Volume 2:
Project Specifications

FOR THE PROJECT

New Wastewater Treatment Plant

FOR THE OWNER

City of Owens Cross Roads

Mayor Tony Craig

Christie D. Eason, Town Clerk

City Council

Scott Baker
Elizabeth Craig
Claude Lang
James Mann
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Prepared by:

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SRF Project CS010972-01
RGS Project 220202

TABLE OF CONTENTS

GEOTECHNICAL ENGINEERING STUDY
Owens Cross Roads New WWTP
Owens Cross Roads, Alabama
Project No: 0668
December 13, 2022

4890 University Square,
Suite 2
Huntsville, Alabama 35816
256-541-0165

December 13, 2022

RGS Civil Design, LLC
2622 Trellis Post Ct SE
Owens Cross Roads, Alabama 35763

ATTN: Mr. Jake Roth, P.E.

SUBJECT: Report of Geotechnical Engineering Study
Owens Cross Roads New WWTP
Sneed Avenue, Owens Cross Roads, Alabama
Project No: 0668

Ladies & Gentlemen:

GTEC has completed the geotechnical engineering study for the above referenced project. We provided our services in general accordance with our Proposal 0668-P, dated July 28, 2022. The purpose of our services was to explore the subsurface soil conditions and groundwater level in order to provide foundation and site preparation recommendations. This report presents our understanding of the project, provides the results of the field exploration and laboratory testing, and discusses our conclusions and recommendations. After you have reviewed our report, we recommend a telephone call to discuss our recommendations.

GTEC thanks you for the opportunity to serve you and looks forward to continued involvement on this and future projects. Please contact the project personnel below with questions concerning this project.

Respectfully submitted,

GTEC,

Lori E. McCafferty, E.I.T.
Staff Engineer

John W. Corbell, P.E.
Principal Engineer & EVP

ALABAMA LICENSED No. 31595 PROFESSIONAL ENGINEER JOHN W. CORBELL

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TABLE OF CONTENTS

APPENDICES

1.0 EXECUTIVE SUMMARY

This summary is provided for the convenience of the reader. Our full report should be read and understood before using our recommendations for design.

Based on the subsurface conditions encountered in our borings, the site is suitable for the proposed development. Shallow auger refusal was encountered in each of the borings ranging from 8.5 to 15 feet below the surface. Due to the expected loads of the new treatment plant, driven pile foundations are being recommended to support the construction.

2.0 INTRODUCTION

GTEC has completed a geotechnical engineering study for the planned wastewater treatment plant expansion in Owens Cross Roads, Alabama. This work was authorized on August 22, 2022 by Mr. Jacob Roth of RGS Civil. The geotechnical scope was requested to be performed following the results of the Waters of the United States delineation.

The purposes of this study were to:

- Explore the general nature of the subsurface conditions based on soil tests across the site:
- Provide a professional opinion regarding the suitability of the site for the intended construction;
- Provide foundation design information and guidelines; and
- Identify likely foundation construction or site development problems.

This report outlines the services provided, describes the surface and subsurface conditions, discusses site geology, and addresses the items listed above.

Assessment of the environmental aspects of this site, including previous land use or the determination of the presence of any chemical, industrial, or hazardous waste is beyond the scope of this study.

3.0 EXPLORATION METHODS

Subsurface conditions at the site of development were investigated by drilling soil test borings. Locations for the borings were determined using a handheld, consumer-grade GPS unit. Therefore, the boring locations as shown on the attached Drawing 0668-1, should be considered approximate. The borings were advanced using a track-mounted Mobile B-45 drilling rig with hollow stem, continuous flight augers. Samples of the soils were obtained using a split spoon sampler at select intervals during Standard Penetration Tests (SPT) conducted in general accordance with ASTM D1586. The SPT “N” value gives an indication of the consistency or relative density of the soils found.

The unconfined compressive strength of cohesive soil samples was estimated in the field using a calibrated pocket penetrometer reading (Pp).

Results of the SPT tests, Pp tests, and sampling locations in each boring is recorded by a GTEC field engineer and are presented in the appended Logs of Borings. The logs contain information concerning the boring method, dates, sample depths, descriptions of the soils or rocks, and other characteristics encountered during drilling. The field engineer classified the soil in general accordance with ASTM D2488, which utilizes the Unified Soil Classification System (USCS, as per ASTM D2487), and prepared the Logs of Borings that were the basis for engineering evaluation and recommendations. The group symbol for each soil type is indicated in the Logs of Borings. The final boring logs represent GTEC's interpretation of the field logs based on the results of the engineering review and laboratory testing of the field samples. Borings were either backfilled with auger cuttings the same day or after obtaining delayed water level readings.

4.0 SITE CONDITIONS

The subject property is in Owens Cross Roads, Alabama located on the north side of Sneed Avenue to the east of the existing wastewater treatment plant. The site is located approximately 150 feet east of the Flint River in an area that is currently heavily wooded. Based on the City of Huntsville Interactive Maps Online Topography, the site slopes upward from the south, north, and west to the center of the site with a minimum elevation of 578 feet on the north and west sides and a maximum elevation of 582 feet at the center of the site. City of Huntsville Interactive Maps Online indicates the site is located in the floodway.

PHOTOGRAPH 1

Description: View from the south side of the site

5.0 SUBSURFACE CONDITIONS

Topsoil was encountered at the surface in each boring ranging in thickness from 4 to 18 inches. Four general clay soil layers were encountered below the topsoil. Sand and gravel content both increase with depth at the site. Specific soil properties for each layer encountered are presented below along with a summary of laboratory tests data from select samples.

The upper layer of soil encountered below the topsoil surface extended to about 2.5 to 6-ft deep. The layer consisted of low plasticity, alluvial, silty clay that was brown and black in color. Standard penetration test (SPT) values in this layer ranged from 10 to 24 blows per foot (bpf) with an average of 15 bpf. Pocket penetrometer test values ranged from 2 to 4.5 tons per square foot (tsf) with an average of 4.0 tsf. Natural moisture contents ranged from 6 to 11 percent with an average of 9 percent.

The next layer in borings B-1 and B-5 consisted of brown and yellow or black, low plasticity, alluvial, sandy clay. SPT values in this layer were 15 and 26 bpf. Pocket penetrometer test values were 2.0 and 4.5 tsf. Natural moisture contents were 7 and 12 percent. This layer extended to about 5 and 9-ft below the existing ground surface.

Boring Number	Sample Depth (feet)	Water Content (%)	Liquid Limit (%)	Plasticity Index (%)
B-5	6.0 to 7.5	10	26	11

The following layer consisted of brown and yellow, low to medium plasticity, silty clay with sand and/or gravel. SPT values in this layer ranged from 11 to over 100 bpf with a typical value of 18 bpf. Higher SPT values were likely inflated due to the increased percentage of gravel in this layer. Pocket penetrometer test values ranged from 2 to 4.5 tsf with an average of 3.5 tsf. Natural moisture contents ranged from 9 to 49 percent with an average of 15 percent. This layer extended to about 8.5 to 15-ft below the existing ground surface. The following table is a summary of the Atterberg limit tests performed on soil samples from this layer.

Boring Number	Sample Depth (feet)	Water Content (%)	Liquid Limit (%)	Plasticity Index (%)
B-1	3.5 to 5.0	11	23	8

High plasticity, brown, gravelly clay with sand was encountered in boring B-1 extending from depths of 12 to 15 feet below the surface SPT values in this soil were over 100 bpf. Higher SPT values were likely inflated due to the increased percentage of gravel in this layer. The pocket penetrometer test value was 1.0 tsf. The natural moisture content was 30 percent.

Auger refusal was encountered between 8.5-ft and 15-ft below the surface.

Groundwater was not encountered below the surface during drilling. Subsequent groundwater level readings indicated the borings had collapsed near the surface. Boring B-5 was open to 4.5 feet with no water present. Because of the geology of this region, the groundwater levels are generally a function of seasonal precipitation and locally heavy rainfall events. Consequently, the groundwater levels can and do fluctuate with time.

6.0 SITE GEOLOGY

Published information indicates the subject site is underlain by the Monteagle Limestone. According to the United States Geological Survey, the Monteagle Limestone consists of light-gray oolitic limestone containing interbedded argillaceous, bioclastic, or dolomitic limestone, dolomite, and medium-gray shale.

Sinkholes are known to be present within this geology, but investigating the potential for sinkhole development on the project site was not included in the scope of services for this study.

7.0 PROPOSED CONSTRUCTION

Currently, GTEC understands Owens Cross Roads is planning to expand their wastewater treatment plant located on Sneed Avenue. The expansion will occur on Madison County Parcel Number 22-04-19-0-001-039.001 and will increase the treatment capacity 0.9 million gallons per day using four Sequential Batch Reactors (SBR). We understand the structures will be constructed above-grade and will not include below-grade walls or basins. The total footprint of the structures will be about 80 feet by 160 feet with 20 feet tall basin walls. Fill is expected to be 4 to 5 feet deep.

