.
6. Remote – With the Local/Off/Remote selector switch in Remote, the following control options are available to the Operator from the HMI.

   a. Manual – With the Manual/Auto software selector switch at the HMI in Manual, the following control options are available from the HMI.

      - Open – This selection runs the gate to the 100% open position.

- Stop – The gate motor shuts down and gate will hold last position.
- Close – This selection runs the gate to the 100% closed position.
- % Open – This selection runs the gate to the desired % open position

b. Auto – Automatic control of PFE Control Gate 1 is not required as part of this project.

7. Alarms - Equipment alarms to the Operator at the HMI are as follows:

   a. Gate fail to open/close within operational parameters set by valve actuator manufacturer plus an additional 10 seconds.

C. Primary Filtration Effluent Control Gate 2 (1-N-01)

1. The purpose of Primary Filtration Effluent (PFE) Control Gate 2 (PFEG-2) is to split PFE flow between secondary treatment and future Aerobic Granular Sludge (AGS) treatment.
2. Until AGS treatment Facility is completed, the gate will be fully opened to divert all PFE flow to secondary treatment. Control of PFE Control Gate 2 (PFEG-2) is an Operator-initiated operation.
3. Control of the PFE Control Gate 2 is initiated at the electric actuator via Local/Off/Remote selector switch.
4. Local – With the Local/Off/Remote selector switch in Local, the following control options are available at the electric actuator. *Local control is intended for maintenance purposes only*.

   a. Open – This selection runs the gate to the 100% open position.
   b. Stop – The gate motor shuts down and gate will hold last position.
   c. Close – This selection runs the gate to the 100% closed position.
   d. % Open – This selection runs the gate to the desired % open position.

5. Off – With the Local/Off/Remote selector switch in Off, operation of the gate is inhibited.
6. Remote – With the Local/Off/Remote selector switch in Remote, the following control options are available to the Operator from the HMI.

   a. Manual – With the Manual/Auto software selector switch at the HMI in Manual, the following control options are available from the HMI.

      - Open – This selection runs the gate to the 100% open position.
      - Stop – The gate motor shuts down and gate will hold last position.
      - Close – This selection runs the gate to the 100% closed position.
      - % Open – This selection runs the gate to the desired % open position.

   b. Auto – With the Manual/Auto selector switch at the HMI in Auto, the following control options are available from the HMI.

      - Plant Operator shall input water level set-point (default to elevation 706.0) to be maintained in Primary Filter Effluent Diversion Structure.
      - PLC will then modulate PFE Control Gate 2 to maintain level set-point.
      - Water level in Primary Filter Effluent Diversion Structure is measured by radar level sensor (LE-111) with remote transmitter (LIT-111).

7. Alarms - Equipment alarms to the Operator at the HMI are as follows:

   a. Gate fail to open/close within operational parameters set by valve actuator manufacturer plus an additional 10 seconds.
   b. Level sensor fail.

D. Primary Filtration Influent Wet Well 1 Inlet Gate (1-N-02)

1. The purpose of Primary Filtration Influent (PFI) Wet Well 1 Inlet Gate (PFWG-1) is to isolate Primary Filtration Influent Wet Well 1 from plant influent flow.
2. The gate will be normally open to allow flow to Primary Filtration Influent Pumps.
3. Control of the PFI Wet Well 1 Inlet Gate is initiated at the electric actuator via Local/Off/Remote selector switch.
4. Local – With the Local/Off/Remote selector switch in Local, the following control options are available at the electric actuator. *Local control is intended for maintenance purposes only*.

    a. Open – This selection runs the gate to the 100% open position.
    b. Stop – The gate motor shuts down and gate will hold last position.
    c. Close – This selection runs the gate to the 100% closed position.
    d. % Open – This selection runs the gate to the desired % open position

5. Off – With the Local/Off/Remote selector switch in Off, operation of the gate is inhibited.
6. Remote – With the Local/Off/Remote selector switch in Remote, the following control options are available to the Operator from the HMI.

    a. Manual – With the Manual/Auto software selector switch at the HMI in Manual, the following control options are available from the HMI.

        - Open – This selection runs the gate to the 100% open position.
        - Stop – The gate motor shuts down and gate will hold last position.
        - Close – This selection runs the gate to the 100% closed position.
        - % Open – This selection runs the gate to the desired % open position

    b. Auto – With the Manual/Auto selector switch at the HMI in Auto, the following control options are available from the HMI.

        - PFI Wet Well 1 Inlet Gate will be fully opened whenever either Primary Filter 1 or Primary Filter 2 is in operation.

7. Alarms - Equipment alarms to the Operator at the HMI are as follows:

    a. Gate fail to open/close within operational parameters set by valve actuator manufacturer plus an additional 10 seconds.

E. <u>Primary Filtration Influent Pumping (1-N-02)</u>

1. The purpose of the four (4) Primary Filtration Influent (PFI) Pumps (PFIP-1, PFIP-2, PFIP-3, and PFIP-4) is to lift water from the Primary Filtration Influent Wet Well 1 to the Primary Filtration Influent Channel 1 and distribute flow to each Primary Filter. Each PFI Pump can pump up to 10MGD at full speed.
2. The PFI Pumps are adjustable speed type, and are powered from VFDs (VFD-PFIP-1, VFD-PFIP-2, VFD-PFIP-3, and VFD-PFIP-4). The VFDs are located in Electrical Room of Main Pump II Building, and communicate with Plant PLC via hard-wired signals and Modbus TCP network connection as shown on drawings.
3. A local disconnect (JS- PFIP-1, JS- PFIP-2, JS- PFIP-3, and JS- PFIP-4) is also provided to lock out power for each PFI Pump. When the local disconnect is activated, an alarm will be displayed at the Plant HMI to notify Plant Operator of such condition.
4. A radar level meter (LE-121 with remote transmitter LIT-121) is installed at the Primary Filtration Influent Wet Well 1 for level monitoring, and PFI Pump dry run protection. Operator will have ability to set high and low level alarm set-points at Plant HMI.
5. Each pump includes a vendor-supplied Motor Protection Relay (MPR) which is mounted in the Primary Filtration 1 Remote I/O Panel (RIO-PFS-1), and monitors each pump for internal seal failure, and overtemp condition. Both pump conditions will be alarmed at the HMI.

Either alarm condition will place the respective pump out of service and remove it from the automatic pump sequencer. The pump will remain out of service until the condition is manually reset by the Operator via the reset pushbutton mounted on front of the Remote I/O Panel.

6. The PFI Pumps do not have check valves on discharge lines. Thus, the pumps shall be programmed with backspin timer after the pumps stop to allow time for gravity drainage from the discharge line back into wet well to stop so the pump is not started when its impeller is rotating backwards.
7. An electromagnetic flowmeter (FE-121 and FIT-121, FE-122 and FIT-122, FE-123 and FIT-123, FE-124 and FIT-124) is installed on discharge of each PFI Pump to flow monitoring and pump speed control.
8. Each PFI Pump will include a control station (CS-PFIP-1, CS-PFIP-2, CS-PFIP-3 and CS-PFIP-4) mounted within pump's line of sight. Control of the pumps is initiated at the PFI Pump Control Station via Hand/Off/Auto selector switch.
9. Hand – With the Hand/Off/Auto selector switch in Hand position, the following control options are available from the control station. *Hand control is intended for maintenance purposes only*.

    a. Pump will be called to run.
    b. Pump speed can be adjusted at the pump's VFD.

10. Off – With the Hand/Off/Auto selector switch in Off position, operation of the pump is inhibited.
11. Auto – With the Hand/Off/Auto selector switch in Auto position, the following control options are available to the Operator from the HMI.

    a. Manual – With the Manual/Auto software selector switch at the HMI in Manual, the following control options are available from the HMI.

        - Start – This selection calls the pump to run.
        - Stop – This selection stops the pump.
        - Speed – This selection sets the speed of the pump from 0-100%.

    b. Auto – With the Manual/Auto software selector switch at the HMI in Auto, the following control options are available from the HMI.

        - Plant Operator will input numbers of Primary Filters and Primary Settling Tanks to be in service, and desired flow to the Primary Filtration. Desired flow can be entered by flow rate or percentage of influent flow measured at Primary Influent Splitter Box.
        - PLC will include flow range logic to limit flow to Primary Filtration from 10 MGD (AGS flow requirement) to 30 MGD (two Primary Filter maximum capacity). Flow to each Primary Settling Tank is also limited to 1.875 MGD.
        - Generally, flow control strategy shall be as shown on Table 1 below.

Table 1. Flow Control Strategy

Scenario 1 - 2 Filters in service																
Plant Flow	18	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
Flow to PF	10	10	12	14	16	18	20	22	24	26	28	30	30	30	30	30
% Flow to PF	56%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	40%	38%	35%	33%	32%
No. of PF in service	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Flow to each PF	5	5	6	7	8	9	10	11	12	13	14	15	15	15	15	15

Flow to PST	8	15	18	21	24	27	30	33	36	39	42	45	50	55	60	65
% Flow to PST	44%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	63%	65%	67%	68%
No. of PST in service	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Flow to each PST	1.333	1.875	2.25	2.625	3.00	3.375	3.75	4.125	4.5	4.875	5.25	5.625	6.25	6.875	7.5	8.125
Scenario 2 - 1 Filter in service (Phase I)																
Plant Flow	18	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
Flow to PF	10	10	12	14	15	15	15	15	15	15	15	15	15	15	15	15
% Flow to PF	56%	40%	40%	40%	38%	33%	30%	27%	25%	23%	21%	20%	19%	18%	17%	16%
No. of PF in service	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Flow to each PF	10	10	12	14	15	15	15	15	15	15	15	15	15	15	15	15
Flow to PST	8	15	18	21	25	30	35	40	45	50	55	60	65	70	75	80
% Flow to PF	44%	60%	60%	60%	63%	67%	70%	73%	75%	77%	79%	80%	81%	82%	83%	84%
No. of PST in service	6	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Flow to each PST	1.333	1.875	2.25	2.625	3.125	3.75	4.375	5	5.625	6.25	6.875	7.5	8.125	8.75	9.375	10

- Flow measurements from four electromagnetic flowmeters (FE-121 and FIT-121, FE-122 and FIT-122, FE-123 and FIT-123, FE-124 and FIT-124) will be used to confirm proper pumping operations. The PLC will continuously compare measured total flow and flow set-point. When two flows are more than an adjustable percentage different from each other, Plant Operator will be notified at the HMI of such condition.
- When level in Primary Filtration Influent Wet Well 1, measured by radar level meter (LE-121 with remote transmitter LIT-121), is below its low level set-point, PFI Pump operation will stop immediately to protect the pumps from dry run.
- When any PFI Pump is out of service, an HMI popup will remind Plant Operator to consider open Primary Filter Influent Gate 3 (PFIG-3) to balance flow between Primary Filters and avoid pumping short circuit.
- Pump Sequencer:

    - When Primary Filter Influent Gate 3 is closed, a pump sequencer shall include selections for Lead and Lag Pump for each Primary Filter. Specifically, PFI Pump 1 and PFI Pump 2 will serve Primary Filter 1, PFI Pump 3 and PFI Pump 4 will serve Primary Filter 2. Sequencers shall be capable of manual selection, position based on runtime hours (with 48 hour dead-band), or round-robin based on calendar days. Pumps that have failed are removed from pump sequencers. Pumps not in the Auto position are not included in the pump sequencers.

    - When Primary Filter Influent Gate 3 is opened, a pump sequencer shall include selections for Lead, Lag 1, Lag 2 and Standby Pump. Sequencers shall be capable of manual selection, position based on runtime hours (with 48 hour dead-band), or round-robin based on calendar days. Pumps that have failed are removed from pump sequencers. Pumps not in the Auto position are not included in the pump sequencers.

12. Alarms - Equipment alarms to the Operator at the HMI are as follows.

    a. PFI Pump VFD Fail.
    b. PFI Pump VFD Excessive Torque.
    c. PFI Pump VFD Excessive Current.
    d. PFI Pump Fail (not running after being called to run).
    e. PFI Pump Overtemp.
    f. PFI Pump Seal Failure.
    g. Primary Filtration Influent Wet Well 1 High Level Alarm.
    h. Primary Filtration Influent Wet Well 1 Low Level Alarm.

13. Interlocks – Equipment interlocks (when in Auto) are as follows.

    a. PFI Pump Overtemp.
    b. PFI Pump Seal Failure.
    c. Primary Filtration Influent Wet Well 1 Low Level Alarm.

F. Primary Filter Influent Gate 3 (1-N-02)

1. The purpose of Primary Filter Influent Gate 3 (PFIG-3) is to isolate or split primary influent flow between Primary Filter 1 and Primary Filter 2.
2. The gate will be normally closed to isolate flow between two Primary Filters. Control of Primary Filter Influent Gate 3 is an Operator-initiated operation.
3. Control of the Primary Filter Influent Gate 3 is initiated at the electric actuator via Local/Off/Remote selector switch.
4. Local – With the Local/Off/Remote selector switch in Local, the following control options are available at the electric actuator. *Local control is intended for maintenance purposes only*.

    a. Open – This selection runs the gate to the 100% open position.
    b. Stop – The gate motor shuts down and gate will hold last position.
    c. Close – This selection runs the gate to the 100% closed position.
    d. % Open – This selection runs the gate to the desired % open position

5. Off – With the Local/Off/Remote selector switch in Off, operation of the gate is inhibited.
6. Remote – With the Local/Off/Remote selector switch in Remote, the following control options are available to the Operator from the HMI.

    a. Open – This selection runs the gate to the 100% open position.
    b. Stop – The gate motor shuts down and gate will hold last position.
    c. Close – This selection runs the gate to the 100% closed position.
    d. % Open – This selection runs the gate to the desired % open position

7. Alarms - Equipment alarms to the Operator at the HMI are as follows:

    a. Gate fail to open/close within operational parameters set by valve actuator manufacturer plus an additional 10 seconds.

G. Primary Filter Influent Gate 1 and Primary Filter Influent Gate 2 (1-N-02)

1. The purpose of Primary Filter Influent Gate 1 (PFIG-1) and Primary Filter Influent Gate 2 (PFIG-2) is to isolate Primary Filter 1 and Primary Filter 2 from primary filtration influent flow.
2. The following control is typical for both Primary Filter Influent Gate 1 and Primary Filter Influent Gate 2.
3. Control of the Primary Filter Influent Gate 1 is initiated at the electric actuator via Local/Off/Remote selector switch.
4. Local – With the Local/Off/Remote selector switch in Local, the following control options are

available at the electric actuator. *Local control is intended for maintenance purposes only*.

a. Open – This selection runs the gate to the 100% open position.
b. Stop – The gate motor shuts down and gate will hold last position.
c. Close – This selection runs the gate to the 100% closed position.
d. % Open – This selection runs the gate to the desired % open position

5. Off – With the Local/Off/Remote selector switch in Off, operation of the gate is inhibited.
6. Remote – With the Local/Off/Remote selector switch in Remote, the following control options are available to the Operator from the HMI.

a. Manual – With the Manual/Auto software selector switch at the HMI in Manual, the following control options are available from the HMI.

- Open – This selection runs the gate to the 100% open position.
- Stop – The gate motor shuts down and gate will hold last position.
- Close – This selection runs the gate to the 100% closed position.
- % Open – This selection runs the gate to the desired % open position

b. Auto – With the Manual/Auto selector switch at the HMI in Auto, the following control options are available from the HMI.

- Primary Filter Influent Gate 1 will be fully opened whenever Primary Filter 1 is in operation.

7. Alarms - Equipment alarms to the Operator at the HMI are as follows:

a. Gate fail to open/close within operational parameters set by valve actuator manufacturer plus an additional 10 seconds.

H. Primary Filtration Effluent Sampler (1-N-03)

1. The purpose of Primary Filtration Effluent Sampler (PFS-SAM-1) is to automatically take samples of the Primary Filtration Effluent (PFE) for lab testing and reporting as may be required by state governing agencies.
2. The Primary Filtration Effluent Sampler samples are taken from the Primary Filtration Effluent Channel 1.
3. The PFE Sampler may be operated in a pace mode based on primary filtration influent (PFI) flow (Flow Pace Mode) or operated in a timed mode (Timed Sample Mode) where the Operator sets sample schedule and the PFE Sampler receives a “take sample” signal from the Plant PLC.
4. The Operator shall select between Flow Pace Mode and Timed Sample Mode.
5. In Flow Pace Mode, the PFE Sampler receives a 4-20mA signal reflective of primary filtration influent (PFI) flow totalized of PFI Pumps’ discharges. The sampler then takes a sample for a volume set by the Operator at the PFE Sampler.
6. In Timed Sample Mode, the Operator selects duration between samples or the number of samples in a 24-hour period. The PLC then signals the PFE Sampler to take a sample via a discrete signal.
7. Alarms – PFE Sampler alarms to the Operator at the HMI are as follows.

a. Common Alarm.
b. Sample Bottles Full.

I. Primary Filter 1 and Primary Filter 2 (1-N-03, 1-N-04 and 1-N-05)

1. The purposes of two Primary Filters 1 and 2 are to replace the aging Primary Settling Tank 1

and 2, to remove suspended solids and organic material from the primary influent flow stream and reduce load on existing aeration system, and to divert volatile solids to anaerobic digesters for increased biogas production.

2. Each Primary Filter is controlled by a vendor-supplied Primary Filter Local Control Panel (PFCP-1 and PFCP-2) mounted in Primary Filtration Control Room 1 at Primary Filtration Facility 1. Primary Filter Local Control Panels will communicate with Primary Filtration 1 Remote I/O Panel (RIO-PFS-1) via Cat6 cable using Modbus TCP/IP protocol.
3. Flow to each Primary Filter will be determined by Primary Filtration Influent Pumping operational strategy as stated above.
4. The following control description is typical for both Primary Filters.
5. Primary filtration influent (PFI) after entering the PFI Channel will flow over the influent weir trough to the Primary Filter Tank where biosolids will be removed by settling to the bottom or catching on the cloth media disk filter. Primary filtration effluent (PFE) will then flow into the center tube and over the effluent weir trough to PFE Channel, and then to secondary treatment.
6. Level in the Primary Filter Tank is monitored by a submersible level transducer (LE/LT-131), along with a ball float switch (LSH-131) for high water level alarm. pH in the tank is also measured with pH probe (AE-131).
7. Each Primary Filter system includes an adjustable speed Backwash Waste Pump (BWP-1), a set of three electrically actuated Backwash Waste Valves (BWV-1, BWV-2, and BWV-3), and a Backwash Waste Discharge Valve (BWDV-1) to remove solids buildup in the filter media. Suction and discharge pressure of Backwash Waste Pump is monitored by pressure instrument as shown on drawings. Backwash waste discharge flow is measured by a vendor-supplied electromagnetic flowmeter (FE/FIT-132) located in Primary Filter Pump Room 1. Electromagnetic flowmeter (FE/FIT-132) is also used for pump interlock to prevent the Backwash Waste Pump (BWP-1) from pumping against a closed valve.
8. An adjustable speed Solids Waste Pump (SWP-1), three electrically actuated Solids Waste Valves (SWV-1, SWV-2, and SWV-3) and a Solids Waste Discharge Valve (SWDV-1) are also provided to remove solids settling in the Primary Filter Tank by gravity. Suction and discharge pressure of Solids Waste Pump is monitored by pressure instrument as shown on drawings. Solids waste discharge flow is measured by a vendor-supplied electromagnetic flowmeter (FE/FIT-131) located in Primary Filter Pump Room 1. Electromagnetic flowmeter (FE/FIT-131) is also used for pump interlock to prevent the Solids Waste Pump (SWP-1), from pumping against a closed valve
9. Piping between backwash waste and solids waste draw off is cross connected such that any/all of those waste flows may go through either Backwash Waste Pump or Solids Waste Pump if either of the pumps fails. Electrically actuated Back-up Valve 1 (BKV-1) is installed to assist with this operation.
10. Backwash Waste Pump (BWP-1) can also provide the recirculation required when the filters are cleaned with a bleach solution. Electrically actuated Back-up Valve 2 (BKV-2) and three electrically actuated Recirculation Valves (RCV-1, RCV-2, and RCV-3) are provided to achieve flow recirculation. Recirculation flow is measured by a vendor-supplied electromagnetic flowmeter (FE/FIT-133).
11. Scum draw off lines operate once to three times per day (operator set-point). During scum draw off cycle, water is allowed to rise and flow over the scum weir and the electrically actuated Scum Valve (PSMV-1) is opened to drain scum by gravity to Scum Wet Well 1 or bypass to 12" Gravity Thickener Overflow line.

J. Primary Filter Sump Pump 1 and Primary Filter Sump Pump 2 (1-N-05)

1. The purpose of the duplex sump pump control system including primarily two Primary Filter Sump Pumps (PFSP-1 and PFSP-2) and Sump Pump Control Panel (SPCP-100) is to pump water from the sump area located within northeast stairwell (Stairwell 2) to the Primary Filter Effluent Weir Channel.
2. Equipment is specified under Section 22 00 05.
3. Three ball floats (LSL-151, LSH-152, and LSH-153) control two pumps with local indication

for pump run, pump fail, control power, high water alarm, and motor overload at the Sump Pump Control Panel.

4. The fourth ball float switch (LSHH-154) is for high-high level alarm providing an alarm signal to the Operator at the Plant HMI.

K. Primary Filtration Scum Overflow Gate (1-N-05)

1. The purpose of Primary Filtration Scum Overflow Gate (SMOG-1) is to allow scum in Primary Filtration Influent Wet Well 1 flow over the weir to Scum Wet Well 1.
2. Control of the Primary Filtration Scum Overflow Gate is initiated at the electric actuator via Local/Off/Remote selector switch.
3. Local – With the Local/Off/Remote selector switch in Local, the following control options are available at the electric actuator. *Local control is intended for maintenance purposes only*.

    a. Open – This selection runs the gate to the 100% open position.
    b. Stop – The gate motor shuts down and gate will hold last position.
    c. Close – This selection runs the gate to the 100% closed position.
    d. % Open – This selection runs the gate to the desired % open position.

4. Off – With the Local/Off/Remote selector switch in Off, operation of the gate is inhibited.
5. Remote – With the Local/Off/Remote selector switch in Remote, the following control options are available to the Operator from the HMI.

    a. Manual – With the Manual/Auto software selector switch at the HMI in Manual, the following control options are available from the HMI.

        - Open – This selection runs the gate to the 100% open position.
        - Stop – The gate motor shuts down and gate will hold last position.
        - Close – This selection runs the gate to the 100% closed position.
        - % Open – This selection runs the gate to the desired % open position.

    b. Auto – With the Manual/Auto selector switch at the HMI in Auto, the following control options are available from the HMI.

        - Plant Operator shall initiate scum overflow process by inputting water level set-point (default to 2 inches below the water level in PFI Wet Well 1) and process duration at Plant HMI. Based on Primary Filtration Influent Wet Well 1's water level measured by the radar level meter (LE-121 with remote transmitter LIT-121), Plant PLC shall modulate Primary Filtration Scum Overflow Gate (SMOG-1) maintain level set-point and allow scum to flow to the Scum Wet Well 1.
        - Primary Filtration Scum Overflow Gate (SMOG-1) shall stop modulating at the end of operator-adjustable scum overflow duration.
        - When high scum flow to Scum Wet Well causes a rise in the wet well level thus tripping the High-High Level Ball Float Switch (LSHH-155), Primary Filtration Scum Overflow Gate shall lower to an operator-adjustable set-point (default to 10 inches) to prevent Scum Wet Well from overflowing.

6. Alarms - Equipment alarms to the Operator at the HMI are as follows:

    a. Gate fail to open/close within operational parameters set by valve actuator manufacturer plus an additional 10 seconds.

L. Scum Pumping (1-N-05 and 1-N-07)

1. Scum from Primary Filter flows to Scum Wet Well 1 by gravity, and scum from Primary Filtration Influent Wet Well flows over Primary Filtration Scum Overflow Gate (SMOG-1) to

Scum Wet Well 1. The purpose of Scum Pump 1 (SMP-1) is to lift scum and send it to either the existing Scum Concentrator (normal operation) or to existing Primary Settling Tanks.

2. The Scum Pump 1 is adjustable speed prerotation pump, and is powered from Scum Pump VFD (VFD-SMP-1). The VFD is located in Electrical Room of Main Pump II Building, and communicates with Plant PLC via hard-wired signals and Modbus TCP network connection as shown on drawings.
3. A local disconnect (JS-SMP-1) is also provided to lock out power for the Scum Pump. When the local disconnect is activated, an alarm will be displayed at the Plant HMI to notify Plant Operator of such condition.
4. Level in the Scum Wet Well is monitored by radar level meter (LE-151 and LIT-151). A ball float switch (LSHH-155) is also provided in the scum wet well for high-high water level alarm.
5. A Doppler flowmeter (FE-173 and FIT-173) is provided for scum flow monitoring and pump speed control. The flowmeter is installed in the lower level of existing GBT Building.
6. The pump includes a vendor-supplied Motor Protection Relay (MPR) which is located in the Primary Filtration 1 Remote I/O Panel (RIO-PFS-1), and monitors each pump for internal seal failure, and overtemp condition. Both pump conditions will be alarmed at the HMI. Either alarm condition will place the pump out of service. The pump will remain out of service until the condition is manually reset by the Operator via the reset pushbutton mounted on front of the Remote I/O Panel.
7. Scum Pump 1 will include a control station (CS-SMP-1) mounted within pump's line of sight. Control of the pump is initiated at the Scum Pump Control Station via Hand/Off/Auto selector switch.
8. Hand – With the Hand/Off/Auto selector switch in Hand position, the following control options are available from the control station. *Hand control is intended for maintenance purposes only*.

    a. Pump will be called to run.
    b. Pump speed can be adjusted at the pump's VFD.

9. Off – With the Hand/Off/Auto selector switch in Off position, operation of the pump is inhibited.
10. Auto – With the Hand/Off/Auto selector switch in Auto position, the following control options are available to the Operator from the HMI.

    a. Manual – With the Manual/Auto software selector switch at the HMI in Manual, the following control options are available from the HMI.

        - Start – This selection calls the pump to run.
        - Stop – This selection stops the pump.
        - Speed – This selection sets the speed of the pump from 0-100%.

    b. Auto – With the Manual/Auto software selector switch at the HMI in Auto, the following control options are available from the HMI.

        - When the scum level in the wet well reaches an operator-adjustable high level set-point, Scum Pump 1 will be called to run. The PLC will adjust pump's speed to pump the scum wet well empty.
        - To avoid overloading the existing Scum Concentrator, Plant Operator will input a maximum discharge flow set-point that Scum Pump 1 can pump. Existing Scum Concentrator is rated for 150 GPM. A PLC interlock is also required so that Scum Pump 1 will not be called to run when the existing Scum Pump is running.
        - When high scum flow to Scum Wet Well causes a rise in the wet well level thus tripping the High-High Level Ball Float Switch (LSHH-155), Primary Filtration Scum Overflow Gate (SMOG-1) shall lower to an operator-adjustable set-point (default to 10 inches) to prevent Scum Wet Well from overflowing. Plant Operator will be notified at Plant HMI of such condition. See functional description of Primary

Filtration Scum Overflow Gate above for additional detail.

- The Scum Pump 1 shall run continuously until the scum wet well is empty, which is indicated by radar level sensor (LE-151 and LIT-151).

11. Alarms - Equipment alarms to the Operator at the HMI are as follows.

    a. Scum Pump 1 VFD Fail.
    b. Scum Pump 1 VFD Excessive Torque.
    c. Scum Pump 1 VFD Excessive Current.
    d. Scum Pump 1 Fail (not running after being called to run).
    e. Scum Pump 1 Overtemp.
    f. Scum Pump 1 Seal Failure.
    g. Scum Wet Well 1 High-High Level Alarm.

M. Gravity Thickener 1 (1-N-06)

1. The purpose of the Gravity Thickener 1 is to thicken primary filtration sludge (PFS) from the Primary Filters. Biosolids referred to as primary filtration thickened sludge will settle to the bottom of the Gravity Thickener, and liquid referred to gravity thickener overflow (GTO) will overflow a weir to the Gravity Thickener Overflow Box. Primary filtration thickened sludge (PFTS) will flow to either existing Digesters or existing Gravity Belt Thickener No. 2. Gravity thickener overflow will flow to Primary Settling Tanks or to secondary treatment.
2. A high-high level ball float switch (LSHH-161) is provided in the Gravity Thickener Overflow Box to alarm Plant Operator in the event of high water level / GTO pipe backing up.
3. Water level within the Gravity Thickener 1 is measured by a radar level meter (LE-161 and LIT-161) mounted to Gravity Thickener's grating bridge. Plant Operator can set high and low level alarm set-points at Plant HMI to get notifications when abnormal levels occur.
4. The Gravity Thickener 1 mechanism is constant speed, operates continuously, and is powered from Main Pump II Motor Control Center (MCC-PFS).
5. The Gravity Thickener 1 includes local torque indication (WI-GT-1) mounted on the Gravity Thickener's motor.
6. The Gravity Thickener 1 includes a torque alarm switch (WSH-GT-1), and a torque cutout switch (WSHH-GT-1). Torque alarm switch will be set to trip at 80% of the AGMA torque, and an alarm will be displayed at Plant HMI when such condition occurs. Torque cutout switch will be set to trip at 125% of the AGMA torque, stop the mechanism, and alert the Operator at the HMI as a "Gravity Thickener 1 Fail" alarm. If the Gravity Thickener 1 has stopped due to overtorque (WSHH-GT-1) condition, an alarm pilot light illuminates at the Main Pump II Motor Control Center indicating the cutout condition.
7. Control of Gravity Thickener 1 is an Operator-initiated operation at the Gravity Thickener 1 Local Control Station (CS-GT-1). The local control station includes a Start pushbutton and mushroom-head Emergency Stop pushbutton. Plant Operator can initiate the Gravity Thickener 1 operation by activating the Start pushbutton. Gravity Thickener 1 mechanism can be stopped by pushing on the Stop pushbutton at the motor control center or Emergency Stop pushbutton at the control station.
8. A local disconnect (JS-GT-1) is also provided to lock out power to the Gravity Thickener 1.
9. Alarms - Equipment alarms to the Operator at the HMI are as follows.

    a. Gravity Thickener 1 Fail.
    b. Gravity Thickener 1 Fail (WSHH tripped).
    c. Gravity Thickener Overflow Box High Level.

N. Power Monitors (1-N-06)

1. Power Monitor equipment is specified in Section 26 24 19.
2. Signals transmitted to Plant SCADA for monitoring and trending are as shown on Drawing 1-N-06. Up to (6) additional signals are as defined by the Owner.

O. Ventilation Control Panel – Primary Filtration Facility I (1-N-06)

1. Ventilation Control Panel (VCP-100) serves as the central monitoring, control, and communications hub for the majority of building HVAC equipment.
2. Ventilation Control Panel equipment is specified in Section 23 09 23.
3. Maintenance alarm, critical alarm, ventilation system failure, combustible gas alarm, and gas detection fault signals are communicated to Plant PLC where they are then alarmed to the Operator at the HMI.

P. Ventilation Control Panel – Main Pump II Building (1-N-06)

1. Ventilation Control Panel (VCP-120) serves as the central monitoring, control, and communications hub for the majority of building HVAC equipment.
2. Ventilation Control Panel equipment is specified in Section 23 09 23.
3. Maintenance and critical alarms are communicated to Plant PLC where they are then alarmed to the Operator at the HMI.

Q. Main Pump II Building Sump Pump 1 and 2 (1-N-06)

1. The purpose of the duplex sump pump control system including primarily two Sump Pumps (SP-121 and SP-122) and Sump Pump Control Panel (SPCP-120) is to pump water from the sump area located in sub-basement level to the existing storm drain.
2. Equipment is specified under Section 22 00 05.
3. Three ball floats (LSL-162, LSH-163, and LSH-164) control two pumps with local indication for pump run, pump fail, control power, high water alarm, and motor overload at the Sump Pump Control Panel.
4. The fourth ball float switch (LSHH-165) is for high-high level alarm providing an alarm signal to the Operator at the Plant HMI.

R. Primary Filtration Thickened Sludge (PFTS) Grinder 1 and 2 (1-N-07)

1. The purpose of the Primary Filtration Thickened Sludge (PFTS) Grinder 1 (GRI-1) and 2 (GRI-2) is to cut down the thickened sludge and precondition the sludge to give it a uniform consistency prior to digestion or secondary thickening.
2. Primary Filtration Thickened Sludge (PFTS) Grinder 1 (GRI-1), its Local Control Panel (CP-GRI-1), and its Local Disconnect (JS-GRI-1) will be newly installed. Primary Filtration Thickened Sludge (PFTS) Grinder 2 (GRI-2), its Local Control Panel (CP-GRI-2), and its Local Disconnect (JS-GRI-2) will be relocated as part of this project.
3. Each PFTS Grinder is controlled by a vendor-supplied PLC-based local control panel located in Gravity Thickener Pump Room 1 at Primary Filtration Facility 1. PFTS Grinder Local Control Panels will communicate with Primary Filtration 1 Remote I/O Panel (RIO-PFS-1) via hard-wired signals.
4. Plant Operator can initiate the grinders' operation at Plant HMI. Refer to specification section 46 24 23 – Sludge Grinders – for addional details on control of the PFTS Grinders.
5. Alarms - Equipment alarms to the Operator at the HMI are as follows.

    a. PFTS Grinder Fail.
    b. PFTS Grinder Overtemp.
    c. PFTS Grinder Running.

S. Primary Filtration Thickened Sludge Pumping (1-N-07)

1. Purpose of the Primary Filtration Thickened Sludge Pump 2 is to transfer primary filtration thickened sludge (PFTS) from Gravity Thickener 1 to existing Digesters. Primary Filtration Thickened Sludge Pump 1 is used to transfer primary filtration thickened sludge (PFTS) from Gravity Thickener 1 to existing Gravity Belt Thickener No. 2. However, manual valves and

piping are installed such that PFTS Pump 1 and PFTS Pump 2 can be used interchangeably.

2. The PFTS Pump 1 is an adjustable speed double disc pump, and is powered from PFTS Pump 1 VFD (VFD-PFTSP-1). The VFD is located in Electrical Room of Main Pump II Building, and communicates with Plant PLC via hard-wired signals and Modbus TCP network connection as shown on drawings.
3. The PFTS Pump 2 is adjustable speed progressive cavity pump, and is powered from PFTS Pump 2 VFD (VFD-PFTSP-2). The VFD is located in Electrical Room of Main Pump II Building, and communicates with Plant PLC via hard-wired signals and Modbus TCP network connection as shown on drawings.
4. A local disconnect (JS- PFTSP-1, and JS- PFTSP-2) is also provided to lock out power for each PFTS Pump. When the local disconnect is activated, an alarm will be displayed at the Plant HMI to notify Plant operator of such condition.
5. PFTS Pump 1 motor is equipped with a vendor-supplied high temperature switch (TSH-173) to alert Plant Operator when the motor is overheated. PFTS Pump 1 includes a pressure gauge (PI-171S) to locally monitor suction pressure, and a pressure gauge (PI-171D) and high pressure switch (PSH-171) to monitor discharge pressure and prevent the pump from pumping against a closed valve.
6. PFTS Pump 2 motor is equipped with a vendor-supplied high temperature switch to alert Plant Operator when the motor is overheated. PFTS Pump casing includes a manufacturer-provided RTD (TE-174) measuring casing temperature with an associated temperature transmitter (TIT-174). Temperature is transmitted to the PLC where the Operator will set high temperature alarm and high-high temperature alarm (based on manufacturer recommendations). Temperature alarms shall alert Plant Operator at Plant HMI. High-high casing temperature shall not allow PFTS Pump 2 operation for dry-run protection against possible equipment damage. PFTS Pump 2 includes a pressure gauge (PI-172S) and a low pressure switch (PSL-172S) to monitor suction pressure and protect the pump from dry-run. A pressure gauge (PI-172D) and high pressure switch (PSH-172) are also included on pump discharge pipe to monitor discharge pressure and prevent the pump from pumping against a closed valve.
7. PFTS Pump 1 discharge flow and PFTS Pump 2 discharge flow are monitored by electromagnetic flowmeters (FE/FIT-172 and FE/FIT-171, respectively).
8. The following control is typical for both PFTS Pumps.
9. PFTS Pump 1 will include a control station (CS- PFTS-1) mounted within pump's line of sight. Control of the pump is initiated at the control station via Hand/Off/Auto selector switch.
10. Hand – With the Hand/Off/Auto selector switch in Hand position, the following control options are available from the control station. *Hand control is intended for maintenance purposes only*.

    a. Pump will be called to run.
    b. Pump speed can be adjusted at the pump's VFD.

11. Off – With the Hand/Off/Auto selector switch in Off position, operation of the pump is inhibited.
12. Auto – With the Hand/Off/Auto selector switch in Auto position, the following control options are available to the Operator from the HMI.

    a. Manual – With the Manual/Auto software selector switch at the HMI in Manual, the following control options are available from the HMI.

        - Start – This selection calls the pump to run.
        - Stop – This selection stops the pump.
        - Speed – This selection sets the speed of the pump from 0-100%.

    b. Auto – With the Manual/Auto software selector switch at the HMI in Auto, the following control options are available from the HMI.

- Plant Operator will select which pump to initiate, and input either the desired flow rate (in GPM) and run time (in minute), or total volume (in gallons) and run time (minutes), or start and stop level set-points based on Gravity Thickener 1 level measured by radar level meter (LE-161 and LIT-161).
- The PLC will adjust the pump speed accordingly to achieve target flow or level.