8.0 BASIS FOR RECOMMENDATIONS

The following recommendations are based on the subsurface data and experience with similar geologic environments. Because the structural elements of the design greatly influence the design recommendations, GTEC must be provided the opportunity to review the following comments and recommendations if locations, elevations, and loadings differ from what is described in the Proposed Construction section of this report. Our recommendations for the proposed development are based, in part, on the data obtained during our subsurface exploration at test locations spaced across the project site. However, variations in subsurface conditions can exist between our test locations which may not be indicated by our field testing and laboratory testing programs. If variations from the conditions described in our report are encountered in the future or if the proposed construction information is incorrect or changed, the recommendations of this report should not be considered valid unless GTEC reviews the changes and verifies or modifies our recommendations.

9.0 DESIGN RECOMMENDATIONS

The following section provides information to the owner and the design team for coordination with other project components including structural and civil planning. Due to the expected structural loads from the new treatment plant, driven pile foundations are being recommended to support the construction.

9.1 Earthwork Recommendations

The foundation and pavement recommendations are reliant on the earthwork results during the site grading phase. Topsoil and unsuitable soils removal should extend at least five feet beyond structure and pavement limits. Once the topsoil is removed and any undercut operations are complete, the stability of the exposed subgrade should be assessed by proofrolling prior to fill placement. The proofrolling should be performed using a loaded dump truck (20 tons) or other similar rubber-tired equipment. Our geotechnical engineer should observe the proofrolling and provide recommendations for treatment if unstable soils are noted during the proofrolling operations. Unstable soils should generally be undercut as directed by a GTEC engineer.

Structural fill is defined as inorganic natural soil free of deleterious materials and debris. Structural fill should have a maximum particle size of 3 inches or less and a maximum dry density of at least 95 pounds per cubic foot (pcf) when tested by the standard Proctor method (ASTM D-698). The material should have a liquid limit no higher than 50 and plasticity index no higher than 30. Soil fill for building and pavement areas should be placed in relatively thin (8-inch or less) layers and compacted to a minimum of 98 percent of the soil's maximum dry density as determined by the standard Proctor moisture-density relationship test.

9.2 Foundations Design

9.2.1 Steel H-Section Pile Foundations

Rock-bearing H-piles are recommended for supporting the proposed structures. The lengths of the piles are expected to range from 8.5 to 15-ft. The recommended capacity is dependent upon the following details. The H-piles should have pile points to protect their integrity upon impact with the rock strata. If needed, splices should be full penetration welds or equivalent moment and tension connections that transfer the service loads approved by the designer. GTEC recommends using the following table for design of the pile locations and quantities.

H-Section Steel Pile Size	Design Load Capacity	Uplift Capacity*
HP 10 inches x 42 lbs	100 kips	1 kips per linear ft
HP 12 inches x 53 lbs	140 kips	1 kips per linear ft

*Uplift capacity calculation should ignore the top 5-ft beneath the pile cap. Once pile spacing is designed additional uplift capacity can be evaluated by GTEC based on the piles behaving as a group.

The capacities are reduced from the steel's ultimate capacity to account for possible undetected crippling and poor load transfer at the interface with rock. These risks are common in the karst bedrock characteristics present at the site. The inclusion of pile points will assist in maintain integrity while passing through dense gravel layers. Piles should have a minimum separation of 24 inches. Locations should have horizontal tolerance of three inches and a plumbness criteria of two inches per ten feet.

Plans should include diagrams and notes for abandoning damaged piles and locating and installing substitute piles and adjusted caps. GTEC recommends a GTEC representative observe driving and record the observation on pile specific logs. The GTEC representative decides if the pile should be accepted, abandoned, or pulled. If vibratory equipment is used to install the piles, then GTEC recommends a hammer should be used to determine that refusal on bedrock has been achieved.

9.2.2 Pile Points

Pile points shall be furnished and installed per industry standard. GTEC recommends light pile points without a teeth requirement. The pile points shall be welded with partial penetration single bevel groove welds placed full flange width along the outside of each pile flange. Either the pile point or the outside of each flange of the pile shall be beveled 45 degrees. The depth of the bevel shall be 3/8" minimum for HP10 and HP12 piles. The width of weld at the outside face of the pile flange shall be the same as the beveled depth. E70XX welding rods shall be used. All welds shall be made in the flat position. The welder shall be AWS certified.

9.3 Site Seismic Category

Based on the field boring data and the requirements of the International Building Code (IBC) Section 1613, this site meets the requirements of a Site Class C.

9.4 Pavement

Stripped and excavated pavement areas should extend at least 5 feet beyond the pavement limits. The excavated area should be evaluated by the geotechnical engineer as discussed in the Earthwork Recommendations section who may recommend undercutting and replacement. A properly prepared, uniform subgrade is critical to long-term pavement life.

9.4.1 Flexible Pavement

The pavement design for the planned parking area should consider whether the pavement will be subjected to light-duty or medium-duty traffic. A light duty pavement section can be used where traffic is expected to primarily consist of autos and occasional light service vehicles. A medium-duty pavement section should be used where the traffic will also consist of occasional light and heavy service vehicles.

CBR testing was not part of our scope of services for this project. Pavement designs are normally based on a design CBR value. A CBR value of 8 considering subgrade improvement has been estimated for this site. Also, for this analysis, GTEC was not provided with traffic data. For our evaluations, the estimated average daily traffic of 100 vehicles per day consisting of 50 percent light trucks per day, 45 percent tractor-trailers, and 5 percent oversized loads. If this traffic information and assumptions are incorrect, GTEC should be contacted to revise the pavement design based on actual traffic types and volumes. The flexible pavements were designed based on a 20-year design life. Using the assumed traffic type and the CBR value, the following light- and medium-duty pavement sections are recommended for the project:

Asphalt Pay Item	Light Duty (inches)	Medium Duty (inches)
424A340 Superpave Bituminous Wearing Surface, 1/2" Max Agg Size, ESAL Range A/B	1	1.5
424B635 Superpave Bituminous Upper Binder, 3/4" Max Agg Size, ESAL Range A/B	2	2.5
ALDOT 825, Type B compacted to 100% ASTM D-1557, 6-inch lift	6	6

9.4.2 Rigid Concrete

A Portland cement concrete can be used for proposed parking and drive areas. We recommend a light duty pavement section consist of 4 inches of Portland of cement concrete underlain by 4 inches of dense graded crushed aggregate base compacted to 98 percent of standard Proctor maximum dry density (ALDOT 825, Type B). The concrete section should have a 28-day compressive strength of 4,000 psi and be air entrained. We recommend the edge of the pavement be thickened to 6 inches to reduce edge stress failures. We recommend any dumpster pads be thickened to 9 inches due to concentrated loads. The dumpster pad should extend the entire length of the truck wheel base in the operating area.

10.0 CONSTRUCTION CONSIDERATIONS

The principal purpose of this section is to comment in general on the items related to earthwork, foundation construction, and pavement placement. It is valuable that GTEC's geotechnical engineer be retained to provide soil-engineering services during the construction phases of the project. The geotechnical engineer can also assist in interpretation of differing subsurface conditions that may be encountered and recommend remedial work, if needed.

10.1 Site Preparation

The entire construction area should be stripped of grass, trees, stumps, vegetation, organic-laden soils, debris, or any other deleterious materials to a minimum of 5 feet outside the structural limits for buildings and paved areas. Depressions or low areas resulting from stripping and or clearing operations should be backfilled to prevent ponding with approved structural fill and compacted in accordance with the Earthwork Recommendations section. We recommend site preparation be monitored by the geotechnical engineer or their representative to verify that the recommendations presented herein are implemented. After stripping surficial soils, we recommend the areas to receive fill be proofrolled as described the Earthwork Recommendations section. Proofrolling should be performed with a fully loaded tandem-axle dump truck or similar

piece of rubber-tired equipment with a minimum loaded weight of 20 tons. The purpose of the proofrolling is to detect any localized or isolated weak soil zones in building and pavement areas prior to backfilling.

10.2 Structural Fill Placement and Compaction

Prior to fill placement, representative samples of each structural fill material should be collected and tested by GTEC to determine the material's moisture-density characteristics (including the maximum dry density, optimum water content, gradation and Atterberg limits). These tests are needed for quality control of the structural fill and to determine if the fill material meets project specification requirements as outlined in the Earthwork Recommendations section of this report. Successful reuse of the excavated, on-site soils as compacted structural fill will depend on the water content and the plasticity of the soils encountered during excavation. Once fill placement begins, a qualified soils technician should perform field density tests to document the degree of compaction being obtained in the field. Structural fills should be placed in thin (6 to 8-inch) loose lifts and compacted to 98 percent of the standard Proctor maximum dry density (ASTM Test Method D698) at or near optimum water content (maximum deviation of ±3 percent). Some moisture conditioning (such as wetting or drying) may be required during the filling operation to obtain the required degree of compaction. The moisture conditioning is highly dependent on weather conditions and site drainage conditions. Therefore, the grading contractor should be prepared to both dry and wet the fill materials to obtain the specified compaction during grading.

10.3 Surface Water Control

If free water is allowed to stand on stable subgrade soils, these soils can absorb water, freeze, swell, and experience a reduction in their support capability. As a result, we recommend that the subgrade surface be graded to provide positive drainage away from the construction areas and towards suitable drainage handling areas, such as a perimeter ditch, French drain, culvert, or retention pond. Trapped or perched water conditions could develop during periods of inclement weather and during seasonally wet periods. Such conditions could cause seepage into excavations and deeper cuts. Therefore, grading of the project should be performed in such a manner to prevent ponding of water and promote runoff away from construction areas. If site grading is performed during the seasonally wet months or after extended periods of inclement weather, wet and water softened near surface soil conditions should be expected.

10.4 Pile Driving Operations

Prior to mobilizing pile driving operations, the contractor should be required to hold a planning meeting to confirm equipment and methods. GTEC should review and approve the proposed equipment, driving methods, and splicing plan. Once approved the pile driving equipment should have adequate cushion blocks to prevent damage to the pile head. Then the contractor should attach points and provide one foot intervals marks on the flange face for advancement observations.

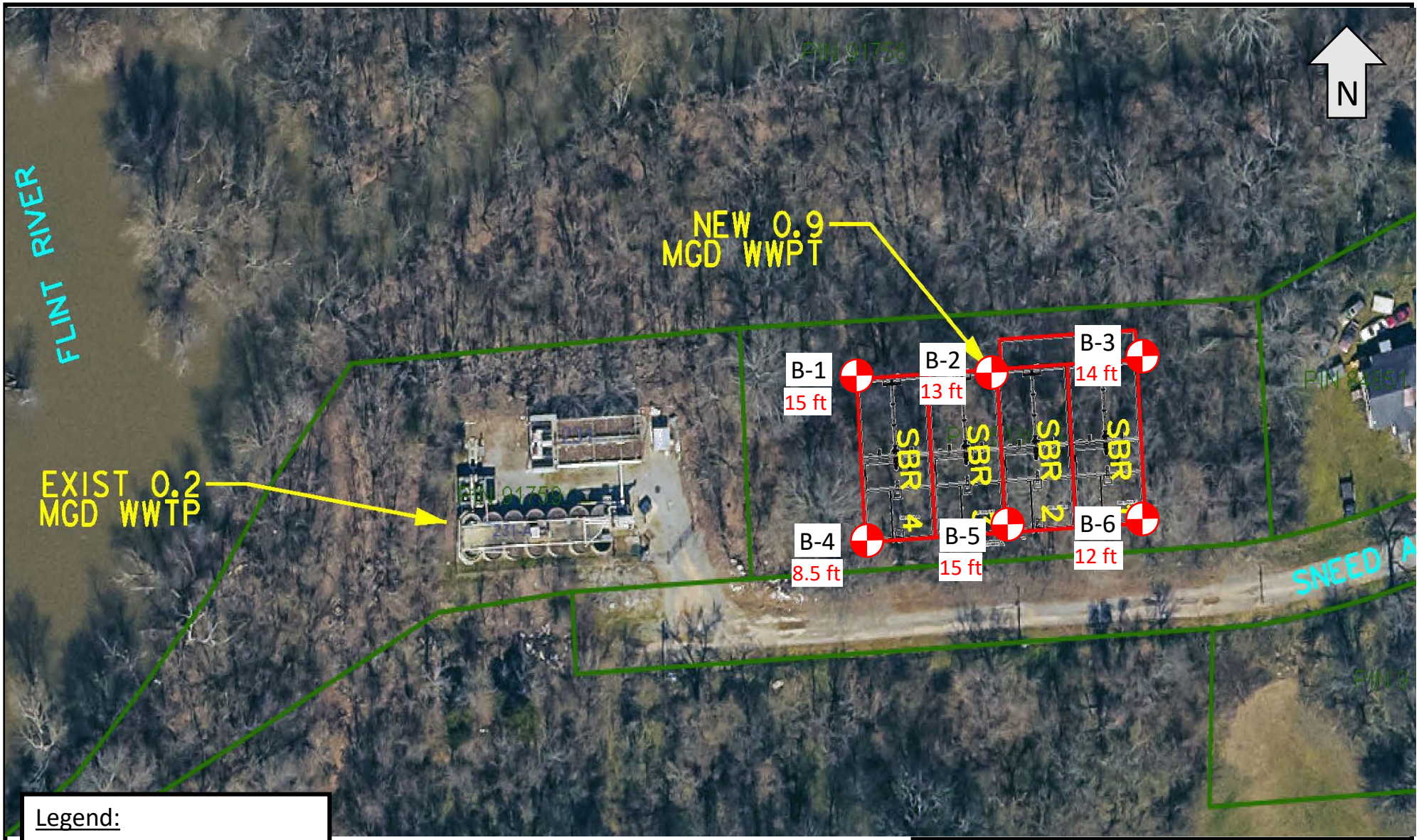
GTEC should observe each pile as it is driven and record the number of blows for each foot of advancement. The contractor and GTEC should agree on a common numbering system to label each pile uniquely. GTEC's records will include date, time, personnel name, contractor superintendent, pile number, advancement rates, hammer model, splicing notes, driven length, and damage or cutoff notes. Based on the observations and the notes GTEC will recommend pile acceptance, abandonment, or removal.

10.5 Excavations

Excavations required for construction of this project must be performed in accordance with the United States Department of Labor, Occupational Safety and Health Administration (OSHA) guidelines (29 CFR 1926, Subpart P, Excavations) or other applicable jurisdictional codes for permissible temporary side-slope ratios and or shoring requirements. The OSHA guidelines require daily inspections of excavations, adjacent areas, and protective systems by a "competent person" for evidence of situations that could result in caveins, indications of failure of a protective system, or other hazardous conditions. Excavated soils, equipment, building supplies, etc., should be placed away from the edges of the excavation at a distance equaling or exceeding the depth of the excavation. The contractor is responsible for providing the "competent person" and all aspects of site excavation safety.

11.0 LIMITATIONS

There are important limitations to this and all geotechnical studies. This report has been prepared for the exclusive use of the RGS Civil Design, LLC, or their agents, for specific application to the proposed wastewater treatment plant expansion project in Owens Cross Roads, Alabama, in accordance with generally accepted soil and geotechnical engineering practices. No other warranty, express or implied, is made. Our conclusions and recommendations are based on design information furnished to us, the data obtained from the field-testing program, and generally accepted geotechnical engineering practice. The findings and recommendations do not reflect variations in subsurface conditions, which could exist in unexplored areas of the site. Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions in other areas will differ from those at the test locations or that the construction process has altered the soil conditions. Therefore, our experienced geotechnical engineer should evaluate executed construction to verify that the conditions anticipated in design actually exist. Otherwise, we assume no responsibility for construction compliance with the design concepts, specifications, or recommendations. In the event that changes are made in the design or location of the improvements, the recommendations presented in this report shall not be considered valid unless the changes are reviewed by our firm and conclusions of this report modified or verified in writing. If this report is copied or transmitted to a third party, it must be copied or transmitted in its entirety, including text, appendices, and enclosures. Interpretations based on only a part of this report may not be valid.



Legend:

- Boring Location (B-X)

X ft - Depth of Refusal

Reference: Prelim Engineer Report, Owens Cross Roads New WWTP Site Plan, Drawn by: JAR, 01/22/22

BORING LOCATION MAP

Scale: Not to Scale

GTEC
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Project Name: Owens Cross Roads New WWTP
Drawn By: LEM
Location: Sneed Avenue, Owens Cross Roads, Alabama
Date: 11/7/22
Drawing No.: 0668-1

LOG OF BORING NO.B-1

Project No.: 0668
Project Name: Owens Cross Roads New WWTP
Project Location: Sneed Ave, Owens Cross Roads, Alabama

Driller: South Bros
Drill Make: Mobile B-45
Hammer:
Hammer Efficiency: 96%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL *Elevation=*	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
0			12 in TOPSOIL	9	4.5+							
			SILTY CLAY, 10% sand, 90% fines, low plasticity, brown and black, stiff to very stiff, moist, residuum, CL	14	4.0	8						
5			SILTY CLAY WITH SAND, 15% sand, 85% fines, low plasticity, brown and yellow to reddish orange and black, hard, moist, residuum, CL	23	4.5	11	23	15	66.7			
				26	4.0	12						
10			SILTY CLAY WITH SAND AND GRAVEL, 20% gravel, 20% sand, 60% fines, medium plasticity,brown and yellow, hard, moist, residuum, CL	30	3.75	11						
15			GRAVELLY CLAY WITH SAND, 40% gravel, 15% sand, 45% fines, high plasticity, brown, hard, wet, residuum, CH	100+	1.0	30						
			AUGER REFUSAL at 15 feet									
20												
25												
30												

COMPLETION DEPTH: 15 ft
DATE: 10/20/22

DEPTH TO WATER INITIAL: Dry
FINAL:

LOG OF BORING NO.B-2

Project No.: 0668
Project Name: Owens Cross Roads New WWTP
Project Location: Sneed Ave, Owens Cross Roads, Alabama

Driller: South Bros
Drill Make: Mobile B-45
Hammer:
Hammer Efficiency: 96%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
			Elevation=									
0			12 in TOPSOIL	5	2.0							
			SILTY CLAY, 10% sand, 90% fines, low plasticity, brown and black, very stiff, moist, residuum, CL	13	4.5+	10						
5			SILTY CLAY WITH SAND AND GRAVEL, 20% gravel, 20% sand, 60% fines, medium plasticity, brown and yellow, hard to very stiff, moist, residuum, CL	32		11						
				25	3.5	9						
10				19	2.0	11						
			AUGER REFUSAL at 13 feet									
15												
20												
25												
30												

COMPLETION DEPTH: 13 ft
DATE: 10/20/22

DEPTH TO WATER INITIAL: Dry
FINAL:

LOG OF BORING NO.B-3

Project No.: 0668
Project Name: Owens Cross Roads New WWTP
Project Location: Sneed Ave, Owens Cross Roads, Alabama

Driller: South Bros
Drill Make: Mobile B-45
Hammer:
Hammer Efficiency: 96%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL *Elevation=*	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
0			4 in TOPSOIL									
			SILTY CLAY, 10% sand, 90% fines, low plasticity, brown and black, very stiff, moist, residuum, CL	10	4.5+	8						
				19	4.5+	9						
5			SILTY CLAY WITH SAND, 15% sand, 85% fines, low plasticity, brown and yellow, very stiff, moist, residuum, CL	19	4.5+	23						
				18	4.5+	13						
10			SILTY CLAY WITH SAND AND GRAVEL, 20% gravel, 20% sand, 60% fines, medium plasticity, brown and yellow, very stiff to hard, moist, residuum, CL	11	3.25	14						
				100+								
15			AUGER REFUSAL at 14 feet									
20												
25												
30												

COMPLETION DEPTH: 14 ft
DATE: 10/20/22

DEPTH TO WATER INITIAL: Dry
FINAL:

LOG OF BORING NO.B-4

Project No.: 0668
Project Name: Owens Cross Roads New WWTP
Project Location: Sneed Ave, Owens Cross Roads, Alabama

Driller: South Bros
Drill Make: Mobile B-45
Hammer:
Hammer Efficiency: 96%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
0			*Elevation=*									
			18 in TOPSOIL	15	4.5+							
			SILTY CLAY, 10% sand, 90% fines, low plasticity, brown and black, very stiff, moist, residuum, CL	12	4.0	6						
5				12	4.5+	11						
				13	3.75	10						
			SILTY CLAY WITH SAND, 15% sand, 85% fines, low plasticity, brown and yellow, very stiff, moist, residuum, CL									
10			AUGER REFUSAL at 8.5 feet									
15												
20												
25												
30												

COMPLETION DEPTH: 8.5 ft
DATE: 10/20/22

DEPTH TO WATER INITIAL: Dry
FINAL:

LOG OF BORING NO.B-5

Project No.: 0668
Project Name: Owens Cross Roads New WWTP
Project Location: Sneed Ave, Owens Cross Roads, Alabama

Driller: South Bros
Drill Make: Mobile B-45
Hammer:
Hammer Efficiency: 96%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
0			*Elevation=*									
			4 in TOPSOIL	12	2.0	9						
			SILTY CLAY, 10% sand, 90% fines, low plasticity, brown and black, very stiff, moist, residuum, CL	11	3.5	9						
			SANDY CLAY, 30% sand, 70% fines, low plasticity, brown and black, very stiff, moist, residuum, CL	15	2.0	7						
5			SILTY CLAY WITH SAND, 15% sand, 85% fines, low plasticity, brown and yellow, very stiff to hard, moist to wet, residuum, CL	15	4.5+	10	26	15	73.0			
				12	3.0	26						
10												
				100+	2.5	49						
15			AUGER REFUSAL at 15 feet									
20												
25												
30												

COMPLETION DEPTH: 15 ft
DATE: 10/20/22

DEPTH TO WATER INITIAL: Dry
FINAL:

LOG OF BORING NO.B-6

Project No.: 0668
Project Name: Owens Cross Roads New WWTP
Project Location: Sneed Ave, Owens Cross Roads, Alabama

Driller: South Bros
Drill Make: Mobile B-45
Hammer:
Hammer Efficiency: 96%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
0			*Elevation=*									
			8 in TOPSOIL									
			SILTY CLAY, 10% sand, 90% fines, low plasticity, brown and black, very stiff to hard, moist, residuum, CL	16	4.0							
				24	3.0	7						
5				19	4.5+	10						
			SILTY CLAY WITH SAND, 5% gravel, 15% sand, 80% fines, low plasticity, brown and yellow, very stiff, moist, residuum, CL	17	4.5+	10						
10			SILTY CLAY WITH SAND AND GRAVEL, 20% gravel, 20% sand, 60% fines, medium plasticity, brown and yellow, very stiff, moist, residuum, CL	12	2.0	11						
			AUGER REFUSAL at 12 feet									
15												
20												
25												
30												

COMPLETION DEPTH: 12 ft
DATE: 10/20/22

DEPTH TO WATER INITIAL: Dry
FINAL:

BORING LEGEND

SOIL SYMBOLS					
Major Divisions				**Group Symbols**	**Typical Names**
Coarse Grain Soils More Than 50% Retained on No. 200 Sieve	**Gravels** 50% or More of Coarse Fraction Retained on #4 Sieve	Clean Gravels		GW	Well-graded gravels and gravel-sand mixtures,little or no fines
				GP	Poorly graded gravels and gravel-sand mixtures,little or no fines
		Gravels With Fines		GM	Silty gravels, gravel-sand-silt mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
	Sands More Than 50% of Coarse Fraction Passes #4 Sieve	Clean Sands		SW	Well-graded sands and gravelly sands, little orno fines
				SP	Poorly graded sands and gravelly sands, littleor no fines
		Sands With Fines		SM	Silty sands, sand-silt mixtures
				SC	Clayey sands, sand-clay mixtures
Fine Grain Soils 50% or More Passes No. 200 Sieve	**Silts and Clays** Liquid Limit 50% or Less			ML	Inorganic silts, very fine sands, rock flour, siltyor clayey fine sands
				CL	Inorganic clays or low to medium plasticity, gravelly or sandy clays, silty clays, lean clays
				OL	organic silts and organic silty clays of lowplasticity
	Silts and Clays Liquid Limit Greater Than 50%			MH	Inorganic silts, micaceous or diatomaceous finesands or silts, elastic silts
				CH	Inorganic clays of high plasticity, fat clay
				OH	organic clays of medium to high plasticity
Highly Organic Soils				PT	Peat, muck and other highly organic soils

Other Commonly Used Soil Symbols

	Topsoil or Cultivated Zone
	Asphalt
	Concrete
	Fill

Sample Types

	Split Spoon Sample
	Undisturbed Sample
	Rock Core

Rock Symbols

	Limestone
	Sandstone
	Conglomerate
	Shale

Other Symbols

	Groundwater Level During Drilling
	Extended Groundwater Level
SPT	Standard Penetration Test
Pp	Pocket Penetrometer Reading

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FIELD PROCEDURES

SOIL TEST BORING, ASTM D1586

The borings were advanced using augers powered by a motor-driven drill rig. At regular intervals, soil samples were obtained with a standard 1.4-inch I.D., 2.0- inch O.D., split-tube sampler. The sampler was initially seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated as the *standard penetration resistance*. Standard penetration resistance, when properly evaluated, is an index to soil strength and density. Field personnel logged and described the samples as they were obtained. Representative portions of each soil sample were then sealed in labeled glass jars or plastic bags and transported to our laboratory. The samples were examined by a geotechnical engineer or engineering geologist to visually check the field descriptions. Boring data, including sample intervals, penetration resistances, soil descriptions, and groundwater level are shown on the Logs of Borings.

The unconfined compressive strength of cohesive soil samples can be estimated in the field using calibrated pocket penetrometer readings (Pp). This test involves pushing a spring-loaded piston 0.25 inches in diameter into an SPT sample, undisturbed sample, or excavation side wall and measuring the spring deflection. The recorded deflection is correlated to unconfined compressive strength.

LABORATORY PROCEDURES

MOISTURE CONTENT OF SOILS, ASTM D2216

The moisture content of soils is an indicator of various physical properties, including strength and compressibility. Selected samples obtained during exploratory drilling were taken from their sealed containers. Each sample was weighed and then placed in an oven heated to 110°C + 5°. The sample remained in the oven until the free moisture had evaporated. The dried sample was removed from the oven, allowed to cool, and re-weighed. The moisture content was computed by dividing the weight of evaporated water by the weight of the dry sample. The results, expressed as a percent, are shown on the Logs of Borings.