13. Alarms - Equipment alarms to the Operator at the HMI are as follows.

    a. PFTS Pump VFD Fail (x2).
    b. PFTS Pump VFD Excessive Torque (x2).
    c. PFTS Pump VFD Excessive Current (x2).
    d. PFTS Pump Fail (not running after being called to run) (x2).
    e. Gravity Thickener 1 High Level Alarm.
    f. Gravity Thickener 1 Low Level Alarm.
    g. PFTS Pump 1 Motor Overtemp.
    h. PFTS Pump 1 High Discharge Pressure.
    i. PFTS Pump 2 Low Suction Pressure.
    j. PFTS Pump 2 High Discharge Pressure.
    k. PFTS Pump 2 Motor Overtemp.
    l. PFTS Pump 2 High Casing Temperature.

T. Power Monitoring (1-N-06)

1. Two Power Monitors are included in the Main Pump II Motor Control Center to monitor power consumption and power quality of each bus. Power monitoring equipment is specified in Section 26 24 19.
2. Signals transmitted to Plant SCADA for monitoring and trending are as shown on drawing. Up to (6) additional signals are as defined by the Owner.

2.08 PSP GRIT BUILDING PLC PANEL, PLC-PSP

A. Gravity Belt Thickener No. 2 Thickened Sludge Pumping (1-N-07)

1. Purpose of the Gravity Belt Thickener (GBT) No. 2 Thickened Sludge Pump is to transfer thickened sludge from GBT No. 2 Hopper to the existing Digesters. The GBT No. 2 Thickened Sludge Pump is located in GBT No. 2 Room in Gravity Belt Thickening Building.
2. The GBT No. 2 Thickened Sludge Pump is an adjustable speed progressive cavity pump, and is powered from existing GBT No. 2 Thickened Sludge Pump VFD (VFD-GBTDP-2) located in Electrical Room of Gravity Belt Thickening Building. The VFD communicates with Plant PLC via hard-wired signals as shown on drawings.
3. The GBT No. 2 Hopper will be replaced as part of this project, and will include a pressure transducer (PIT-212) for thickened primary sludge level measurement.
4. GBT No. 2 Thickened Sludge Pump motor is equipped with a vendor-supplied high temperature switch (TSH-212) to alert Plant Operator when the motor is overheated. GBT No. 2 Thickened Sludge Pump casing includes a manufacturer-provided RTD (TE-212) measuring casing temperature with an associated temperature transmitter (TIT-212). Temperature is transmitted to the PLC where the Operator will set high temperature alarm and high-high temperature alarm (based on manufacturer recommendations). Temperature alarms shall alert Plant Operator at Plant HMI. High-high casing temperature shall not allow the pump operation for dry-run protection against possible equipment damage. A pressure gauge (PI-212) and high pressure switch (PSH-212) are also included on pump discharge pipe to monitor discharge pressure and prevent the pump from pumping against a closed valve.
5. GBT No. 2 Thickened Sludge Pump is initiated at the existing control station (LCP-212) via Local/Off/Remote selector switch.
6. Local – With the Local/Off/Remote selector switch in Local position, pump initiation and

speed control can be done at the pump's VFD. *Local control is intended for maintenance purposes only*.

7. Off – With the Local/Off/Remote selector switch in Off position, operation of the pump is inhibited.
8. Remote – With the Local/Off/Remote selector switch in Remote position, the following control options are available to the Operator from the HMI.

    a. Manual – With the Manual/Auto software selector switch at the HMI in Manual, the following control options are available from the HMI.

        - Start – This selection calls the pump to run.
        - Stop – This selection stops the pump.
        - Speed – This selection sets the speed of the pump from 0-100%.

    b. Auto – With the Manual/Auto software selector switch at the HMI in Auto, the following control options are available from the HMI.

        - Plant Operator will input a desired thickened primary sludge flow rate (in GPM) and run time (in minute), or total volume (in gallons) and run time (minutes). PLC shall adjust pump speed to meet flow requirement.
        - PLC logic is also programmed with low sludge level interlock such that Gravity Belt Thickener (GBT) No. 2 Thickened Sludge Pump shall be called to stop when level in the GBT No. 2 Hopper measured by the pressure transducer (PIT-212) is lower than an operator adjustable set-point to prevent the pump from dry-run.

9. Alarms - Equipment alarms to the Operator at the HMI are as follows.

    a. GBT No. 2 Thickened Sludge Pump VFD Fail.
    b. Hopper High Level Alarm.
    c. Hopper Low Level Alarm.
    d. GBT No. 2 Thickened Sludge Pump Overtemp.
    e. GBT No. 2 Thickened Sludge Pump High Discharge Pressure.
    f. GBT No. 2 Thickened Sludge Pump High Casing Temperature.
    g. GBT No. 2 Thickened Sludge Pump High-High Casing Temperature

PART 3 – EXECUTION – NOT USED

END OF SECTION

SECTION 40 66 00
NETWORK AND COMMUNICATION EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes plant-wide data highway communication devices, equipment, and processes.

C. General Design Requirements:

1. Process Control Network:

a. Provide high speed link between PST's and Process Control Network to allow sharing of real-time data.
b. Provide expandable system to accommodate addition of future equipment as specified elsewhere.
c. Provide couplers, terminators, junction boxes, and other associated cable connectors.
d. Provide cabling suitable for conduit routing as shown elsewhere.
e. Provide data highway as shown on Drawings.
f. Process Control Network between buildings shall be Singlemode Fiber Optic (1000Base-FX).
g. Process Control Network within buildings shall be Cat 6 UTP (100Base-TX).
h. Maximum distance between building nodes 2000 meters.
i. Maximum distance intra-building nodes is 100 meters.

1.02 ABBREVIATIONS AND REFERENCES

A. FCC: Federal Communications Commission

B. IEEE: Institute of Electrical and Electronics Engineers

C. ISO: International Standards Organization

D. LAN: Local Area Network

E. NEC: National Electrical Code

F. NEIS: National Electrical Installation Standards

G. NRTL: Nationally Recognized Testing Laboratory

H. PST: Programmable Logic Controller

I. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section.
2. Submit Product Data and Shop Drawings in one complete submittal package.

3. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cut sheets and product specifications for devices specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for control devices specified.
2. Cable routing drawings for Process Control Network.
3. Cable termination detail drawings.
4. Location and function of all communication module types.
5. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

PART 2 – **PRODUCTS**

2.01 SINGLE-MODE OPTICAL FIBER CABLE

A. Manufacturer:

1. Siemon XGLO OS2.
2. Corning
3. Lucent Technologies.

B. Fiber Characteristics

1. General Fiber Specifications:

a. All fiber shall be of same manufacturer.
b. Fiber shall meet the distance limitations for 10 Gigabit Ethernet Max Transmission Distance (m).
c. All fibers in the cable must be usable and meet required specifications following installation and testing.
d. Fibers shall have dual wavelength capability; transmitting at 1310 and 1550nm ranges.
e. OS2.
f. 12 strand (6-pair).
g. 7.3mm cable diameter.
h. Glass core, 250 m coating; tight buffered construction designed for outdoor installation; Kevlar aramid yarn strength members surrounding the cladding of each strand; plenum rated jacket.
i. Complies with TIA/EIA-568-B.3 for color-coding.
j. Outer Jacket: UV & moisture resistant LSOH.
k. Optical Fiber proof stress: (1,500N).
l. Crush resistance: 5N/mm.
m. Operating temperature: -4º F to +158ºF (0 dB added attenuation).

C. Fiber Optic Cable Installation:

1. Provide an additional 10 feet of cable slack at each hand hole, and connection points allowing for future reconfiguration of connection closets. Cable shall be neatly organized using cable management hardware.

2. Do not exceed cable manufacturers minimum bend radius under tension or final installation.

3. Cable tension:

   a. Do not exceed cable manufacturer's maximum tensile rating during cable installation.
   b. No residual tension shall remain on cable after installation except that which is due to cable's weight in vertical rise.
   c. Cable tension shall be monitored during installation if winch is used for installation. Hand pulls do not require monitoring.

4. Vertical Rises:

   a. Secure vertical cable at top of run.
   b. Attachment point shall comply with cable's minimum bend radius.
   c. Provide intermediate support when manufacturer specified maximum cable rise has been reached.

5. Cable Splicing and Termination:

   a. All fiber strands shall be terminated at both ends.
   b. Use of splices shall not cause attenuation of signal exceeding allowable attenuation budget.
   c. Make no splices within conduit or duct banks. Make splices within pull boxes or process control system equipment enclosures.

6. Fiber optic cable identification

   a. All fibers shall be color coded to facilitate individual fiber identification.
   b. Labels shall meet the legibility, defacement, exposure and adhesion requirements of UL-969. Labeling shall conform to the requirements specified within ANSI/TIA/EIA-606-A or to the requirements specified by the Owner.

2.02 FIBER OPTIC CONNECTOR ASSEMBLIES

A. All fiber optic connector assemblies shall use high quality ST connectors installed with anaerobic adhesive on jacketed pigtails.

B. Assemblies shall be provided with control panels for field splicing to Plant-Wide Data Highway Cable upon installation of control panels.

C. Assemblies shall utilize a PC finish on the tip of the fiber to provide high yield during splicing, and to meet EIA and IEC standards for repeatability.

D. All connectors that are metallic in nature shall be corrosion proof and shall withstand minimum of 0.75 microns of corrosion per year.

2.03 FIBER PATCH CORDS

A. The fiber patch cord shall optical properties shall match that or exceed the optical characteristics of the fiber. The fiber cladding shall be covered by aramid yarn and a jacket of flame-retardant PVC.

B. Fiber optic connector type shall match that of mated equipment.

C. Patch cords shall not exceed 3 feet in length unless specifically required for application.

2.04 ENHANCED CAT 6 UTP CABLE

A. Manufacturer:

1. Siemon.
2. Or Equal.

B. 4 pair Category 6 cable shall conform to TIA/EIA 568A Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section, and UL® LAN Certification and Follow-up Program.

C. Indoor installations shall be plenum rated.

D. Cables shall be marked as UL verified and RoHS Compliant.

E. When traversing enclosures and panels containing 3-phase power, cable shall be rated for 600V.

F. Applications standards supported should include, but be not limited to, IEEE 802.3, 1Base5, 10BASE-T; IEEE 802.5, 4Mbps, 16Mbps (328 ft [100m]) and TP-PMD.

G. Cables shall be identified at Network Rack connections with equipment name and tag number.

H. Cable shall be round, and shall meet the following electrical requirements:

1. All Values are guaranteed:

Frequency (MHz)	Insertion Loss (dB)	NEXT (dB)	ACR (dB)	PSACR (dB)	Return Loss (dB)	Propagation Delay (ns)
1	2.0	77.3	75.3	73.3	20.0	550
4	3.8	68.3	64.5	62.5	23.6	532
10	5.9	62.3	56.4	54.4	26.0	525
16	7.5	59.2	51.8	49.8	26.0	523
20	8.4	57.8	49.4	47.4	26.0	522
31.25	10.6	54.9	44.3	42.3	25.0	520
62.5	15.2	50.4	35.1	33.1	23.5	519
100	19.6	47.3	27.7	25.7	22.5	518
160	25.4	44.2	18.9	16.9	21.5	517
200	28.7	42.8	14.1	12.1	21.0	517
250	32.6	41.3	8.8	6.8	20.5	516

I. Operating Temperature: -20° to 60°C.

J. Bend Radius: 1 inch.

K. #23AWG solid bare copper.

L. 75°C temperature rating of insulation (minimum).

M. DC Resistance: <9.38Ω/100m.

N. Mutual Capacitance: <330pF/100m.

2.05 UTP PATCH CORDS FOR EQUIPMENT ENCLOSURES

A. Manufacturer:

1. Lucent Technologies.
2. Panduit.

B. Provide Category 6 Modular Patch Cords as follows:

1. Power sum rated.
2. Patch cords shall not exceed 3 feet in length unless specifically required for application.
3. Conform to the requirements of EIA/TIA 568B Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and UL® LAN Certification and Follow-up Program.
4. Equipped with molded 8 pin modular connector (RJ45, 8x8) on each end and conform to the length(s) specified on the detailed drawing.
5. Round, and 24-AWG copper, stranded conductors, tightly twisted into individual pairs.
6. Built-in exclusion features to prevent accidental polarity reversals and split pairs.

C. UL® Verified for EIA/TIA 568B Electrical Performance

D. UL® and c (UL®) Listed for Fire Safety

E. ISO 9001 Certified Manufacturer

F. Austel Approved

G. FCC Compliant

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 FIBER OPTIC CABLE TESTING REQUIREMENTS

A. Provide all labor, materials, tools, field-test instruments and equipment required for the complete testing, identification and administration of the work called for in the Contract Documents.

B. In addition to the tests detailed in this document, the Contractor shall notify Owner of any additional testing that is deemed necessary to guarantee a fully functional system.

C. Testing procedure shall include testing the attenuation and polarity of the installed cable runs with an optical loss test set (OLTS) and the installed condition of the cabling system and its components with an optical time domain reflectometer (OTDR). The condition of the fiber end faces shall also be verified.

D. Testing shall be performed on each cabling link (connector to connector).

E. Testing shall be performed on each cabling channel (equipment to equipment) that is identified by the Owner. Testing shall not include any active devices or passive devices within the link or channel other than cable, connectors, and splices, i.e. link attenuation does not include devices such as optical bypass switches, couplers, repeaters, or optical amplifiers.

F. All tests shall be documented including OLTS dual wavelength attenuation measurements for multimode and singlemode links and channels and OTDR traces and event tables for multimode and singlemode links and channels.

G. Owner witness and/or review field testing.

H. Owner shall be notified of the start date of the testing phase five (5) business days before testing commences.

I. Owner may require a parallel random sample of 5% of the installed links. The results of this parallel testing shall be stored in accordance with Part 3 of this document. The results obtained shall be compared to the data provided by the Contractor. If more than 2% of the parallel test results differ in terms of the pass/fail determination, Contractor shall repeat 100% testing at no cost to the Owner.

3.03 FIBER OPTIC CABLE ACCEPTANCE PARAMETERS AND TESTING PROCEDURES

A. Unless otherwise specified by Owner, each cabling link shall be in compliance with the following test limits.

1. Optical Loss Testing Singlemode Links

a. The link attenuation shall be caSTulated by the following formulas as specified in ANSI/TIA-568-C.0.
b. Link Attenuation(dB) = Cable_Attn(dB) + Connector_Attn(dB) + Splice_Attn(dB)
c. Cable_Attn(dB) = Attenuation_Coefficient (dB/km) * Length (km)
d. Connector_Attn(dB) = #_of_connector_pairs * connector_loss (dB)
e. Maximum allowable connector_loss = 0.75 dB
f. Splice_Attn(dB) = #_of_Splices * Splice_loss (dB)
g. Maximum allowable splice_loss = 0.3 dB
h. The values for the Attenuation_Coefficient (dB/km) are listed in the table below.

Type of Optical Fiber	Wavelength (nm)	Attenuation coefficient (dB/km)	Wavelength (nm)	Attenuation coefficient (dB/km)
Single-mode 9/125 µm	1310	0.4	1550	0.3

2. OTDR Testing Parameters

a. Reflective events (connections) shall not exceed 0.75
b. Non-Reflective events (splices) shall not exceed 0.3 dB

3. Magnified end face inspection

a. Fiber connections shall be visually inspected for end face quality
b. Scratched, pitted, or dirty connectors shall be diagnosed and corrected.

B. Any link or channel that fails the test requirements shall be diagnosed and corrected. Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements. The final and passing result of the tests for all links and channels shall be provided in the test results documentation as specified herein.

C. If one (1) pair of strands for each fiber optic cable are found to be broken the entire cable shall be abandoned, or removed, and a new cable shall be installed at no additional cost to Owner.

3.04 ADDITIONAL OPTICAL FIBER CABLE TESTING REQUIREMENTS

A. Link and channel test results from the OLTS and OTDR shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.

B. Fiber end faces shall be inspected at 200X or 400X magnification. 200X magnification is suitable for inspecting multimode fibers. 400X magnification shall be used for examination of singlemode fibers. Scratched, pitted, or dirty connectors shall be corrected. End face images shall be recorded in the memory of the test instrument for subsequent uploading to a PC and reporting.

C. Testing of the cabling shall be performed using high quality test cords of the same fiber type as the cabling being tested. The test cords for OLTS testing shall be between 1m and 5m in length. The test cords for the OTDR testing shall be approximately 100m for the launch cable and at least 25m for the receive cable.

D. Optical loss testing on backbone links.

1. Singlemode backbone links shall be tested at 1310nm and 1550nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper or the equivalent method..

2. Use the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B, and ANSI/TIA/EIA-526-7, Method A.1 or the equivalent method. Contractor shall follow the procedures established by these standards or application notes to accurately conduct performance testing.

E. OTDR Testing

1. Fiber links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss.

a. Singlemode: 1310nm and 1550nm

2. Each fiber link and channel shall be tested in both directions
3. A launch cable shall be installed between the OTDR and the first link connection.
4. A receive cable shall be installed after the last link connection.

F. Length Measurement

1. The length of each fiber shall be recorded.
2. It is preferable that the optical length be measured using an OLTS or OTDR.

G. Polarity Testing.

1. Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with clause E.5.3 of ANSI/TIA-568-C.0. The polarity of the paired duplex fibers shall be verified using an OLTS.

3.05 FIBER OPTIC CABLE TEST DOCUMENTATION

A. Test results documentation

1. Test results saved within the field test instrument shall be transferred into a Windows-based database utility that allows for the maintenance, inspection and archiving of the test records. These test records shall be uploaded to the PC unaltered, i.e. “as saved in the field test instrument”. The file format, CSV (comma separated value) does not provide adequate

protection of these records and shall not be used.

2. The test results documentation shall be available for inspection by the Owner during the installation and shall be provided to the Owner within 5 working days of completion of tests.
3. Test results shall be provided in an electronic database for each tested optical fiber and shall contain the following information.

    a. The identification of the customer site as specified by the end user.
    b. The name of the test limit selected to execute the stored test results.
    c. The name of the personnel performing the test.
    d. The date and time the test results were saved in the memory of the tester.
    e. The manufacturer, model and serial number of the field test instrument.
    f. The version of the test software and the version of the test limit database held within the test instrument.
    g. The fiber identification number
    h. The length for each optical fiber.
    i. Test results to include OLTS attenuation link and channel measurements at the appropriate wavelengths and margin (difference between the measured attenuation and the test limit value).
    j. Test results to include OTDR link and channel traces and event tables at the appropriate wavelengths.
    k. The length for each optical fiber as caSTulated by the OTDR
    l. The overall Pass/Fail evaluation of the link-under-test for OLTS and OTDR measurements.

4. Test results documentation shall include a summary section at or near the front of detailed test documentation and shall be limited to 2 pages. Summary section shall indicate (at a glance) all tests and their corresponding pass/fail status.

END OF SECTION

SECTION 40 70 00
INSTRUMENTATION OF PROCESS SYSTEMS

PART 1 – **GENERAL**

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13 – Process Instrumentation and Control.

B. Section includes instrumentation and initial parameters.

1.02 ABBREVIATIONS AND REFERENCES

A. NEC: National Electrical Code

B. NEIS: National Electrical Installation Standards

C. NEMA: National Electrical Manufacturers Association

1.03 DEFINITIONS

A. The Rating column of instrument tables refers to the NEC hazardous environment rating the device is to be installed in.

1. CID1 – Class I Division 1 Group D
2. CID2 – Class I Division 2 Group D
3. NR – Not Rated

1.04 SUBMITTALS

A. Provide submittals under the specification section that is referenced for each instrument, device, and equipment listed below.

B. Submittals are not required for Section 40 70 00.

C. Provide devices/instrumentation/equipment as listed below and as shown on Drawings:

PART 2 – **PRODUCTS**

2.01 CONTROL STATIONS – DEFINITIONS (Ref. Section 40 67 15)

A. HAND/OFF/AUTO, RUN: One 3-position selector switch with 3 contact blocks (XOO/OXO/OOX) for HOA functionality. One indicating light (green) to display equipment running.

B. START, E-STOP: One momentary START pushbutton. One NC maintained contact mushroom-head pushbutton for e-stop.

2.02 CONTROL STATIONS (Ref. Section 40 67 15)

A. Provide control stations as defined in CONTROL STATIONS – DEFINITIONS above.

B. Mount operators in common control station enclosures with specified rating in accordance with room classification shown on Drawings and listed in table below:

Tag	Equipment	Type	Rating
CS-PFIP-1	Primary Filtration Influent Pump (PFIP) 1 Control Station	A	NR
CS-PFIP-2	Primary Filtration Influent Pump (PFIP) 2 Control Station	A	NR
CS-PFIP-3	Primary Filtration Influent Pump (PFIP) 3 Control Station	A	NR
CS-PFIP-4	Primary Filtration Influent Pump (PFIP) 4 Control Station	A	NR
CS-SMP-1	Scum Pump 1 Control Station	A	NR
CS-GT-1	Gravity Thickener 1 Control Station	B	NR
CS-PFTSP-1	Primary Filtration Thickened Sludge Pump (PFTSP) 1 Control Station	A	NR
CS-PFTSP-2	Primary Filtration Thickened Sludge Pump (PFTSP) 2 Control Station	A	NR

2.03 MAGNETIC FLOW ELEMENT AND TRANSMITTER (Ref. Section 40 71 00)

Tag	Description	Service	Pipe Dia.	Liner	Range	Rating
FE-121, FIT-121	PFIP 1 Discharge	P.F. Influent	18”	Hard Rubber	0-12 MGD	NR
FE-122, FIT-122	PFIP 2 Discharge	P.F. Influent	18”	Hard Rubber	0-12 MGD	NR
FE-123, FIT-123	PFIP 3 Discharge	P.F. Influent	18”	Hard Rubber	0-12 MGD	NR
FE-124, FIT-124	PFIP 4 Discharge	P.F. Influent	18”	Hard Rubber	0-12 MGD	NR
FE/FIT-171	PFTSP 2 Discharge	P.F. Thickened Sludge	4”	Hard Rubber	0-150 GPM	NR
FE/FIT-172	PFTSP 1 Discharge	P.F. Thickened Sludge	6”	Hard Rubber	0-300 GPM	NR

2.04 DOPPLER FLOW SENSOR AND TRANSMITTER (Ref. Section 40 71 00)

Tag	Location	Pipe Dia.	Range	Rating
FE-173, FIT-173	Scum from Primary Filters	6”	0-200 GPM	NR

2.05 LEVEL SWITCH, BALL FLOAT (Ref. Section 40 72 00)

Tag	Location	Setting (Elev)	Rating
LSHH-161	Gravity Thickener Overflow Box	712.00	CID2
LSHH-155	Scum Wet Well	704.00	CID1

2.06 LEVEL ELEMENT AND TRANSMITTER, MICROWAVE RADAR (Ref. Section 40 72 00)

Tag	Location	Range (ft)	Rating
LE-111, LIT-111	P.F. Effluent Diversion Structure	0-20	NR
LE-121, LIT-121	P.F. Influent Wet Well 1	0-20	CID1
LE-161, LIT-161	Gravity Thickener 1	0-20	NR
LE-151, LIT-151	Scum Wet Well 1	0-20	CID1

2.07 PRESSURE GAUGE/INDICATOR (Ref. Section 40 73 00)

Tag	Location	Seal Type	Range
PI-172S	PFTS Pump 2 Suction Pressure	Annular	30” Hg-15 PSI
PI-172D	PFTS Pump 2 Discharge Pressure	Annular	0-100 PSI
PI-212	GBT 2 Thickened Sludge Pump Discharge Pressure	Annular	0-100 PSI

2.08 ANNULAR PRESSURE SEAL, FLANGE CONNECTION (Ref. Section 40 73 00)

Tag	Location	Pipe Dia.
PI-172S and PSL-172S	PFTS Pump 2 Suction Pressure	6”
PI-172D and PSH-172D	PFTS Pump 2 Discharge Pressure	6”
PI-212 and PSH-212	GBT 2 Thickened Sludge Pump Discharge Pressure	6”

2.09 PRESSURE SWITCH (Ref. Section 40 73 00)

Tag	Location	Seal Type	Setting	Rating
PSL-172S	PFTS Pump 2 Suction Pressure	Annular	2 PSI	NR
PSH-172D	PFTS Pump 2 Discharge Pressure	Annular	100 PSI	NR
PSH-212	GBT 2 Thickened Sludge Pump Discharge Pressure	Annular	100 PSI	CID2

2.10 PRESSURE (LEVEL MEASUREMENT) INDICATING TRANSMITTER (Ref. Section 40 73 00)

Tag	Location	Specials	Range (ft.)	Rating
PIT-212	GBT 2 Cake Hopper	Knife Gate	0-10	CID2

2.11 TEMPERATURE TRANSMITTER, UNIVERSAL (Ref. Section 40 74 00)

Tag	Location	Range	Rating
TIT-174	PFTS Pump 2 Casing Temperature	40°F to 300°F	NR
TIT-212	GBT 2 Thickened Sludge Pump Casing Temperature	40°F to 300°F	CID2

PART 3 – **EXECUTION**

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer’s written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

END OF SECTION

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SECTION 40 71 00
FLOW MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Items specified in this section shall be provided by Contractor.

C. Section includes field flow elements, sensors, and transmitters for Process Instrumentation and Control.

D. Ranges and performance parameters are listed in Section 40 70 00.

E. Training in accordance with section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. ANSI: American National Standards Institute

B. CSA: Canadian Standards Association

C. EN: European Standards (generic)

D. FM: Factory Mutual

E. IEC: International Electrotechnical Commission

F. NEC: National Electrical Code

G. NEIS: National Electrical Installation Standards

H. NEMA: National Electrical Manufacturers Association

I. NIST: National Institute of Standards and Technology

J. NRTL: Nationally Recognized Testing Laboratory

K. OSHA: Occupational Safety and Health Administration

L. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification section 40 70 00.

PART 2 – PRODUCTS

2.01 MAGNETIC FLOW ELEMENT AND TRANSMITTER

A. Manufacturer:

1. Krohne Optiflux
2. Endress+Hauser 400 Series
3. Or Equal.

B. Design is based on startup average velocity of 3 ft/sec through meter. Meters requiring greater velocities to meet specified accuracy and proper performance are not acceptable.

C. Flowmeter system accuracy shall be ±0.3% of flow rate over 10:1 turndown minimum. Repeatability shall be ±0.1% and response time programmable from 1 sec to 100 sec.

D. Meters shall be furnished with NIST certification of calibration.

E. Flow Element:

1. Low frequency, electromagnetic induction type producing dc pulse signal directly proportional and linear to liquid flow rate.
2. Splash-proof and weather-resistant NEMA 6P design housing (when provided with remote transmitter). Watertight external and internal electrical conduit connections.
3. Provide power from signal converter.

4. Unless otherwise specified, materials of construction shall be:

    a. Flow meter liner: Hard Rubber.
    b. Electrode materials: S316 Stainless Steel.
    c. Electrode type: Bullet nose.
    d. Grounding rings: 316 Stainless Steel.

5. Use grounding rings or gaskets on each end of magnetic flow meter to provide ground path and prevent interference with flow signal. Probes are not acceptable.
6. Sensing head interchangeable with meter body of same manufacturer without performing flow recalibration.
7. High impedance device of not less than 1012 ohms to minimize span shift due to electrode coating.

F. Transmitter:

1. Remote or integrally mounted according to Drawings and Plans, microprocessor controlled.
2. Operate on 120Vac, 60 Hz power.
3. Provide pulsed dc voltage to magnet coils of magnetic flow meter to establish magnetic field.
4. Convert flow signal from magnetic flow meter to analog and digital output signals, for bidirectional flow.
5. Span to be continuously adjustable between 2 and 31 ft/sec. Adjustment shall be by keypad.
6. Display shall have 2 rows of 16 alpha numeric characters minimum. Top row shall indicate instantaneous flow rate in direct engineering units, field selectable.
7. Converter interchangeable with magnetic flow meter of same manufacturer and requires no additional flow calibration adjustment.
8. 4-20 mAdc analog current output into 0 to 900 ohm load and 24Vdc scaled, pulse output software adjustable.
9. Locate flow rate indicator within each converter. Indicator shall display flow rate in engineering units as listed in Section 40 70 00.
10. Noise reduction feature to minimize effects of noise generating processes.
11. Automatic empty pipe detection.
12. Suitable for -5°F to +140°F ambient temperature.
13. Provide thermostatically controlled condensate heater to allow use in condensate environments.

G. Cable:

1. Provide sufficient standard length of manufacturer's signal cable connecting meter and converter without splice.

2.02 MAGNETIC FLOW ELEMENT AND TRANSMITTER – RESTRICTED RUNS

A. Manufacturer:

1. Endress+Hauser 400 Series
2. McCrometer

B. Primary Filtration Influent Pump Discharge Flowmeters (FE/FIT-121, FE/FIT-122, FE/FIT-123, and FE/FIT-124) shall require no more than one pipe diameter upstream straight run and zero pipe diameter downstream straight run for manufacturer-approved installation.

C. Design is based on startup average velocity of 3 ft/sec through meter. Meters requiring

greater velocities to meet specified accuracy and proper performance are not acceptable.

D. Flowmeter system accuracy shall be ±0.5% of flow rate over 10:1 turndown minimum. Repeatability shall be ±0.1% and response time programmable from 1 sec to 100 sec.

E. Meters shall be furnished with NIST certification of calibration.

F. Flow Element:

1. Low frequency, electromagnetic induction type producing dc pulse signal directly proportional and linear to liquid flow rate.
2. Splash-proof and weather-resistant NEMA 6P design housing (when provided with remote transmitter). Watertight external and internal electrical conduit connections.
3. Provide power from signal converter.
4. Unless otherwise specified, materials of construction shall be:

    a. Flow meter liner: Hard Rubber.
    b. Electrode materials: S316 Stainless Steel.
    c. Electrode type: Bullet nose.
    d. Grounding rings: 316 Stainless Steel.

5. Use grounding rings or gaskets on each end of magnetic flow meter to provide ground path and prevent interference with flow signal. Probes are not acceptable.
6. Sensing head interchangeable with meter body of same manufacturer without performing flow recalibration.
7. High impedance device of not less than 1012 ohms to minimize span shift due to electrode coating.

G. Transmitter:

1. Remote or integrally mounted according to Drawings and Plans, microprocessor controlled.
2. Operate on 120Vac, 60 Hz power.
3. Provide pulsed dc voltage to magnet coils of magnetic flow meter to establish magnetic field.
4. Convert flow signal from magnetic flow meter to analog and digital output signals, for bidirectional flow.
5. Span to be continuously adjustable between 2 and 31 ft/sec. Adjustment shall be by keypad.
6. Display shall have 2 rows of 16 alpha numeric characters minimum. Top row shall indicate instantaneous flow rate in direct engineering units, field selectable.
7. Converter interchangeable with magnetic flow meter of same manufacturer and requires no additional flow calibration adjustment.
8. 4-20 mAdc analog current output into 0 to 900 ohm load and 24Vdc scaled, pulse output software adjustable.
9. Locate flow rate indicator within each converter. Indicator shall display flow rate in engineering units as listed in Section 40 70 00.
10. Noise reduction feature to minimize effects of noise generating processes.
11. Automatic empty pipe detection.
12. Suitable for -5°F to +140°F ambient temperature.
13. Provide thermostatically controlled condensate heater to allow use in condensate environments.

H. Coatings:

1. Surface preparation, priming, and finish coating of mag meters shall be compatible and in accordance with System 11 in Section 09 96 00.

a. Ground rings and ground straps of mag meter shall not be coated.
b. Color shall match adjacent process piping.

I. Cable:

1. Provide sufficient standard length of manufacturer's signal cable connecting meter and converter without splice.

2.03 DOPPLER FLOW ELEMENT AND TRANSMITTER

A. Manufacturer:

1. Pulsar Measurement – Greyline DFM 6.1.
2. Or Equal.

B. The sensor transmits continuous high-frequency sound through the pipe wall into the flowing liquid. Sound is reflected to the sensor from particles in the liquid. If the liquid is flowing, the reflected sound returns at an altered frequency (the Doppler Effect). The sensor continuously measures this frequency shift to accurately measure velocity

C. Accuracy: ±2% of reading or 30 mm/s (1.2 in/s) whichever is greater.

D. Repeatability: ±0.1%.

E. Flow Transducer:

1. SE4 single-head stainless steel ultrasonic sensor mounted externally on pipe.
2. Capable of withstanding accidental submersion pressures to 10 psi.
3. CE tested for maximum industrial noise rejection
4. Flow range: ±0.1 ft/s to 40 ft/s.
5. Pipe Diameter: 4 inches.
6. Operating Temperature: -40 °F to 300 °F.

F. Transmitter:

1. Remote mounted according to Drawings and Plans, microprocessor controlled.
2. Operate on 120Vac, 60 Hz power.
3. Convert flow signal from magnetic flow meter to analog and digital output signals, for bidirectional flow.
4. NEMA4X (IP66) polyester with a clear polycarbonate face.
5. Display flow rate, relay states, 16-digit totalizer, operating mode, and calibration menu.
6. Analog Output: Isolated 4-20mA (1 kΩ load max.).
7. Control Relays: Two (2) 5 A rated SPDT, programmable flow alarm, and/or proportional pulse.
8. Data Logger: Built-in 26 million point logger with USB output and Windows software.
9. Operating Temperature: -10 °F to 140 °F.
10. UL Listed.

G. Cable:

1. Provide sufficient standard length of manufacturer's signal cable connecting sensor and

converter without splice.

H. Accessories:

1. Provide coupling compound and a stainless steel mounting bracket with adjustable pipe straps.

PART 3 – **EXECUTION**

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Include Engineer tag number as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 72 00
LEVEL MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Items specified in this section shall be provided by Contractor.

C. Section includes field level elements, sensors, and transmitters for Process Instrumentation and Control.

D. Ranges and performance parameters are listed in Section 40 70 00.

E. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. ANSI: American National Standards Institute

B. CSA: Canadian Standards Association

C. EN: European Standards (generic)

D. FM: Factory Mutual

E. IEC: International Electrotechnical Commission

F. NEC: National Electrical Code

G. NEIS: National Electrical Installation Standards

H. NEMA: National Electrical Manufacturers Association

I. NIST: National Institute of Standards and Technology

J. NRTL: Nationally Recognized Testing Laboratory

K. OSHA: Occupational Safety and Health Administration

L. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 BALL FLOAT LEVEL SWITCH

A. Manufacturers:

1. Contegra FS 90.
2. Siemens 9G-EF.
3. Or Equal.

B. Float: 316 Stainless Steel.

C. Provide sufficient length of PVC jacketed cable.

D. For Class I, Divisions 1 or 2 hazardous (classified) locations, provide intrinsically safe relays in corresponding control panel.

E. Mounting Hardware: 316 Stainless Steel on vertical mounting pipe or Stainless Steel cable with anchor weight as indicated on Drawings.

F. Switch: Non-Mercury tilt type 1A @ 150VAC/VDC non-inductive.

2.02 MICROWAVE RADAR LEVEL ELEMENT AND TRANSMITTER

A. Manufacturers:

1. VEGA
2. Siemens
3. Or Equal.

B. Antenna:

1. Design transducer to emit radar signal with time lapse between transmitted and received signal converted into usable voltage capable of driving totalizer, sample rate counter, and flow rate meter or liquid level indicator. DC voltage produced shall be proportional to distance from detector to material being measured.
2. Operating temperatures: -40°F to +392°F.
3. Impervious to damage from submersion in wastewater or concentrated ferric chloride or alum, and have high resistance to corrosive and gaseous industrial atmosphere.
4. Mounting shall be as shown on Drawings. Other methods of mounting will be considered if recommended by detector manufacturer.
5. Non-contact design detector with no moving parts or mechanical linkages.
6. Explosion-proof certified by Factory Mutual Research (FM) for Class I, Division I, Groups C and D when sensor is located in hazardous area.

C. Transmitter:

1. Provide remote indicator for monitoring unit.
2. Linear, isolated 4-20 mAdc HART, signal for remote indication from each monitoring unit.
3. Enclosure: NEMA 12 for interior applications. NEMA 4X for exterior application or wet locations. Wall mounted where noted, otherwise integral with sensor.
4. Explosion-proof certified by Factory Mutual Research (FM) for Class I, Division I, Groups C and D when transmitter is located in hazardous area.
5. Temperature:

    a. Ambient: -40°F to 176°F.
    b. Process: -40°F to 266°F.

6. Loop Power: 24VDC

D. Cable:

1. Provide sufficient length of cable as standard with manufacturer to connect level sensor to monitoring unit without splicing.

E. Design Requirements:

1. Accuracy of system: +1% of full scale at any point in calibrated range.
2. Based on Drawings, installation details, and Section 40 70 00, radar manufacturer shall select radar equipment; type of antenna, horn diameter and coordinate antenna length, or extensions required, with Contractor for each monitoring location.
3. Radar shall be configured and programmed by manufacturer's representative on-site.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Include Engineer tag number as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

SECTION 40 73 00
PRESSURE, STRAIN, AND FORCE MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes field pressure elements, sensors, switches, and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. ANSI: American National Standards Institute

B. CSA: Canadian Standards Association

C. EN: European Standards (generic)

D. FM: Factory Mutual

E. IEC: International Electrotechnical Commission

F. NEC: National Electrical Code

G. NEIS: National Electrical Installation Standards

H. NEMA: National Electrical Manufacturers Association

I. NIST: National Institute of Standards and Technology

J. NRTL: Nationally Recognized Testing Laboratory

K. OSHA: Occupational Safety and Health Administration

L. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.
2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 PRESSURE GAUGE/ INDICATOR

A. Manufacturer:

1. Ashcroft 1009.
2. U.S. Gauge, Division of Ametek, Inc.
3. Wika.
4. Or Equal.

B. Gauge Housing Material: 316 Stainless Steel

C. Mounting: Stem

D. Dial Size: 3-1/2 inch

E. Units shall be bellows or Bourdon tube actuated pressure gauges. Gauges shall be stem mounting with 3-1/2-inch dial size, unless otherwise noted.