ATTERBERG LIMITS DETERMINATION, ASTM D4318

Representative samples were subjected to Atterberg limits testing to determine the soil's plasticity characteristics. The plasticity index (PI) is the range of moisture content through which the soil deforms as a plastic material. It is bracketed by the liquid limit (LL) and the plastic limit (PL). The liquid limit is the moisture content at which the soil becomes wet enough to flow as a viscous fluid. To determine the liquid limit, a soil specimen is first passed through a No. 40 sieve. The materials finer than the No. 40 sieve are retained, and the moisture content is then manipulated until the soil is in a viscous fluid state. A portion of this soil is then placed in a brass cup of standardized dimensions. A groove is cut through the middle of the soil specimen with a grooving tool of standard dimensions. The cup is attached to a cam that lifts the cup 10 mm and then allows the cup to fall onto a hard rubber base. The cam is rotated at about 2 cycles per second until the two halves of the soil specimen come in contact at the bottom of the groove for a distance of 1/2 inch. The number of blows required to achieve this 1/2-inch contact is recorded, and part of the specimen is subjected to a moisture content determination. The remainder of the specimen is allowed to air dry for a short time, and the grooving process and cam action repeated. This testing sequence is repeated until more than 25 blows is required to achieve the required groove contact. After the number of blows vs. moisture content for the various test points are plotted on arithmetic graph paper, the moisture content corresponding to 25 blows is designated the liquid limit.

The plastic limit (PL) is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into threads 1/8-inch diameter. The plastic limit is determined by taking a pat of soil remaining from the liquid limit test and repeatedly rolling, kneading, and air drying it until the soil breaks into threads about 1/8 inches in diameter and 3/8 inches long. The moisture content of these soil threads is then determined and is designated the plastic limit. The results of the liquid and plastic limits tests are tabulated on the Logs of Borings.

DETERMINATION OF SOILS FINER THAN NO. 200 SIEVE, ASTM D1140

The clay and silt content of granular soils affects their physical properties such as strength, compressibility, and permeability. Selected soil samples were tested to determine the percent, by weight, of soil particles finer than the No. 200 sieve (silt and clay size particles). Soil particles finer than 75 microns were flushed through a No. 200 sieve using water. The coarse materials retained on the No. 200 sieve were dried to obtain their dry weight. The dry weight of materials retained on the No. 200 sieve was compared to the dry weight of the total test specimen. The difference in weight, expressed as a percentage of the pre-wash weight, is designated as the percentage of "fines" (silt and clay size particles).

February 15, 2023

RGS Civil Design, LLC
2622 Trellis Post Ct SE
Owens Cross Roads, Alabama

ATTN: Mr. Jake Roth, P.E.

SUBJECT: Foundation Recommendation Addendum
Owens Cross Roads New WWTP
Owens Cross Roads, Alabama
GTEC Project No. 0668

Ladies and Gentlemen,

GTEC has completed the supplemental foundation recommendations for the above referenced project. The purpose of our services was to provide foundation recommendations for the new treatment plant. This report presents our understanding of the project, provides the results of the field exploration, and discusses our conclusions and recommendations. After you have reviewed our report, we recommend a telephone call to discuss our recommendations.

PROJECT INFORMATION

GTEC, LLC issued a *Geotechnical Engineering Study* for the proposed Owens Cross Roads New WWTP located in Owens Cross Roads, Alabama on December 13, 2022. Our study encountered alluvial soils extending to depths ranging from 3 to 9 feet beneath the surface. Due to the potential for settlement in the alluvial layer, GTEC provided H-pile design recommendations for a maximum design load of up to 140 kips and a maximum uplift capacity of up to 1 kips per linear feet in order to limit the potential for settlement of spread footings. GTEC's recommendation was based on empirical correlations between settlement, bearing pressure, and Standard Penetration Test N-Values. We understand vibratory stone columns are being considered for this design.

REVISED DESIGN RECOMMENDATIONS

Vibratory Stone Columns

GTEC recommends the use of Vibratory Stone Columns to support the proposed new treatment plant, limit total settlement to less than 1 inch, and limit differential settlement to less than ½ inch.

We anticipate an allowable bearing pressure of up to 5,000 pounds per square foot (psf) can be achieved by using stone columns at the site. However, the allowable bearing pressure will be provided by the geotechnical specialty contractor. Vibratory stone columns are constructed by excavating a vertical shaft through the subgrade soil interval and backfilling with crushed stone. During placement of the stone column, compactive energy is applied to densify the stone backfill as well as densify the surrounding in-situ soils. The effectiveness of densifying the surrounding in-situ soils is dependent on soil type, with sandy /gravelly soils being the most easily densified and highly plastic silts/clays being less easily densified. The construction equipment and methods are dependent on the geotechnical specialty contractor. The stiffer stone columns transfer loads through the weaker soil subgrade to the deeper, stiff residual soils. If an open-graded stone backfill is used, stone columns can also serve as a drainage path to relieve pore water pressures induced by building or fill loads which allows for more rapid settlement.

While the specialty contractor should provide the spacing, size, depth, and installation requirements for stone columns, the following items should be considered when designing a stone column. We recommend the stone column extend to bedrock at a depth of 15 feet. Groundwater is expected to infiltrate excavations during stone column installation.

CLOSING REMARKS

GTEC thanks you for the opportunity to serve you and looks forward to continued involvement on this and future projects. Please contact the project personnel below with questions concerning this project.

Respectfully,
GTEC

Lori E. McCafferty, E.I.
Staff Engineer

John W. Corbell, P.E.
Principal Engineer & EVP

SECTION 316250 – AGGREGATE PIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes designing, furnishing and installing materials, and constructing a ground improvement system at the locations noted on the drawings and specified herein. Ground improvement system shall be either vibro stone columns or rammed piers. "Aggregate piers" referenced in these specifications refer to both vibro stone columns and rammed piers.

B. WORK INCLUDED:

1. Provision of all equipment, material, labor and supervision to design and install aggregate pier elements. Design shall rely on subsurface information presented in the project geotechnical report. Removal of spoils from the site (which result from aggregate pier construction), removal of spoils off the working pad, footing excavation, and subgrade preparation following aggregate pier installation is not included.

2. Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 01 Specifications, apply to the work in this specification.

C. Related Sections:

1. Section 033000 "Cast in Place Concrete" for concreting operations.

1.3 REFERENCED STANDARDS

1. Design: The ground improvement installer shall be responsible for design of a vibro stone column or rammed pier ground improvement system that meets the global stability, allowable bearing capacity and settlement requirements stated in the geotechnical report and on the contract documents. Industry recognized standards or design methods specific to the installer's equipment and construction methods shall be used.

2. Modulus and Uplift Testing
   a. ASTM D-1143 – Pile Load Test Procedures
   b. ASTM D-1194 – Spread Footing Load Test
   c. ASTM D-3689 – Uplift Load Test

3. Materials and Inspection
    a. ASTM D-1241 – Aggregate Quality
    b. ASTM STP 399 – Dynamic Penetrometer Testing
    c. ASTM D-422 – Gradation Soils

1.4 Approved Installers

A. Installers of aggregate pier foundation systems shall have a minimum of 5 years experience with the installation of aggregate piers and shall have completed at least 50 projects.

1.5 INFORMATIONAL SUBMITTALS

A. The installer shall submit detailed design calculations and construction drawings to the Architect and to the Geotechnical Engineer of Record for approval at least three (3) weeks prior to the start of construction. All plans shall be sealed by a Professional Engineer in the State in which the project is constructed (referred in this specification as "the Designer").

B. Modulus and Uplift Test Data

1. The Installer shall furnish the General Contractor a description of the installation equipment, installation records, complete test data, analysis of the test data and recommended design parameter values based on the modulus test results. The report shall be prepared under supervision of a registered professional engineer.

C. Daily Progress Reports

1. The Installer shall furnish a complete and accurate record of aggregate pier installation to the General Contractor. The record shall indicated the pier location, length, average lift thickness and final elevations of the base and top of piers. Ther record shall also indicate the type and size of the densification equipment used. The Installer shall immediately report any unusual conditions encountered during installation to the General Contractor, to the Designer and to the Testing Agency.

1.6 CONFLICTS IN SPECIFICATIONS/REFERENCES

A. Where specifications and reference documents conflict, the Contract Documents and Geotechnical Report shall govern.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate used for piers constructed above the water table shall be Type 1 Grade B in accordance with ASTM D-1241-68, or shall be other graded aggregate selected by the Installer and successfully used in the modulus test. It shall be compacted to a densification and strength,

which provides resistance to the dynamic penetration test (ASTM STP 399) of a minimum average of 15 blows per 1.75-inch vertical movement.

B. For aggregate used for piers constructed below the water table, the gradation shall be the same as Type 1 Grade B, except that particles passing the No. 40 sieve shall be eliminated. Alternatively, No. 57 stone or other stone selected by the Stone Column or Aggregate Pier Installer may be used. Dynamic penetration resistance testing is inappropriate for this material.

C. Potable water or other suitable source shall be used to increase aggregate moisture content where required. Access to water on site shall be provided to the Installer.

D. Installer to coordinate adequate and suitable marshalling areas on the project site for the use of the Installer for the storage of aggregate and equipment.