F. Accuracy shall be ±1% of span at ambient conditions of 73.4°F and 29.92” Hg barometric pressure. ASME B40.100 Grade 1A minimum.

G. The sensing element material shall be phosphor-bronze if coupled with diaphragm seal, otherwise provide type 316 stainless steel.

H. Element shall sense pressure or vacuum with scale range as specified in Section 40 70 00.

I. Element shall be suitable for temperatures of media monitored.

J. Liquid filled for alleviation of vibration.

K. For pressure applications up to a maximum of 10psi:

1. Provide bellows type gauge (Ashcroft 1188 or equal).
2. Compound style (suitable for vacuum and pressure).
3. Case Material: Phenolic.
4. Bellows and Socket material: Type 316 stainless steel. Media being measured must be compatible with the wetted parts of the pressure instrument.
5. Window: laminated safety glass.
6. When a diaphragm seal is used, it shall be a high displacement style.

L. Accessories:

1. Include isolation valve to isolate from process when being serviced.
2. When noted in Section 40 70 00 or shown on Drawings, provide with diaphragm seal as specified in this Section.

2.02 ANNULAR PRESSURE SEAL, FLANGE CONNECTION

A. Manufacturer:

1. Red Valves Series 40.
2. RKL (a Red Valve Company).
3. Onyx Valve Company
4. Or Equal.

B. End Connections: ANSI 150 pound flanged unless otherwise noted

C. Flange Construction: Carbon Steel

D. Flexible Cylinder: Buna-N

E. Filling Fluid: Silicone Oil

F. Unit shall be pressure-sensing, pipe spool type suitable for measuring dirty or corrosive fluids up to a working pressure of 275 psi.

G. Unit shall consist of a carbon steel pipe spool and an elastomeric liner with a space between filled with the noted fluid.

H. Unit shall be arranged and designed to directly transmit the process pressure by means of the fluid through an opening in the spool wall to a pressure-sensing device attached and sealed to the spool by a drilled and threaded boss.

I. Unit shall be sized as noted in Section 40 70 00.

J. Seal shall be suitable for fluid pressures to 200 psig and shall be furnished with a Buna-N flexible cylinder, unless otherwise noted.

K. Unit shall have fill connections and other features required to permit refill of the seal volume and calibration of unit in the field.

2.03 PRESSURE SWITCH

A. Manufacturers:

1. Ashcroft Type 400/700 Series.
2. Or Equal.

B. Adjustable setpoint pressure.

C. Set Point Repeatability: +/- 1% of range

D. Pressure setpoint as noted in Section 40 70 00.

E. Fixed deadband.

F. Hermetically sealed SPDT rated at 5 amps, 120Vac. (may be wired normally open or normally closed).

G. Process connection: ½ inch NPT.

H. Type: Housed diaphragm type.

I. Actuator Seal: Buna-N.

J. Housing: NEMA 4 or NEMA 7 as required for installation environment.

K. Adjustment: External tamperproof.

L. Options: When more than one discrete signal is shown on drawings, provide dual SPDT outputs.

M. Accessories:

1. Include isolation valve to isolate from process when being serviced.
2. When noted in Section 40 70 00, provide with diaphragm seal as specified in this Section.

2.04 PRESSURE INDICATING TRANSMITTER

A. Manufacturer:

1. Rosemount 3051L with 1199 Seal.
2. Endress and Hauser PMP 75 with Seal.
3. Or Equal.

B. Differential capacitance open loop principle device to produce analog current signal as function of liquid level input to it.

C. Mounting: 3”, 150-lb flange mount.

D. Housing: Threaded cover, NEMA 4.

E. Wetted Parts (Process Side): Flush mount, Type 316 stainless steel diaphragm.

F. Measurement Requirements:

1. Range of measurement as described in Section 40 70 00.

G. Output: 4-20 mAdc into 400 ohms (24Vdc power) or 1,000 ohms (45Vdc power).

H. Adjustments: Zero, span, and dampening.

I. Performance:

1. Accuracy: ±0.15% of span including temperature and static pressure effects.
2. Turndown: 100:1 or better.
3. Temperature: Operating range -40°F to +185°F, minimum.

J. Construction: NEMA 7 explosion-proof, FM approved for Class I, Division 1 service when located in classified area.

K. Accessories:

1. Weatherproof integral output indicator scaled to engineering units indicated in Section 40 70 00.
2. Provide 3", flange mount 316 stainless steel transmitter isolation knife gate valve drilled and tapped with two 1/4" NPT flushing ports. Valve shall be Wey Valve Incorporated Model TI3 (TI3/316/316/S2/P2/UC/PPD2) or equal.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Include Engineer tag number as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

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SECTION 40 74 00
TEMPERATURE MEASUREMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this section shall conform to general requirements of Section 40 61 13.

B. Section includes thermal field elements, sensors, and transmitters for Process Instrumentation and Control.

C. Ranges and performance parameters are listed in Section 40 70 00.

D. Training in accordance with Section 40 61 26.

1.02 ABBREVIATIONS AND REFERENCES

A. ANSI: American National Standards Institute

B. CSA: Canadian Standards Association

C. EN: European Standards (generic)

D. FM: Factory Mutual

E. IEC: International Electrotechnical Commission

F. NEC: National Electrical Code

G. NEIS: National Electrical Installation Standards

H. NEMA: National Electrical Manufacturers Association

I. NIST: National Institute of Standards and Technology

J. NRTL: Nationally Recognized Testing Laboratory

K. OSHA: Occupational Safety and Health Administration

L. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:
1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are not acceptable.

B. Product Data:
1. Catalog cuts and product specifications for instrumentation specified.

C. Shop Drawings:
1. Installation and assembly drawings and specifically prepared technical data for instrumentation specified.

2. Submit in accordance with Section 01 33 00.

D. Operation and Maintenance (O&M) Data:
1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Items provided under this Section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).
1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

1.05 MEASUREMENT

A. Measurement ranges and performance parameters as listed in specification Section 40 70 00.

PART 2 – PRODUCTS

2.01 TEMPERATURE TRANSMITTER, UNIVERSAL

A. Manufacturers

1. Rosemount 3144P
2. Endress+Hauser iTEMP
3. PR Electronics 7501
4. Or Equal

B. Transmitter capable of accepting RTD, T/C, mV, and ohm sensor inputs to produce analog current signal as a function of process temperature.

C. Pre-assembled extension fitting and transmitter head with temperature element and thermowell as specified elsewhere in this section, unless noted otherwise.

D. Construction: NEMA 7 explosion-proof, FM approved for Class I, Division 1 service when located in classified area.

E. Temperature element as specified in Section 40 70 00.

F. Extension Fittings and Connection Heads

1. Nipple Coupling.
2. Materials: 316 stainless steel.
3. Process: 1 inch NPT connection, unless noted otherwise.
4. NEMA 4X Enclosure.
5. Flat Cover type with threaded cover.
6. Materials: Low-copper aluminum alloy.
7. Electrical: 3/4 inch NPT connection, unless noted otherwise.

G. Transmitter

1. Transmitter Type:
   a. Loop powered, 2-wire.
   b. Locate within connection head.

2. Performance:
   a. Ambient Temp: -20°F to +120°F. Variations shall not affect accuracy by more than plus or minus 0.25 percent of range per 50°F.
   b. Accuracy: Plus or minus 0.25 percent of reading, or, plus or minus 0.25°F, whichever is greater. Conform to SAMA Standard RC 21-4-1966.
   c. Repeatability: Plus or minus 0.1 percent of span.
   d. Response Time: Less than 10 seconds (bare bulb test in agitated water).

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed to each unit (where sensor and transmitter separately mounted).

B. Engrave with process application as listed in Specifications.

C. Include Engineer tag number as listed in Specifications and on Drawings.

3.03 TRAINING

A. Provide training as specified in Section 40 61 26.

END OF SECTION

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SECTION 40 78 00
PANEL MOUNTED INSTRUMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Items specified in this Section shall conform to general requirements of Section 40 61 13.

B. Section includes control panel devices for Process Instrumentation and Control Systems.

1.02 ABBREVIATIONS AND REFERENCES

A. IEC: International Electrotechnical Commission

B. IEEE: Institute of Electrical and Electronics Engineers

C. NEC: National Electrical Code

D. NEIS: National Electrical Installation Standards

E. NEMA: National Electrical Manufacturers Association

F. NRTL: Nationally Recognized Testing Laboratory

G. OSHA: Occupational Safety and Health Administration

H. UL: Underwriters Laboratories

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section.
2. Submit Product Data and Shop Drawings in one complete submittal package.
3. Partial submittals are not acceptable.

B. Product Data:

1. Catalog cuts and product specifications for devices specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for control devices specified.
2. Submit in accordance with Section 01 33 0.

D. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic test/calibration/cleaning for instrumentation and controls in service.
3. Submit in accordance with Section 01 78 23.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing instrumentation of types and capacities indicated that have record of successful in-service performance.

B. Devices shall be latest and most modern design at time of bidding.

C. As much as possible devices shall be products of one manufacturer to achieve standardization for maintenance, spare parts, operation, and service.

PART 2 – PRODUCTS

2.01 PILOT DEVICES.

A. Manufacturer:

1. Allen Bradley 800T/800H.
2. Square D Class 9001, Type K.
3. Or Equal.

B. Construction:

1. Heavy duty.
2. Watertight.
3. Oil-tight.
4. Flush panel mounting.
5. Size to mount in 30.5-mm diameter cutout.
6. Match NEMA rating of device with the installed location environmental classification.

C. Pilot devices on panels shall be identified as follows:

1. Equipment Off/Closed = Red.
2. Equipment On/Open = Green.
3. Alarm = Red.
4. Start = Green.
5. Stop = Red.
6. Emergency Stop = Mushroom Head Push-Pull (Red).
7. Warning = Amber.
8. Power = White.

D. Pushbuttons:

1. Flush head unless specified elsewhere.
2. Contact Blocks:

a. Double break silver contacts.
b. Ac Ratings: 7,200 va make, 720 va break.
c. Single pole, single throw.
d. Up to six tandem blocks.

3. Momentary contact unless specified elsewhere.
4. Non-illuminated.
5. Legend plates, as required, for type of operation or as specified elsewhere.

E. Emergency Stop:

1. Jumbo red mushroom head.
2. Contact Blocks:

    a. Double break silver contacts.
    b. Ac Ratings: 7,200va make, 720va break.
    c. Single pole, single throw.
    d. Up to six tandem blocks.

3. Push/pull.
4. Maintained contact.
5. Non-illuminated.
6. Legend plates:

    a. Extra large.
    b. Yellow.
    c. Round.

F. Selector Switches:

1. Maintained position unless specified elsewhere.
2. Contact Blocks:

    a. Double break silver contacts.
    b. Ac Ratings: 7,200va make, 720va break.
    c. Single pole, double throw or double pole, single throw.
    d. Up to six tandem blocks.

3. Operators:

    a. Number of positions as specified elsewhere.
    b. Standard knob type unless specified elsewhere.

4. Legend plates as required for type of operation or specified elsewhere.

G. Pilot Lights:

1. LED Lamp.
2. Transformer type.
3. Bayonet, 6Vac bulb.
4. Colored lens as specified elsewhere.
5. Interchangeable lenses.
6. Transformer rated for 120Vac
7. Push to test.
8. Legend plates as specified elsewhere.

H. Control Stations.

1. NEMA rating as follows:

    a. NEMA 7 in Class I, Division 1 or 2 Hazardous (Classified) Locations.
    b. NEMA 4X 316 Stainless Steel in indoor wet or corrosive locations or outdoors.
    c. NEMA 12 in other areas.

2. Nameplates:

    a. Engraved laminated plastic.

b. Letters 3/16 in. high.
c. Black letters on white background.
d. Identify per equipment controlled, using names found on Drawings.

2.02 MOTOR STARTER CONTROL RELAYS.

A. Manufacturer:

1. Square D.
2. Cutler-Hammer.
3. Or Equal.

B. Construction:

1. Industrial type.
2. 300Vac rated.
3. Ac operation.
4. Used for operation of large motor starter coils or other 120Vac loads whose current requirements (continuous or inrush) exceed capacity of control relays listed below.

C. Operating data:

1. Pickup time: 11 ms maximum.
2. Dropout time: 6 ms maximum.

D. Coil:

1. Molded construction.
2. 120Vac, 60Hz.
3. Continuous rated.
4. 155va inrush, maximum.
5. 22va sealed, maximum.

E. Contacts:

1. Double break.
2. Silver alloy.
3. Convertible.
4. Color-coded to indicate status.
5. 60 amp make, 6 amp break (120Vac inductive).

F. DIN rail-mounting capability.

G. Accessories:

1. Add-on pole attachment.

a. 4 NO and 4 NC contacts.
b. Add-on to 0 to 4-pole relay.

2. Latch attachment.

2.03 CONTROL RELAYS.

A. Manufacturer:

1. Allen Bradley
2. Potter and Brumfield.
3. Idec.
4. Magnecraft.
5. Or Equal.

B. Operating Data:

1. Pickup Time: 13 ms maximum.
2. Dropout Time: 10 ms maximum.
3. Operating Temperature: -45°F to 150°F.

C. ac Coil:

1. 120Vac.
2. Continuous rated.
3. 3.5va inrush maximum.
4. 1.2va sealed, maximum.
5. 50-60 Hz.
6. Light to indicate energization.
7. Minimum Dropout Voltage: 10% of coil rated voltage.

D. dc Coil:

1. 24Vdc.
2. Continuous rated.
3. Light to indicate energization.
4. Minimum Coil Resistance:

a. 24Vdc: 450 Ω.

E. Contacts:

1. Gold flashed fine silver, gold diffused for 1 amp or less resistive load.
2. Silver cadmium oxide.
3. 3 form C.
4. 300Vac.
5. 10 amp make, 1.5 amp break, (inductive).

F. Rated at 10 million operations.

G. 11 pin, square socket.

H. DIN rail mountable.

I. Enclosed and protected by polycarbonate cover.

J. Visible indication of energized coil.

K. Provide relay-retaining clips.

2.04 TERMINAL BLOCKS

A. Manufacturer:

1. Phoenix Contact.

2. Weidmuller.
3. Or Equal.

B. 300 v rating for 120 v circuits and below, 600 v rating for 480 v circuits.

C. Clamping screw type.

D. Isolating end caps for each terminal.

E. Identification on both terminals.

F. Clip-mounted on DIN rail.

G. Accepts AWG 12 to 22.

H. Feed-Through Terminals:

1. 20 Amp rating

I. Switched Terminals:

1. Knife disconnect with test sockets.
2. 10 Amp rating.

J. Fused Terminals:

1. Hinged fuse removal/disconnect.
2. 10 Amp rating.
3. Include blown fuse indication.

2.05 ELECTRONIC CURRENT ISOLATOR

A. Manufacturer:

1. Phoenix Contact Model MCR Series.
2. PR Electronics.
3. Or Equal.

B. Solid state instrument to electrically isolate one instrument loop from another instrument loop. Converter to accept 4-20 mAdc input signal and provide equal but isolated and power-boosted output.

C. Mounting: DIN Rail.

D. Temperature compensated, calibration-free.

E. Input: 4-20 mAdc into 50 ohms.

F. Output: 4-20 mAdc into output load up to 500 ohms.

G. Isolation: Common mode up to 700Vac between input and output.

H. Accuracy: 0.5% of span.

I. Provide power supply specific to isolator.

2.06 SURGE PROTECTORS

A. Manufacturer:

1. Islatrol - IE-100 series
2. SOLA STFE Elite Series.
3. No Substitute Permitted.

B. High frequency noise filter/surge protector to protect control panel incoming power supply.

C. Wire to protect specified microprocessor based process control system devices including:

1. PLC
2. Ethernet Switches
3. OIU
4. Any other microprocessor based equipment located in or powered from PLC Panel.

D. Input power:

1. 120 or 240Vac, model dependant.
2. 47-63 Hz.

E. Peak surge current: Minimum 10,000 amp line-neutral, line to ground, and neutral to ground.

F. Frequency response:

1. Normal mode: 90 dB max, 100 kHz to 50 MHz.
2. Common mode: 60 dB max, 5 MHz to 50 MHz.

G. Response time:

1. < 0.5 ns normal mode.
2. <5 ns common mode.

H. Transient protection per IEEE C62.41:

1. Category A Ringwave (6kV, 200A, 100 MHz): < 60 V peak.
2. Category B Ringwave (6kV, 500A, 100 MHz): < 100 V peak.

I. LED status indicator.

J. Form C contact for remote status indication.

2.07 INTRINSICALLY SAFE BARRIERS

A. Manufacturer:

1. PR Electronics
2. Or Equal.

B. Intrinsically safe barrier located in safe area, allow intrinsically safe interface to devices located in Class I, Division 1 or 2, Group C or D hazardous (classified) locations per National Electrical Code ANSI/NFPA 70 (NEC).

C. Non-Zener Diode mode of protection

D. UL and CE listed, FM approved.

E. Operating temperature range -20 to 60 degrees F.

F. Supply voltage: 20–35 VDC.

G. DIN rail mounted.

H. Isolation: 250 V rms between safe and hazardous area terminals.

I. LED indication of operation status and malfunction.

J. Discrete Input

1. Suitable for monitoring of switch closure, NAMUR sensors.
2. Capable of line fault detection when specified, provide series and parallel resistors at switch location when line fault detection specified.
3. Safe area contact ratings: 125 VAC, 0.5 A, resistive.

K. Analog Input

1. Suitable for monitoring of 4-20 mAdc signals.
2. Safe area output: Isolated 4-20 mAdc, active or passive dependant on application.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install and wire in accordance with equipment/instrument manufacturer's written instructions, approved submittals, applicable requirements of the NEC, NEIS, and recognized industry practices.

3.02 IDENTIFICATION

A. Provide Type 316 stainless steel tag permanently affixed adjacent to each device that has Engineer tag number referenced on Drawings.

B. Engrave Engineer tag number as listed in Specifications and on Drawings.

END OF SECTION

DIVISION 43

PROCESS GAS AND LIQUID HANDLING EQUIPMENT

SECTION 43 23 13
SCUM PUMPING EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes:

1. Scum Pump 1 (SMP-1).

1.02 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Pump shall comply with Schedule 1 of this Section.
2. Provide prerotation pump system with each scum pump including suction bell, pump removal system, and a prerotation basin. Prerotation system shall be self-cleaning and shall be capable of capturing, entraining, and pumping floatables and other debris. Pump rotation shall be as shown on Drawings.
3. Pumps shall be single-passage, clog-free pump, utilizing screw-centrifugal impeller.
4. Suitable for pumping primary scum (PSM).
5. Equipment shall remain free from excessive noise and vibration per HI standards for a single-vane centrifugal pump.
6. Design equipment so parts readily accessible for inspection and repair, easily duplicated and replaced, and suitable for service specified.
7. Pump shall be sized for operating in a continuous, non-submerged conditions.
8. Adequately size motor horsepower so each pump is non-overloading throughout entire pump performance curve.
9. Entire pumping unit, including pump, motor and power cable assembly, monitoring equipment, and pump removal system shall be suitable for installation in Class I, Division 1, Group D hazardous classified locations as approved by Factory Mutual.

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Manufacturer's specification and descriptive literature.
2. Performance Data.
3. Head, capacity, horsepower demand, and pump efficiency curves from shut-off to maximum capacity of pumps.
4. Head, capacity, horsepower demand, and pump efficiency for points specified in the Submersible Centrifugal Pump Schedules.
5. Motor data. Submit in accordance with Section 26 05 84
6. Coating systems. Submit in accordance with Section 09 96 00.
7. Recommended procedures for job site storage, handling, installation, and start-up.
8. Quantity and type of spare parts to be supplied

C. Shop Drawings:

1. Detailed layout drawings.
2. Installation and assembly drawings and specifically prepared technical data for submersible centrifugal equipment.
3. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of submersible centrifugal equipment with referenced standards.
2. Certified reports of field tests and observations.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of submersible centrifugal equipment in service.
3. Submit in accordance with Section 01 79 10.

G. Submit Instructional Services information in accordance with Section 01 79 30.

1.04 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.05 SOURCE QUALITY CONTROL

A. Factory Certified Performance Test(s):

1. Perform on each pump in accordance with test requirements of Hydraulic Institute (HI) 14.6. Pumps shall meet performance acceptance grade 2B requirements.
2. Determine capacity, head, brake horsepower and hydraulic efficiency.
3. Test each pump at minimum of 6 points, at rated capacity specified, and at flow rate greater than maximum capacity specified in Scum Pumping Equipment Schedule 1.
4. Prepare and submit certified performance curves.
5. Test actual assembled pumps to be provided. Results of prior tests on similar or identical pumps are not acceptable.

B. Factory Certified Hydrostatic Test(s):

1. Perform on each pump.
2. Minimum test pressure shall be 1.5 times pump shutoff head.
3. Prepare and submit report of results.
4. Test actual assembled pumps to be provided. Results of prior tests on similar or identical pumps are not acceptable

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All equipment and parts shipped to the job site shall be properly protected from the elements so that no damage or deterioration occurs from the time of delivery to the time when the installation is complete and the units are placed into operation.

B. Store equipment in a clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

1.07 SPARE PARTS

A. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

1. One set of bearings per pump model.
2. One set mechanical seals per pump model.
3. One complete set of gaskets per pump model.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Prerotation Hidrostal

2.02 PUMP

A. Single passage, clog-free pump utilizing a screw-centrifugal impeller.

B. Overall pump design shall combine high efficiency, low required NPSH, large solid passage, and the ability to handle rags or other fibrous material without plugging.

C. Hydraulic design of impeller shall combine the action of a positive displacement screw with the action of a single-vane centrifugal impeller to provide a single non-bifurcated flowstream with only gradual changes in flow direction.

1. Leading edge of impeller vane shall blend into the impeller body in such a way that any rag or other fibrous material caught on the leading edge and folded over both sides of the vane will be unfolded and released as the textile follows the flowstream through the pump.
2. Impeller flange or impeller shall contain a spiral groove on the rear face so that any solids in the pumped media are discharged from the space between the backplate and the rear of the impeller.

D. Geometry of the impeller and suction piece shall be conical, so any axial adjustment of the impeller will cause the clearance between the impeller and suction piece to change uniformly along the entire length of the impeller.

E. Suction and discharge flanges shall be drilled to meet ANSI 125-lb bolting.

F. Cast Iron Construction:

1. Pump volute, backplate, and suction piece: ASTM A 48, Class 30 cast iron.
2. Impeller and volute liners: 450 Brinell hardness hi-chrome Iron ASTM A532, Class 111 Type A. Statically and dynamically balanced.

3. Suction piece or impeller shall be externally adjustable to compensate for wear by means of regulating screws so that the necessary running clearances between the liner and impeller can be maintained for optimum hydraulic efficiency.

G. Shaft Sealing: Tandem mechanical seal arrangement contained in an oil chamber.

1. Seal nearest bearing shall utilize carbon/ceramic faces. Isolate seal cooling oil from bearing frame.
2. Seal nearest impeller shall be stainless steel or rubber bellows-type construction, attached to rotating face and clamped to shaft to prevent contaminants from contacting stainless steel springs that load seal face. Solid tungsten-carbide rotating face running against solid silicon-carbide stationary face.
3. The mechanical seal nearest the impeller shall be isolated from contaminants in the pumped media and shall be designed to minimize debris reaching the seal.
4. Provide a flush port on the seal nearest impeller.
5. Tandem mechanical seal arrangement requiring external flush are not acceptable.
6. Seals shall be dimensionally interchangeable with standard off-the-shelf, in-size, John Crane mechanical seals.

H. Suction Bell:

1. Material: 316 stainless steel.
2. Provide spun sleet suction bell to prevent premature vortexing of the liquid column to extend the prerotation range.

2.03 MOTOR

A. Horsepower and requirements as specified in Schedule 1 of this Section.

B. 460 v, 3-ph, 60 Hz

C. 1.13 minimum service factor.

D. Inverter duty rated

E. NEMA B designed for continuous duty.

F. Explosion proof rated for Class 1, Division 1 area.

G. Immersible type, suitable for full-load continuous operating in either submerged or non-submerged conditions.

H. Motors shall be air filled with stator and rotor housed in a watertight chamber containing only air.

I. Motors shall incorporate a separate heat-exchanger circuit, with a shaft-mounted cooling impeller circulating oil from a jacket surrounding the stator housing to a heat-exchanger surface cast into the pump backplate. The circulating oil shall transfer excess motor heat directly to the pumped media inside the pump volute, without the need of submergence for adequate motor cooling at any continuous power output up to and including rated powers in ambient of 40°C.

J. Motor stator windings and leads shall be insulated with moisture resistant, Class F insulation rated for 155°C.

K. Motors shall have the stator varnish applied by the "vacuum-pressure impregnation" method to ensure thorough and complete varnish penetration. The stator shall be heat-shrink fitted into the stator housing.

L. Watertight motor cable entry:

1. The sealing components shall be mechanically isolated from cable strains by a two-piece restraining clamp, which will securely grip the cable above the moisture-sealing components and bear any mechanical forces applied to the cable.

2. The cable moisture seal shall consist of an elastomer grommet, prevented from extruding past the cable by stainless-steel retaining washers on either side. The grommet shall be compressed tightly against the cable outside diameter (and the entry assembly inner diameter) by a screwed follower gland.

3. Each individual conductor shall be interrupted by a solid-copper isolation dam to prevent wicking of moisture through the conductor strands.

4. The cable insulation shall be sealed by an epoxy poured into the cable entry and totally encapsulating the stripped-back insulation and the individual copper dams. This poured epoxy seal shall also function as a redundant seal for the cable outside diameter.

5. The cable free end shall be sealed from moisture-entry during shipping, storage, and prior to connection to the control panel by a plastic sleeve securely clamped over the cable end.

M. Protection Devices:

1. Provide normally open thermal sensors embedded in the stator windings, wired in series, to open a protective circuit if winding temperature exceeds rated operating temperature. Supply relay as required.

2. Provide conductivity probe to monitor moisture content of the oil in the chamber between the mechanical seals. Wire probe to a separate protective circuit, to provide a 'seal fail'.

3. Cable leads for the protection devices shall be housed separately from the power cable, and the protection device cable sealing system shall be identified to the power cable sealing system.

N. Power/Control Cable:

1. Size in conformance with National Electric Code (NEC) standards.
2. Provide adequate length to connect to splice box without splicing.

2.04 PREROTATION BASIN AND BAFFLES

A. Manufacturer shall provide a prefabricated basin for installation by the Contractor. Manufacturer shall be responsible for the design geometry and shall certify that the installed basin(s) will allow the prerotation system to meet the specified pumping criteria.

B. Manufacturer shall provide a rectangular fiberglass basin of the appropriate geometry that allows the basin, pump/motor and discharge base pipe fast-out to be pre-assembled outside the wet-well for simplified field installation. The basin shall be so constructed that it can be easily filled with concrete outside the wet-well by the Contractor, and the manufacturer shall furnish a plate and/or a discharge base pipe, which both locates and contains the anchor bolts for the fast-out during the concrete pour. This plate/discharge base pipe shall also be designed so that it can be used to rotate and move the basin after filling. Three eye bolts shall also be encapsulated in the concrete for lifting and lowering, and the anchor bolts and eye bolts shall be furnished by the manufacturer.

C. After the concrete has set, the basin shall be turned over using the locator plate/discharge base pipe, the fast-out shall be mounted on the anchor bolts, and the pump can/shall be attached to the fast-out while outside the wet-well. The assembly can/shall then be lowered into the wet-well for final adjustment and grouting.

D. The prefabricated basin shall be constructed of a minimum thickness 1/4" reinforced fiberglass. The coating shall be a gel coat of 9-12 mils equal to Pittsburgh Paint #56-5335 (blue).

2.05 PUMP REMOVAL SYSTEM

A. Provide guide rail, pump mounting base, discharge base pipe, and lifting chain and cable for pump removal. Provide anchor bolts and accessories for complete system. System shall comply with design and performance requirements and as specified. See Section 05 50 00.

B. Guide system - Provide two Type 316 stainless steel guide rails, upper and intermediate guide brackets as recommended by pump manufacturer for connecting rail(s) to structure, and slide bracket for connecting pump to guide rail(s). Guide cables in lieu of guide rails are not acceptable.

1. Guide rail diameter and thickness as recommended by pump manufacturer.
2. Provide upper guide rail bracket with integral hooks on both sides of guide plate that fastens to structure.
3. Contractor to verify elevations during submittal process.

C. Discharge base pipe:

1. Provide for automatic, leak-tight connection to pump discharge. Pump shall be supported by a positive metal-to-metal contact interlocking flange, additionally by a nitrile rubber ring. Discharge base pipe shall be horizontal pipe (elbow is not acceptable) thru the wall as shown on Drawing 5-M-05.
2. ANSI B16.1 Class 125 flange for connection to piping.
3. Provide for connection of guide rails.

D. Furnish pump lifting-chain positive-recovery system consisting of the following:

1. Provide high tensile strength proof-tested Type 316 stainless steel chain, minimum 10 links, of required capacity to lift pump. Connect short-length of lifting chain to lifting bail of submersible pump.
2. Provide length of Type 316 Stainless Steel guide cable (wire-rope) connected to short-length of lifting chain to extend min. 5-feet beyond top of wet well.

a. Guide cable shall be suitably sized to support chain and length of cable hanging.
b. Connecting link between guide cable and chain shall be sized to allow grip-eye to slip over to access chain links.
c. Ends of cable shall not be frayed. Weld or epoxy ends to prevent fraying.
d. Contractor shall coil additional length at top of wet well and use Type 316 stainless steel wire to hold coil shape.
e. If no hooks are provided with upper guide bracket, Contractor shall provide Type 316 stainless steel hook at top of wet well from which to hang guide cable. Type 316 stainless steel wire tie coil to hook.
f. At free end of guide cable attach plastic tag or stainless steel tag with the words "NOT FOR LIFTING PUMP" stamped into tag. Grip-Eye shall be able to slip over attached tag without interference.

3. Furnish forged eye of stainless steel, provided separately to connect to the end of the lifting cable or chain of Owner's pump lifting device.

4. Eye shall be sized per pump manufacturer's recommendation.
5. Provide miscellaneous hardware for installation, including shackles to connect short-length of lift chain to pump lifting bail and link to connect short-length of lift chain to guide cable. Material: Type 316 Stainless Steel.

2.06 FASTENERS

A. Anchor bolts: Stainless Steel. Comply with pump manufacturer's requirements and in accordance with Section 05 50 00.

2.07 COATINGS

A. Manufacturer is responsible for surface preparation, priming, and finish coating of equipment prior to shipment.

A. Provide in accordance with Section 09 96 00 unless specified otherwise in this Section.

B. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

C. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install in accordance with Manufacturer's written instructions and approved submittals.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for workdays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

a. 1 workday for Installation Services
b. 1 workday for Instructional and Startup Services

2. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

SCUM PUMPING EQUIPMENT
SCHEDULE 1

Name of Pump(s)	Scum Pump 1
Tag Number(s)	SMP-1
Number of Pumps	1
Fluid Pumped	Primary Scum (PSM)
Discharge Size	4 inch
Minimum Spherical Solids Size	3 inches
Maximum Motor Horsepower	5.2
Motor Voltage	460 v, 3-phase, 60 hz
Maximum RPM	1,720
Constant or Adjustable Speed	Adjustable Speed
Performance Requirement at Rated Speed	
Maximum Speed (rpm)	1,720
Design Operating Point 1	
Capacity (gpm)	150
Head (ft)	41
Design Operating Point 2 (at reduced speed)	
Capacity (gpm)	110
Head (ft)	37
Design Operating Point 3 (at reduced speed)	
Capacity (gpm)	100
Head (ft)	22
Operating Point along Pump Curve at 100% speed - Shut-off	
Capacity (gpm)	0
Head (ft)	50
Operating Point along Pump Curve at 100% speed - at Run-out	
Capacity (gpm)	360
Head (ft)	20

END OF SECTION

SECTION 43 23 57
PROGRESSING CAVITY PUMP EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. GBT 2 Thickened Sludge Pump (GBTDP-2-212)

a. Casing temperature sensor (TE-212).
b. Motor thermal switch (TSH-212)

2. Primary Filtration Thickened Sludge Pump 2 (PFTSP-2)

a. Casing temperature sensor (TE-174).
b. Motor thermal switch (TSH-174).

1.02 REFERENCES

A. ASTM: American Society for Testing and Materials

1.03 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Pump shall be positive displacement, progressing cavity type with gear joint or a positively sealed and lubricated pin joint drive train.
2. Pumping equipment shall comply with the Progressing Cavity Pump Schedule(s) of this Section.
3. Equipment shall be suitable for thickened primary filtration sludge (PFTS) at solids concentrations up to 7 percent.
4. Equipment shall be free from shock, vibration, cavitation, overheating, and excessive noise while operating at specified conditions.
5. Equipment shall continuously operate without damage while operating under load.
6. Design equipment so parts are readily accessible for inspection and repair, easily duplicated and replaced, and suitable for service specified.

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for progressing cavity equipment specified.
2. Motor data. Submit in accordance with Section 26 05 84.
3. Coating systems. Submit in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for progressing cavity equipment.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Test Results:

1. Certified reports of manufacturer's factory production and final test curves indicating compliance of progressing cavity pumping equipment with this section.
2. Certified reports of field tests and observations.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of progressing cavity equipment in service.
3. Submit in accordance with Section 01 79 10.

G. Submit Instructional Services information in accordance with Section 01 79 30.

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain progressing cavity equipment system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver progressing cavity equipment and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store progressing cavity equipment in clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

1.07 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.
   a. One rotor and stator per pump model.
   b. One complete set of O-rings, gaskets, and seals per pump model.

2. Provide special tools required for checking, testing, parts replacement, and maintenance.
3. Spare parts shall be suitably packaged and clearly labeled and identified with the name and number of the equipment to which they belong.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Seepex SCT Series

B. Moyno EZ Strip Series

2.02 MATERIALS

A. Suitable for application specified in the Progressing Cavity Pump Schedule(s) and as specified below.

1. Suction Housing: thick-walled cast iron, ASTM 35.
2. Bearing Housing: thick-walled cast iron, ASTM 35.
3. Rotor: Alloy Steel, SAE 1045, ASTM A331-90, grade 4150 cold finish with yield strength greater than 55,000 pounds per square inch plated with 0.01-inch of hard chrome Duktil Coated (1250 Vickers Hardness).
4. Stator: Nitrile 100, 70 Durometer hardness.
5. Pin joints: High speed steel, air hardened to 60-65 HRc.
6. Connecting rod: Machined of alloy steel, SAE 1045, ASTM 331-90, grade A8630.
7. Plug-in shaft: 1.4021(ASTM 420 – SS2303) stainless and hardenable steel.

2.03 PUMP FABRICATION

A. General:

1. All cast iron parts shall be free from sand holes, blow holes, and other defects.
2. Suction connection for GBTDP-2-212 shall be 6” flanged rotated upwards for connection to discharge hopper provided by Contractor; coordinate requirements with Contractor if dimensions are different from that shown in Progressing Cavity Pump Schedule.
3. Suction connection for PFTSP-2 shall be 6” flange rotated horizontal.
4. Discharge connections shall be 6” flanged with bolt hole dimensions and spacing to ANSI standards.

B. Pump:

1. Housing shall include a 1” NPT drain connection.

C. Rotor:

1. Rotor shall be of one-piece construction with integrally machined rotor head.
2. Rotor shall be of one-piece construction with rotor head attached by a key for ease of maintenance.
3. Rotors cut to length with welded rotor heads shall not be acceptable.
4. Rotor shall have single helix design.
5. Rotors shall be replaceable without dismantling the pump suction or discharge flanges or associated piping. Pumps that require additional space for axial/horizontal removal of the rotor shall not be allowed.

D. Stator:

1. Stator housing shall allow for maintenance in place by changing of the pump rotor and stator without disconnecting the pump discharge piping.
2. The opening of the stator, on the suction side of the pump, shall be beveled to at least a 30 degree angle from the vertical to lesson entrance losses.

3. Stators shall be replaceable without dismantling the pump suction or discharge flanges or any associated piping. Pumps that require additional space for axial/horizontal removal of the stator shall not be allowed.
4. Stator shall be rigidly fastened to the suction housing and discharge flange by one of the following methods:

    a. Seepex: Fasten stator to pump with four thru-bolts. The fit between the rotor and stator at the point of contact shall compress the stator material sufficiently to form a seal and to prevent leakage from the discharge back to the inlet end of the pumping chamber
    b. Moyno: Stator shall be molded with a seal integral to the stator elastomer preventing the metal stator tube and the bonding agent from the elastomer from contacting the pumped liquid.

5. Seepex stator designs shall additionally incorporate a retensioning feature to compensate for wear in lieu of increasing pump speed.
6. Stators shall be manufactured to size. Stators made in long lengths and cut to size are not acceptable.

E. Bearings:

1. Bearing shall be integral to the pump or gear/motor, designed for all loads imposed by specified service.
2. Bearings shall be grease lubricated, tapered roller or ball bearing type with diverging pressure angles to maximize shaft stability. Bearings located in a gear box shall be oil lubricated.
3. Bearings shall be designed for a minimum B-10 life of 100,000 hours under maximum operating conditions and shall not require periodic lubrication.
4. Bearings shall be protected from contaminates by means of a bearing cover plate bolted to the bearing housing.

F. Drive Components:

1. Drive:

    a. Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod. The pin shall be constructed of high speed steel, air hardened to 60-65 HRc. The joint shall be grease lubricated with a high temperature (450° F), PTFE filled synthetic grease, covered with Buna N sleeve and positively sealed with hose clamps constructed of 304 stainless steel.

2. Bushed Pin Joints:

    a. Each pump rotor shall be driven through a positively sealed and lubricated pin joint. The pin joint shall have replaceable bushings, constructed of air-hardened tool steel of 57-60 HRc, in the rotor head and coupling rod.
    b. Joint shall be grease or oil lubricated and covered with Buna N sleeve and positively sealed with hose clamps constructed of 304 stainless steel.
    c. Stainless steel shell shall cover the rotor side universal joint assembly to protect the elastomer sleeve from being damaged by tramp metals or glass.

3. Drive shaft and Sealing:

    a. Shaft shall be of one-piece construction through the bearings and shaft seal area.
    b. Drive shaft shall be coated in the packing contact area with the same chromium nitride material of 1250 Vickers hardness that is used as the rotor coating. The stuffing box shall

be of ample depth for 5 rings of packing and be provided with lantern rings and seal water flush connections.

c. Seal shall be flushless and require no seal water.

G. Pump and motor shall be mounted on a common fabricated steel base.

H. Motors:

1. 460 Volt, 3-phase, 60 Hertz.
2. Horsepower and speed as stated in Progressing Cavity Pump Schedule(s).
3. Inverter duty rated.
4. Provide motors Class F insulation, totally enclosed fan cooled (TEFC) motor for each pump to achieve specified capacity and not exceed Code G starting characteristics.
5. Gearbox/Gearmotor: pumps shall be of the compact, close-coupled design. The gear reducer shall be sized for a minimum service factor of 1.5 and designed with a thrust load capability of 150 percent of the actual thrust load.
6. Motor shall conform to requirements of Section 26 05 84.
7. Motors shall be suitable for use with adjustable frequency drives provide under Section 26 29 23. Provide torque, horsepower and speed requirements and additional information required to adjustable frequency drive manufacturer.
8. Size to prevent overheating and damage to motor when operating over entire range of specified operating conditions.
9. Provide a thermal sensor (TSH-174, TSH-212) for each pump imbedded in windings to provide signal for alarm and shutdown at high motor temperature.

2.04 DRY RUN PROTECTION

A. The stator shall be fitted with a sensor sleeve and PT-100 RTD temperature sensor (TE-174, TE-212) to monitor casing temperature.

2.05 COATING

A. Provide in accordance with Section 09 96 00 unless specified otherwise in this Section.

B. Manufacturer is responsible for surface preparation, prime coat, and second coat of equipment in the factory prior to shipment unless otherwise noted.

C. Manufacturer is responsible for the surface preparation and all motor coatings in the factory prior to shipment.

D. Contractor shall provide final third finish coat for equipment in the field and be responsible for touchup and any additional specified coatings.

E. Final color of exposed equipment and motors shall be selected by Owner.

F. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

G. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install progressing cavity equipment in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for man-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

a. 1 workdays for Installation, Instructional and Post Startup Services.

2. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

PROGRESSING CAVITY PUMP SCHEDULE 1	
Name of Pump(s)	GBT 2 Thickened Sludge Pump
Tag Number(s)	GBTDP-2-212
Number of Pumps	1
Fluid Pumped	Thickened Primary Filtration Sludge up to 7%
Motor Horsepower	20
Maximum RPM	1,800
Discharge	6" (Seepex), 8" (Moyno)
Suction	6" (Seepex), 8" (Moyno)
Motor	460 volt, 3-phase, 60 Hertz
Motor Mounting	Direct Drive
Maximum Spherical Solids Size	32.5 mm
Constant or Variable Frequency	Variable Frequency Constant Torque
Hazardous Classification	Class I, Division 2, Group D
Normal Operating Point	
Capacity (gpm)	40 to 75
Total Dynamic Head (psi)	5 to 70 psi
Maximum Speed (rpm)	140
Max Design Operating Point	
Capacity (gpm)	150
Total Dynamic Head (psi)	10 to 70 psi
Maximum Speed (rpm)	270
Note: Items listed above including horsepower and sizing is for "A" manufacturer. If "B" manufacturer requires higher horsepower or alternate sizing, then Contractor shall provide at no additional cost all electrical changes and motor. Pipe layout drawings are based on "A" manufacturer. If "B" manufacturer requires additional fittings and reduces, then Contractor shall provide at no additional cost all changes.	
rpm = revolutions per minute gpm = gallons per minute ft = feet	

PROGRESSING CAVITY PUMP SCHEDULE 2	
Name of Pump(s)	Primary Filtration Thickened Sludge Pump 2
Tag Number(s)	PFTSP-2
Number of Pumps	1
Fluid Pumped	Thickened Primary Filtration Sludge up to 5%
Motor Horsepower	30
Maximum RPM	1,800
Discharge	6
Suction	6
Motor	460 volt, 3-phase, 60 Hertz
Motor Mounting	Direct Drive
Maximum Spherical Solids Size	32.5 mm
Constant or Variable Frequency	Variable Frequency Constant Torque
Hazardous Classification	Not Rated
Design Normal Operating Range	
Capacity (gpm)	40-50
Total Dynamic Head (psi)	5 to 70 psi
Maximum Speed (rpm)	100
Max Design Operating Point	
Capacity (gpm)	195
Total Dynamic Head (psi)	15 to 60 psi
Maximum Speed (rpm)	350
Note: Items listed above including horsepower and sizing is for "A" manufacturer. If "B" manufacturer requires higher horsepower or alternate sizing, then Contractor shall provide at no additional cost all electrical changes and motor. Pipe layout drawings are based on "A" manufacturer. If "B" manufacturer requires additional fittings and reduces, then Contractor shall provide at no additional cost all changes.	
rpm = revolutions per minute gpm = gallons per minute ft = feet	

END OF SECTION

SECTION 43 23 78
DOUBLE DISC PUMPING EQUIPMENT

PART 1 – **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Primary Filtration Thickened Sludge Pump 1 (PFTSP-1).
2. Pressure Gauges PI-171S and PI-171D.
3. Discharge pressure sensor and switch assembly (PSH-171).
4. Internal Thermal Overload Protection (TSH-173) for motor.
5. Pulsation dampeners.

1.02 DEFINITIONS

A. NPT: National Pipe Thread.

1.03 REFERENCES

A. OSHA: Occupational Safety and Health Act.

1.04 SYSTEM DESCRIPTION

A. Design Requirements:

1. Pumping equipment shall comply with the Schedule(s) of this Section.
2. Equipment shall be suitable for pumping fluid as specified in the Schedule(s) of this Section.
3. Equipment shall be continuous, unattended operation.
4. Equipment shall operate dry without damage.
5. Equipment shall be self-priming.
6. Design equipment so parts readily accessible for inspection and repair, and suitable for service specified.
7. Design of equipment shall not require removal of pump from process piping for routine maintenance or disc replacement.
8. Motor horsepower shall be non-overloading throughout entire pump performance curve.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for double disc pumping equipment specified.
2. Motor data in accordance with Section 26 05 84.
3. Coating system in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for double disc pumping equipment.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of double disc pumping equipment with referenced standards.
2. Certified reports of field tests and observations.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of rotary lobe equipment in service.
3. Submit in accordance with Section 01 79 10.

G. Submit Instructional Services information in accordance with Section 01 79 30.

1.06 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain double disc pumping equipment system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver double disc pumping equipment and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store double disc pumping equipment in clean, dry location.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Penn Valley Pump Co.

2.02 MATERIALS

A. Suitable for application specified in the Schedule(s) of this Section and as specified below:

1. Housing: Class 30 Cast Iron housings with glass lining
2. Discs: High tensile neoprene, with multiple layers of fabric for longevity and strength.
3. Disc connecting rods: High tensile aluminum.
4. Trunnions: Fabric-reinforced neoprene
5. Clack Valve: Neoprene with multiple layers of fabric encapsulating a rigid core.
6. Shaft: Hardened high-tensile stainless steel.

7. Cams: High tensile, cast bronze alloy.
8. Frame and Base: 316 stainless steel.
9. Pump shall incorporate a “Maintain-in-Place” design that does not require pump removal from frame or disconnecting of piping for maintenance.

2.03 PUMP FABRICATION

A. General:

1. Pump shall be a simplex heavy duty, double disc, positive displacement type.
2. Pump shall have three housings, horizontally spit with hinged housings, to allow access to the internal components.
3. Pump shall operate dry without damage.
4. Pumping action shall be achieved by two free floating, non-captive discs attached to connecting rods driven by a rotating shaft and eccentric cams. The reciprocating action of the discs shall function to prevent back flow. No internal check valves shall be required.

B. Pump Housing:

1. Disc shall be mounted to the connecting rod by a hardened, high strength, stainless steel stub shaft.
2. Flexible trunnions shall seal the pump fluid chamber.
3. Line with porcelain glass

C. Suction Port:

1. A 6-inch, two-piece “swan neck” style port shall convey flow to the suction housing to minimize debris buildup.
2. Clack valve shall be full port, have an integral O-ring, and shall be integrally mounted to the ‘swan neck’. The mounting face shall be machined.

D. Drive Assembly:

1. Drive shaft shall be stainless steel and minimum 1-15/16 inch diameter, withstanding a dead head situation.
2. The shaft shall be mounted on four self-aligning, sealed bearings. The eccentric cams shall be pinned or keyed to the shaft. Bearings shall not require grease lubrication.
3. The pump shall be V-belt driven consisting of 2 groove Type B arrangement.
4. The pulley ratios shall be sized to provide the maximum pump speed listed in the Schedule(s) of this Section and to provide the required torque generated between the pump and the motor.
5. Provide OSHA approved, 316 stainless steel frame and covers.

E. Mounting:

1. Pump and V-belt assembly shall be mounted on a side motor opposite hand mounting frame.
2. Mount pump and V-belt assembly on a common sub base manufactured from 2.5-inch square tubing. Base shall be of sufficient gusseted, reinforcing, and braces to withstand loads and resist wearing and buckling at all times. Cap ends of tubing with black plastic plugs.

F. Pulsation Dampeners:

1. Provide on the suction and discharge lines.
2. Pulsation dampener shall be mounted on a 6 inch flanged glass lined spool piece.

3. The main tube shall be 8 inch diameter, schedule 40 carbon steel pipe with fully welded end cap.
4. Provide pulsation dampener assembly with a 1 inch flanged connection located at the top, suitable for connection with the vacuum and pressure switch assembly.
5. 60 pounds per square inch maximum pressure.
6. 150 pounds per square inch, standard flanges.

G. Motor:

1. Motor shall be 480 volt, 3 phase, 60 Hertz, totally enclosed fan cooled (TEFC) inverter duty type.
2. Motor shall conform to requirements in Section 26 05 84.
3. Motor size as specified in the Schedule(s) of this Section.
4. Provide a thermal sensor (TSH-173) embedded in windings to provide signal for alarm and shutdown at high motor temperature.

H. Pressure Protection:

1. Pressure sensor and switch shall be mounted to the top of the suction and discharge pulsation dampeners.

   a. PI-171S, PI-171D and PSH-171.

2. Provide pressure sensors with diaphragm seals on the discharge pulsation dampener. PVP420, Red Valve42/742 or equal: 1 inch NPT, PVC body, EDPM elastomeric sensing tube, glycerine filled. The process pressure is sensed through a 360-degree elastomeric tube, where glycerine transfers pressure to the gauge and switch.
3. The suction pulsation dampener shall be fitted with a 4-inch stainless steel 30 inch Mercury – 30 pounds per square inch gauge.
4. The pressure assembly, on the discharge pulsation dampener, shall be fitted with a 4-inch stainless steel 0 – 60 pounds per square inch gauge and an adjustable pressure switch factory set at 60 pounds per square inch: Ashcroft, Barksdale, or equal.
5. All assembly fittings shall be 316 stainless steel.
6. Provide assemblies with capability to be cleaned in place by air from an air compressor. Assembly shall have a PVC ball valve mounted to the top of the sensor, where the other end is fitted with a universal, quick acting coupling suitable for the application.

2.04 COATINGS

A. Provide in accordance with Section 09 96 00 unless specified otherwise in this Section.

B. Manufacturer is responsible for surface preparation, prime coat, second coat and final third finish coat of equipment in the factory prior to shipment unless otherwise noted.

C. Manufacturer is responsible for the surface preparation and all motor coatings in the factory prior to shipment.

D. Contractor be responsible for touchup.

E. Final color of exposed equipment and motors shall be manufacturer's standard color scheme.

F. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

G. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – **EXECUTION**

3.01 INSTALLATION

A. Install double disc pumping equipment in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for workdays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

   a. 1 workdays for Installation, Instructional and Post Startup Services.

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

SCHEDULE 1 TO SECTION 43 23 78 Primary Filtration Thickened Sludge Pump 1	
Name of Pump(s)	Primary Filtration Thickened Sludge Pump 1
Tag Number(s)	PFTSP-1
Number of Pumps	One
Fluid Pumped	Thickened Primary Sludge 1.5% to 3%
Motor Horsepower	20
Full Load Amps	25.4
Maximum Motor RPM	1,160
Discharge	6-inch
Suction	6-inch
Motor	460 volt, 3-phase, 60 Hertz
Constant or Variable Frequency	Variable Frequency
Hazardous Classification	Not Rated
Performance Requirement at Rated Speeds	
Maximum Pump Speed (rpm)	300
Primary Design Operating Point	
Capacity (gpm)	200
Total Dynamic Head (feet)	138
Secondary Design Operating Point	
Capacity (gpm)	250
Total Dynamic Head (feet)	92
Tertiary Design Operating Point	
Capacity (gpm)	330
Total Dynamic Head (feet)	50
Minimum Operating Point	
Capacity (gpm)	40
Total Dynamic Head (feet)	20
rpm = revolutions per minute gpm = gallons per minute ft = feet	

END OF SECTION

SECTION 43 25 13
SUBMERSIBLE CENTRIFUGAL PUMPS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Primary Filtration Influent Pump 1, 2, 3 and 4 (PFIP-1, -2, -3, -4)
2. Pump removal mechanism for each pump.
3. Controls-related equipment for each pump.

1.02 REFERENCES

A. ANSI: American National Standards Institute.

B. ASTM: American Society of Testing and Materials.

C. NEC: National Electrical Code.

D. NEMA: National Electrical Manufacturers Association.

1.03 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Pumping equipment shall comply with Submersible Centrifugal Pump Schedule(s) of this Section.
2. Equipment shall be suitable intended installation.
3. Equipment shall be suitable for pumping materials indicated in Submersible Centrifugal Pump Schedule(s).
4. Equipment shall be suitable for continuous operation at maximum fluid temperature of 104 degrees Fahrenheit (F) at all operating speeds specified and without external cooling fluid.
5. Motor horsepower of each pump shall be non-overloading throughout entire pump performance curve.
6. Design motor for up to 10 evenly spaced starts per hour.
7. Equipment shall be free from shock, vibration, cavitation, overheating, and noise while operating at specified conditions.
8. Motor housing shall be air filled to provide dissipation of heat, permanent bearing lubrication and prevent airborne moisture contamination.
9. Equipment shall be continuous operation without damage while operating under load and unsubmerged.
10. Design equipment for continuous submergence under water without loss of watertight integrity to depth of 65-feet.
11. Design equipment for removal and reinstallation of pumps without need to enter wet well and without removal of fasteners.
12. Design pump removal guide mechanism and permanently mounted discharge connection elbow so no part of pump bears on wet well structure.
13. Connection of pump to permanently mounted discharge elbow shall not leak.
14. Design equipment so parts readily accessible for inspection and repair, easily duplicated and replaced, and suitable for service specified.
15. Entire pumping unit, including pump, motor and power cable assembly, monitoring equipment, and pump removal system shall be suitable for installation in Class I, Division 1, Group D hazardous classified locations as approved by Factory Mutual.
16. Casing shall be end suction with centerline discharge.

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Manufacturer's specification and descriptive literature.
2. Performance Data.
3. Head, capacity, horsepower demand, and pump efficiency curves from shut-off to maximum capacity of pumps.
4. Head, capacity, horsepower demand, and pump efficiency for points specified in the Submersible Centrifugal Pump Schedules.
5. Motor data. Submit in accordance with Section 26 05 84
6. Coating systems. Submit in accordance with Section 09 96 00.
7. Recommended procedures for job site storage, handling, installation, and start-up.
8. Quantity and type of spare parts to be supplied

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for submersible centrifugal pumps.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of submersible centrifugal equipment with referenced standards.
2. Certified reports of field tests and observations.
3. Pump supplier shall provide model tested station design to assure trouble-free pump operation.
4. Factory NPSH test data from identical size pumping unit.

E. Submit in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of submersible centrifugal equipment.
3. Submit in accordance with Section 01 79 10.

G. Submit Instructional Services information in accordance with Section 01 79 30.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

1. Emergency Service: Manufacturer or manufacturer representative maintains service center capable of providing training, parts, and emergency maintenance and repairs at Project site with 48 hours maximum response time.

B. Single-Source Responsibility: Obtain submersible centrifugal pump system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.06 SOURCE QUALITY CONTROL

A. Factory Certified Performance Test(s):

1. Perform on each pump in accordance with test requirements of Hydraulic Institute (HI14.6 – Grade 1U) for Rate of Flow, Total Head, Power and Efficiency.
2. Determine capacity, head, brake horsepower and hydraulic efficiency.
3. Test each pump at minimum of 6 points including shutoff, at rated capacity specified, and at flow rate greater than maximum capacity specified in Submersible Centrifugal Pump Schedule(s).
4. Prepare and submit certified performance curves.
5. Test actual assembled pumps to be provided. Results of prior tests on similar or identical pumps are not acceptable.

B. Factory Certified Hydrostatic Test(s):

1. Perform on each pump.
2. Minimum test pressure shall be 1.5 times pump shutoff head.
3. Prepare and submit report of results.
4. Test actual assembled pumps to be provided. Results of prior tests on similar or identical pumps are not acceptable.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver submersible centrifugal pumps and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store submersible centrifugal pumps in a clean, dry location.

C. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site.

1.08 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

a. One set of bearings for each pump model.
b. One mechanical seal set for each pump model.
c. One set of o-rings for each pump model.
d. One gasket set complete for each pump model.

2. Provide special tools required for checking, testing, parts replacement, and maintenance.
3. Spare parts shall be suitably packaged and labeled with the name and number of the equipment to which they belong.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Flygt

B. Sulzer

2.02 MATERIALS

A. Suitable for application specified in Submersible Centrifugal Pump Schedule(s) of this Section and as specified below:

1. Pump case: Cast iron, ASTM A-48, Class 35B C.I.
2. Motor housing: Cast iron, ASTM A-48, Class 35B C.I.
3. Impeller: ASTM A-532 (Alloy III A) 25% chrome cast iron or cast iron, ASTM A45, Class 35B with the leading edges hardened to minimum 450 Brinell.
4. Seal housing: Cast iron, ASTM A-48, Class 35B C.I.
5. Discharge base elbow: Cast iron, ASTM A-48, Class 35B C.I.
6. Pump/motor shaft: ASTM A479 S43100T or A276 Type 420 Stainless Steel
7. O-rings: Viton or NBR.
8. Fasteners: Stainless steel, ASTM A276, Type 316.
9. Lower seal faces: Silicon or Tungsten-carbide (rotating seal ring) versus Silicon or Tungsten-carbide.
10. Upper seal faces: Silicon or Tungsten-carbide (rotating seal ring) versus Silicon or Tungsten-carbide.
11. Guide rails and brackets: Stainless steel, ASTM A276, Type 316.
12. Lift chain or cable: Stainless steel, Type 316 Stainless Steel.
13. Power/control cable: chloropene rubber or neoprene. Each cable shall be provided with Type 316 stainless steel Kellum grips for strain relief.
14. Anchor bolts: Stainless steel, ASTM A276, Type 316. See Section 05 50 00.

2.03 PUMP FABRICATION

A. General:

1. Provide metal-to-metal contact machined surfaces.
2. Machine and fit mating surfaces with O-rings where watertight sealing is required. All mating surfaces shall be flame proof joints with special labyrinth joint to prevent flame or spark travel to pumped media.
3. Rectangular cross sectioned gaskets, elliptical O-rings, grease, or secondary sealing compounds are not acceptable.
4. Pump with attached rail guides and discharge sealing flange.

B. Impeller:

1. Non-clog type, semi-open or enclosed, multi-vane, back swept design passing minimum spherical solid size specified in Submersible Centrifugal Pump Schedule(s) of this Section.
2. Impeller design shall handle solids, fibrous materials, heavy sludge, rag-laden and other matter found in waste water.
3. Leading edges shall be mechanically self-cleaned upon each rotation across a spiral groove located on volute bottom.
4. The volute (Flygt) shall have replaceable suction cover insert ring which is cast spiral-shaped, sharp-edged grooves, insert ring shall be ASTM A-532 (Alloy III A) 25% chrome cast iron.
5. The volute (Sulzer) shall have replaceable suction cover which is cast spiral-shaped, sharp-edged grooves. Stainless steel wear rings shall be hardened to minimum 450 Brinell.

6. Internal volute bottom shall provide effective sealing between pump volute and impeller.
7. Sharp spiral grooves shall provide shearing edges across which each impeller vane leading edge shall cross during its rotation in order to remain unobstructed.
8. Clearance between internal volute bottom and impeller leading edges shall be adjustable.
9. Impeller vanes shall have screw-shaped leading edges hardened to Rockwell (Rc) 45.
10. Balance statically and dynamically.
11. Impellers shall be locked to the shaft.
12. All impellers shall be coated with an alkyd resin primer.

C. Shaft:

1. Provide common pump/motor shaft. Pump shaft shall be extension of motor shaft. Pump shaft and motor shaft with connection coupling is not acceptable.
2. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with moisture sensor a float type switch that will signal if the chamber should reach 50% capacity.

D. Shaft Seals:

1. Provide 2 totally independent mechanical seals each with its own independent spring system, installed in tandem, with an oil chamber between seals.
2. Provide 1 stationary and 1 positively driven rotating seal ring for each seal.
3. Easily inspected and replaced.
4. Shall not require maintenance or adjustment.
5. Shall not depend on direction of rotation for sealing.
6. Shall not rely on pumped media for sealing.
7. Lower seal shall be replaceable without disassembly of seal chamber or use of special tools.
8. Pump-out vanes shall be present on backside of impeller to keep contaminants out of seal area.
9. Provide seal leak detection probe in motor housing.
10. Provide drain and inspection plug with positive anti-leak seal easily accessible external to pump.
11. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a moisture sensor or float type switch that will signal if the chamber should reach 50% capacity.

E. Bearings:

1. Heavy-duty single row to provide minimum L-10 life of 100,000 hours at axial and radial loadings while operating at specified operating conditions.

F. Motor:

1. Horsepower as specified in Submersible Centrifugal Pump Schedule(s) of this Section.
2. 480v, 3-ph, 60 Hz.
3. IEEE Premium Efficiency Motor. Minimum motor efficiency of 93 percent at 100 percent of full load.
4. 1.15 minimum service factor per NEMA Standards.
5. Inverter duty rated, NEMA MG 1, Part 31.
6. Moisture resistant, Class H insulation rated for 180 degrees Celsius (C).

7. Use trickle impregnation method or VPI Process (Vacuum Pressure Impregnation) using Class H monomer-free polyester to fill voids in windings. Shall meet minimum 95 percent fill factor. Multiple step dip and bake-type stator insulation process is not acceptable.
8. Explosion proof rated for Class I, Division 1 area.
9. Suitable for continuous operation at 40 degrees C over ambient temperature.

G. Cooling system: Provide motor cooling to comply with design and performance requirements.

H. Power/Control Cable:

1. Size in conformance with National Electrical Code (NEC) standards.
2. Provide watertight cable entry seal to comply with design and performance requirements.
3. Provide length to connect to splice box without splicing.

2.04 PUMP MONITORING MODULES

A. Pump monitoring modules and sockets to be installed under Division 40 of the Project Documents for all pumps listed in the Submersible Centrifugal Pump Schedule(s) of this Section. Install pump monitoring modules as shown on Process and Instrumentation Diagram for Primary Filtration Influent Pumping.

B. Pump monitor shall provide dual function monitoring for both over-temperature via bi-metal, thermistor, or RTD sensor and seal failure via moisture sensor or float switch. Only low-voltage leakage system allowed.

C. Each module shall provide dual color (red/green) light-emitting diodes (LED) for alarm status (one for each fault indication), power LED as well as Test and Reset push buttons.

D. Module shall provide independent 100 ma, 24 Volt AC or 5 amps, 210 Volt AC rated Form C outputs for both over-temperature and seal failure. Module shall have a 24 Volt AC or 24-240 Volt AC input power range, a 2.8 watt power consumption, and shall be UL approved.

2.05 PUMP REMOVAL SYSTEM

A. Provide guide rail, pump mounting base, discharge base elbow, and lifting chain and cable for pump removal. Provide anchor bolts and accessories for complete system. System shall comply with design and performance requirements and as specified. See Section 05 50 00.

B. Guide system - Provide Type 316 stainless steel single or two guide rails system, upper and intermediate guide brackets as recommended by pump manufacturer for connecting rail(s) to structure, and slide bracket for connecting pump to guide rail(s). Guide cables in lieu of guide rails are not acceptable.

1. Guide rail diameter and thickness as recommended by pump manufacturer.
2. Provide upper guide rail bracket with integral hooks on both sides of guide plate that fastens to structure.
3. Contractor to verify elevations during submittal process.

C. Discharge base elbow:

1. Provide for automatic, leak-tight connection to pump discharge.
2. ANSI B16.1 Class 125 flange for connection to piping.
3. Provide for connection of guide rails.

D. Pump Lifting System: Furnish pump lifting-chain positive-recovery system consisting of the following:

1. Provide Grip-Eye System or approved equal for each pump.
2. Provide high tensile strength proof-tested Type 316 stainless steel chain, minimum 10 links, of required capacity to lift pump. Connect short-length of lifting chain to lifting bail of submersible pump.
3. Provide length of Type 316 Stainless Steel guide cable (wire-rope) connected to short-length of lifting chain to extend min. 5-feet beyond top of wet well.

    a. Guide cable shall be suitably sized to support chain and length of cable hanging.
    b. Connecting link between guide cable and chain shall be sized to allow grip-eye to slip over to access chain links.
    c. Ends of cable shall not be frayed. Weld or epoxy ends to prevent fraying.
    d. Contractor shall coil additional length at top of wet well and use Type 316 stainless steel wire to hold coil shape.
    e. If no hooks are provided with upper guide bracket, Contractor shall provide Type 316 stainless steel hook at top of wet well from which to hang guide cable. Type 316 stainless steel wire tie coil to hook.
    f. At free end of guide cable attach plastic tag or stainless steel tag with the words "NOT FOR LIFTING PUMP" stamped into tag. Grip-Eye shall be able to slip over attached tag without interference.

4. Furnish forged Grip-Eye of stainless steel, provided separately to connect to the end of the lifting cable or chain of Owner's pump lifting device.
5. Grip-Eye shall be sized per pump manufacturer's recommendation.
6. Provide miscellaneous hardware for installation, including shackles to connect short-length of lift chain to pump lifting bail and link to connect short-length of lift chain to guide cable. Material: Type 316 Stainless Steel.

E. Anchor bolts: Stainless Steel. Comply with pump manufacturer's requirements and in accordance with Section 05 50 00.

2.06 COATINGS

A. Provide in accordance with Section 09 96 00 unless specified otherwise in this Section.

B. Manufacturer is responsible for surface preparation, prime coat, second, and third coat of equipment in the factory prior to shipment unless otherwise noted.

C. Contractor shall be responsible for touchup and any additional specified coatings.

D. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

E. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install submersible centrifugal pumps in accordance with manufacturer's written instructions.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for man-days indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

   a. 3 workdays for Installation Services.
   b. 1 workday for Instructional Services.
   c. 1 workday for Post Startup Services.

2. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

SUBMERSIBLE CENTRIFUGAL PUMP SCHEDULE 1	
Name of Pump(s)	Primary Filtration Influent Pumps 1, 2, 3 and 4
Tag Number(s)	PFIP-1, -2, -3, -4
Number of Pumps	Four
Fluid Pumped	Primary Influent
Motor Horsepower	60
Max Full Load Amps	80
Maximum RPM	885
Discharge	14 inch (Flygt), 16 inch (Sulzer)
Suction	Flooded
Motor	480 volt, 3-phase, 60 Hertz
Minimum Spherical Solids Size	4.7-inch
Constant or Variable Frequency	Variable Frequency
Hazardous Classification	Class I, Division 1, Group D
Performance Requirement at Rated Speeds	
Maximum Speed (rpm)	885
Primary Design Operating Point	
Capacity (gpm)	7,000
Total Dynamic Head (ft)	18
Minimum efficiency	67
Operating Point 1 (Reduced Speed)	
Capacity (gpm)	7,000
Total Dynamic Head (ft)	13
Minimum efficiency	65
Operating Point 2 (Reduced Speed)	
Capacity (gpm)	3,500
Total Dynamic Head (ft)	10
Minimum efficiency	70
Operating Point 3 (Reduced Speed)	
Capacity (gpm)	3,500
Total Dynamic Head (ft)	15
Minimum efficiency	68
Maximum Operating Point at Maximum Speed	
Capacity (gpm)	1,800
Total Dynamic Head (ft)	10
Minimum Shutoff Head	
Total Dynamic Head (ft)	43 (Flygt), 31 (Sulzer)
Note: Items listed above including horsepower and sizing is for "A" manufacturer. If "B" manufacturer requires higher horsepower or alternate sizing, then Contractor shall provide at no additional cost all electrical changes and motor.	
rpm = revolutions per minute gpm = gallons per minute ft = feet	

END OF SECTION

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DIVISION 44

POLLUTION AND WASTE CONTROL EQUIPMENT

SECTION 44 31 60
ODOR CONTROL FANS

PART 1 – GENERAL

1.01 SUMMARY

A. Provide one (1), 900 cubic feet per minute (cfm) fiberglass reinforced (FRP) exhaust fans designed to draw air from the Primary Filter Tanks at the Primary Filter Building.

B. Fans shall include all appurtenances described herein, be factory tested and balanced and be delivered within the identified schedule. Bid shall include submittals, tools and spare parts, warranty, shipping costs, taxes and start-up and training services.

1.02 SUBMITTALS

A. Shop drawings shall be submitted to the engineer for evaluation and approval in accordance with Section 01 33 00. Fabrication of equipment and ordering of system components shall not begin until the Engineer has approved the shop drawings. The shop drawings shall include at least the following:

1. Certified shop and erection drawings showing important details of construction, dimensions, materials and anchor bolt locations.
2. Descriptive literature, bulletins and/or catalogs of the equipment.
3. A complete bill-of-materials.
4. Complete assembly, foundation and installation drawing together with detailed specifications and data covering materials, parts and other accessories.

B. Submit manufacturer's recycled content percentage or certification for supplied products.

C. Operating and maintenance manuals shall be furnished to the engineer in accordance with Section 01 33 00. The manuals shall be prepared specifically for this installation and shall include detailed operating and maintenance instructions and specifications relative to the assembly, alignment, lubrication, adjustment and maintenance of the unit furnished under this contract, together with complete parts lists of shop drawings, certified dimension drawings and design calculations. The manual shall be approved by the Engineer, prior to equipment start-up and testing.

1.03 QUALITY ASSURANCE

A. Fan manufacturer shall have a minimum of 10 years of experience in the manufacturer of equipment similar to that specified.

B. The Equipment Manufacturer shall provide a list of at least ten (10) U.S. installations where equipment similar to that proposed to be furnished has been in successful operation.

C. The term "installation" shall mean individual projects/contracts. Multiple equipment units for a project shall be considered as one (1) installation toward meeting the experience requirements. Each installation information shall include, but not be limited to, the following:

1. Name and location of the installation.
2. Name of person in direct responsible charge for the equipment.
3. Address and phone number of the person in direct responsible charge.
4. Month and year the equipment was placed in operation.

5. Capacity of Equipment

1.04 MANUFACTURER'S INSPECTION AND START-UP

A. The Contractor shall furnish the services of the equipment manufacturer's qualified field representative to inspect the equipment after installation, provide startup services, and supervise all initial start-up operations and functional testing as specified herein to meet the requirements of Section 01 79 10. Services shall be provided as required to ensure complete and operational equipment.

B. In the event that the equipment does not perform as specified, the Contractor, at no additional expense to the Contract, Owner or the Owner's representative, shall make provisions for the field representative to stay on site until all problems are resolved to the Owners satisfaction.

1.05 MANUFACTURER'S CERTIFICATE

A. The Contractor shall furnish the Engineer with a Manufacturer's Certificate, signed by an authorized representative of the Manufacturer, certifying that the equipment is installed in a complete and satisfactory manner and has been functionally tested such that it is ready for operation.

1.06 TRAINING

A. Provide the service of a qualified manufacturer's representative to thoroughly train Owners personnel in the operation and maintenance of the equipment installed. Training shall be provided as required to ensure Owner's personnel understanding of equipment and shall follow the general outline training requirements specified in Sections 01 79 10 and 01 79 30.

1.07 PROJECT/SITE CONDITIONS

A. The one (1) proposed fan will be located outside adjacent to the Main Control Building. The new fan will be mounted to a new concrete equipment pad

1.08 WARRANTY AND GUARANTEE

A. Contractor shall warrant and guarantee to the Owner that all work will be in accordance with Section 01 78 36, and that the equipment, material, workmanship, performance and installation will not be defective for a period of two (2) years. This warranty will commence upon delivery of the products and will expire on the second (2) year from substantial completion of the installation of the products.

PART 2 – PRODUCTS

2.01 FRP EXHAUST FANS

A. Manufacturers:

Fiberglass reinforced plastic (FRP) fans shall be one of the following, with all appurtenances as described herein. Fans shall be suitable for moving humid air. Fan shall be fabricated in accordance with ASTM D4167 97.

1. New York Blower
2. Hartzell

B. Design Criteria:

Table 1 – Fan Design Criteria	
Tag	EF-105
Design Air Flow Rate (acfm)	900
Design Static Pressure (in. w.c.)	1
Drive Type	Belt
Arrangement	1
Rotation	CCW
Discharge Position	TH
Motor Position	Z
Wheel Size (inches)	-
Shaft and hardware	316 SS
Shaft Seals	Double Lipped Teflon
Brake HP	-
Motor HP	2
Motor Rating	TEFC- Class I/Div 2 Inverter Duty Rated
Motor Heaters	No
Motor Voltage	460V, 3Ø, 60 Hz.
Motor Efficiency	Premium
Minimum Fan Efficiency	-
Air Density (lbs/ft3)	0.0748
Max. Fan RPM	-
Max. Outlet Velocity (ft/min)	-
Base	Unitary Base with Vibration Isolators
Vibration Isolators	Yes
Extended Lube Lines to Outside of Belt Guard	Yes
Radiated Sound with 10 in wc static pressure	85 dBA

C. Fan Materials:

1. All parts that come in contact with the air stream shall be FRP or FRP encapsulated. The fans shall be constructed in strict accordance with ASTM D-4167 standard specification for FRP fans and blowers to ensure structural integrity. Fans shall be statically and dynamically balanced at design operating speed prior to shipment.
2. Fan housing shall be constructed of a fire-retardant vinyl ester resin with an ASTM E84 Class I rating. Housing laminate construction shall conform to ASTM Standard C-582. Airstream surfaces shall be smooth. Fan inlet and outlet shall be flanged. Inlet assembly shall be bolted to allow wheel removal.
3. The fan wheel shall be backwardly-inclined design. Wheel shall be fabricated of a fire-retardant vinyl ester resin with an ASTM E84 Class I rating. Wheel hub shall be permanently bonded to the shaft and completely encapsulated in FRP to ensure corrosion-resistant integrity. Steel wheels coated with FRP are not acceptable.
4. All parts of the fan that may come in contact with the air being handled shall be made of nonferrous material for spark resistance.
5. FRP fan shall have a gel coating with a minimum thickness of 20 mils. Gel coat shall be applied using a 2-coat application process. The final layer shall be a pigmented gel coating containing UV inhibitor. Final surface color of gel coating shall be gray.
6. Welded steel unitary base coated with epoxy enamel to 2-3 mils dry film thickness.
7. 316 stainless steel anchor bolts and hardware.

8. Bearings are to be grease lubricated, precision anti-friction ball or spherical roller, self aligning, pillow block design. Bearings shall be designed for a minimum L-10 life of 30,000 hours when rated at the fan's maximum cataloged operating speed. Fan bearings must be easily accessible for inspection and maintenance.