E. Void Forms: Retain paragraph below if Project-site mixing is permitted. ACI 301 applies measuring, batching, and mixing requirements from ASTM C 94/C 94M to Project-site mixing.

PART 3 - DESIGN REQUIREMENTS

3.1 STONE COLUMN AND AGGREGATE PIER DESIGN

A. The Aggregate Pier design stiffness modulus value shall be verified by the results of the modulus test, described in this specification.

B. Stone Columns or Aggregate Piers shall be designed in accordance with generally-accepted engineering practice and the methods described in Section 1 of these Specifications. The design shall meet the following criteria.

1. Minimum Allowable Bearing Pressure for Aggretate Pier Reinforced Soils: 4,000 psf

2. Minimum Aggregate Pier Area Coverage (for square Spread Footings): 30%

3. Estimated Total Long-Term Settlement for Footings: Per Geotechnical Report

4. Estimated Long-Term Differential Settlement of Adjacent Footings: Per Geotechnical Report

5. Maximum Aggregate Pier Spacing Below Slabs: 10 feet on center each direction

C. The design submitted by the Installer shall consider the bearing capacity and settlement of all footings supported by aggregate piers, and shall be in accordance with acceptable engineering practices and these specifications. Total and differential settlement shall be considered.

D. The Stone Column or Aggregate Pier systems shall be designed to preclude plastic bulging deformation at the top-of-pier design stress and to preclude significant tip stresses as determined from the shape of the telltale test curve from telltales installed in modulus test piers. The results of the modulus test shall be used to verify the design assumptions.

3.2 DESIGN SUBMITTAL

A. The installer shall submit PDF copies of construction drawings and shop drawings, (the Design Submittal), for approval at least three (3) weeks prior to the beginning of construction. All drawings shall be prepared and sealed by a Professional Engineer, licensed in the state where the piers are to be built.

PART 4 - CONSTRUCTION

4.1 STONE COLUMNS

A. Install stone columns with a down-hole vibrator capable of densifying the aggregate by forcing it radially into the surrounding soil. The vibrator shall be of sufficient size and capacity to construct stone columns to the diameters and lengths shown on the Installer's approved construction drawings.

B. The probe and follower tubes shall be of sufficient length to reach the elevations shown on the Installer's approved construction drawings. The probe, used in combination with the available pressure to the tip jet, shall be capable of penetration to the required tip elevation. Preboring shall be permitted if it is specified in the Installer's approved construction procedure submittal.

C. The probe and follower shall have visible markings at regular increments to enable measurement of penetration and repenetration depths.

D. Provide methods for supplying to the tip of the probe a sufficient quality of air or water to widen the probe hole to allow adequate space for stone backfill placement around the probe.

E. The probe shall penetrate into the foundation soil layer to the minimum depths required in the Installer's construction plans.

F. Lift thickness shall not exceed 4 feet. After penetration to the treatment depth, slowly retrieve the vibrator in 12-inch to 18-inch increments to allow backfill placement.

G. Compact the backfill in each lift by repenetrating it at least twice with the vibrating probe to densify and force the stone into the surrounding soil.

H. Install stone columns so that each completed column is continuous throughout its length.

4.2 RAMMED PIERS

A. All Aggregate Pier elements shall be pre-augered using mechanical drilling or excavation equipment. Installation of piers without pre-augering shall not be allowed because this technique results in significant disturbance and remolding of the matrix soils surrounding the piers.

B. If cave-ins occur during excavation such that the sidewalls of the hole are deemed to be unstable, steel casing or a drilling slurry shall be used to stabilize the excavation.

C. If cave-ins occur on top of a lift of aggregate such that the volume of the caved soils is greater than 10 percent of the volume of the aggregate in the lift, then the aggregate shall be considered contaminated and shall be removed and replaced with uncontaminated aggregate.

D. Special high-energy impact densification apparatus shall be employed to densify the Aggregate Pier elements during installation. The apparatus shall apply direct downward impact energy to each lift of aggregate.

E. A minimum tamper energy level of 250,000 foot-pounds of force per minute shall be applied by the energy source.

F. The bottom of the excavation shall be densified prior to the placement of the aggregate. If wet, soft or sensitive soils are present, open-graded aggregate, such as ASTM no. 57 stone or other, shall be placed at the bottom of the excavation and compacted to stabilize the element bottom and may serve as the initial lift.

G. Densification shall be performed using a beveled tamper. The beveled tamper foot is required to adequately increase the later earth pressure in the matrix soil during installation.

H. Downward pressure shall be applied to the tamper shaft during tamping.

I. Each lift of aggregate shall be tamped for a minimum of 15 seconds.

4.3 PLAN LOCATION AND ELEVATION OF AGGREGATE PIER ELEMENTS

A. The center of each pier shall be within six inches of the plan locations indicated. The final measurement of the top of piers shall be the lowest point on the aggregate in the last compacted lift. Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

4.4 REJECTED AGGREGATE PIER ELEMENTS

A. Aggregate pier elements improperly located or installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the Designer approves other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner.

PART 5 - QUALITY CONTROL

5.1 QUALITY CONTROL REPRESENTATIVE

A. The Installer shall have a full-time Quality Control (QC) representative to verify and report all QC installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the Design Engineer, the General Contractor and to the Testing Agency. The QC procedures shall include the preparation of Aggregate Pier Progress Reports completed during each day of installation and containing the following information:

1. Footing and Aggregate Pier locations

2. Aggregate Pier length and drilled diameter

3. Planned and actual Aggregate Pier elevations at the top and bottom of the element

4. Average lift thickness for each Aggregate Pier

5. Soil types encountered at the bottom of the Aggregate Pier and along the length of the element

6. Depth to groundwater, if encountered

7. Documentation of any unusual conditions encountered

8. Type and size of densification equipment used

5.2 QUALITY CONTROL VERIFICATION PROCEDURE

A. The installer shall be responsible for design of a verification program to assure the quality of the construction. The program shall verify that the installed ground improvement system satisfies the performance requirements noted on the contract plans and the design requirements determined by the ground improvement system designer. As a minimum, the verification program shall include the following:

1. Program to monitor performance of the ground improvement system during and after construction of the proposed structure or embankment to be supported. This program may include installation of settlement plates, monitoring points, inclinometers, piezometers, or other instrumentation.

2. Stone column installation shall be monitored by an on board computer monitoring system. Monitoring system shall log stone column number, time of installation, depth, hydraulic pressure applied during the boring process and during the compacting process. Recorded data for each stone column shall be plotted depth/pressure versus time. Installation records for each shall be made available upon request in electronic format within 24 hours of installation.

3. Proposed means and methods for verification that the installed aggregate piers meet the strength and/or stiffness criteria required by the design. This may include, but shall not be limited to, modulus or load tests on individual elements and/or groups, soil borings, and other methods as approved by the Engineer.

4. Quality control program to verify that the ground improvement system is installed in accordance with the designer’s specifications and the requirements in this special provision. The quality control program shall include testing and observations by qualified personnel employed by the ground improvement installer or an independent testing laboratory.

PART 6 - QUALITY ASSURANCE

6.1 INDEPENDENT ENGINEERING TESTING AGENCY

A. The Owner or General Contractor is responsible for retaining an independent engineering testing firm to provide Quality Assurance services. The Testing Agency should be the Geotechnical Engineer of Record.

6.2 RESPONSIBILITIES OF GEOTECHNICAL ENGINEER & INDEPENDENT ENGINEERING TESTING AGENCY:

A. The Geotechnical Engineer of Record shall review and approve the Installer's Design Submittal.

B. The Testing Agency shall monitor the installation of aggregate pier elements to verify that all work is performed in accordance with the approved Design Submittal.

C. The Testing Agency & Geotechnical Engineer of Record shall observe footing excavations and densification of aggregate piers and provide written reports per section 7.3.D.

D. The Testing Agency shall report any discrepancies to the Installer and General Contractor immediately.

PART 7 - RESPONSIBILITIES OF GENERAL CONTRACTOR

7.1 PREPARATION

A. The Installer shall located and protect underground and above ground utilities and other structures from damage during installation of the Aggregate Pier elements.

B. The General Contractor will provide the site to the Installer, after earthwork in the area has been completed.

C. Site subgrade shall be established by the General Contractor within 6 inches of final design subgrade.

7.2 UTILITY EXCAVATIONS

A. The General Contractor shall coordinate all excavations made subsequent to Aggregate Pier installations so that at least five feet of horizontal distance remains between the edge of any installed Aggregate Pier and the excavation. In the event that utility excavations are required at horizontal distances of less than five feet from installed Aggregate Piers, the General Contractor shall notify the Aggregate Pier Designer to develop construction solutions to minimize impacts on the installed Aggregate Piers.