D. Fan Motors:

1. Fan motors shall be TEFC - Class I, Division 2, 2 HP, premium efficiency, inverter duty rated, 460V, 3-phase.
2. Provided in accordance with Section 26 05 84.

E. Accessories: Each fan shall be provided with the following accessories:

1. Flanged and drilled inlet and outlet
2. Flanged flexible connectors on the connection to fan inlet and outlet
3. Lifting eyes
4. Neoprene gasketing on all bolted FRP joints
5. All hardware shall be 316 stainless steel with nylok fittings
6. Raised and bolted access door
7. Lubricated double lip Teflon shaft seals
8. Unitary base with vibration isolators.
9. Fixed pitch V-belt drive
10. Housing drain with ball valve
11. 316 SS shaft and hardware
12. Double-lip Teflon shaft seals
13. Lube lines extended to outside of belt guard
14. Vibration sensors
15. Inlet and outlet flanged, flexible connectors

F. Finishes:

1. The fan base and support fan structure shall be shop prime painted and finish coated at the factory with industrial grade two-coat epoxy enamel system to a thickness of 2-3 mil dry film thickness.
2. Any defects in painting shall be corrected in the field by the supplier, as required, in accordance with Section 09 96 00.
3. All finish colors shall be gray.
4. All external fasteners shall be of type 316 stainless steel construction.

G. Grounding:

1. All fans shall have a "carbon rich" resin coat on all interior airstream surfaces.
2. Provide grounding straps secured from side of fan housing to steel base.

2.02 FLEXIBLE CONNECTORS

A. Provide flanged flexible connectors for the inlet and outlet of each FRP fan. The connectors shall be constructed of EPDM (1/4" thick minimum) and 304 stainless steel backing bars predrilled to match bolt patterns on fan inlet and outlet flanges. The connectors shall be 8-inches long. Connectors shall be rated for a maximum vacuum of 20-inches water column (w.c.) and a maximum pressure of 60-inches w.c. Connectors shall be J.P. America Model HRF or equal. The connectors must be water-tight and shall not allow condensed water to leak out while in operation.

2.03 ACOUSTICAL JACKET

A. Manufacturer shall provide a factory fitted acoustical jacket for fan as specified in this section. Jacket shall be fully weather resistant and field installed.

B. Material

1. Inner Jacketing: 16.5 oz/sq yd Teflon impregnated fiberglass non-spliced cloth
2. Outer Jacketing:

   a. 16.5 oz/sq yd Teflon impregnated fiberglass non-spliced cloth
   b. Color: Gray.

3. Gussets: 16.5 oz/sq yd Teflon impregnated fiberglass non-spliced cloth
4. Liner: 16 oz/ sq ft mass loaded acoustical septum
5. Insulation:

   a. 1" THK 11# Density "E type" mat, mechanically bound
   b. 1" THK (3" compressed to 1"), LD fiberglass

6. Thread: Teflon coated fiberglass thread
7. Attachments: Teflon coated cloth belts with SST double D-rings, hook and loop seam fastener
8. I.D. Tags: ATC type 304 SST with embossed lettering

C. The estimated reduction in noise level shall be approximately –11 dBA at 3 Feet from housing radiated noise levels based on a Q Factor of 1. Inlet or discharge noise will not be reduced.

2.04 TOOLS AND SPARE PARTS

A. The following spare parts shall be furnished. Only one set is required for both fans. Not one set per fan.

1. One set of replacement belts.
2. One set of shaft seals.
3. One set of bearings of each type and size
4. Any special tools required for the adjustment and operation of the fan
5. One-year supply of lubrication

PART 3 – EXECUTION

3.01 INSTALLATION SUPERVISION, START-UP AND OPERATOR TRAINING

A. Contractor shall electrically ground all fan parts.

B. Upon completion of the installation, the services of the manufacturer's factory trained representative shall be provided at the project site in accordance with Division 01 and as stated in this section.

Startup Assistance	one trip, minimum 4 hours on site
Follow-up Adjustments/Training	one trip, minimum 4 hours on site

C. During the checkout and start-up phase, the manufacturer's representative shall inspect all system components for proper connection and alignment and assist the installation contractor in placing the equipment in a proper operating condition.

D. Upon satisfactory completion of the start-up and calibration, the representative of the manufacturer shall instruct Owner's personnel in the proper operation and maintenance of the equipment in accordance with Section 01 79 10. The manufacturer's representative who will be providing the instruction shall have prior operation, maintenance and instructing experience acceptable to the Engineer.

END OF SECTION

DIVISION 46

WATER AND WASTEWATER EQUIPMENT

SECTION 46 10 10
REFRIGERATED WASTEWATER SAMPLING EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Primary Filtration Effluent Sampler (PFS-SAM-1)

1.02 DEFINITIONS

A. Programmable Logic Controller (PLC)

B. Chlorofluorocarbon (CFC)

C. Fahrenheit (F)

D. Direct Current (DC)

E. Alternating Current (AC)

1.03 REFERENCES

A. National Electrical Manufacturers Association (NEMA)

B. Ingress Protection (IP)

1.04 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. Automatic refrigerated wastewater sampler for sequential and composite sampling applications, suitable for indoor and outdoor installation without additional weather protection.
2. Capable of collecting samples from combined wastewater and shall route the samples to a storage container for collection and analysis.
3. Sampler shall be suited to collect priority pollutant or general purpose samples in multiple bottles.
4. Operate from 115 volt, single-phase power supply.
5. The sampler shall include a plug to be powered by an 115V outlet.

1.05 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for refrigerated wastewater sampling equipment specified.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for refrigerated wastewater sampling equipment.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Submit in accordance with Section 01 33 00.

E. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of equipment in service.

3. Submit in accordance with Section 01 78 23.

1.06 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain Refrigerated Wastewater Sampling Equipment from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver Refrigerated Wastewater Sampling Equipment to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is made safe from such hazards.

B. Store Refrigerated Wastewater Sampling Equipment in clean, dry location.

1.08 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

a. Provide spare parts necessary to maintain the equipment in service for a period of two years, including but not limited to the items listed below:

1) Six (6) pump tubes per sampler (shall be stored in plastic bags out of sunlight)
2) 3/8-inch x 100-feet vinyl suction line
3) One (1) pump assembly

b. Provide special tools required for checking, testing, parts replacement, and maintenance.

c. Spare parts shall be suitably packaged and labeled with the name and number of the equipment to which they belong.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Teledyne ISCO - Model 5800

2.02 AUTOMATIC SAMPLER

A. Sample Pump:

1. Peristaltic pump typically producing a line velocity of 3.0 feet per second in a 3/8 inch inside diameter suction line at 3 feet of head and capable of producing 28 feet of lift.
2. Body of pump shall be constructed of high strength Noryl® plastic and designed for corrosion resistance.
3. Body of pump shall be housed in a separate pocket of the sampler's frame.
4. Before and after each sample is collected, the pump shall air purge the suction line. Pre-purges and post-purges shall be automatically controlled and shall not require pre-calibration adjustments.
5. The sample stream shall be a direct tubing path from sample source to sample bottle.
6. Pump shall contain a latched cover and thumbscrew opening for the replacement of pump tubing.
7. Pump shall contain a built-in magnetic safety interlock where the opening of the latch would remove power to the pump motor.

B. Refrigerator

1. Materials:

a. The shell of the refrigerator shall be constructed of rotationally molded ultra-violet resistant polyethylene with molded-in-place thermal insulation, providing corrosion and weather resistance.
b. Refrigerant used shall be non-CFC with an ozone depletion potential of zero, HFC-134a.
c. Copper refrigeration lines, condenser coil, and evaporator plate shall be powder coated with heat-treated polyester for additional corrosion resistance.
d. Other exposed metal components shall be either plated aluminum or stainless steel.

2. Construction:

a. The top of the refrigerator door shall be recessed and the bottle rack shall slide out for easy accessibility.
b. Refrigerator's door shall have hasps capable of accepting a padlock to prevent unauthorized tampering with the sample compartment.
c. A compression gasket shall be used to seal the refrigerator door.
d. Power supply and solid-state thermostat shall be contained in an epoxy-potted enclosure housed in a separate pocket of the sampler's molded frame.
e. Shall include long-life electronic temperature sensing devices that shall measure the refrigeration compartment and evaporator plate temperatures. A microprocessor shall utilize this to control operation of the compressor, built-in heaters, and self-defrosting cycle.
f. Compressor shall have a high-temperature safety cutout.
g. Condensing coil with forced air cooling.
h. Current unit temperature shall be displayed on display and stored for sampling reports.

3. Performance:

    a. Maintain a sample temperature of 39 degrees +/- 1.8 degree F in ambient temperatures from -20 degrees to 120 degrees F.
    b. Refrigerator shall have a 5-minute recovery time to return to 39 degrees F once the door has been opened for 1-minute in 75 degrees F ambient temperatures

C. Enclosures

1. Top section housing the control panel, pump, distributor electronics, and power supply box shall be NEMA 4X, 6, and IP 67.
2. Sampler shall be designed to operate, indoors and outdoors, without the need for a secondary enclosure.

D. Controller:

1. Controller shall be housed in separate pocket of the sampler's molded frame beneath flip cover.
2. Controller shall use a 2 row, 20 column, 40 total character display to show sampler status and program information.
3. 18-position keypad shall be used for all program entries, manual control of the sampler, and data transfer functions.
4. Sampler's memory shall maintain the program settings, stored programs, and the results of the last sampling sequence when the sampler is turned off or an external power interruption occurs.
5. User initiated diagnostics routine shall determine the operational status of the sampler, any errors detected shall be displayed to the user.
6. Sampler shall have four standard digital alarm outputs capable of direct wiring to the PLC or data logger (5 volt, 100 milliamps).
7. Sampler shall output an event mark of 12 volts DC for the duration of the sample fill, from the flowmeter connector
8. Sampler shall not take samples while a remote dry 2 amp contact is open. Sampling shall be enabled when that contact is closed.

E. Sampler Delivery System

1. Sampler program shall allow the user to select from three types of sample distribution:

    a. Samples per bottle: minimum of 15 samples shall be capable of being deposited in each sample container.
    b. Bottles per sample: all sample bottles shall be capable of being filled with a singe initiation.
    c. Multiple bottle compositing: allow user to simultaneously create a pair of set of bottles containing multiple samples.
    d. Sampler shall deliver repeatable sample volumes accurate to +/- 10ml or +/- 10% of the programmed value.
    e. User can select sample volumes from 10 to 9,990 ml in 1-ml increments.
    f. Sampler shall be able to be programmed to rinse the suction line with source liquid up to three times.
    g. Liquid Detector:

        1) Sampler shall use a non-wetted, non-conductive detector to sense the presence of the liquid and shall not be dependent on, or affected by any compositional, chemical, or physical property of the liquid and require no routine maintenance or cleaning.
        2) Liquid detection system shall minimize the effects of changing head, intermittent flow in the suction line, or variable battery conditions on sample volume.

3) After initial detection of liquid, the sensor shall monitor for the presence of liquid during the sample collection sequence.
4) Liquid detector shall also monitor for anomalies in the sample collection process, if no liquid is detected the sampler shall be capable of retrying the sampling sequence up to three times.

h. Pump Revolution Counter:

1) After liquid detection, the pump revolution counter shall count actual pump revolutions to determine sample volume delivery to the storage containers.
2) If liquid flow is interrupted during the sample collection sequence, the detector shall inhibit the pump revolution counter from incrementing the counter until liquid flow is restored.
3) Automatic compensations for air slugs in the sample shall be made by the delivery system.
4) The pump revolution counter shall monitor the total number of pump revolutions and alert the user when a pre-selected number of counts have been reached.
5) A tubing life indicator shall alert the user to the need for pump tubing replacement on the sampler display screen.

F. Flow Pacing of Samples:

1. User can program the sampler to collect sequential or composite samples at user-definable intervals.
2. A delay to first sample collection shall be programmable in minutes from 1 to 9,999 or by the real time clock.
3. Time Pacing of Samples:

a. Sampler shall use an internal real-time clock to provide both time and date information.
b. Uniform time paced samples shall be collected at regular time intervals from 1 minute to 9,999 minutes.
c. Sample volumes may be equal or proportional to flow.

4. Flow Pacing of Samples:

a. Analog Input

1) Sampler shall have a standard 4-20mA flow proportional input compatible with most flow meters without additional interfacing.
2) Samples shall be equal in volume and taken at variable times proportional to flow.

5. Flow-Weighted Volumes:

a. Analog Input

1) Sampler shall have a standard 4-20mA flow proportional input compatible with most flow meters without additional interfacing.
2) Samples shall be equal taken at equal time intervals and variable volumes proportional to cumulative flow.

6. Distributor

a. Distributor shall be housed in separate pocket of the refrigerator's molded frame
b. Belt-driven by a stepper motor.
c. Optical sensor shall be used for positive location of the distributor arm.

d. A single adjustable distributor arm shall be used for a bottle configurations and sampler mounting possibilities.
e. Distributor arm shall be movable by hand for ease of sample recovery and will relocate itself before the next sample is taken.

7. Sampler Data Storage:

a. Sampler shall be capable of storing key information for each sampling routine.
b. Information shall be accessible at any time during or after a sampling routine on the sampler's display.
c. Sampler shall also create and store two reports: program settings and a sampling results report.
d. Sampling results report shall list the sample number, if error occurred, time of the sample, and the sample temperature.
e. Error codes used in the report shall be listed and defined at the end of the report.
f. Report shall verify correct operation, indicate regulatory compliance, or used as an enforcement document.
g. Program settings shall allow the sampler programming to be verified.
h. Report shall include the sampling mode, enable time or mode, delay to fist sample, and the intervals between samples and other programmed parameters.

G. Suction Lines and Strainers:

1. Provide suction line as shown on the drawings.
2. Suction line shall be made of 3/8 inch ID Vinyl.
3. Strainer shall be made of stainless steel.

H. Sample Collection Containers:

1. Sampler shall be provided with a 5-gallon polyethylene sample containers with lid and polypropylene screw cap.
2. Sample container shall have a wide mouth and contain no inaccessible corners to aid in cleaning.

I. Electrical:

1. Provide sampler with cord and plug for 120 volt, single phase, 20 amp receptacle.

J. Accessories:

1. Provide a PVC flow-through sample chamber with a PVC "stinger" probe.
2. Provide 100% stainless steel weight strainer to be attached to end of each sampler suction line.
3. Fasten hose to strainer using stainless steel or plastic retainers or clamps without protruding edges to collect rags.
4. Provide a minimum of two unpowered Form C contacts as sampler alarm outputs for direct connection to 120 VAC PLC inputs.
5. Provide one 5800 Multi-purpose cable for the Analog input requirement

PART 3 – EXECUTION

3.01 EXAMINATION

A. The Refrigerated Wastewater Sampling Equipment shall be factory assembled and factory run tested prior to shipment.

3.02 INSTALLATION

A. Install Refrigerated Wastewater Sampling Equipment in accordance with manufacturer's written instructions.

3.03 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for workdays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include:

a. 1 workday of Startup Services in include installation verification, start-up and O&M training per Structure.

2. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

END OF SECTION

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SECTION 46 24 23
SLUDGE GRINDERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. PFTS Grinder 1 (GRI-1).
2. Relocate PFTS Grinder 2 (GRI-2) and provide 6” flanged pipe connections.
3. High motor temperature switch (TSH-171).
4. Relocate High motor temperature switch (TSH-172).
5. PFTS Grinder 1 Control Panel (CP-GRI-1).
6. Relocate PFTS Grinder 2 Control Panel (CP-GRI-2).

1.01 REFERENCES

A. American Society for Testing and Materials (ASTM)

B. Underwriters Laboratory (UL)

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. In-line (6” flanged pipe connection) grinder capable of grinding raw wastewater from sanitary sewer, including wipes.
2. Grinder capacity: 350 gallons per minute.
3. At a flowrate of 350 gallons per minute, headloss shall be a maximum 0.8 psi at 6% solids.
4. Nominal cutting area of 12” inches x 8.5 inches.
5. Suitable for continuous operation.

B. Existing Grinder (GR-1-111) and 5 HP motor in GBT Building to be relocated and renamed PFTS Grinder 2 (GRI-2). Provide new 6” flanged pipe connections for existing grinder.

1. Existing Grinder

a. Model No: 30004T-1208
b. S/O: 112767
c. Serial No. 112767-1-1

2. Existing Motor

a. Manufacturer: Baldor
b. Cat. No: 1203353393-000050
c. Spec: M36A003S268G2
d. 5 hp, 460v, 3 ph, 60 Hz.

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for equipment specified.
2. Motor data. Submit in accordance with Section 26 05 84.
3. Proposed coating system. Submit in accordance with Section 09 96 00.
4. Performance data.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for equipment.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.
3. Control sequencing and logic. Provide to Systems Integrator.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of equipment with referenced standards.
2. Certified reports of field tests and observations.

E. Submittals shall be in accordance with Section 01 33 00.

F. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of equipment in service.
3. The amount and specification for any lubricant required.
4. Submit in accordance with Section 01 78 23.

G. Submit Instructional Service information in accordance with Section 01 79 30.

1.04 QUALITY ASSURANCE

A. Items provided under this section shall be listed or labeled by Underwriters Laboratories Inc. (UL) or other Nationally Recognized Testing Laboratory (NRTL).

1. Term "NRTL" shall be as defined in Occupational Safety and Health Administration (OSHA) Regulation 1910.7.
2. Terms "listed" and "labeled" shall be as defined in National Electrical Code (NEC), Article 100.

B. Manufacturer Qualifications: Firms experienced in manufacturing equipment of types and capacities indicated that have record of successful in-service performance.

C. Single-Source Responsibility: Obtain in-line grinder equipment system components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. All equipment and parts shipped to the job site shall be properly protected from the elements so that no damage or deterioration occurs from the time of delivery to the time when the installation is complete and the units are placed into operation.

B. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site, during storage, and during installation.

1.06 SPARE PARTS

B. Extra Materials:

1. Furnish extra materials, matching products installed, necessary to maintain the equipment in service for a period of two years. Package with protective covers for storage and identified with labels describing contents.

a. One complete gasket set per grinder model.
b. One complete set of seals per grinder model.

2. Provide special tools required for checking, testing, parts replacement, and maintenance.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. JWC Environmental Muffin Monster

2.02 CONSTRUCTION

A. General:

1. Grinder shall consist of end housings, covers, shafts, reducer, motor, cutters, spacers, bearings and seals.
2. Grinder shall be two-shaft design, capable of continuous operation processing wet or dry.
3. Two-shaft design shall consist of two parallel shafts alternately stacked with individual intermeshing cutters and spacers positioned on shaft to form helical pattern.
4. Operate at low speeds with maximum cutter speed approximately 60 rpm.
5. Provide coated carbon steel lifting brackets for grinder retrieval. Coating to conform to Section 09 96 00.

B. Cutters and Spacers:

1. Cutters and spacers construction shall be heat treated alloy steel.
2. Cutters shall be hardened to 45-52 Rockwell C, shall be serrated with 17 cam-shaped teeth, have a nominal thickness of 0.438 inches (+0.001/-.001 inch).
3. Spacers shall be hardened to 34-52 Rockwell C, shall have a nominal thickness of 0.446 inches ((+0.001/-.001 inch), and shall have a knurled outside diameter.
4. Inside configuration of both individual cutters and individual spacers shall be hexagonal to fit hexagonal shafts.
5. Total clearance of individual cutters and spacers on shaft shall minimize wear on cutters, and increase compressive strength of spacers.
6. Cutter tooth height shall not exceed ½ inch above root diameter of the cutter.
7. Cutter to cutter clearance shall be a maximum of 0.005 inches.
8. Cutter tip to adjacent spacer shall be nominally 0.015 inches.

C. Shafts:

1. Shafts shall be heat treated AISI 4140 alloy steel with minimum tensile-strength of 149,000 pounds per square inch.
2. Shafts shall be hexagonal shape with a minimum 2 inch diameter.
3. Shafts shall be hardened to 38-42 Rockwell C.

D. Housings and Covers:

1. Housings and covers shall be of ASTM A536-84 ductile iron or ASTM A48 carbon steel, with the exception of the bottom cover, which shall be of A36 carbon steel.
2. Main body housing and bottom end housing shall have integral bushing deflectors to guide solids away from steal cartridges.
3. Main housing side rails shall have evenly-spaced horizontal fingers to maximize flow and maximize capture of solids by cutter stack.

E. Transfer Gears and Low-Speed Coupling:

1. Transfer gears shall be of involute profile and fabricated from heat treated alloy steel.
2. Design transfer gear teeth, thickness and harness, to be suitable for transfer torque up to the rated breakdown torque of the motor.
3. Interface between transfer gears and low-speed coupling shall be factory lubricated with grease.
4. If shaft coupling is used, provide low-speed 3-jaw type coupling. The 3-jaw halves shall be of heat treated alloy steel.
5. If shaft coupling is not used, the gear speed reducer shall be Nord parallel shaft geared type of reducer with "Heavy Shock" load classification. The highspeed shaft of the grinder shall be directly coupled with the reducer without use of a coupling.

F. Speed reducer and High-Speed Coupling:

1. Provide grease lubricated, cycloidal type speed reducer or oil lubricated helical gear reducer.
2. Reduction ratio: 29:1
3. Provide high-speed 3-jaw type coupling with Buna-N spider. The 3-jaw halves shall be of sintered iron.

G. Motor:

1. TEFC motor design
2. 5 hp, 460v, 3 ph, 60 Hz.
3. 1,770 rpm
4. Service Factor: 1.15
5. Motor efficiency shall not be less than 87.5% at full load.
6. Power factor shall not be less than 78% at full load.
7. Provide bimetallic switches imbedded in motor stator windings for detection of motor over-temperature condition.
8. Required running torque:
   a. Grinder shall provide a minimum peak shaft torque of 1,090 lb-in/hp (226 Nm/kW).
   b. Grinder shall provide a minimum peak force at cutter tip of 5,563 lb_f/hp (5,065N/kW).
9. Motor shall be in accordance with Section 26 05 84.

H. Shaft Bearings and Seals:

1. Cutter shaft radial and axial loads shall be borne by sealed oversized deep-groove (Conrad type) ball bearing at each end.
2. Cutter shafts shall be supported on both ends.
3. Shaft seals type shall be mechanical.
4. Each bearing and seal arrangement shall be incorporated into a replaceable cartridge-style housing.
5. Face materials: Tungsten carbide to tungsten carbide.

6. Cutter shaft bearings shall not require external flushing or any periodic lubrication.
7. Mechanical seal cartridges shall be rated at 90-psi continuous duty by seal supplier and shall be rated to operate wet or dry.
8. Bearings shall be housed in replaceable cartridge that supports and aligns bearings and seals.
9. Cartridge shall be independent of stack height. Cutter stack tightness shall not affect seal performance.
10. Seal faces shall maintain factory set preload independent of stack tightness.
11. Seals shall meet required pressure rating regardless of cutter stack fit.
12. Independent seal design shall provide protection against axial loading on shafts and bearings during shaft deflection.
13. O-rings: Buna-N elastomers.
14. Each seal face shall be locked to provide positive drive on rotating face and positive lock on static face.

2.03 CONTROLS

A. Local Control Panels (CP-GRI-1)

1. Provide PFTS Grinder 1 Control Panels (CP-GRI-1).
2. Control Panel shall be UL listed.
3. Control Panel shall be equipped with ON-OFF/RESET-REMOTE three position selector switch and operate as follows:

    a. In OFF/RESET, grinder shall not run. This position shall also reset the fail indicators.
    b. In ON, grinder shall run in forward direction. RUN pilot light will illuminate.
    c. In REMOTE, grinder shall run in forward direction if Remote Run command from Plant PLC is active. RUN pilot light will illuminate
    d. If grinder jam condition occurs, controller shall stop grinder, then reverse its rotation to clear obstruction. If jam condition still exists, control shall go through two additional reversing cycles within 30 seconds (3 times total) before signaling a grinder JAMMED condition. JAMMED pilot light will illuminate.
    e. When grinder overload condition or over temperature occurs, controller shall shut grinder off and activate relay and MOTOR OVERLOAD or MOTOR OVERTEMP pilot light.
    f. FAIL relay will be active when either JAMMED, MOTOR OVERLOAD, or MOTOR OVERTEMP CONDITION occurs.
    g. CONTROL POWER ON pilot light will illuminate when control power transformer is energized and all fuses are in good condition.
    h. If grinder is stopped due to fail condition and power failure occurs, pilot light shall reactivate when power is restored.
    i. Control reset shall be from local panel controls.

4. Control Panel shall have indicator lights for RUN (green), MOTOR OVERTEMP (red), MOTOR OVERLOAD (red), JAMMED (red), and CONTROL POWER ON (amber) conditions.

5. Control Panel shall provide overcurrent protection for motor through current sensing switch mounted directly on starter contactor.

6. Control panel shall provide motor over-temperature protection for motor through bimetallic switches in motor stator.

7. Provide additional set of dry contacts for indication of following conditions:

    a. Grinder in REMOTE.

b. Grinder RUNNING.
c. Grinder MOTOR OVERTEMP.
d. Grinder MOTOR FAIL.

8. Accept 480v, 3-phase power source with local circuit breaker lockable disconnect switch located inside the control panel with through door operator. Provide control power transformer to produce 120-volt AC power from the supply power. Transformer shall be sized and fused in accordance with code to accommodate the control power requirements.

9. Provide PLC, Panasonic AFPX-C14R.

10. Enclosure:

    a. Provide NEMA 4X 304L stainless steel wall-mounted enclosure.
    b. Provide separate enclosures for each Grinder.
    c. Enclosure shall be suitable for housing control devices, relays, terminal blocks and reversing motor starter.
    d. Provide access into panel for power and monitoring signals out.
    e. Selector switches and pilot lights shall be sized to mount in 30.5-mm diameter cutout. Manufacturer shall be Allen Bradley 800T/800H or Square D Class 9001, Type K.
    f. Provide legend plates for local control panels, and front-panel mounted devices.

11. Motor Starter:

    a. Starter shall be full voltage reversing type with 120-volt operating coils.
    b. Overload relay shall be adjustable and sized for the full load amp rating and service factor of the motor.
    c. Provide in accordance with Section 26 24 16.

2.04 COATINGS

A. Provide in accordance with Section 09 96 00.

B. Manufacturer is responsible for surface preparation, first coat, and second coating of equipment in the factory prior to shipment unless otherwise noted.

C. Manufacturer is responsible for the surface preparation and all motor coatings in the factory prior to shipment.

D. Contractor is responsible for third coat, touchup, and any additional specified coatings.

E. Final color of non-submerged equipment shall be the same color as the piping that serves the equipment, see Section 40 05 05 for pipe color. Color of submerged equipment can be manufacturer's standard color.

F. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

G. Coat machined or bearing surfaces and holes with protective grease.

PART 3 – **EXECUTION**

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's written instructions.

B. Relocate PFTS Grinder 2 (GRI-2), provide 6" flanged pipe connections and relocate PFTS Grinder Control Panel (CP-GRI-2).

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for workdays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. See Section 01 61 00. Include at a minimum:

a. 2 workday for Installation Services.
b. 1 workday for Instructional Services.
c. 1 workday for Post Startup Services

2. In addition to the services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

3.04 DEMONSTRATION

A. After installation is complete, test and demonstrate operation of equipment in accordance with Section 01 79 10. In addition to services specified above, provide Supplier's or Manufacturer's field services as required to successfully complete systems demonstrations in accordance with Section 01 79 10.

B. Supplier or Manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system related areas other than wastewater treatment process. See Section 01 79 10.

C. After installation has been completed, test in-line grinder equipment under normal operating conditions in presence of Engineer.
D. Repair imperfections found upon testing.

END OF SECTION

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SECTION 46 61 41
CLOTH MEDIA DISK FILTERS

PART 1 – GENERAL

1.01 SUMMARY

A. Section generally includes:

1. Cloth Media Disk Filters.
2. Backwash Waste (BWW) Pumps
3. Solids Waste Pumps.
4. Other associated valves and equipment.

B. Section includes the following equipment components with the following tag numbers:

1. Cloth Media Disk Filters.

a. Filter Drive 1 (PFD-1)
b. Filter Drive 2 (PFD-2)

2. Backwash/Solids Waste Pumps.

a. BWW Pump 1 (BWP-1)
b. Solids Waste Pump 1 (SWP-1)
c. BWW Pump 2 (BWP-2)
d. Solids Waste Pump 2 (SWP-2)

3. Control Systems

a. Primary Filter 1 Local Control Panel (PFCP-1)
b. Primary Filter 2 Local Control Panel (PFCP-2)

4. Backwash Waste Valves

a. BWW Valve 1 (BWV-1)
b. BWW Valve 2 (BWV-2)
c. BWW Valve 3 (BWV-3)
d. BWW Valve 4 (BWV-4)
e. BWW Valve 5 (BWV-5)
f. BWW Valve 6 (BWV-6)

5. Solids Waste Valves

a. Solids Waste Valve 1 (SWV-1)
b. Solids Waste Valve 2 (SWV-2)
c. Solids Waste Valve 3 (SWV-3)
d. Solids Waste Valve 4 (SWV-4)
e. Solids Waste Valve 5 (SWV-5)
f. Solids Waste Valve 6 (SWV-6)

6. Recirculation Valves

a. Recirculation Valve 1 (RCV-1)
b. Recirculation Valve 2 (RCV-2)
c. Recirculation Valve 3 (RCV-3)
d. Recirculation Valve 4 (RCV-4)

e. Recirculation Valve 5 (RCV-5)
f. Recirculation Valve 6 (RCV-6)

7. Waste Valves

a. BWW Discharge Valve 1 (BWDV-1)
b. BWW Discharge Valve 2 (BWDV-2)
c. Solids Waste Discharge Valve 1 (SWDV-1)
d. Solids Waste Discharge Valve 2 (SWDV-2)

8. Back-up Valves

a. Back-up Valve 1 (BKV-1)
b. Back-up Valve 2 (BKV-2)
c. Back-up Valve 3 (BKV-3)
d. Back-up Valve 4 (BKV-4)

9. Scum Valves

a. Scum Valve 1 (PSMV-1)
b. Scum Valve 2 (PSMV-2)

10. Manual Isolation Valves and Check Valves

a. Manual Plug Valve for each Pump discharge
b. Manual Plug Valve for each Pump suction
c. Check Valve for each Pump discharge

11. pH Probes

a. Influent pH Probe 1 (AE-131)
b. Influent pH Probe 2 (AE-141)

12. Level Transmitters

a. Level Transmitter 1 (LE/LT-131)
b. Level Transmitter 2 (LE/LT-141)

13. Ball Float Switches

a. High Level Ball Float Switch 1 (LSH-131)
b. High Level Ball Float Switch 2 (LSH-141)

14. Electromagnetic Flowmeters

a. Backwash Waste Discharge Flowmeter 1 (FE/FIT-132)
b. Solids Waste Discharge Flowmeter 1 (FE/FIT-131)
c. Recirculation Flow Transmitter 1 (FIT-133)
d. Recirculation Flow Element 1 (FE-133)
e. Backwash Waste Discharge Flowmeter 2 (FE/FIT-142)
f. Solids Waste Discharge Flowmeter 2 (FE/FIT-141)
g. Recirculation Flow Transmitter 2 (FIT-143)
h. Recirculation Flow Element 2 (FE-143)

15. Pump Suction Pressure Indicating Transmitters

a. Backwash Waste Pump 1 Suction Pressure Transmitter (PT-132)
b. Solids Waste Pump 1 Suction Pressure Transmitter (PT-131)
c. Backwash Waste Pump 2 Suction Pressure Transmitter (PT-142)
d. Solids Waste Pump 2 Suction Pressure Transmitter (PT-141)

16. All piping within primary filter tanks

17. All filter and filter backwash appurtenances

1.02 SYSTEM DESCRIPTION

A. Furnish all labor, materials, equipment, and incidentals required for installation of the disk filter units.

B. Furnish disk filters designed to filter total suspended solids down to a nominal size of 5 microns in size for Primary Influent Wastewater.

C. Provide filters to fit within new concrete filter tanks.

D. Service Conditions: Each disk filter shall be capable of filtering primary influent wastewater after screening and grit removal. Design shall be for 7.5 MGD Average Daily Flow and 15 MGD Peak Day Flow to each filter. Filter effluent total suspended solids concentration shall not be greater than 50 mg/l with 250 mg/l influent TSS at Average Daily Flow Rate and 120 mg/L influent TSS at Peak Day Flow. Annual average TSS removal shall exceed 80% under all loading conditions. Backwash and solids removal system shall be designed for solids filter loading of 10 ppd/sf peak day and 12 ppd/sf peak hour without utilizing overflow that bypasses primary influent.

E. During filtration, the filter unit shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwashing. The filter flow path shall be from the outside of the cloth frame to the inside. Systems with flow paths from the inside to the outside of the cloth frame that collect filtered solids and plastic debris on the interior surfaces of the cloth frame shall not be acceptable.

F. The operator shall be able to bring a drained filter tank on line by opening the influent isolation device.

G. Hazardous Environment Rating:

1. The interior of the Filter Tank area electrical classification shall be rated for Class I Division I Group D. Motors within the filter tank shall be rated for a temperature code T3C (160 Deg.C).

2. Areas surrounding the Filter Tank within 3-ft of removable / openable access hatches shall be rated for Class I Division 2 Group D to a height 1’-6” above the deck as indicated on the Drawings.

3. The Primary Filter Pump Room 1 and Primary Filtration Control Room 1 with pumps, valves and electrical / controls equipment shall be Unclassified. Motors within the filter tank shall be rated for a temperature code T2A (280 Deg.C).

1.03 SUBMITTALS

A. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for equipment specified.

2. Calculations that verify the effective filtration surface area. Media surface fused directly to support structure such that water cannot pass through the media shall not be included in these calculations
3. Hydraulic loading rate calculations
4. Solids loading rate calculations
5. Hydraulic profile through the filter showing the following:

    a. Top of structure elevation
    b. Backwash initiate level
    c. Influent weir length
    d. Influent weir elevation
    e. Influent weir nappe as design and peak flow
    f. Effluent weir length
    g. Effluent weir elevation
    h. Effluent weir nappe at design and peak flow
    i. Scum weir length
    j. Scum weir elevation
    k. Emergency overflow weir elevation and scum weir length and elevation

6. Elongation and breaking strength test report from ISO certified textile laboratory

C. Shop Drawings

1. Installation and assembly drawings and specifically prepared technical data for equipment.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of equipment with referenced standards.
2. Certified reports of field tests and observations.
3. Manufacturer shall provide certified third party testing or peer reviewed journal article demonstrating the ability of the filtration technology to remove greater than 90% of microplastics.

E. Programmable Logic Controller (PLC) Program:

1. Upon complete installation and start-up, manufacturer shall provide one electronic copy of each PLC program to the Owner. The PLC program shall be in format readable by Allen-Bradley CompactLogix PLC controller.
2. Owner shall reserve all rights to the PLC programs.

F. Submittals shall be in accordance with Section 01 33 00.

G. Submit Operation and Maintenance (O&M) Data in accordance with Section 01 78 23.

H. Submit Instructional Service information in accordance with Section 01 79 30.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. The filter supplier shall have experience in the design and manufacture of cloth media filters for a minimum of ten (10) years and shall be able to demonstrate a minimum of fifty (50) installations within the United States in municipal wastewater applications with cloth media.

2. The filter supplier shall have experience in the design and manufacture of cloth media filters for primary filtration for a minimum of two (2) years and shall be able to demonstrate a minimum of two (2) primary filtration installations within the United States in municipal wastewater applications with cloth media.

3. The filter supplier shall complete or have completed onsite piloting for 1 season / 9 months.

1.05 DELIVERY, STORAGE, AND HANDLING

A. All equipment and parts shipped to the job site shall be properly protected from the elements so that no damage or deterioration occurs from the time of delivery to the time when the installation is complete and the units are placed into operation.

B. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site, during storage, and during installation.

1.06 SPARE PARTS

A. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

B. Each filter shall be provided with the following spare parts:

1. Two (2) frame and cloth assemblies.
2. One (1) backwash/solids waste valve and actuator.
3. One (1) Viton V-ring effluent port/centertube seal.
4. One (1) fuse of each type.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Aqua-Aerobic Systems, Inc, Model APDFC-108 x 24EPC AquaPrime filters

2.02 EQUIPMENT

A. Each filter unit shall include

1. Filter Tank Mounting Brackets and Hardware
2. Drive Assembly
3. Centertube Assembly
4. Cloth Media Disks
5. Backwash and Solids Removal System
6. Backwash/Waste Pump Assembly
7. Valves
8. Pressure Transducer Assembly
9. Float Switch
10. Level Transducer
11. pH Sensor
12. Electrical Control System and Internal Components

2.03 MATERIALS OF CONSTRUCTION

A. Filter Tank

1. Each filter shall be installed in a concrete tank.

B. Filter Tank Mounting Brackets and Hardware

1. Each filter tank shall be fitted with 316 stainless steel mounting brackets to accommodate attachment of the filter components to inside of the filter tank.
2. All mounting brackets shall be attached to the inside of filter tank wall with 316 stainless steel anchors and hardware.
3. Through the wall spool piping and all filter external piping shall be provided by the Contractor. Through the wall spool piping shall be flanged.

C. Drive Assembly (PFD-1, PFD-2)

1. Each filter shall include an adjustable drive assembly with a gearbox, cast iron hub with 316 stainless steel sprocket segments, 15-5 PH stainless steel drive chain with 17-4 PH stainless steel link pins, and a 316 stainless steel chain guard.
2. The gearbox shall be parallel in-line helical type, AGMA Class 1 with a 5 HP drive motor rated for 460 volt, 3 phase, 60 Hz. Gear reducer shall be SEW or equal. Drive motor shall be SEW, Weg, or equal. Comply with Section 26 05 84.
3. To reduce energy demand, the drive assembly shall rotate the disks only during backwash. Systems requiring constantly rotating disks during filtration will not be acceptable.
4. Belt drive systems or systems with multiple drive units per filter will not be acceptable.
5. The Contractor shall provide an internal access platform between the tank side walls and motors and gearboxes.

D. Centertube Assembly

1. Each centertube assembly shall include a minimum 1/4" thick 316 stainless steel centertube weldment, driven sprocket, wheel assemblies, 316 stainless steel disk segment rods, and frame and cloth assemblies.
2. Each centertube assembly shall also include a Viton v-ring effluent port seal which provides superior chlorine resistance. Materials other than Viton are not acceptable for seal materials.
3. Systems with swivel joints requiring routine lubrication are not acceptable.
4. The driven sprocket shall be multi segment made of nylon 6
5. All fasteners shall be 316 stainless steel.

E. Cloth Media Frame and Disks

1. Each cloth disk assembly shall be comprised of eight (8) individual segments, each consisting of a cloth media sock supported by an injection molded polypropylene co-polymer frame with corrosion resistant assembly hardware. Cloth/frame assemblies shall be constructed such that each segment is easily removable from the centertube, without special tools, to allow for removal and replacement of the cloth at the point of installation. Systems requiring special tools and/or the return of media segments to the factory for replacement will not be considered.
2. Each cloth disk assembly shall have a minimum of 107.6 square feet of effective submerged filtration area. Each disk shall be divided into no more than eight (8) segments and shall be easily removable for service. If the wet weight of the filter disk segment is greater than 50 pounds, a lifting mechanism shall be provided.
3. Cloths shall be of microfiber pile construction having a nominal filtration rating of 5 microns and shall be designed specifically for primary filtration applications. Granular media and screens having structured identical openings shall not be allowed. The pile cloth shall be free chlorine resistant cloth.
4. Cloth filter media must have obtained conditional acceptance under California Title 22 regulations. The approval letter associated with this acceptance must be included with submittals.

5. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational headloss. Woven mesh or microscreen type media with no filtration depth are not acceptable.
6. Individual pile fibers shall be held in place by a support backing integral to the media. To facilitate proper flow of backwash water through the cloth, the medium's back side shall be of open construction consisting of 10% open area at least 50 times larger than the nominal filtration media in any direction. Media that uses sewn in support structures, which have the potential to prevent free flow through the media, shall not be allowed.
7. Cloth strength is critical to ensure long term performance of the media. Cloth media breaking strength and elongation shall be tested in accordance with ASTM Standard D5035 2R-E method by an ISO certified laboratory specializing in textile testing. Breaking strength shall be in excess of 200 lbf (890 N) in the warp and the weft direction. Elongation shall be less than 10% at 60 lbf (270 N) in the warp and the weft direction. Test reports shall be provided with submittals to demonstrate compliance with this requirement.
8. To avoid excessive media movement, deformation and folding during backwash, the maximum distance between cloth restraints must not exceed 36 inches.

F. Backwash and Solids Removal System

1. The backwash function shall incorporate a pump that draws filter effluent through the cloth as the media rotates past the fixed backwash shoe, thereby removing accumulated solids from the cloth surface.
2. Each disk shall be cleaned by a minimum of two backwash shoes, one on each side. The backwash shoes shall remain in a fixed position. Stainless steel springs shall be used to maintain the proper tensioning of the backwash shoe against the media surface. The backwash shoe shall be in direct contact with the cloth to ensure effective media cleaning. Systems utilizing media cleaning mechanisms that do not contact the filter media will not be acceptable.
3. Neither the cloth / support assemblies nor the backwash shoes shall include any gridwork overlays or other interferences that would prevent direct contact of the backwash shoes with the cloth fibers.
4. The backwash system shall include 316 stainless steel backwash shoe supports with UHMW backwash shoes, reinforced PVC flexible hose with stainless steel hose clamps, 316 stainless steel backwash manifolds, and PVC sludge collection manifold.

G. Backwash/Solids Waste Pump Assembly (BWP-1, BWP-2, SWP-1, SWP-2)

1. Each backwash/solids waste pump assembly shall include one (1) backwash waste pump and one (1) solids waste pump, valves and gauges.
2. The backwash/solids waste pumps shall be shipped loose for field installation by the Contractor. Backwash piping between the filter tank and pumps as well as piping following the pumps shall be supplied by the Contractor. Contractor shall supply unions or flanges for service, and interconnecting wiring.
3. The backwash/solids waste pumps shall be a Gorman Rupp model T6A60S, externally mounted centrifugal pump. Pump shall be provided with a 20 HP, 460 volt, 3 phase, 60 Hz motor and operate at variable RPM. Motor shall be inverter duty rated and comply with Section 26 05 84. Each pump shall be rated for 782 gpm at 58.3 ft TDH with 34.3 ft allowable discharge head consisting of static head between EL 696.00 at pump and water surface elevation of 715.58 over the gravity thickener effluent weir and after losses in internal filter piping and pump suction piping have been accounted for.
4. Each pump shall be provided with epoxy dowel, stainless steel anchors.

5. Backwashing shall be initiated by filter tank water level, timer, or manually through the operator interface.
6. Operator shall have the ability to specify backwash time interval elapses through the operator interface. The backwash water shall be pressurized by the filter's backwash/waste pump for discharging from the filter system. Systems utilizing non-pressurized backwash flow will not be accepted.
7. Vacuum Gauges (PI-131, PI-132, PI-141, PI-142):

    a. Vacuum gauge shall have a minimum 3.5" dial with all stainless steel welded construction, 30" Hg to 15 psi compound range, liquid filled, ¼" NPT process connection, 316 stainless steel bourdon tube and tip material, and bronze socket material. Provide isolation valve to isolate from process when being serviced. Include 316SS diaphragm seal for each vacuum transmitter/gauge assembly as shown on Drawings. Manufacturer shall be Ashcroft, U.S. Gauge, Wika, or equal.

8. Pressure Gauges (PI-133, PI-134, PI-143, PI-144):

    a. Pressure gauge shall have a 3.5" dial with a black painted steel case, 0-30 psi, heat resistant polycarbonate window, ¼" NPT process connection, "C" shaped bronze bourdon tube, and brass socket material, in accordance with Section 40 73 00. Provide isolation valve to isolate from process when being serviced. Include 316SS diaphragm seal as shown on Drawings. Manufacturer shall be Ashcroft, U.S. Gauge, Wika, or equal.

9. Filtering shall not be interrupted during normal backwashing and solids waste discharge.

H. Flowmeters (FE/FIT-131, FE/FIT-132, FE-133, FIT-133, FE/FIT-141, FE/FIT-142, FE-143, FIT-143)

1. Three flowmeters shall be provided per filter.
2. Flowmeter shall be 6" Krohne electromagnetic flowmeter with remote wall mounted transmitter (FE-133, FIT-133, FE-143, FIT-143) or integral transmitter (FE/FIT-131, FE/FIT-132, FE/FIT-141, FE/FIT-142) as shown on Drawings.
3. Flow element:

    a. Provide power from signal converter.
    b. Use grounding rings or gaskets on each end of magnetic flowmeter to provide ground path and prevent interference with flow signal. Probes are not acceptable.
    c. Flowmeter liner: Hard Rubber, Polyurethane, or Polyethylene.
    d. Electrode materials: Hastalloy C.
    e. Electrode type: Bullet nose.
    f. Grounding rings: 316 Stainless Steel.

4. Flow transmitter:

    a. Operate on 120Vac, 60 Hz power.
    b. 4-20 mAdc analog current output into 0 to 900 ohm load and 24Vdc scaled, pulse output software adjustable.
    c. Locate flow rate indicator within each converter. Indicator shall display flow rate in engineering units.
    d. House in cast aluminum enclosure to meet NEMA 4X requirements.
    e. Suitable for -40°F to +140°F for outdoor applications.
    f. Flow transmitter shall be powered from corresponding local control panel.

5. Provide sufficient standard length of manufacturer's signal cable connecting meter and converter without splice.

6. The flowmeter shall be provided loose to be installed and wired by the installing Contractor.

I. Valves and Actuators

1. Layout and configuration as shown on Process and Instrumentation Diagrams Drawings 1-N-03, 1-N-04 and 1-N-05.
2. Each filter shall have three (3) 6” backwash waste plug valves with electric actuators to be supplied by the manufacturer.
3. Each filter shall include two (3) 6” solids waste type plug valves with electric actuator.
4. Each filter shall include two (3) 6” recirculation plug valves with electric actuator.
5. Each filter shall include one (1) 10” scum plug valve with electric actuator.
6. Each filter shall include one (2) 6” backup plug valves with electric actuator.
7. Each filter shall include two (2) 6” discharge plug valves with electric actuator.
8. Each filter shall include two (2) 6” pump suction plug valves.
9. Each filter shall include two (2) 6” pump discharge plug valves.
10. Each filter shall include two (2) 6” pump discharge Type V206 flanged swing flex check valves.
11. Each filter shall include a solids waste removal system consisting of perforated manifold. The manifold shall be designed to siphon settled solids for waste discharge through the backwash/waste pump.
12. The operation of the solids waste removal system shall be automatic with user adjustable intervals and duration through the operator interface. Filters that are designed without a solids waste removal system will not be acceptable.
13. Actuators shall be Rotork.
14. Valves and actuators shall be in accordance with Section 40 05 53. Plug valves shall be Type V005.

J. Influent Weir Trough, Effluent Weir Troughs, Scum / Overflow Box, Scum Weir

1. Scum weir shall be provided by Contractor.
2. Each filter shall include a 316 stainless steel influent and effluent troughs with finger weirs.
3. The finger weirs shall each have a length of 30 feet.
4. The weir shall be mounted to the filter tank & effluent chamber respectively using 316 stainless steel anchors and hardware.
5. The filter tank wall must be smooth and plumb to facilitate a quality installation.
6. Each filter shall include a 316 stainless steel Scum / Overflow Box with overflow weir and scum pipe connection.

K. pH Sensors (AE/AIT-131, AE/AIT-141)

1. Provide one Endress and Hauser pH probe with remote transmitter for each filter unit.
2. Probe shall contain glass and reference electrode, thermo-compensator, and pre-amplifier for electrode.
3. Probe shall have 316 Stainless steel or PVC/LCP case, platinum electrode, and refillable reference electrode with ceramic plug.
4. Range: 0 to 14.
5. Transmitter shall be rated for NEMA 4X and require 120VAC input power. The transmitter shall be powered from corresponding local control panel.
6. Transmitter shall include minimum of 2 isolated 4-20 mAdc outputs into 600 ohms, and be wall mounted.
7. Field attachment of the pipe and supports to the filter shall be the responsibility of the installing contractor.

L. Level Transducer Assembly (LE/LT-131, LE/LT-141)

1. Manufacturer: PMC VL2000, KPSI, Contegra SLX, Siemens A1000i.
2. A submersible level transducer shall be supplied for each filter tank. The level transducer shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of 0 psi to 5 psi. Units shall monitor the water level in the filter tank.
3. Level transducer shall be provided with a mounting bracket and 316 stainless steel anchors.
4. Electrical connection shall be 2-wire, loop powered through a #16 AWG shielded twisted pair cable.
5. An aneroid bellows providing vented gage atmospheric reference shall be supplied for Contractor installation in junction box.
6. The installing Contractor shall provide junction box, bellows mounting and interconnecting wiring.

M. Float Switch (LSH-131, LSH-141)

1. Manufacturer: Contegra FS 90, Siemens 9G-EF.
2. A float switch shall be furnished to indicate emerging overflow level.
3. The float shall be made of 316 stainless steel and contain a non-mercury tilt type 1A @ 150VAC/VDC non-inductive switch.
4. Provide sufficient length of PVC jacketed cable, and provide intrinsically safe relays in corresponding local control panel.
5. The installing Contractor shall provide 316 stainless steel on vertical mounting pipe or stainless steel cable with anchor weight as indicated on Drawings.

N. Pump Suction Pressure Transmitter (PT-131, PT-132, PT-141, PT-142)

1. Manufacturer: SOR Inc. 805, Endress+Hauser, PMP 51, Ashcroft A2.
2. The vacuum transmitter shall have 316L stainless steel wetted parts, and stainless steel casing.
3. Measuring range of -14.5 to 14.5 psi converted to a 4-20 mADC signal.
4. Accuracy: 0.25% of span including temperature and static pressure effects.
5. Provide 316SS diaphragm seal for each vacuum transmitter/gauge assembly as shown on drawing.

O. Control System and Internal Components (PFCP-1, PFCP-2)

1. The automatic and manual controls for operation of the AquaPrime® Filter system shall be furnished fully assembled, wired and pre-programmed in a UL 508A Certified Industrial Control Panel. Short circuit rating of control enclosure shall be 5 KA RMS symmetrical at 480 VAC maximum. Minimum 65,000 AIC rating.
2. Controls shall be provided to control or monitor equipment as described in the Contract Drawings.
3. The control system shall include the following control components and practices:

    a. Control Panel Wiring and Assembly

        1) All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Input power shall be 480-V, 3-phase.
        2) In addition to NEC and NEMA requirements, wiring shall be as follow:

            a) Power: 12 AWG stranded minimum, type MTW, 600V.
            b) Control: 16 AWG stranded minimum, type MTW, 300V.
            c) Analog Signal: Twisted pair, 18 AWG, Beldon 8760 or equal.

3) Wire colors are as follows:

a) AC neutral conductor: White.
b) AC hot conductor: Black.
c) Grounding conductor: Green.
d) AC control conductor, powered from within panel: Red.
e) AC control conductor, powered from remote source: Orange.
f) DC (+) power conductor, discrete signal: Blue.
g) DC (-) power conductor, discrete signal: Blue with white stripe.
h) DC control conductor, discrete signal: Blue.
i) Twisted pair cable (+) signal conductor, analog signal: White.
j) Twisted pair cable (-) signal conductor, analog signal: Black.
k) Intrinsically safe wiring: Light Blue

4) All wires shall be clearly marked with an identification number consistent with the wiring schematic drawing. Wire markers shall be a thermal transfer printable type. The material shall be a self-laminating vinyl. Labels shall be Brady THT-9-427-10 or equal.
5) Wiring inside the control panel shall be run in PVC wiring duct rated for continuous temperatures up to 122° F (50°C). Devices mounted in the enclosure door shall have wires run in spiral wrap to avoid pinch points when opening and closing the door. Size wire duct to be no more than 50% full. Maintain 2" clearance between wire duct and terminals
6) Control components mounted internal and external to the enclosure shall be mounted with stainless steel hardware and clearly labeled with a plastic identification nametag. The tag shall be white with black lettering.

b. Control Enclosure

1) Enclosure shall be manufactured by Hoffman or equal.
2) The enclosure shall house a flange mounted dead front main disconnect, control power transformer, all motor starters, variable frequency controls, a programmable logic controller, interlocks, alarms, indicating lights and operator controls required for the operation of the filter system.
3) Panels shall be 60-inches wide by 18-inches deep by 60-inch high for floorstand-mounted.
4) The automatic controls shall be provided in a UL listed, NEMA Type 4X rated 304 SS wall mounted enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and outdoors.
5) Enclosure shall include a seamless foam-in-place gasket to assure watertight and dust-tight seal.
6) The color of the enclosure shall be gray, inside and out.
7) Enclosure shall include painted white, mild steel (12 gauge) sub-panel mounted with collar studs.
8) The control enclosure shall be mounted in control room.

c. Control Panel Quality Assurance

1) All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed.
2) Testing shall consist of the following:

a) Point to point testing of all wiring prior to application of power
b) Intended supply voltage shall be applied to the enclosure
c) All components shall be tested for proper operation and calibration

d) The PLC and operator interface program shall be loaded and functionally checked
e) All components shall be checked to confirm proper mounting specifications have been followed.
f) Enclosure shall be inspected for defects and repaired if necessary
g) All labeling of wires and devices are correct, properly installed and clean

3) The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.
4) Upon the successful completion of the control testing of the enclosure assembly, all applicable documentation (i.e. finalized drawing set, signed control checklist cover page, device data sheets, etc.) shall be placed in the drawing pocket of the enclosure.

d. Corrosion Inhibitor

1) Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity.
2) The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.
3) The corrosion inhibitor shall be Hoffman AHCI5E or equal.

e. Main Disconnect Circuit Breaker

1) A UL listed, automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure(s).
2) The primary function of the disconnect switch shall be to provide a means to manually open a circuit and automatically open a circuit under overload or short circuit conditions.
3) The disconnect breaker shall have a door mounted operating mechanism with trip indication.
4) Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided.
5) The disconnect circuit breaker shall be a Square D/FAL, HDL, JDL, LAL, MGL, PGL or equal.

f. Variable Frequency Drive – Drive Assembly

1) UL Listed Variable Frequency Drive (VFD) shall be provided to control the drive assembly of the filter.
2) The VFD shall control the drive assembly speed via an analog signal from the PLC. The VFD output frequency shall be programmable.
3) The VFD shall be provided in a NEMA Type 20 panel mount package and rated for an operating temperature of -4° to 122°F (-20° to 50°C). The VFD shall have a 65 kA maximum short circuit rating when protected with an Allen Bradley 140M motor circuit protector or Class CC/J fuse.
4) The VFD shall be Danfoss VLT Aqua. Provide with Modbus TCP Protocol communications, and mounting kit for surface mount VFD keypad.

g. Variable Frequency Drive – Backwash and Waste Pumps

1) UL Listed Variable Frequency Drive(s) (VFD) shall be provided to control the backwash and solids waste pumps of the filters.
2) The VFD shall control pump speed via an analog signal from the PLC.
3) The VFD output frequency shall be programmable.

4) The VFD shall be provided in a NEMA Type 20 panel mount package and rated for an operating temperature of -4° to 122°F (-20° to 50°C).
5) The VFD shall have a 65 kA maximum short circuit rating when protected with an Allen Bradley 140M motor circuit protector or Class CC/J fuse.
6) The VFD shall be Danfoss VLT Aqua. Provide with Modbus TCP Protocol communications, and mounting kit for surface mount VFD keypad.

h. Transformer

1) A step-down multi-tap transformer shall be supplied when there is a necessity to reduce incoming 3-phase power to 120 VAC single-phase.
2) The transformer power wire connections (incoming and outgoing) shall be protected with a finger-safe cover to protect against accidental contact.
3) Primary and secondary fuse protection shall be provided.
4) Transformer shall be UL listed and of continuous wound construction with vacuum impregnated with non-hygroscopic thermosetting varnish.
5) Transformer shall be Square D 9070T or equal.

i. Transformer primary and secondary fuse

1) Properly rated fuses and fuse blocks shall be provided for primary and secondary protection of the transformer.
2) Each fuse shall be equipped with a thermoplastic cover to protect against accidental contact.
3) Clip style fuse block shall be rated up to 600 VAC and 100 amps, dual element, time delay fuses shall be rated up to 600 VAC.
4) Fuse blocks and fuses shall be UL listed.
5) Fuses shall be Littelfuse Class CC or equal.
6) Fuse blocks and fuse covers shall be manufactured by Marathon or equal.

j. Circuit Breaker

1) All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker.
2) Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed.
3) Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or equal.

k. Fuses

1) Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure.
2) Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse.
3) Fuses shall be rated up to 250 VAC and be Littelfuse or equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps.
4) Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or equal.

l. Pilot Device

1) Pilot devices (pushbuttons, selector switches, and indicating lights) shall be mounted through the control enclosure door for manual operation of the filter. All

front panel mounted pilot devices shall include legend plates indicating type of operation.

2) Pushbuttons: Momentary contact, flush head, 7,200va make, 720va break.
3) Emergency Stop: Jumbo red mushroom head, push/pull type, 7,200va make, 720va break.
4) Selector Switches: Maintained position, standard knob type, 7,200va make, 720va break.
5) Lights shall be a 6 VAC LED type lamp, transformer and push to test type. Color coding shall be applied as required and is as follows:

    a) Amber – Alarm active, caution
    b) Green – Valve open, motor running
    c) Red – Valve closed
    d) White – Power on

6) All pilot devices shall be UL Listed, 30.5mm style, NEMA Type 4X rated, oil and water tight with finger safe guards located on the contact blocks to prevent accidental contact with wire connections.
7) Operator device function shall be identified with an engraved white Gravoply nameplate with black letters.
8) Pilot devices shall be Allen-Bradley 800T/800H, Square D 9001 Type K, or equal.

m. High Frequency Noise Filter

1) A UL listed active tracking filter shall be provided to protect the PLC, Ethernet switch, and OIT.
2) It shall be designed for a single phase input voltage of 120/240VAC operating at 47 to 63 Hz.
3) The unit shall provide surge capacity of 10,000 amps and protect in all modes (Line to neutral, line to ground and neutral to ground).
4) The noise filter shall be an Islatrol - IE-100 series or equal.

n. Uninterruptible Power Supply

1) A UL listed uninterruptible power supply suitable for location in a UL 508 panel shall be provided to power the OIT, PLC, network switch, and media converter by switching to an emergency battery backup without data loss or downtime.
2) Nominal input voltage and output voltage shall be 120VAC with an autosensing input frequency of 47 to 63 Hz.
3) The output power capacity shall be minimum 125% of connected electrical load, and able to power connected devices for a period of 30 minutes after the utility power has failed
4) The UPS shall be provided with LED status indicators and operate from 32° to 122°F (0° to 50°C).
5) Provide bypass contactor or other means to automatically bypass UPS allowing operation of system controls in event of UPS failure.
6) UPS shall have a permanent mounting.
7) The UPS shall be an Allen Bradley 1609-D or equal.

o. Ground Fault Duplex Receptacle

1) A UL listed ground fault circuit interrupter (GFCI) duplex receptacle shall be provided within the panel for instrument (e.g. programming terminal, modem, etc.) use only.
2) The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating.

3) The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button).
4) Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients.
5) Receptacle shall be Hubbell DRUBGFI20 or equal.

p. 24 Volt DC Power Supply

1) An UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components.
2) The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power.
3) The power supply shall have a green LED which shall be illuminated when output voltage is "OK".
4) Power Supplies shall have an efficiency of at least 80% with high efficiency models (~90%) available.
5) Manufacturer: Phoenix Contact or equal.

q. Control Relay

1) UL listed control relays for general control purposes shall be supplied with a pilot light to indicate when the coil is in an energized state.
2) The relay socket shall be DIN rail mounted inside the enclosure.
3) The relays shall provide the following ratings: 120VAC coil with 3.5VA inrush maximum current, 24Vdc coil with 450 Ω resistance minimum.
4) Relays shall be Allen Bradley, Potter and Brumfield, or equal.

r. Terminal Block

1) Clamping screw type terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections.
2) All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall be 300 v rating for 120 v circuits and below, 600 v rating for 480 v circuits.
3) Terminal blocks shall be Phoenix Contact or equal.

s. Programmable Logic Controller

1) Automatic operation of the Filter shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel.
2) The PLC components shall consist of a power supply, CPU, discrete input and output modules, and analog input and output modules.
3) All input and output points supplied (including unused) shall be wired to terminal blocks.
4) All discrete inputs/outputs are rated for 120VAC, and all analog inputs/outputs are rated for 4-20mADC.
5) The PLC processor shall be Allen Bradley 1769 CompactLogix™ Series .
6) Provide input/output modules to accommodate all required input and output points plus 10% spare for each type of input and output.

t. Ethernet Switch

1) An Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface and plant networking.
2) The switch shall support both 10 and 100 Mbit/s operation and provide for store and forward switching mode.

3) The switch shall have minimum of four (4) 10/100Base-T ports with RJ-45 sockets supporting auto-crossing, auto-negotiation and auto-polarity, and minimum of two (2) single-mode 1G fiber optic SFP transceivers suitable for duplex ST connectors.
4) The unit shall be DIN rail mounted and require 24VDC or 120VAC power. Diagnostic LEDs for power, link status, data, and data rate shall be provided.
5) The Ethernet switch shall be UL listed and manufactured by Allen-Bradley, or equal.

u. Protocol Converter

1) A protocol converter shall be provided inside the control enclosure to allow communication between Ethernet/IP network and Plant's Modbus TCP/IP network.
2) The converter will connect to the Primary Filter PLC and network switch specified above.
3) Provide suitable adapter if required.
4) The unit shall be DIN rail or panel mounted.
5) The media converter shall be UL listed and manufactured by ProSoft, Moxa or equal.

v. Operator Interface Terminal Overview

1) The control system shall be equipped with a UL listed operator interface that provides control display screens for each control panel.
2) These screens shall be used by the operator to monitor and control filter status, set-point and alarm information.
3) The Interface shall allow the Operator access to adjust the following operating parameters:

a) Backwash interval, Backwash duration, Solids Waste interval, Solids Waste duration, Number of Backwashes between Solids Waste interval.

4) The operator interface shall provide information to assist the Operator in assessing the status of the filter system. The interface screen shall display, at minimum, the following parameters:

a) Water level in the filter, Time since last Backwash, Time since last Solids Waste withdrawal, Elapsed time on the Drive Motor, Elapsed time on the Backwash/Waste Pump(s), Total Backwash time and cycles, Total Solids Waste withdrawal time and cycles.

5) The operator interface shall allow the Operator to:

a) Initiate Backwash
b) Control all electric actuated valves

6) The interface shall display the alarm history. The alarm history shall include the time and date of the most recent 25 alarms along with the description of the alarm.

a) The interface shall also display current alarms, including the date, time and a description of the alarm.
b) As a diagnostic aid to the Operator, the interface shall display the time between Backwashes for the most recent 40 Backwashes.

w. Operator Interface Terminal

1) The operator interface shall be a NEMA 4X rated, 15” diagonal, color touchscreen display with Ethernet and serial communications.
2) The display type shall be color active matrix thin-film transistor (TFT) with 1024 x 768 XGA Resolution.
3) Aspect Ratio: 4:3.
4) The rated operating temperature shall be 0 - 55 °C (32 - 131 °F).
5) The operator interface shall be PanelView Plus 7.

x. Coordinate communication of parameters listed and implied on P&ID drawings 1-N-03, -4, -5 with System Integrator described in Section 40 61 13.

2.04 COATINGS

A. Provide in accordance with Section 09 96 00.

B. Manufacturer is responsible for surface preparation, first coat, and second coating of equipment in the factory prior to shipment unless otherwise noted.

C. Manufacturer is responsible for the surface preparation and all motor coatings in the factory prior to shipment.

D. Contractor is responsible for third coat, touchup, and any additional specified coatings.

E. Final color of non-submerged equipment shall be the same color as the piping that serves the equipment, see Section 40 05 05 for pipe color. Color of submerged equipment can be manufacturer’s standard color.

F. Stainless steel, bronze, and nonmetallic surfaces shall not be coated.

G. Coat machined or bearing surfaces and holes with protective grease.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Contractor to inspect shipment upon delivery and notify manufacturer immediately of any damaged items.

3.02 STORAGE

A. Store media on Project Site in accordance with manufacturer’s written recommendations and approved shop drawings.

3.03 INSTALLATION

A. Each filter disk shall be installed in the concrete filter tank as specified in the Drawings.

B. The Contractor is responsible for all through the wall spool piping and all external piping.

C. Install disk filter units in accordance with manufacturer’s written recommendations and approved submittals.

3.04 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Representative for disk filters shall be present at Project Site or classroom designated by Owner for minimum workdays specified below, travel time excluded.

   a. 2 trips, each of 3 workdays duration (6 days total) for Installation and Instructional Services. 1 trip, 1 workday duration for post startup services. Any additional service days required shall be at Contractor's expense and at no additional cost to Owner.

2. Services shall be as specified in Section 01 61 00. Representative shall direct services to specific system operation, maintenance, and troubleshooting. Engineer will present process design and philosophy.

3. In addition to services specified above, provide manufacturer's services as required to successfully complete systems demonstration as specified in Section 01 79 10.

END OF SECTION

SECTION 46 71 13
CIRCULAR GRAVITY THICKENER

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes materials, equipment, and components for Gravity Thickener included but not limited to:

1. Gravity Thickener 1 (GT-1).
2. Gravity Thickener High Torque Alarm (WSH-GT-1).
3. Gravity Thickener High High Torque Cutout (WSHH-GT-1).
4. Gravity Thickener Shear Torque Indicator (WI-GT-1).
5. Gravity Thickener support bridge/walkway with extending railing post as light pole.

B. Weir provided by Contractor.

1.02 REFERENCES

A. AISC: American Institute of Steel Construction

B. AGMA: American Gear Manufacturers Association

C. ASTM: American Society of Testing and Materials

D. OSHA: Occupational Safety and Health Act

1.03 SYSTEM DESCRIPTION

A. Provide gravity thickener equipment suitable for installation in concrete basins as shown on the contract drawings and as specified herein.

1. Tank Geometry:

a. Tank Diameter	55 feet
b. Tank Side Water Depth	11.5 feet
c. Floor Slope	2-3/4 inches per foot

2. Equipment Dimensions:

a. Center Pier	24 inch diameter with concentric 12-inch feed pipe
b. Influent Feedwell	10 feet diameter minimum
c. Depth of Influent Feedwell	4 feet minimum
d. Effluent Troughs	18 inch wide x 27 inch deep

B. Provide a center pier supported, center feed design with peripheral overflow.

C. Provide a center drive mechanism that supports a walkway, maintenance platform and rotating structural steel cage.

D. The cage shall support the truss arms.

E. Fabricated steel structures shall be shipped in the largest sub-assemblies permitted by carrier regulations, properly match-marked and identified for ease of field erection.

F. The equipment shall be designed to thicken primary filter backwash and primary filter solids waste sludge by effectively settling suspended solids and scrape the settled solids from the basin floor to the sludge withdrawal sump as shown on the drawings. The rake arms shall be fitted with pickets to aid in thickening. Feed sludge shall pass from the influent pipe into the feedwell and finally into the settling area of the tank. The supernatant shall be collected uniformly by the peripheral launder and discharge into the GTO Box 1.

G. The equipment furnished for each thickener mechanism shall include but not be limited to: walkway with handrails, center drive assembly, center drive platform, feedwell, center pier center cage sludge collection arms with rake blades, weirs, anchor bolts and assembly fasteners.

H. Except where specifically indicated otherwise, all plates and structural members designated for submerged service shall have a minimum thickness of 1/4 inch. All structural steel will conform to ASTM A-36 requirements and steel plate will conform to ASTM A283C requirements. Anchor bolts used to secure the mechanism to the tank shall 316 stainless steel. Assembly fasteners shall be 316 stainless steel. See the Gravity Thickener Mechanism Material Schedule below.

GRAVITY THICKENER MECHANISM MATERIAL SCHEDULE

Component Name	Material
Drive housing	Cast Iron
Submerged Steel in contact with process water	A36 Carbon Steel
Non-Submerged Steel	A36 Carbon Steel
Grating & Handrails	Aluminum
Fasteners and Anchor Bolts	316 SS (all fasteners shall be isolated for dissimilar metals)

I. Design Criteria

1.	Minimum intermittent flow	375 gpm
2.	Design average intermittent flow	782 gpm
3.	Design peak continuous flow	1,564 gpm
4.	Design peak intermittent flow	1,939 gpm
5.	Maximum solids loading rate	40 pounds/day/feet^2
6.	Drive continuous (AGMA rated) torque	40,000 foot-pound
7.	Alarm Torque	32,000 foot-pound (0.80x continuous)
8.	Motor cutout torque	50,000 foot-pound (1.25x continuous)
9.	Shear Pin	60,000 foot-pound (1.5x continuous)
10.	Drive momentary peak torque	80,000 foot-pound (2.0x continuous)
11.	Mechanism rotation	Clockwise
12.	Rake arm tip speed	0.05 rpm
13.	Minimum ball race diameter	46-inches diameter

1.04 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for equipment specified.
2. Certificate of design stamped by a Registered Professional Engineer stating that the equipment to be provided for this project meets or exceeds all design requirements of these specifications. The certificate shall state the respective loads and design criteria.
3. Drive mechanism rating calculations, stamped by a Registered Professional Engineer, verifying the compliance of the drive gears and bearings with the specified continuous torque rating and bearing life rating.
4. Motor data. Submit in accordance with Section 26 05 84.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for equipment.
2. Wiring Diagrams: Show power and control connections and distinguish between factory-installed and field-installed wiring.

D. Submit manufacturer's recycled content percentage or certification for supplied products.

E. Test Results:

1. Certified reports of manufacturers' factory production and final tests indicating compliance of equipment with referenced standards.
2. Certified reports of field tests and observations.

F. Submit in accordance with Section 01 33 00.

G. Operation and Maintenance (O&M) Data:

1. Operating instructions and maintenance data for materials and products for inclusion in O&M Manual.
2. Manufacturer's written instructions for periodic tests of circular gravity thickening equipment in service.
3. Submit in accordance with Section 01 78 23.

H. Submit Instructional Services information in accordance with Section 01 79 30.

I. Submit manufacturer sustainability disclosure.

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain circular gravity thickening equipment components from single manufacturer with responsibility for entire system. Unit shall be representative product built from components that have proven compatibility and reliability and are coordinated to operate as unit as evidenced by records of prototype testing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. All equipment and parts shipped to the job site shall be properly protected from the elements so that no damage or deterioration occurs from the time of delivery to the time when the installation is complete and the units are placed into operation.

B. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site, during storage, and during installation.

C. Fabricated assemblies shall be shipped in the largest sections permitted by carrier regulations, properly match-marked for ease of field erection.

D. The mechanism shall be lubricated in accordance with the instructions of the thickener manufacturer's field service representative. The required lubricants shall be provided by the contractor.

1.07 MAINTENANCE

A. Extra Materials:

1. Furnish extra materials matching products installed, as described below, packaged with protective covering for storage, and identified with labels describing contents.

a. One set of rake blade squeegees.
b. One set of drive seals and gaskets.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Walker Process Equipment

B. Envirodyne Systems, Inc.

2.02 GENERAL

A. Each thickener mechanism shall be of the center-drive type, pier supported. The thickener shall be designed to remove sludge uniformly from the bottom of the tank.

2.03 CENTER DRIVE ASSEMBY

A. General

1. Drive mechanism consisting of primary helical gear reduction, intermediate worm gear reduction unit (Walker Process) or intermediate planetary gear reduction unit (Envirodyne) and enclosed final reduction unit consisting of internal spur gear and pinion in a turntable base is to be completely assembled and finish painted in the Manufacturer's shop.
2. All gearing shall be enclosed in gray cast iron ASTM A-48 Class 40B housings except fabricated steel housings for Envirodyne final reduction unit. Exposed gearing and submerged bearings will not be acceptable
3. The drive shall be designed to allow removal and replacement of internal gear, balls and strip liners without raising the walkway.
4. All components of the drive mechanism shall be designed in accordance with AGMA Standard 6034-B92 "Practice for Enclosed Cylindrical Worm Gear Speed Reducers and Gearmotors", and Standard 2001-D04 "Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth"; for 24-hour continuous, uniform load duty and 20-year design gear life at the specified output speed. The AGMA rated torque of the drive shall be the lowest value computed for worm gear set, spur gear and pinion for strength and durability.
5. Select conservative values for bending strength and pitting resistance life factors Kl and Cl based on a minimum of 420,000 cycles of the main gear. The drive AGMA torque

rating shall be as specified above with a minimum 1.25 service factor.

6. All bearings shall be designed for a minimum B-10 life of 200,000 hours except main bearing B-10 life shall exceed 100 years.

B. Primary Reduction Unit

1. Provide commercially available helical gear reducer or gearmotor in a cast housing.
2. All bearings shall be anti-friction type running in oil.
3. Motor shall be totally enclosed, ball bearing type, of ample power for starting and continuously operating the drive mechanism without overloading.
4. The drive motor shall be a maximum of 1 horsepower and shall be totally enclosed, fan cooled, with a 1.15 service factor. Operating electric current will be 460 volt, 3 phase, and 60 hertz. Each motor will be NEMA Design B employing Class F insulation designed for an ambient temperature of 40 degree C. Motor shall be at least 24 inches above the gravity thickener platform to avoid hazardous envelope. Motor shall comply with the requirements of Section 26 05 84.
5. Primary drive unit shall drive the intermediate reduction through a chain and sprocket arrangement with #80L self-lubricating chain and non-corrosive OSHA approved removable chain guard or Primary drive unit shall drive the intermediate reduction through a direct coupled arrangement.
6. Provide proper chain tension by an adjustable steel base mounted on the intermediate reduction unit (Walker Process).

C. Intermediate Reduction Unit

1. Provide worm gear or planetary gear speed reduction with grease and oil lubricated anti-friction type bearings in cast iron housing securely bolted on the machined top face of the final reduction unit. Worm and shaft shall be a two-piece assembly for ease of maintenance. Cycloidal will not be acceptable.
2. Align and maintain accurate centers with the final reduction gearing. Swivel base mounting of the intermediate unit will not be acceptable.
3. Mount an electro-mechanical Shear Torque Indicator (WI-GT-1) on the thrust end of the worm shaft consisting of plate spring assembly (Walker Process), plunger (Walker Process), 6-inch indicator dial, two (2) micro-switches (one N.O. and one N.C.) and a terminal block, all enclosed in a stainless steel weather tight housing. Amperage metering devices will not be considered equal to the overload device specified.
4. Micro-switches shall be factory set to: (1) sound an alarm when the load on the mechanism reaches 80% of the AGMA torque (WSH-GT-1); and (2) stop the motor when the load reaches 125% of the AGMA torque (WSHH-GT-1).
5. Provide a shear pin device mounted in an easily accessible location.