B. Recommended procedures may include:

1. Using cement-treated base to construct portions of the Aggregate Piers subject to future excavations.

2. Replacing excavated soil with compacted crushed stone in the portions of excavations where the Aggregate Piers have been disturbed. The placement and compaction of the crushed stone shall meet the following requirements.
   a. The crushed stone shall meet the gradation specified by the Designer.
   b. The crushed stone shall be placed in a controlled manner using motorized impact compaction equipment.
   c. The aggregate should be compacted to 95% of the maximum dry density as determined by the modified Proctor method (ASTM D-1557).
   d. The Testing Agency shall be on site to observe placement, compaction, and provide density testing. The test results shall be submitted to the Designer and the General Contractor. The subcontractor shall provide notification to the Testing Agency and the Designer when excavation, placement, and compaction will occur and arrange for construction observation and testing.

7.3 FOOTING BOTTOMS

A. Excavation and surface compaction of all footings shall be the responsibility of the General Contractor.

B. Foundation excavations to expose the tops of Aggregate Pier elements shall be made in a workmanlike manner, and shall be protected until concrete placement, with procedures and equipment best suited to (1) prevent softening of the matrix soil between and around the Aggregate Pier elements before pouring structural concrete, and (2) achieving direct and firm contact between the dense, undisturbed Aggregate Pier elements and the concrete footing.

C. Recommended procedures for achieving these goals are to:

1. Limit over-excavation below the bottom of the footing to 3-inches (including disturbance from the teeth of the excavation equipment,

2. Compaction of surface soil and top of Aggregate Pier elements shall be prepared using a motorized impact compactor (“Wacker Packer,” “Jumping Jack,” or similar). Sled-type tamping devices shall not be used. Compaction shall be performed over the entire footing bottom to compact any loose surface soil and loose surface pier aggregate.

3. Place footing concrete immediately after footing excavation is made and approved, preferably the same day as the excavation. Footing concrete must be placed on the same day if the footing is bearing on expansive or sensitive soils.

4. If same day placement of footing concrete is not possible, place a minimum 3-inch thick lean concrete seal (“mud mat”) immediately after the footing is excavated and approved.

END OF SECTION

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section specifies cast-in-place concrete, including formwork, reinforcing, mix design, placement procedures, and finishes.

B. Cast-in-Place Concrete includes the Following:

1. Foundations and Footings
2. Slabs-on-Grade
3. Foundation Walls
4. Tanks and Basins
5. Framed Floors and Columns
6. Equipment Pads and Bases

1.03 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, dry-shake finish materials, and others if requested by Engineer.

C. Shop drawings for reinforcement detailing fabricating, bending, and placing concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, bent bar diagrams, and arrangement of concrete reinforcement. Include special reinforcing required for openings through concrete structures. Reproduction of contract drawings for use, as erection drawings will not be permitted.

D. Shop drawings for formwork indicating fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing special form joints or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.

1. Engineer's review is for general applications and features only. Designing formwork for structural stability and efficiency is Contractor's responsibility.

E. Samples of materials as requested by Engineer, including names, sources, and descriptions.

F. Laboratory test reports for concrete materials and mix design test.

1.04 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. American Concrete Institute (ACI) 301, "Specifications for Structural Concrete for Buildings".
2. ACI 318, "Building Code Requirements for Reinforced Concrete".
3. ACI 350, "Code Requirements for Environmental Engineering Concrete Structures".
4. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice".

B. Concrete Testing Service: Engage a testing agency acceptable to Engineer to perform material evaluation tests and to design concrete mixes.

C. Materials and installed work may require testing and re-testing at any time during progress of Work. Tests, including re-testing of rejected materials for installed Work, shall be done at Contractor's expense.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form", Class I.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or another acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration to match Architect's control sample. Provide solid backing and form supports to ensure stability of textured form liners.

D. Forms for Cylindrical Columns and Supports: Metal, glass-fiber-reinforced plastic, or paper or fiber tubes that will produce smooth surfaces without joint indications. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.

E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel stiffened to support weight of placed concrete without deformation.

F. Carton Forms: Biodegradable paper surface, treated for moisture-resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

G. Form Release Agent: Provide commercial formulation form release agent with a maximum of 350 g/L volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

H. Form Ties: Snap-off metal form ties designed to prevent form deflection and to prevent spalling of concrete upon removal. Provide units that will leave no metal closer than 1-1/2 inches (38 mm) to the plane of the exposed concrete surface.

1. No ties shall leave holes not larger than 1 inch (25 mm) in diameter in the concrete surface.

2.02 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615 Grade 60 (ASTM A 615M Grade 400), deformed.

B. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI Specifications.

1. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

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

2.03 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I.

1. Use one brand of cement throughout Project unless otherwise acceptable to Engineer.

B. Fly Ash: ASTM C 618, Type F.

C. Normal-Weight Aggregates: ASTM C 33 and as specified. Provide aggregates from a single source for exposed concrete.

1. For exposed exterior surfaces, do not use fine or course aggregates that contain substances that cause spalling.

2. Local aggregates not complying with ASTM C 33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to Engineer.

D. Water: Potable

E. Admixtures, General: Provide concrete admixtures that contain not more than 0.1 percent chloride ions.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

1. Add air-entraining admixture to all concrete at manufacturer's prescribed rate to achieve 4-6% air content at placement unless noted otherwise. Do not allow air content of hard-trowel-finished floors to exceed 3 percent. Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. Air-Tite, Cormix Construction Chemicals

b. Air-Mix or Perma-Air, Euclid Chemical Co.

c. Darex AEA or Daravair, W.R. Grace & Co.

d. MB-VR or Micro-Air, Master Builders, Inc.

e. Sealtight AEA, W.R. Meadows, Inc.

f. Sika AER, Sika Corp.

G. Water-Reducing Admixture: ASTM C 494, Type A.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. Chemtard, ChemMasters Corp.

b. PSI N, Cormix Construction Chemicals

c. Eucon WR-75, Euclid Chemical Co.

d. WRDA, W.R. Grace & Co.

e. Pozzolith Normal or Polyheed, Master Builders, Inc.

f. Metco W.R., Metalcrete Industries

g. Prokrete-N, Prokrete Industries

h. Plastocrete 161, Sika Corp.

H. High-Range Water-Reducing Admixture: ASTM C 494, Type F or Type G.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. Super P, Anti-Hydro Co., Inc.

b. Cormix 200, Cormix Construction Chemicals

c. Eucon 37, Euclid Chemical Co.

d. WRDA 19 or Daracem, W.R. Grace & Co.

e. Rheobuild or Polyheed, Master Builders, Inc.

f. Superslump, Metalcrete Industries

g. PSPL, Prokrete Industries

h. Sikament 300, Sika Corp.

I. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. Q-Set, Conspec Marketing & Manufacturing Co.

b. Lubricon NCA, Cormix Construction Chemicals

c. Accelguard 80, Euclid Chemical Co.

d. Daraset, W.R. Grace & Co.

e. Pozzutec 20, Master Builders, Inc.

f. Accel-Set, Metalcrete Industries

J. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. PSI-R Plus, Cormix Construction Chemicals

b. Eucon Retarder 75, Euclid Chemical Co.

c. Daratard-17, W.R. Grace & Co.

d. Pozzolith R, Master Builders, Inc.

e. Protard, Prokrete Industries

f. Plastiment, Sika Corporation

2.04 RELATED MATERIALS

A. Reglets: Where sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217 inch (0.46 mm) thick galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot-dip galvanized sheet steel, not less than 0.0336 inch thick (0.76 mm) with bent tab anchors. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.

C. Waterstops: Provide flat, dumbbell-type or centerbulb-type waterstops at construction joints and other joints as indicated. Size to suit joints.

D. Rubber Waterstops: Corps of Engineers CRD-C 513.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

a. The Burke Co.

b. Progress Unlimited.

c. Williams Products, Inc.

E. Polyvinyl Chloride Waterstops: CRD-C 572.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:

a. The Burke Co.

b. Greenstreak Plastic Products Co.

c. W.R. Meadows, Inc.

d. Progress Unlimited

e. Schlegel Corp.

f. Vinylex Corp.

F. Sand Cushion: Clean, manufactured or natural sand.

G. Vapor Retarder: Provide vapor retarder that is resistant to deterioration when tested according to ASTM E 154, as follows:

1. Polyethylene sheet not less than 8 mils (0.2 mm) thick.

2. Water-resistant barrier consisting of heavy kraft papers laminated together with glass-fiber reinforcement and overcoated with black polyethylene on each side.

a. Product: Subject to compliance with requirements, provide Moistop by Fortifiber Corporation.

H. Vapor Barrier: Pre-molded seven-ply membrane consisting of reinforced core and carrier sheet with fortified bitumen layers, protective weathercoating, and plastic antistick sheet. Water vapor transmission rate of 1 perm when tested according to ASTM E 96, Method B. Provide manufacturer's recommended mastics and gussett tape.

1. Product: Subject to compliance with requirements, provide Sealtight Pre-molded Membrane by W.R. Meadows, Inc.

I. Nonslip Aggregate Finish: Provide fused aluminum oxide granules or crushed emery as the abrasive aggregate for a nonslip finish, with emery aggregate containing not less than 50 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rustproof, nonglazing and unaffected by freezing, moisture, and cleaning materials.