D. Final Reduction

1. Provide internal, full depth involute tooth design, ductile iron or alloy steel spur gear driven by a heat treated steel pinion from the slow speed shaft of the intermediate reduction unit. Stub tooth design will not be acceptable.
2. Provide cast iron or A36 steel turntable base with annular raceway to contain balls upon which the internal gear rotates. The ball race shall ensure low unit ball load, long life and stability without the use of submerged guide shoes, bumpers or steady bearings.
3. Provide four (4) renewable special hardened (38-42 Rockwell C) steel liner strips force fitted (pins and cap screws not permitted) into the turntable base and internal gear for balls to bear on vertically and horizontally or provide four (4) point contact renewable special hardened (58-60 Rockwell C) steel raceway fitted (pins and cap screws not permitted) into the turntable base and internal gear for balls to bear on vertically and horizontally.

4. Provide bearings at top and bottom of pinion to ensure complete tooth contact between mating surfaces. Pinion and pinion shaft shall be furnished as a two-piece assembly for ease of maintenance.
5. Provide an internal gear of solid or split design with precision mating surfaces for ease of removal of gear, balls and liner strips without raising bridge.
6. Internal gear, pinion and balls to run in an oil bath and be protected by a felt or neoprene seal and vertical neoprene dust shield.
7. Provide oil filling and level pipe along with a drain plug and sight gauge.
8. Turntable base shall be bolted to the center column and be designed to support the bridge, internal gear and rotating mechanism.

2.04 CENTER PIER

A. A cylindrical 3/8" thick ASTM A36 steel plate center pier shall support the drive, collector mechanism and access bridge. Colum base and topplate to be reinforced ¾-inch thick center column.

B. Top of pier to have a drive mounting plate set plumb with the centerline.

C. Drive to be positioned, leveled and grouted in place on top of pier with a non-shrink grout.

D. Manufacturer to provide minimum eight (8) 1-inch diameter anchor bolts and steel template/grout shield to accurately locate anchors.

E. The 24-inch center pier shall bolt down to concrete and a concentric 12-inch feed pipe shall serve as the influent pipe. Provide type 316 stainless steel coupling connection with neoprene gaskets each end for connection of 12” ductile plain end influent pipe provided by contractor to 12-inch feed pipe. Two access ports shall be provided in center pier to make feed pipe connection.

F. Center pier shall have a minimum of three (3) overflow areas at its upper end to diffuse flow into the flocculation feedwell at a velocity not to exceed 1.75 fps at maximum design mixed liquor flow.

2.05 CENTER CAGE AND RAKE ARMS

A. The minimum angle size used for construction of the center cage and rake arms shall be 2-inch x 2-inch x 1/4-inch members.

B. The thickener mechanism shall include two (2) sludge removal arms of ASTM A36 steel truss construction, a minimum of 3 feet 6 inches square with ASTM A36 steel raking blades and adjustable 304 stainless steel squeegees on all blades. The truss arms shall include pickets. The rake blades shall be properly spaced to insure complete raking of the basin floor twice per revolution.

C. The center cage and rake arms shall be designed such that calculated stresses do not exceed the AISC allowable stress at twice the drive 100% rating.

2.06 INFLUENT FEEDWELL

A. The influent feedwell fabricated from 1/4-inch steel plate sections supported from the drive cage or bridge extensions.

B. Incorporate steel stiffeners at the top and bottom to maintain shape and rigidity.

C. Feedwell shall be of adequate size to diffuse the flow into the tank at a uniform flow through velocity.

2.07 HALF-SPAN ACCESS BRIDGE

A. Provide a bridge of wide flange beam construction extending from the tank wall to the stationary drive base.
B. Bridge to be designed for the dead load and a live load of 50#/sq. ft., with a deflection not exceeding L/360 of the span.

C. Provide a 3-ft wide walkway of 1-1/4 inch x 3/16-inch aluminum grating extending over the entire bridge length.

D. Provide a 2-rail aluminum handrail consisting of 1-1/2-inch diameter, Schedule 40 mechanically fastened aluminum pipe for rails and Schedule 80 posts. Post spacing not to exceed 5-ft.

E. Provide a 4-inch high x ¼-inch aluminum toe plate along both sides of bridge and bridge extension.

F. Provide a minimum 8-ft x 10-ft rectangular platform to provide a 2-ft working clearance around the drive.

G. Extend railing post (minimum 2.5-inch diameter) 10-ft above platform for lighting installation by others. See drawings for location.

2.08 COATINGS

A. Provide coatings in accordance with Section 09 96 00.

B. Manufacturer is responsible for the surface preparation and all motor coatings in the factory prior to shipment. Interior motors shall be coated with System 10 and exterior motors shall be coated with System 11.

C. Contractor is responsible for touchup and any additional specified coatings.

D. Owner has the right to final color selections. Unless noted otherwise:

1. Final color of non-submerged equipment shall be the same color as the piping that serves the equipment, see Section 40 05 05 for pipe color.
2. Color of submerged equipment can be manufacturer's standard color.

E. Stainless steel, aluminum, bronze, and nonmetallic surfaces shall not be coated.

F. Coat machined or bearing surfaces and holes with protective grease.

2.09 FASTENERS

A. Anchor Bolts

1. All anchor bolts shall be a minimum of 1/2-inch diameter type 316 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.

B. Fasteners

1. All structural fasteners shall be a minimum of 1/2-inch diameter and shall be made of type 316 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Manufacturer shall ship equipment in fabricated assemblies in the largest sections permitted by carrier regulations and match-marked for field erection.

B. Contractor shall drain and survey tank to provide the manufacturer with dimensions required to provide equipment that functions properly. Contractor shall provide field assembly and installation of equipment in accordance with manufacturer's written instructions.

C. Contractor to coordinate draining and cleaning the gravity thickener with the Owner for Engineer inspection of existing grout layer prior to gravity thickener shop drawing submittal. If it is determined the existing grout layer needs replaced, then Contractor shall provide a 2-inch layer of grout to the tank floor in strict accordance with the manufacturer's recommendations. Screed boards shall be supplied by Contractor.

3.02 IDENTIFICATION

A. Provide equipment identification marker complete with equipment name and tag number in accordance with Section 40 05 97. Coordinate field location with Engineer.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Services:

1. Supplier's or manufacturer's representative for equipment specified herein shall be present at jobsite or classroom designated by Owner for workdays indicated, travel time excluded, for assistance during plant construction, plant startup, and training of Owner's personnel for plant operation. Include three separate trips to provide the following field services at a minimum:
   a. 1 workdays for Installation Services.
   b. 1 workday for Start-up and Instructional Services.
   c. 1 workday for Post Startup Services

2. Supplier or manufacturer shall direct services to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas other than wastewater treatment process. See Section 01 61 00.
3. In addition to the services specified above, provide manufacturer’s services as required to successfully complete systems demonstration as specified in Section 01 79 10.

3.04 DEMONSTRATION

A. Torque Test:

1. Contractor shall perform test under Manufacturer’s supervision.
2. Test by anchoring thickener mechanism.
3. Start thickener drive to demonstrate the structure's ability to withstand loads resulting from at least 125 percent of drive design torque.
4. Demonstrate proper operation of high torque alarm and cut-off.
5. Repeat test to verify results.

END OF SECTION

SECTION 46 71 16
THICKENED SLUDGE HOPPER

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Hopper for existing Andritz Gravity Belt Thickener as shown on drawings.

1.02 SYSTEM DESCRIPTION

A. Design and Performance Requirements:

1. System shall be designed to store thickened primary filter sludge with a solids concentration of 3% to 7%.
2. The sludge storage hopper shall have minimum active storage capacity of 325 gallons with nominal dimensions as shown on drawings and a 60 degree angle of repose.
3. Equipment shall continuously operate without damage while operating under load.
4. Design equipment so parts are readily accessible for inspection and repair, easily duplicated and replaced, and suitable for service specified.

1.03 SUBMITTALS

A. General:

1. Submit Product Data in sufficient detail to confirm compliance with requirements of this Section. Submit Product Data and Shop Drawings in one complete submittal package. Partial submittals are unacceptable.

B. Product Data:

1. Catalog cuts and product specifications for equipment specified.
2. Coating Systems in accordance with Section 09 96 00.

C. Shop Drawings:

1. Installation and assembly drawings and specifically prepared technical data for equipment.

D. American Iron and Steel Compliance Certification:

1. This project is being funded by the Clean Water State Revolving Fund that requires that all of the iron and steel products used in the project to be produced in the United States (“American Iron and Steel Requirement”). The Contractor and his/her suppliers shall comply with Section 436 of federal H.R. 3547. These requirements apply to and are binding to the Manufacturer of the products specified in this Section unless variance or De Minimums documentation has been submitted by the Contractor.
2. The Manufacturer shall provide with the shop drawing submittal one signed and dated Certification Letter (a sample copies of which are provided in the Appendix). The Certification Letter shall demonstrate compliance with Section 436 of federal H.R. 3547.

E. Submittals shall be in accordance with Section 01 33 00.

1.04 DELIVERY, STORAGE, AND HANDLING

A. All equipment and parts shipped to the job site shall be properly protected from the elements so that no damage or deterioration occurs from the time of delivery to the time when the installation is complete and the units are placed into operation.

B. Manufacturer shall define the requirements to properly protect the equipment and parts shipped to the job site, during storage, and during installation.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Jim Myers and Sons

B. Andritz Separation Technologies

2.02 MATERIALS

A. Unless specified otherwise in this Section, all components shall be Type 316L stainless steel. Material thickness shall be a minimum of 3/16" steel thickness.

B. Hopper: Type 316L stainless steel.

C. Supports: Type 316L stainless steel. Construct from welded Type 316L stainless steel I-beams or formed channels, with minimum thickness of 3/8 inch and minimum web/wall thickness of 1/4 inch.

D. All fasteners shall be Type 316L stainless steel (minimum 1/2 inch diameter).

2.03 CONSTRUCTION

A. The hopper shall be mounted on the discharge end of the existing Andritz gravity belt thickener as shown on Drawings 8-SMNE-04 and 8-MN-05.

B. The hopper shall receive sludge from the top and discharge to a pump suction at the bottom.

C. The hopper shall connect to the existing GBT No. 2 sludge discharge flange which also contains an overflow to the GBT No. 2 drip pan.

D. The bottom of hopper shall be 8" flange connection in vertical as low as possible to maximize volume and install 8" knife gate valve, 8" x 6" rubber expansion joint and GBT-2 Thickened Sludge Pump to be provided by Contractor.

E. The hopper shall be constructed with dimensions shown on drawings and without cross bracing. Facilitate leg mounting installation on concrete foundation, as shown on drawings. Provide anchor bolts for support structure.

F. Design integral hopper supports for dead loads and live loads assuming hoppers completely full of biosolids of 65 lb/ft3 density. No weight shall be added to the GBT unit or pumping equipment.

G. All welding shall conform to the American Welding Society Structural Welding Code.

2.04 COATINGS

A. Stainless steel surfaces shall not be coated.

PART 3 – **EXECUTION**

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's written instructions.

END OF SECTION

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Section VI

Appendix

CERTIFICATE OF INSTALLATION SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify the equipment supplier/manufacturer has inspected this equipment and that it has been properly installed, adjusted, and calibrated. I further certify this equipment may now be operated for test purposes and/or normal use.

MANUFACTURER'S REPRESENTATIVE

Signature | Date

Name (print)

Title

Representing

CONTRACTOR

Signature | Date

Name (print)

Title

Comments:

This form shall be completed and submitted to Engineer prior to training of Owner's personnel in accordance with Payment Bond.

CERTIFICATE OF INSTRUCTIONAL SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify the equipment supplier/manufacturer has instructed OWNER'S personnel in the startup, operation, and maintenance of this equipment as required in the Specifications.

CONTRACTOR

Signature | Date

Name (print)

Title

I hereby certify that my operating personnel received ____ days instruction from

_____

for startup, operation, and maintenance of this equipment.

OWNER

Signature | Date

Name (print)

Title

Comments:

This form shall be completed and submitted to Engineer after training of Owner's personnel in accordance with Payment Bond.

CERTIFICATE OF POST STARTUP SERVICES

Project

Equipment

Specification Section

Contract

I hereby certify the equipment supplier/manufacturer has inspected this equipment, made adjustments and calibrations, and that it is operating in conformance with the design, Specification, and manufacturer's requirements. Notation of improper operation shall be detailed and recommendations made and attached to this form.

MANUFACTURER'S REPRESENTATIVE

Signature | Date

Name (print)

Title

Representing

CONTRACTOR

Signature | Date

Name (print)

Title

OWNER

Signature | Date

Name (print)

Title

Comments:

This form shall be completed and submitted to Owner upon completion of the 1-year reinspection as required by the Specifications.

REQUEST FOR INFORMATION

Request No.	Date:
Contractor:	Specification Section / Drawing No.:
Project:	
Contract:	
This is a request for a information on the following:	
Prepared By:	Date Response Needed:
Response:	
Prepared By:	Date:
Response Returned to Contractor On:	
cc: Owner:_____ Resident Project Representative:_____	

CONTRACTOR'S REQUEST FOR SUBSTITUTION

(Include With Submittal)

Provisions requiring submittal of this form are described in Specification Sections 01 33 00 and 01 61 00 and paragraph 6.05 of the General and Supplementary Conditions.

Substitution Request No.: _____

Project: _____

Contract: _____

We hereby apply for consideration of _____
(*Proposed Substitute Manufacturer*)
as a substitute manufacturer to the manufacturer(s) named in Specification Section _____

Paragraph/Drawing No. _____ for the following reasons. (*Check one or more.*)

_____ The specified equipment or material is unavailable or the time of delivery will substantially delay the construction of the project, but not as result of CONTRACTOR'S failure to pursue Work promptly or coordinate various activities. (*Provide supporting information.)*

_____ The proposed equipment or material will provide for packaging and coordination with other equipment from a single source supplier. *(Submit name of source supplier and other equipment to be packaged.)*

_____ The proposed equipment or material is a "Substitute Item" to that specified and the CONTRACTOR will provide the OWNER with a credit of $_____ if the equipment or material is accepted.

We certify that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar in substance to the specified, be suited to the same use as that specified, and will not prejudice CONTRACTOR'S achievement of Substantial Completion on time.

Contractor: _____

Signature: _____ Date: _____

Name (print): _____

Title: _____

NOTE: ENGINEER may require CONTRACTOR to furnish, at CONTRACTOR'S expense, additional data about the proposed substitute including but not limited to, an analysis by CONTRACTOR of the equivalency of the proposed substitute to the named item.

A. Physical Characteristics of Proposed Substitute (if applicable).

Operating Weight:_____ Height:_____ Width:_____ Depth:_____

Voltage:_____ Hertz:_____ KW or HP:_____

B. Will acceptance of the proposed substitute by the OWNER:

1. Require a change in the Drawings or Specifications: Yes_____ No_____
   If yes, attach an explanation and detailed drawings or specifications.
2. Require payment of any license fee or royalty: Yes_____ No_____
   If yes, attach an explanation.
3. Result in a change of contract time: Yes_____ No_____
   If yes, attach an explanation.

C. Variations of proposed substitute from specified material, equipment, methods or procedures include: *(If none, state none. Attach separate listing if more space is needed.)*

1. _____
2. _____
3. _____
4. _____

D. Service Source (Maintenance, Repair, and Replacement) Availability:

1. Name of Business:_____

   Address:_____

   Years in Business:_____ Factory Authorized: Yes_____ No_____

   Parts Stocked: Major: Yes_____ No_____ Minor: Yes_____ No_____

   Field Service Staff Available: Yes_____ No____

2. Name of Business:_____

   Address:_____

   Years in Business:_____ Factory Authorized: Yes_____ No_____

   Parts Stocked: Major: Yes_____ No_____ Minor: Yes_____ No_____

   Field Service Staff Available: Yes_____ No_____

E. Identify costs, direct or indirect, if any, associated with acceptance of this proposed substitute.
   (If none, state none.)

_____

_____

INSTALLATION LIST

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

*****

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

*****

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

*****

Location:_____ Telephone No.:_____

Date Installed:_____ Date Started Up:_____

Owner's Representative to be Contacted:_____

Engineer's Representative to be Contacted:_____

Firm's Name:_____ Telephone No.:_____

GEOCON
PROFESSIONAL SERVICES

July 13, 2021

Kam Law, PhD, PE, ENV SP
Donohue & Associates, Inc.
230 W Monroe Street
Suite 2925
Chicago, Illinois, 60606

Re: Geotechnical Engineering Report REVISED
Primary Filtration Facility 1
Rock River Reclamation District
3333 Kishwaukee Street
Rockford, Illinois
GEOCON Project No. 21-G0593

Dear Kam:

Pursuant to our proposal for geotechnical engineering services, we have completed a subsurface exploration and geotechnical analyses for the above referenced project. This electronic copy of the Geotechnical Engineering Report includes our findings and recommendations for the proposed project referenced above. Please contact our office if you require hard copies of the report.

GEOCON Professional Services, LLC. (GEOCON) appreciates the opportunity to be of service during this phase of the project. If there are any questions or comments you may have regarding the contents of the report, or if we may be of any further service, please contact us at your convenience.

Sincerely,

GEOCON Professional Services, LLC.

Brandon Filafusi, M.S., E.I.T.
Project Engineer

KENNETH K. RIPPY
062 - 044859
REGISTERED
PROFESSIONAL
ENGINEER
OF
ILLINOIS

Kenneth K. Rippy, PE
Senior Engineer

Geotechnical Engineering Report REVISED

Primary Filtration Facility 1
Rock River Reclamation District
3333 Kishwaukee Street
Rockford, Illinois

Kam Law, PhD, PE, ENV SP
Donohue & Associates, Inc.
230 W Monroe Street
Suite 2925
Chicago, Illinois, 60606

Prepared By:
GEOCON Professional Services, LLC.
9370 West Laraway Road, Suite D
Frankfort, Illinois 60423

July 13, 2021

GEOCON Project No. 21-G0593

TABLE OF CONTENTS

APPENDIX

GEOTECHNICAL ENGINEERING REPORT REVISED

Primary Filtration Facility 1
Rock River Reclamation District
3333 Kishwaukee Street
Rockford, Illinois

INTRODUCTION

This report presents the results of a subsurface investigation for the proposed Primary Filtration project located at 3333 Kishwaukee Street, in Rockford, Illinois. The investigation included performance of borings at the locations shown on the Boring Location Diagram in the attached Appendix. The purpose of this report was to determine and evaluate the subsurface conditions existing at the subject site, and to establish related geotechnical parameters to be utilized for the design and construction of the project.

Authorization to perform this subsurface exploration and analysis was given in the form of a fully executed Subconsultant Services Agreement, dated May 28, 2021. The above referenced document described the project scope and contained general conditions for performance of the work.

PROJECT AND SITE DESCRIPTION

The site is located at the existing Rock River Water Reclamation District wastewater treatment facility in Rockford, Illinois. The Rock River borders the site on the west. The area of the proposed Primary Filtration facility is currently developed with an existing clarifier that is immediately surrounded by landscaped areas. Clarifiers 1 and 2 are located on the east side of the proposed facility. We understand that the project will include repurposing Clarifiers 3 and 4 and constructing a new Primary Filtration facility within the existing structure.

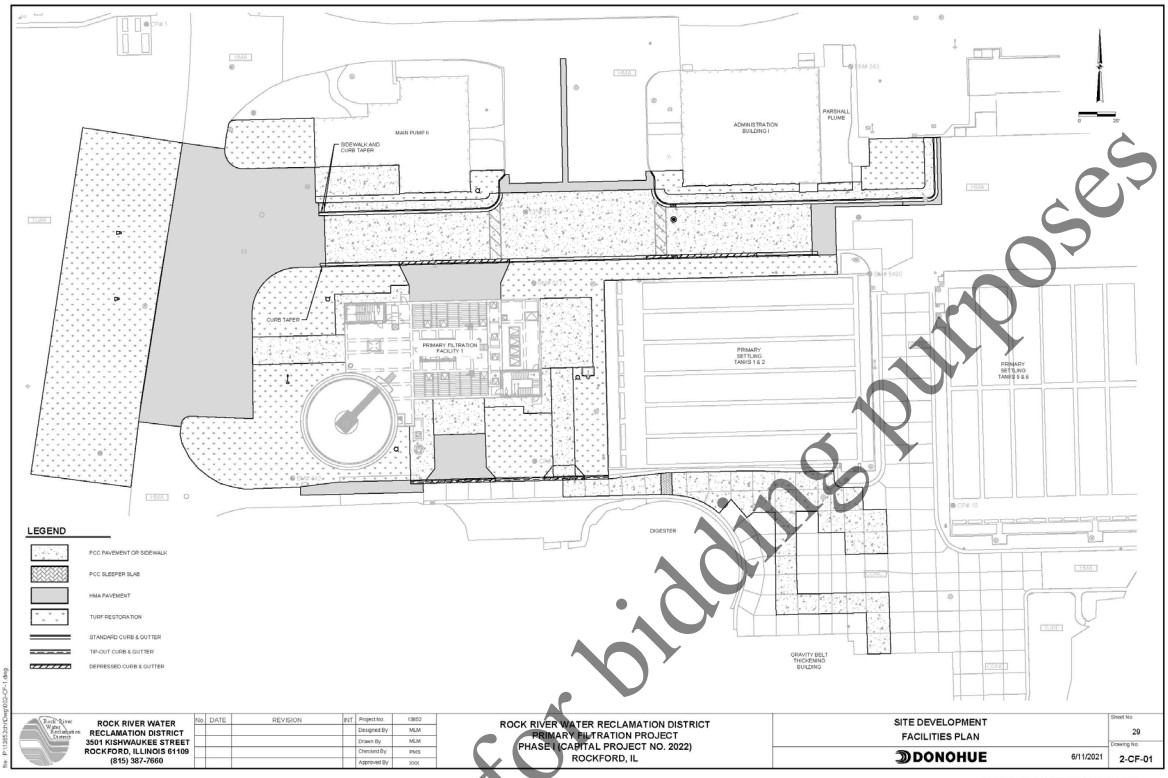
Based on information provided by the client, the Primary Filtration Project includes installation of Cloth Media Disk Filter (CMDF) units as a replacement for the aging Primary Clarifier Nos. 1-4. The CMDF units will be operated in parallel with Primary Clarifier Nos. 5-10, and the CMDF effluent will combine with primary effluent upstream of the existing Flow Splitter Box to the aeration tank system. As described in the Facility Plan, the construction of the Primary Filtration Project will be split into two (2) phases:

Phase I – Installation of at least two (2) and possibly four (4) CMDF units. Hydraulically connect Primary Filter Unit Nos. 1 and 2 for a capacity of 30 MGD. Install influent pumps to lift flow to Filter Unit Nos. 1 and 2.

Phase II – Hydraulically connect Primary Filter Unit Nos. 3 and 4 for an additional capacity of 30 MGD. Install influent pumps to lift flow to Filter Unit Nos. 3 and 4.

Upon completion of Phase I and II, the total capacity of the Primary Filters would be 60 MGD.

A summary of the facility improvements (Phase I) is shown below:



Existing grades around the perimeter of the existing structure is about El. 702 to 703 feet and the surface slopes down to the southwest, towards the Rock River, which is located about 450 feet southwest of the project area. Design information for the new Primary Filtration Facility building that will be constructed within the existing structure is preliminary, however, it is anticipated that spread footings or mat foundations will be used to support the interior equipment, and the foundations will be constructed near El. 693 feet, or about 2 feet above the existing base slab of the clarifier structure. Foundation loads were not provided but are expected to be relatively light.

SUBSURFACE EXPLORATION

Six (6) soil borings labeled SB-01 to SB-06 were advanced for this project at the locations shown on the Boring Location Diagram included in the Appendix. The borings were advanced to a depth of 30 feet below grade, as noted on the individual logs. Groundwater monitoring wells (GMWs) were installed at SB-01 and SB-04. The wells extended to a depth of +/-20 feet below grade and were screened in the water bearing sand.

The boring locations were staked in the field by Rock River Water Reclamation District prior to drilling, and the ground surface elevations were estimated using topographic information provided by the client. After 24 hours completion of the borings not completed with GMWs, the bore holes were backfilled with soil cuttings and patched with like materials as encountered at the boring.

Drilling and Sampling Procedures

The soil borings were performed with a track-mounted drilling rig equipped with a rotary head. Conventional, continuous flight, hollow-stem augers were used to advance the boring with representative samples obtained in the boring employing split-barrel sampling techniques in accordance with ASTM Procedure D-1586. Soil samples were taken at 2.5-foot intervals from the surface to a depth of 15 feet, followed by intervals of 5 feet to the termination depths of the borings.

The Standard Penetration Test (SPT) is defined as the number of blows required to advance a 2-inch O.D., split-barrel sampler a distance of one foot by a 140-pound hammer falling 30 inches, commonly described as the N-value. These sampler resistances provide a useful indication of the consistency or relative density of most soil deposits and are reported on the boring logs presented in the Appendix. Samples of cohesive soils obtained from the borings were tested with a calibrated hand penetrometer to aid in evaluating the soil strength characteristics. The results from this testing is tabulated on the boring logs.

Water level observations made during drilling operations and approximately 24 hours after drilling are noted on the boring logs.

It should be noted that it is difficult to determine the stratigraphy of the upper 2 to 3 feet of the profile from the soil borings due to the size of the bore hole, about 6 inches in diameter, and intermittent sample intervals. Further, the split spoon sampler tends to push through softer soils such as fill or topsoil, resulting in little or no sample recovery from these soils. It is recommended that test pits be excavated to better define the depth of topsoil or fill if such information is required prior to construction.

Laboratory Tests

Additional characteristics of the foundation materials were determined in the laboratory to provide data on which to classify and estimate the engineering properties of the subsurface soil deposits encountered in the borings. All samples were visually classified by the geotechnical engineer according to the Unified Soil Classification System (ASTM D-2488). An explanation of the symbols used in this system is included in the Appendix. Unless notified to the contrary, all samples will be disposed of after one month.

Representative samples were tested in the laboratory to determine the natural moisture content of the soils. All moisture contents are expressed as a percentage of the dry weight of soil. Representative samples of the cohesive soils encountered in the borings were tested in the laboratory with a calibrated RIMAC spring tester to determine the approximate unconfined compressive strength of the soil samples. Selected samples were also subjected to Grain Size Analyses testing in accordance with ASTM D 422 and Atterberg Limits Testing in accordance with ASTM D 4318.

LOCAL GEOLOGY

Native soils in the site area are expected to consist of the Cahokia Alluvial deposits. These deposits are located in flood plains and channels of modern rivers and streams. The deposited materials typically consist of poorly sorted sands, silts, or clays with local deposits of sandy gravel. In many areas these deposits overlie well-sorted glacial outwash associated with the Henry Formation.

SOIL CONDITIONS

The types of subsurface materials encountered at the test boring locations are described on the Soil Boring Logs. The lines delineating the changes in strata on the logs represent an approximate boundary between the various soil classifications. It must be recognized that the soil descriptions are considered representative for the specific test hole location, but that variations may occur between the sampling intervals and at other locations on the site. A summary of the major soil profile components is described in the following paragraphs. A more detailed description and supporting data for the boring location can be found on the individual boring log.

Borings SB-01 to SB-05 encountered a thin veneer of topsoil at the ground surface whereas SB-06 was located in an HMA drive where the pavement section consisted of 5 inches of asphalt underlain by 19 inches of sand fill mixed with clay. Primarily granular soil deposits were encountered below the surficial materials with the upper 6 to 10 feet described as fill at SB-01, SB-02, SB-04 and SB-05. In general, the sand was described as poorly graded fine sand with variable density classifiers based on N-values ranging from 2 to 25 blows per foot. The samples were saturated with groundwater below a depth of about 13 feet, which correlates to elevations ranging from El. 687 to 691 feet. Based on Hazen's Relation, the estimated hydraulic conductivity of the poorly graded fine sand layer is 0.024 cm/sec.

At SB-01 to SB-03, a stratum of silty to lean clay was encountered at a depth of about 8 feet below grade. The lean clay was described as medium stiff to hard with unconfined compressive strengths ranging from 0.8 to 3.8 tsf and moisture contents ranging from 22.2 to 31.9 percent. Atterberg limits testing indicated the lean clay had liquid limits ranging from 30 to 41 and plasticity indices ranging from 8 to 16.

A layer of coarse sandy gravel was encountered at SB-01 and SB-02 below a depth of 22 feet. The coarse sandy gravel was described as medium dense with N-values ranging from 14 to 20 blows per foot and the samples were saturated with groundwater. Based on Hazen's Relation, the estimated hydraulic conductivity of the gravel layer is 1.8 cm/sec.

GROUNDWATER CONDITIONS

Groundwater measurements recorded during drilling and in the wells at various intervals after completion of drilling are tabulated below:

TABLE 1: GROUNDWATER MEASUREMENTS

Boring No.	Surface Elevation, Feet	Groundwater depth measured at the time of drilling, Feet	Groundwater elevation measured in the Piezometers, Feet			
			6/15/2021	6/16/2021	7/6/2021	
SB-01	702	14	688.8	688.8	688.8	
SB-02	701	14	693.0			
SB-03	702	13	694.0			
SB-04	704	13	691.0	689.9	689.4	
SB-05	704	15	689.0	689.0		
SB-06	703	13	690.0	690.0		

Fluctuations of the groundwater level will occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times during the lives of the structures may be different than the levels indicated on the boring logs. Also, groundwater can be perched within variable existing fill and granular materials within or above lower permeability soil. Actual design groundwater elevations should consider the possibility of groundwater level fluctuations.

ENGINEERING RECOMMENDATIONS

Foundations

We understand the walls and base slab of the existing clarifier structure, near El. 691 feet, will remain in place and foundations for the Primary Filtration facility will bear on the existing base slab near El. 693 feet. The thickness of the existing slab was not provided. Based on results of the borings, the existing slab is supported by native loose to medium dense sand or very loose clayey sand encountered below El. 689 feet. The clayey sand at SB-02 and SB-03 exhibited N-values ranging from 3 to 4 blows per foot, while the sand encountered at SB-01, SB-04 and SB-05 exhibited N-values ranging from 6 to 15 blows per foot. Due to the lower N-values and presence of groundwater, the net allowable bearing pressure applied on the subgrade below the existing slab should be limited to 2,000 psf. The net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at footing base elevation. The recommended allowable bearing pressures could be increased by one-third for transient live loads.

Footings should bear at least 3.5 feet below lowest adjacent finished grade for frost protection and to minimize moisture changes in the soil beneath footings. Continuous formed wall footings should have a minimum width of 18 inches and isolated column footings should have a minimum width of 24 inches.

The base of all foundation excavations should be free of water and loose soil or demolition debris prior to placing concrete.

Assuming that the foundation design and construction for planned structures are performed in accordance with the recommendations in this report, maximum post-construction settlements of less than approximately 1 inch would be anticipated. Differential settlement across structure areas, due to variation of subsurface conditions and foundation loadings, could be on the order of 1/2 to 2/3 the total settlement.

Seismic Considerations

Based on data obtained from the borings, a Seismic Site Classification of "D" should be assumed in accordance with the 2015 Edition of the IBC. The following tables contain Site Coefficients and Seismic Design Parameters for the project as per the 2015 International Building Code (IBC).

Table 2A: Values for Short Time Periods

Site Class	S_s	F_a	S_{MS}	S_{DS}
D	12.4% (0.124)	1.6	0.198	0.132

S_s: The maximum considered earthquake ground motion for a short time period at the project area is 12.4% (0.124) based on Figure 1613.5(1) from the IBC code.
F_a: The site coefficient for short time periods from Table 1613.5.3(1) from the IBC code.
S_{MS}: Maximum considered earthquake spectral response accelerations for short time periods.
S_{DS}: Five percent damped design spectral response accelerations for short time periods.

Table 2B: Values for 1-Second Periods

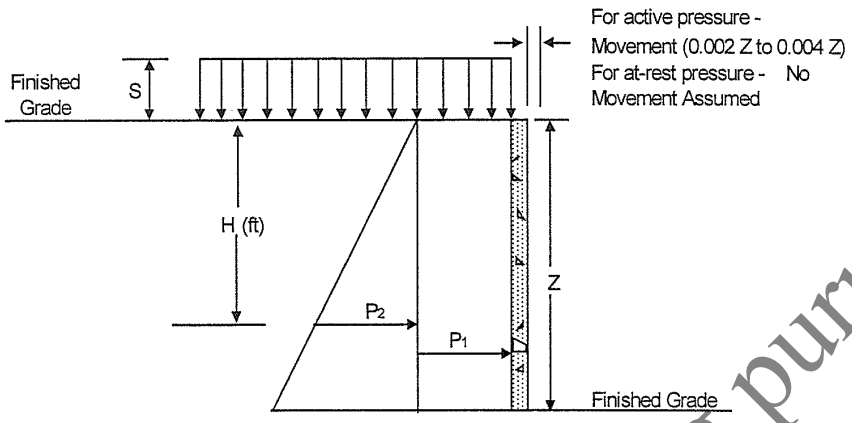
Site Class	S_1	F_v	S_{M1}	S_{D1}
D	5.8% (0.058)	2.4	0.138	0.092

S_1: The maximum considered earthquake ground motion for a 1-second time period at the project area is 5.8% (0.058) based on Figure 1613.5(2) from the IBC code.
F_V: The site coefficient for 1-second time periods from Table 1613.5.3(2) from the IBC code.
S_{MS}: Maximum considered earthquake spectral response accelerations for 1-second time periods.
S_{DS}: Five percent damped design spectral response accelerations for 1-second time periods.

Lateral Earth Pressures

Walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of freestanding cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall rotation. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.

EARTH PRESSURE COEFFICIENTS



Earth Pressure Conditions	Coefficient For Backfill Type	Surcharge Pressure, P_1, (psf)	Earth Pressure, P_2, (psf)
Active (K_a)	Granular - 0.33 Lean Clay - 0.42	(0.33)S (0.42)S	(40)H (50)H
At-Rest (K_o)	Granular - 0.46 Lean Clay - 0.58	(0.46)S (0.58)S	(55)H (70)H
Passive (K_p)	Granular - 3.0 Lean Clay - 2.4	--- ---	--- ---

Conditions applicable to the above conditions include:

- For active earth pressure, wall must rotate about base, with top lateral movements 0.002Z to 0.004Z, where Z is wall height;
- For passive earth pressure, wall must move horizontally to mobilize resistance;
- Uniform surcharge, where S is surcharge pressure;
- Horizontal backfill, compacted to at least 95% of standard Proctor maximum dry density;
- Loading from heavy compaction equipment not included;
- No groundwater acting on wall;
- No safety factor included;
- Ignore passive pressure in frost zone.

Based on the grain size tests performed on materials encountered in the borings and subsequent correlations based on Table 6 of NAVFAC Soil Mechanics Design Manual 7.1, we estimate the following unit weights will be applicable for wall design using on-site soils as backfill materials. The estimated unit

weights assume the soils are compacted to 95% of the Modified Proctor maximum dry density (ASTM D-1557).

ESTIMATED SOIL UNIT WEIGHT

Soil Type	Unified Symbol	Estimated Dry Unit Weight (pcf)	Estimated Total Unit Weight (pcf)
Fine to Coarse Silty Sand	SM	115	130
Fine to Medium Sand	SP	105	115
Fine to Coarse Sand	SW	120	130

Backfill placed against structures should consist of granular soils or low plasticity cohesive soils. For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively. To calculate the resistance to sliding, a value of 0.4 should be used as the ultimate coefficient of friction between the footing and the underlying granular soil.

Specific information regarding flood elevations of the Rock River and longer-term monitoring of the piezometers would be required for a more accurate evaluation of the seasonal high and low groundwater conditions on-site. Below the long term seasonal high groundwater level, a combined hydrostatic and lateral earth pressures should be calculated for lean clay backfill using an equivalent fluid weighing 90 and 100 pcf for active and at-rest conditions, respectively. For granular backfill, an equivalent fluid weighing 85 and 90 pcf should be used for active and at-rest, respectively. These pressures do not include the influence of surcharge, equipment or floor loading, which should be added. Equipment having total gross weight of greater than 5 tons should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided.

It may be necessary to design the structures to withstand hydrostatic and buoyancy forces. Resistance to buoyancy forces could be provided by the effective weight of the structure or by the use of anchors or thickened slabs and enlarged footings.

Site Preparation and Earthwork

All existing structures or other below ground objects encountered within 2 feet below any new slabs or pavements should be removed from the subgrade. If existing basements are encountered, they must be backfilled as described under *Controlled Compacted Fill*. All demolition trenches must be cleared of debris and loose unsuitable soils that are not adequate for foundation or pavement support. The crushed stone encountered beneath the pavements can be left in place, but the condition of the stone should be evaluated during stripping operations. If the crushed stone is saturated, it may need to be removed, dried, and re-used as structural fill in other areas. Existing concrete that will be removed during demolition may also be reused as fill, however the recycled materials should have all unsuitable materials (rebar, mesh, wood, etc.) removed before reuse and the gradations should correspond to IDOT's CA-1, CA-6 or CA-7 gradations.

In order to evaluate the subgrade, it is recommended that the subgrade soils be proof rolled to identify any weak or unsuitable areas at or just below the subgrade elevation. Proofrolling may be accomplished

with a fully loaded single axle dump truck or other pneumatic tire equipment which provides a similar subgrade loading. Areas that experience rutting or pumping under the proof roll load should be improved by subgrade improvement methods such as disking and drying, chemical stabilization/modification, or removal and replacement. Disking, drying and recompaction must be carried out during suitable weather conditions which allows for drying of the subgrade prior to recompaction. Although not as economical as moisture conditioning mentioned above, chemical modification such as lime stabilization has the advantage of allowing work to proceed under adverse weather conditions. Finally, the removal and replacement method involves undercutting the excessively wet or soft soils and replacing with IDOT CA-1 crushed limestone aggregate. The CA-1 can be supplemented with Tensar TX190L geogrid, or equivalent, in maximum lifts of 1 foot and capped off with a minimum of 6 inches of IDOT CA-6 to reduce surface water to infiltrate the subgrade. After the subgrade soils are stabilized, and suitable for support of new site grading fill or pavements, low areas may then be raised to the planned grades with properly compacted fill as described in the following section.

The existing subgrade soils will be susceptible to disturbance from precipitation, construction traffic, and vibrations. Care should be taken to avoid disturbance of the subgrade soil and construction traffic over prepared subgrades should be avoided. If the subgrade soils become disturbed during construction, they should be scarified and recompacted or removed and replaced prior to placing new site grading fill or granular subbase material.

Controlled Compacted Fill

The on-site sand materials encountered in the borings are considered suitable for use as structural backfill provided the material is free of organics and other deleterious material and can be adjusted to near optimum moisture contents suitable for recompaction. All structural fill should be placed on firm subgrades, and the fill should be placed in lifts and properly compacted. All newly placed fill should be placed in 9 inch or less loose lifts and compacted to at least 95 percent of the Modified Proctor test (ASTM D-1557) maximum dry density. The fill should be placed within +/- 2 percent of the optimum moisture content value determined by laboratory Proctor testing.

The site should be graded to promote runoff of surface water in order to minimize ponding of precipitation on the prepared subgrades, or in excavations. If the subgrade becomes saturated, or becomes deteriorated from repeated construction traffic, the affected material should be removed, and these materials should be disked and recompacted or undercut and replaced with suitable fill prior to further construction in those areas.

GEOCON recommends that the evaluation of the subgrade and selection of fill materials for various applications should be done in consultation with the geotechnical engineer, and placement of fill for structural applications be monitored and tested by a representative of the geotechnical engineer.

Slabs

Subgrades for support of slabs should be prepared as recommended in the Site Preparation and Earthwork section of this report. For concrete slabs or pavements constructed directly on approved soil subgrades prepared as recommended, a modulus of subgrade reaction, k, of 100 pci could be used for design.

Pavements

Subgrades for support of pavements should be prepared as recommended in the Site Preparation and Earthwork section of this report. Based on our experience with similar projects, recommended pavement sections are shown in Table 3A and 3B below:

TABLE 3A. RECOMMENDED HMA PAVEMENT SECTION

Pavement Material	Light Duty Parking Areas	Heavy Duty Drives & Parking Areas
	Thickness (inches)	
Hot Mix Asphalt Surface Course 9.5mm	2	2
Hot Mix Asphalt Binder Course 19.0mm	2	4
Aggregate Base (IDOT) CA-06	10	12
Total Pavement Section	14	18

TABLE 3B. RECOMMENDED PCC PAVEMENT SECTION

Pavement Material	Light Duty Parking Areas	Heavy Duty Drives & Parking Areas
	Thickness (inches)	
PCC	5	7
Aggregate Base (IDOT) CA-06	6	6
Total Pavement Section	11	13

It is recommended that the aggregate base be compacted to a minimum of 95 percent of the Modified Proctor test (ASTM D-1557) maximum dry density. The hot mix asphalt should be compacted to a minimum of 93 percent of the maximum theoretical density value. Also, rigid pavements, such as Portland cement concrete pavements, are recommended to have a maximum joint spacing of 12 to 15 feet. The joints should be sealed after cutting to retard the downward migration of water and incompressibles; however, the sealing material should not be applied until the majority of the shrinkage cracking has occurred.

It is recommended that saw-cut joints, if used, be completed as soon as possible after the concrete has cured sufficiently to safely allow the placement of saw cutting equipment and personnel on the surface of the concrete. Prompt completion of saw-cut joints will greatly assist in channeling the propagation of shrinkage cracks that occur during initial curing of the concrete, thereby reducing the appearance of cracks in undesired areas.

Pavements should be sloped to promptly remove surface water. Ponding of water on pavement sections and saturation of pavement subgrades is a common cause of premature pavement deterioration. Routine maintenance consisting of repairing damaged areas is helpful in maintaining pavement life and serviceability. Pavement specifications should reference the Illinois Department of Transportation (IDOT) Standard Specifications.

Corrosion Potential

Soil Corrosivity Indication Series tests were performed by Terracon to evaluate the corrosion potential of concrete and steel exposed to the site soils. A copy of the laboratory test results are included in the Appendix.

Based on the results of the tests made on the samples submitted, it does not appear that any special corrosion protection would be required at the site. However, specific requirements for the underground piping should be evaluated by the designer for the subsurface conditions identified in this study.

Excavations

All excavations for the proposed structures and utility lines should be performed in accordance with OSHA Health and Safety Standards for Excavations 29 CFR. Part 1926, as a minimum, and in accordance with any other applicable local, state, and federal safety regulations. The contractor should be aware that slope heights, slope inclination, and excavation depths should in no instance exceed those specified by these safety regulations. Flatter slopes than those indicated by these regulations may be required depending upon the soil conditions encountered, extent of dewatering and other external factors. Construction site safety is the sole responsibility of the contractor who should also be solely responsible for the means, methods, and sequencing of construction operations.

OSHA Health and Safety Standards for excavations classify soils into three basic types (e.g. type A, B, and C). Depending upon the soil type, OSHA requirements for excavation slopes range from 3/ 4H to 1V for Type A soils, 1H to 1V for type B soils, and 1-1/2H to 1V for Type C soils (horizontal to vertical). OSHA dictates that any excavation extending to depth of more than 20 feet shall be designed by a registered professional engineer. Granular soils classify as type C soil according to OSHA regulations. OSHA recommends a maximum slope inclination of 1 to 1.5 horizontal to 1 vertical for dewatered excavations in granular soils.

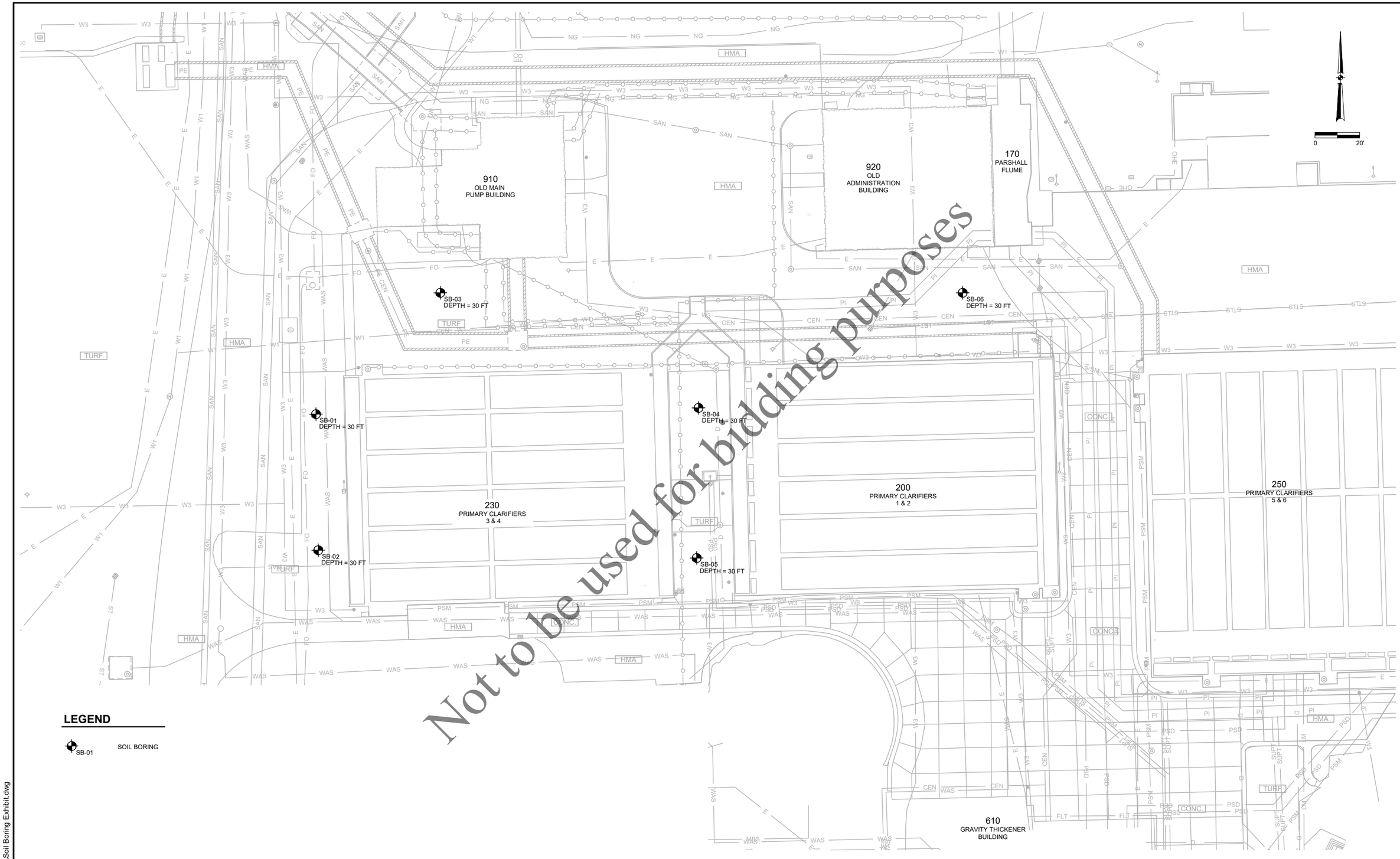
GENERAL COMMENTS

This geotechnical exploration and analysis has been conducted to aid in the evaluation of the subsurface conditions on the subject site. The recommendations presented herein are based on the available soil information obtained and the design information provided. Any changes in the soil conditions encountered during construction, design, or location should be brought to the attention of the soils engineer to determine if modifications in the recommendations are required. The final design plans and specifications should also be reviewed by the soils engineer to determine that the recommendations presented herein have been interpreted and implemented as intended.

This geotechnical study has been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. The findings, recommendations, and opinions contained herein have been promulgated in accordance with generally accepted practice in the fields of foundation engineering, soils mechanics, and engineering geology. No other representations expressed or implied, and no warranty or guarantee is included or intended in this report.

APPENDIX

Boring Location Diagram
Soil Boring Logs
General Notes
Grain Size Distribution
Atterberg Limits Results
Soil Corrosivity Results
Groundwater Elevation Table



LEGEND

SB-01 SOIL BORING

file: P:\13852\cht\Dwg\Soil Boring Exhibit.dwg

Rock River Water Reclamation District

ROCK RIVER WATER RECLAMATION DISTRICT
3501 KISHWAUKEE STREET
ROCKFORD, ILLINOIS 61109
(815) 387-7660

No.	DATE	REVISION	INT.

Project No.	13852
Designed By	XXX
Drawn By	XXX
Checked By	XXX
Approved By	XXX

ROCK RIVER WATER RECLAMATION DISTRICT
PRIMARY FILTRATION PROJECT
PHASE I (CAPITAL PROJECT NO. 2022)
ROCKFORD, IL

SITE DEVELOPMENT
SOIL BORING EXHIBIT

DONOHUE 4/30/2021

Sheet No.

Drawing No.

GEOCON PROFESSIONAL SERVICES

BORING NO. SB-01

CLIENT Donohue & Associates, Inc. **PROJECT NAME** Primary Filtration Project (Capital Project No. 2022)

PROJECT NUMBER 21-G0593 **PROJECT LOCATION** Rock River Reclamation District, Rockford, IL

DATE COMPLETED 6/14/21 **LOGGED BY** TW/JG **DRILLING METHOD** 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	701.8		0-2" TOPSOIL											
			dark brown SAND (FILL) trace clay, gravel, and topsoil loose to medium dense	SS 1	100	9-8-5 (13)			15.4					
5				SS 2	89	3-3-4 (7)			7.9					
	696.0		brown POORLY GRADED SAND trace gravel medium dense	SS 3	67	3-5-7 (12)			2.9					
10				SS 4	100	7-7-5 (12)			3.3					
	691.5		gray SILTY CLAY trace organics medium stiff	SS 5	100	2-2-2 (4)	1.0	0.8	31.9					
	689.0		▽ brown and gray POORLY GRADED SAND loose to medium dense, wet	SS 6	67	2-3-3 (6)			18.7					
15														
20				SS 7	67	5-7-8 (15)			22.4					
	680.0		WELL GRADED GRAVEL with SAND medium dense, wet											
25				SS 8	78	7-7-7 (14)			24.5					
30	672.0			SS 9	89	6-8-12 (20)			22.0					

Bottom of borehole at 30.0 feet.

COMPLETION DEPTH 30 ft **GROUND ELEVATION** 702 ft

CAVE DEPTH ft **BACKFILL** Soil Cuttings

GROUND WATER LEVELS:

▽ **AT TIME OF DRILLING** 14.00 ft / Elev 688.00 ft

AT END OF DRILLING ---

▼ **24hrs AFTER DRILLING** 13.20 ft / Elev 688.80 ft

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Well set at El. 683 ft with 10 ft screen to El. 693 ft.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

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GEOCON PROFESSIONAL SERVICES

BORING NO. SB-02

CLIENT Donohue & Associates, Inc. **PROJECT NAME** Primary Filtration Project (Capital Project No. 2022)

PROJECT NUMBER 21-G0593 **PROJECT LOCATION** Rock River Reclamation District, Rockford, IL

DATE COMPLETED 6/14/21 **LOGGED BY** TW/JG **DRILLING METHOD** 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	700.8		0-2" TOPSOIL											
			dark brown SAND to CLAYEY SAND (FILL) trace steel nails, clay, and topsoil medium dense	SS 1	78	6-7-7 (14)			9.3					
5				SS 2	67	4-5-6 (11)			11.7					
	695.0													
	693.0		brown POORLY GRADED SAND trace gravel loose, moist	SS 3	56	3-4-4 (8)			8.0					
			dark gray to brown LEAN CLAY with SAND trace roots very stiff	SS 4	89	8-5-6 (11)	3.5	3.8	22.2					
10				ST 5	50		2.25		22.7			30	22	8
	688.0													
			gray SILTY CLAYEY SAND loose, very moist to wet	SS 6	72	2-2-2 (4)			26.7					
15														
	682.0													
20			brown and gray POORLY GRADED SAND medium dense, wet	SS 7	78	3-8-8 (16)			25.1					
	678.0													
			WELL GRADED GRAVEL trace sand medium dense, wet	SS 8	56	10-7-8 (15)			7.1					
25	673.0													
			gray POORLY GRADED SAND trace gravel medium dense, wet	SS 9	56	8-8-8 (16)			11.9					
30	671.0		Bottom of borehole at 30.0 feet.											

COMPLETION DEPTH 30 ft **GROUND ELEVATION** 701 ft

CAVE DEPTH ft **BACKFILL** Soil Cuttings

GROUND WATER LEVELS:

AT TIME OF DRILLING 14.00 ft / Elev 687.00 ft

AT END OF DRILLING ---

24hrs AFTER DRILLING 8.00 ft / Elev 693.00 ft

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

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GEOCON PROFESSIONAL SERVICES

BORING NO. SB-03

CLIENT Donohue & Associates, Inc. **PROJECT NAME** Primary Filtration Project (Capital Project No. 2022)

PROJECT NUMBER 21-G0593 **PROJECT LOCATION** Rock River Reclamation District, Rockford, IL

DATE COMPLETED 6/14/21 **LOGGED BY** TW/JG **DRILLING METHOD** 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	701.3		0-8" TOPSOIL											
			brown POORLY GRADED SAND trace gravel loose	SS 1	89	3-2-3 (5)			5.1					
5				SS 2	67	3-3-5 (8)			3.6					
				SS 3	89	3-3-4 (7)			6.7					
	694.0		▼											
			dark gray and brown LEAN CLAY trace sand very stiff	SS 4	89	3-4-5 (9)	3.0	2.2	28.0					
10			sand seam at 10.5 ft	ST 5	75		2.0		26.0			41	25	16
	689.0		▽											
			gray SILTY CLAYEY SAND very loose, very moist to wet	SS 6	100	2-2-1 (3)			19.7					
15														
	683.0													
			brown and gray POORLY GRADED SAND trace clay loose, wet	SS 7	78	3-4-5 (9)			22.2					
20														
	679.0													
			gray POORLY GRADED SAND with gravel medium dense, wet	SS 8	33	7-8-9 (17)			11.5					
25														
				SS 9	78	8-10-15 (25)			15.2					
30	672.0		Bottom of borehole at 30.0 feet.											

COMPLETION DEPTH 30 ft **GROUND ELEVATION** 702 ft

CAVE DEPTH ft **BACKFILL** Soil Cuttings

GROUND WATER LEVELS:

▽ **AT TIME OF DRILLING** 13.00 ft / Elev 689.00 ft

AT END OF DRILLING ---

▼ **24hrs AFTER DRILLING** 8.00 ft / Elev 694.00 ft

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

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GEOCON PROFESSIONAL SERVICES

BORING NO. SB-04

CLIENT Donohue & Associates, Inc. **PROJECT NAME** Primary Filtration Project (Capital Project No. 2022)

PROJECT NUMBER 21-G0593 **PROJECT LOCATION** Rock River Reclamation District, Rockford, IL

DATE COMPLETED 6/15/21 **LOGGED BY** TW/JG **DRILLING METHOD** 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	703.6		0-5" TOPSOIL											
			dark brown to brown SAND (FILL) with crushed concrete very loose to loose	SS 1	56	5-3-2 (5)			5.6					
5				SS 2	56	2-1-3 (4)			6.8					
	697.0			SS 3	67	2-1-2 (3)			7.5					
			brown POORLY GRADED SAND trace gravel medium dense, moist to wet	SS 4	89	3-4-7 (11)			2.8					
10				SS 5	67	3-3-4 (7)			2.8					
				SS 6	67	5-6-10 (16)			9.4					
15														
				SS 7	56	5-7-10 (17)			20.2					
20														
				SS 8	67	6-9-12 (21)			22.5					
25														
				SS 9	89	8-9-10 (19)			20.3					
30	674.0		Bottom of borehole at 30.0 feet.											

COMPLETION DEPTH 30 ft **GROUND ELEVATION** 704 ft

CAVE DEPTH ft **BACKFILL** Soil Cuttings

GROUND WATER LEVELS:

AT TIME OF DRILLING 13.00 ft / Elev 691.00 ft

AT END OF DRILLING ---

24hrs AFTER DRILLING 14.10 ft / Elev 689.90 ft

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Well set at El. 686 ft with 10 ft screen to El. 696 ft.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

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GEOCON PROFESSIONAL SERVICES

BORING NO. SB-05

CLIENT Donohue & Associates, Inc. **PROJECT NAME** Primary Filtration Project (Capital Project No. 2022)

PROJECT NUMBER 21-G0593 **PROJECT LOCATION** Rock River Reclamation District, Rockford, IL

DATE COMPLETED 6/15/21 **LOGGED BY** TW/JG **DRILLING METHOD** 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	703.2		0-10" TOPSOIL											
			dark brown SAND and TOPSOIL (FILL) dense	SS 1	33	8-15-23 (38)			5.7					
	701.0		dark brown SAND (FILL) trace black clay and gravel very loose to loose	SS 2	67	3-4-5 (9)			11.5					
5				SS 3	56	2-1-1 (2)			8.9					
10	694.0			SS 4	67	2-3-4 (7)			6.4					
			brown POORLY GRADED SAND trace gravel medium dense, moist to wet	SS 5	78	4-5-7 (12)			2.9					
15			▼	SS 6	89	5-7-8 (15)			5.7					
20				SS 7	67	6-5-6 (11)			25.1					
25				SS 8	67	7-7-6 (13)			23.3					
30	674.0			SS 9	56	6-8-8 (16)			20.7					

Bottom of borehole at 30.0 feet.

COMPLETION DEPTH 30 ft **GROUND ELEVATION** 704 ft

CAVE DEPTH ft **BACKFILL** Soil Cuttings

GROUND WATER LEVELS:

▽ **AT TIME OF DRILLING** 15.00 ft / Elev 689.00 ft

AT END OF DRILLING ---

▼ **24hrs AFTER DRILLING** 15.00 ft / Elev 689.00 ft

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

9370 W. Laraway Road, Suite D Frankfort, IL 60423 Phone 815-806-9986 Fax 815-464-8691

GEOCON PROFESSIONAL SERVICES

BORING NO. SB-06

CLIENT Donohue & Associates, Inc. **PROJECT NAME** Primary Filtration Project (Capital Project No. 2022)

PROJECT NUMBER 21-G0593 **PROJECT LOCATION** Rock River Reclamation District, Rockford, IL

DATE COMPLETED 6/15/21 **LOGGED BY** TW/JG **DRILLING METHOD** 3.25 in. HSA

DEPTH (ft)	ELEVATION (ft.)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (Qp) (tsf)	UNC. STRENGTH (Qu) (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	ORGANIC CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX
0	702.6		5" ASPHALT											
	701.0		dark brown CLAY and SAND (FILL) medium dense	SS 1	78	7-7-9 (16)			5.3					
			brown POORLY GRADED SAND trace gravel loose to medium dense, moist to wet	SS 2	56	3-5-6 (11)			5.7					
5				SS 3	89	3-3-4 (7)			3.0					
				SS 4	89	3-7-8 (15)			3.3					
10				SS 5	44	6-7-4 (11)			4.6					
			▼	SS 6	56	4-4-5 (9)			16.7					
15														
				SS 7	56	6-5-5 (10)			28.4					
20														
				SS 8	89	8-10-10 (20)			18.9					
25														
				SS 9	100	7-15-14 (29)			17.8					
30	673.0		Bottom of borehole at 30.0 feet.											

COMPLETION DEPTH 30 ft **GROUND ELEVATION** 703 ft

CAVE DEPTH ft **BACKFILL** Soil Cuttings

GROUND WATER LEVELS:

▽ **AT TIME OF DRILLING** 13.00 ft / Elev 690.00 ft

AT END OF DRILLING ---

▼ **24hrs AFTER DRILLING** 13.00 ft / Elev 690.00 ft

NOTES

Groundwater levels were recorded at the time of drilling and may not represent the groundwater conditions at the time of construction.

Lines of Demarcation represent an **approximate** boundary between soil types. Variations may occur between sampling intervals and between boring locations, and the transition may be gradual. Dashed lines are indicative of potentially erratic or unknown changes.

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GEOCON PROFESSIONAL SERVICES

GENERAL NOTES

CLIENT Donohue & Associates, Inc. **PROJECT NAME** Primary Filtration Project (Capital Project No. 2022)

PROJECT NUMBER 21-G0593 **PROJECT LOCATION** Rock River Reclamation District, Rockford, IL

SAMPLE IDENTIFICATION

Visual soil classifications are made in general accordance with the United Soil Classification System (USCS) on the basis of textural and particle size categorization, and various soil behavior characteristics. Visual classifications should be substantiated by appropriate laboratory testing when a more exact soil identification is required to satisfy specific project applications criteria.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D-2487-98)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	$C_u \geq 4$ AND $1 \leq C_c \leq 3$	GW	WELL-GRADED GRAVEL
			$C_u \geq 4$ AND/OR $1 \geq C_c \geq 3$	GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	$C_u \geq 6$ AND $1 \leq C_c \leq 3$	SW	WELL-GRADED SAND
			$C_u \geq 6$ AND/OR $1 \geq Cc \geq 3$	SP	POORLY-GRADED SAND
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR MH	SM	SILTY SAND
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	PI>7 AND PLOTS>"A" LINE	CL	LEAN CLAY
			PI<4 AND PLOTS<"A" LINE	ML	SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	PI PLOTS >"A" LINE	CH	FAT CLAY
			PI PLOTS <"A" LINE	MH	ELASTIC SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT

PROJECT LITHOLOGIC SYMBOLS (USCS)

ASPHALT: Asphalt

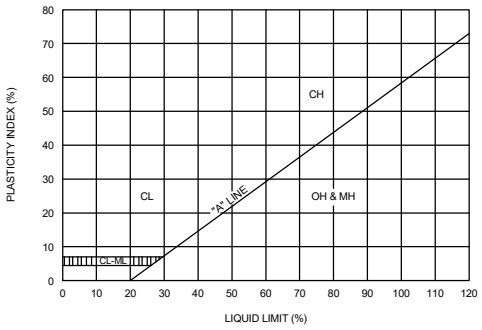
TOPSOIL: Topsoil

PROJECT SAMPLE TYPES

Split Spoon (SS)

Shelby Tube (ST)

PLASTICITY CHART



SOIL RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

NON-COHESIVE SOILS		COHESIVE SOILS		
RELATIVE DENSITY	N-VALUE*	CONSISTENCY	N-VALUE*	COMPRESSIVE STRENGTH (TSF)
VERY LOOSE	0 - 4	VERY SOFT	0 - 2	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 5	0.25 - 0.50
MEDIUM DENSE	10 - 30	MEDIUM STIFF	5 - 10	0.50 - 1.0
DENSE	30 - 50	STIFF	10 - 14	1.0 - 2.0
VERY DENSE	OVER 50	VERY STIFF	14 - 32	2.0 - 4.0
		HARD	OVER 32	OVER 4.0

* N-VALUE: NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).

ABBREVIATIONS

SS	-	SPLIT-SPOON SAMPLE	LL	-	LIQUID LIMIT (%)
ST	-	SHELBY TUBE SAMPLE	PL	-	PLASTIC LIMT (%)
AU	-	AUGER SAMPLE	PI	-	PLASTIC INDEX (%)
MC	-	MOISTURE CONTENT (%)	NP	-	NON PLASTIC
-200	-	PERCENT PASSING NO. 200 SIEVE	DD	-	DRY DENSITY (PCF)
Qp	-	POCKET PENETROMETER (TSF)	DCP	-	DYNAMIC CONE PENETROMETER
Qu	-	UNCONFINED STRENGTH (TSF)	IBV	-	IMMEDIATE BEARING VALUE

GRAIN SIZE DISTRIBUTION

PRINT DATE 7/1/2021

CLIENT Donohue & Associates, Inc.

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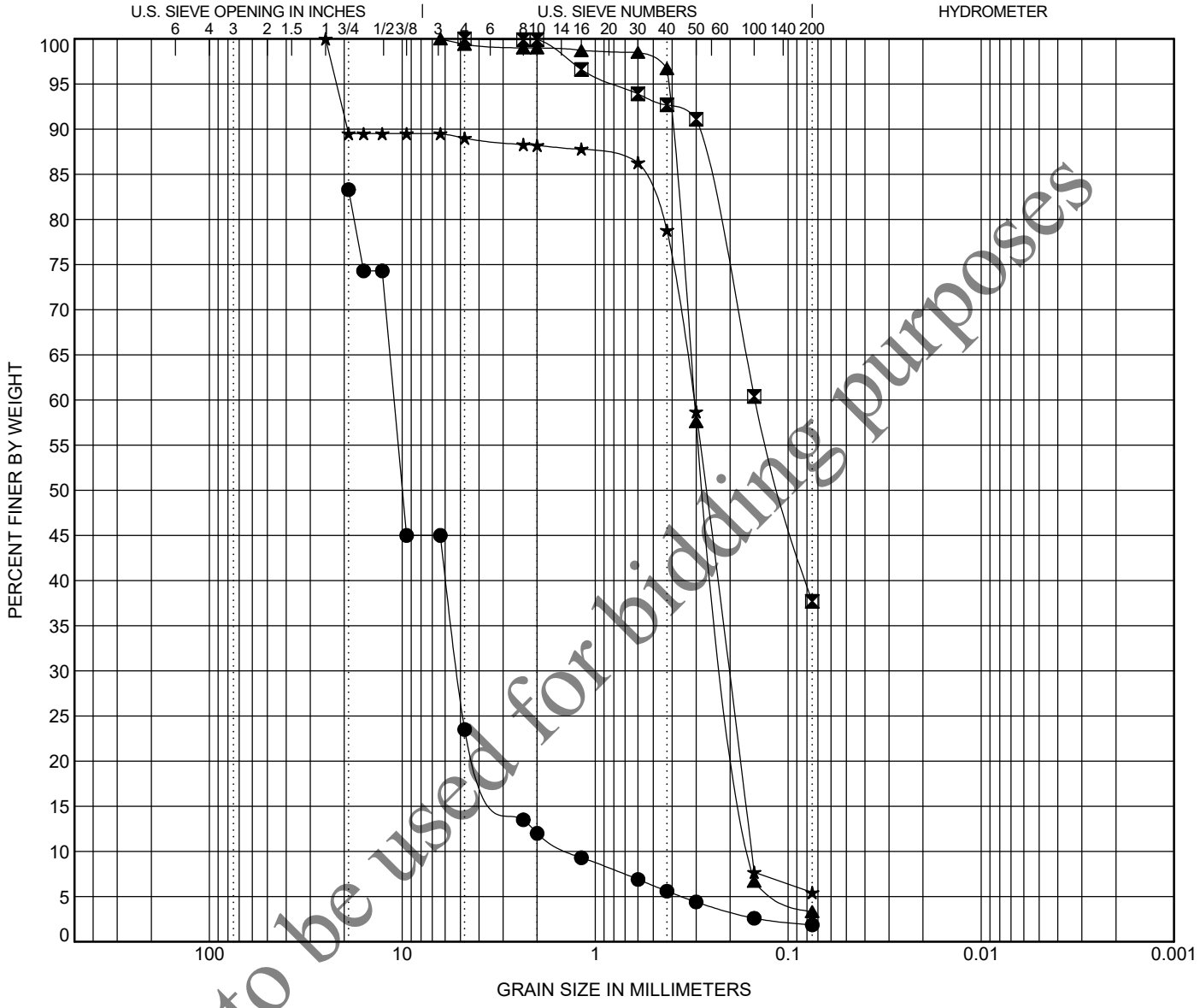

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	SB-01	23.5	WELL-GRADED GRAVEL with SAND(GW)				1.80	8.15
⊠	SB-02	11.0	SILTY CLAYEY SAND(SC)					
▲	SB-04	18.5	POORLY GRADED SAND(SP)				0.88	1.95
★	SB-06	11.0	POORLY GRADED SAND(SP)				0.87	1.98

	BOREHOLE	DEPTH	D100	D60	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	SB-01	23.5	19	11.022	9.982	1.353	59.8	21.6	1.9	
⊠	SB-02	11.0	4.75	0.148	0.109		0.0	62.3	37.7	
▲	SB-04	18.5	6.35	0.306	0.271	0.157	0.6	96.1	3.3	
★	SB-06	11.0	25	0.307	0.267	0.155	11.0	83.6	5.4	

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ATTERBERG LIMITS RESULTS

GEOCON PROFESSIONAL SERVICES

PRINT DATE 7/1/2021

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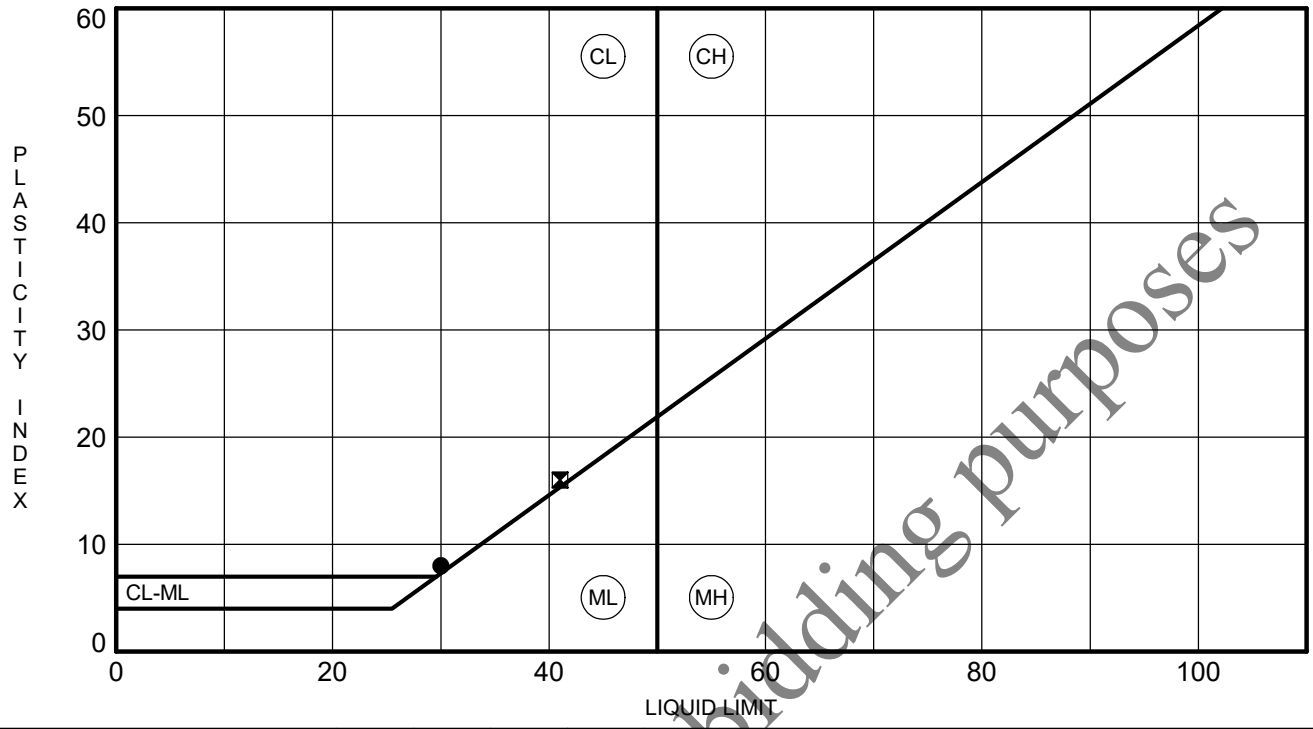

	BOREHOLE	DEPTH	LL	PL	PI	Fines	Classification
●	**SB-02**	**10.0**	**30**	**22**	**8**		**LEAN CLAY with SAND (CL)**
⊠	**SB-03**	**10.0**	**41**	**25**	**16**		**LEAN CLAY with SAND (CL)**

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Soil Resistivity	**AASHTO T 280/ ASTM G 57**
Soil pH	**AASHTO T 289/ ASTM G 51**
Soil REDOX	**DIPRA**
Soil Sulfides	**DIPRA**
Water Content	**AASHTO T 93/ ASTM D 2216**

Laboratory Services Group **192 Exchange Boulevard** **Glendale Heights, Illinois 60139** **Ph. (630) 717-4263**

Soil Corrosivity Indication Series

Project No.: **11211000**
Project Name: **Primary Filtration (21-G0593)**
Client Name: **Geocon**
Test Date: **6/24/2021**

Summary of Test Results

Boring / Sample No.	Resistivity at As Received WC (ohm-cm)	Resistivity at Saturated WC (ohm-cm)	pH Soil Water Slurry	REDOX (mV) Soil Water Slurry	Sulfides Reaction	As Received WC%	Saturated WC%	Total Points
B-3 @ 5.0'	104000	24800	7.99	145	Negative	3.6	21.6	
Points		0	0	0	0			**0**
Description:	Brown sand with silt							
B-3 @ 10.0'	2080	1960	6.99	151	Negative	27.4	43.5	
Points		5	0	0	0			**5**
Description:	Very dark brown to black lean clay trace sand							
B-5 @ 5.0'	13600	10800	7.58	196	Negative	10	16.5	
Points		0	0	0	0			**0**
Description:	Dark brown silty sand							
B-5 @ 10.0'	20000	12400	7.75	225	Negative	6.7	16.3	
Points		0	0	0	0			**0**
Description:	Dark brown silty sand							

Soil Test Evaluation for Ductile Iron Pipe (10-point system) * †							
Resistivity **	**Points**	**pH**	**Points**	**Redox**	**Points**	**Sulfides**	**Points**
<1,500 ohm-cm	10	0 to 2	5	Negative	5	Positive	3.5
≥1,500 to 1,800	8	2 to 4	3	0 to +50 mV	4	Trace	2
>1,800 to 2,100	5	4 to 6.5	0	+50 to +100 mV	3.5	Negative	0
>2,100 to 2,500	2	6.5 to 7.5	0***	> +100 mV	0		
>2,500 to 3,000	1	7.5 to 8.5	0				
>3,000	0	> 8.5	3				

* Ten points = corrosive to ductile iron pipe; protection is indicated
** Based on water-saturated soil box
*** If Sulfides are present and low (< 100mV) or negative Redox, add 3 points

21-G0593 Primary Filtration Project (Capital Project No. 2022) GEO Investigation, Rock River Reclamation District, Rockford, IL					
Groundwater Readings					
Boring Number	Surface Elevation, ft	Bottom of PZ Elevation, ft	Groundwater Elevation		
			6/16/2021	7/6/2021	
SB-01	702	683	688.8	688.8	
SB-04	704	686	689.9	689.4	