J. Colored Wear-Resistant Finish: Packaged dry combination of materials consisting of portland cement, graded quartz aggregate, coloring pigments, and plasticizing admixture. Use coloring pigments that are finely ground nonfading mineral oxides interground with cement. Color as selected by Architect from manufacture standards, unless otherwise indicated.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
    a. Conshake 600 Colortone, Conspec Marketing & Mfg. Co.
    b. Floorcron, Cormix Construction Chemicals
    c. Quartz Tuff, Dayton-Superior
    d. Surflex, Euclid Chemical Co.
    e. Colorundum, A.C. Horn, Inc.
    f. Quartz Plate, L&M Construction Chemicals, Inc.
    g. Colorcron, Master Builders, Inc.
    h. Floor Quartz, Metalcrete Industries
    i. Lithochrome Color Hardener, L.M. Scofield Co.
    j. Harcol Redi-Mix, Sonneborn-Chemrex
    k. Hard Top, Symons Corporation

K. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz/sq. yd. (305 g/sq. m), complying with AASHTO M 182, Class 2.

L. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof Paper
2. Polyethylene Film
3. Polyethylene-Coated Burlap

M. Liquid Membrane-Forming Curing Compound: Liquid-type membrane forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kg/sq. m when applied at 200 sq. ft/gal (4.9 sq. m/L).

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
    a. A-H 3 Way Sealer, Anti-Hydro Co., Inc.
    b. Spartan-Cote, The Burke Co.
    c. Conspec #1, Conspec Marketing & Mfg. Co.
    d. Sealco 309, Cormix Construction Chemicals
    e. Day-Chem Cure and Seal, Dayton Superior Corporation
    f. Eucocure, Euclid Chemical Co.
    g. Horn Clear Seal, A.C. Horn, Inc.
    h. L & M Cure R, L & M Construction Chemicals, Inc.
    i. Masterkure, Master Builders, Inc.
    j. CS-309, W.R. Meadows, Inc.
    k. Seal-N-Kure, Metalcrete Industries

l. Kure-N-Seal, Sonneborn Chemrex

m. Stontop CS2, Stonhard, Inc.

N. Water-Based Acrylic Membrane Curing Compound: ASTM C 309, Type I, Class B.

1. Provide material that has a maximum volatile organic compound (VOC) rating of 350 g/L.

2. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. Highseal, Conspec Marketing and Mfg. Co.

b. Sealco – VOC, Cormix Construction Chemicals

c. Safe Cure and Seal, Dayton Superior Corp.

d. Aqua-Cure, Euclid Chemical Co.

e. Dress & Seal WB, L & M Construction Chemicals, Inc.

f. Masterkure 100W, Master Builders, Inc.

g. Vocomp-20, W.R. Meadows, Inc.

h. Metcure, Metalcrete Industries

i. Stontop CS1, Stonhard, Inc.

O. Evaporation Control: Monomolecular film forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. Aquafilm, Conspec Marketing and Mfg. Co.

b. Eucobar, Euclid Chemical Co.

c. E-Con, L & M Construction Chemicals, Inc.

d. Confilm, Master Builders, Inc.

e. Waterhold, Metalcrete Industries

P. Underlayment Compound: Free-flowing, self-leveling, pumpable, cement-based compound for applications from 1 inch (25 mm) thick to feathered edges.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. K-15, Ardex, Inc.

b. Self-Leveling Wear Topping, W.R. Bonsal Co.

c. Conflow, Conspec Marketing and Mfg. Co.

d. Corlevel, Cormix Construction Chemicals

e. Level Layer II, Dayton Superior Corp.

f. Flo-Top, Euclid Chemical Co.

g. Gyp-Crete, Gyp-Crete Corp.

h. Levelex, L & M Construction Chemicals, Inc.

i. Underlayment 110, Master Builders, Inc.

j. Stoncrete UL1, Stonhard, Inc.

k. Concrete Top, Symons Corp.

l. Thoro Underlayment Self-Leveling, Thoro System Products

Q. Bonding Agent: Polyvinyl acetate or acrylic base.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. Aquafilm, Conspec Marketing and Mfg. Co.

b. Eucobar, Euclid Chemical Co.

c. E-Con, L & M Construction Chemicals, Inc.

d. Confilm, Master Builders, Inc.

e. Waterhold, Metalcrete Industries

R. Underlayment Compound: Free-flowing, self-leveling, pumpable, cement-based compound for applications from 1 inch (25 mm) thick to feathered edges.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. K-15, Ardex, Inc.

b. Self-Leveling Wear Topping, W.R. Bonsal Co.

c. Conflow, Conspec Marketing and Mfg. Co.

d. Corlevel, Cormix Construction Chemicals

e. Level Layer II, Dayton Superior Corp.

f. Flo-Top, Euclid Chemical Co.

g. Gyp-Crete, Gyp-Crete Corp.

h. Levelex, L & M Construction Chemicals, Inc.

i. Underlayment 110, Master Builders, Inc.

j. Stoncrete UL1, Stonhard, Inc.

k. Concrete Top, Symons Corp.

l. Thoro Underlayment Self-Leveling, Thoro System Products

S. Bonding Agent: Polyvinyl acetate or acrylic base.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. Polyvinyl Acetate (Interior Only):

1. Superior Concrete Bonder, Dayton Superior Corp.
2. Euco Weld, Euclid Chemical Co.
3. Weld-Crete, Larsen Products Corp.
4. Everweld, L & M Construction Chemicals, Inc.
5. Herculox, Metalcrete Industries
6. Ready Bond, Symons Corp.

b. Acrylic or Styrene Butadiene:

1. Acrylic Bondcrete, The Burke Co.
2. Strongbond, Conspec Marketing and Mfg. Co.
3. Day-Chem Ad Bond, Dayton Superior Corp.
4. SBR Latex, Euclid Chemical Co.
5. Daraweld C, W.R. Grace & Co.
6. Hornweld, A.C. Horn, Inc.
7. Everbond, L & M Construction Chemicals, Inc.
8. Acryl-Set, Master Builders Inc.
9. Intralok, W.R. Meadows, Inc.
10. Acrylpave, Metalcrete Industries
11. Sonocrete, Sonneborn-Chemrex
12. Stonlock LB2, Stonhard, Inc.
13. Strong Bond, Symons Corp.

T. Epoxy Adhesive: ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material type, grade, and class to suit Project requirements.

1. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

a. Burke Epoxy M.V., The Burke Co.

b. Spec-Bond 100, Conspec Marketing and Mfg. Co.

c. Resi-Bond (J-58), Dayton Superior

d. Euco Epoxy System #452 or #620, Euclid Chemical Co.

e. Epoxtite Bonder 2390, A.C. Horn, Inc.

f. Epabond, L & M Construction Chemicals, Inc.

g. Concresive Standard Liquid, Master Builders, Inc.

h. Rezi-Weld 1000, W.R. Meadows, Inc.

i. Metco Hi-Mod Epoxy, Metalcrete Industries

j. Sikadur 32 Hi-Mod, Sika Corp.

k. Stonset LV5, Stonhard, Inc.

l. R-600 Series, Symons Corp.

2.05 PROPORTIONING AND DESIGNING MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. For the trial batch method, use an independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.

1. Do not use the same testing agency for field quality control testing.

2. Limit use of fly ash to not exceed 25 percent of cement content by weight.

B. Submit written reports to Engineer of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Engineer.

C. Design mixes to provide normal weight concrete as noted.

D. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps, Slabs, and Sloping Surfaces: Not more than 3 inches (75 mm).

2. Reinforced Foundation Systems: Not less than 2 inches (50 mm) and not more than 4 inches (100 mm).

3. Concrete Containing High-Range Water-Reducing Admixture (superplasticizer): Not more than 8 inches (200 mm) after adding admixture to site-verified 2-3 inch (50 – 75 mm) slump concrete.

4. Other Concrete: Not more than 4 inches (100 mm).

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

2.06 ADMIXTURES

A. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.

Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).

Use high-range water-reducing admixture in pumped concrete, concrete for heavy use industrial slabs, architectural concrete, parking structure slabs, concrete required to be watertight, and concrete with water-cement ratios below 0.50.

Use air-entraining admixture in exterior exposed concrete unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to achieve 4-6% air content at point of placement. Do not allow air content of hard-trowel-finished floors to exceed 3 percent.

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

2.07 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85 deg F (29 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.01 GENERAL

Coordinate the installation of joint materials, vapor retarder/barrier, and other related materials with placement of forms and reinforcing steel.

3.02 FORMS

A. General: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction tolerances and surface irregularities complying with the following ACI 347 limits:

1. Provide Class A tolerances for concrete surfaces exposed to view, or where such tolerances are required for proper operation of installed equipment.

2. Provide Class C tolerances for other concrete surfaces.

B. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in the Work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent cement paste from leaking.

C. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like for easy removal.

D. Provide temporary openings for clean-outs and inspections where interior area of formwork is inaccessible before and during concrete placement. Securely brace temporary openings and set tightly to forms to prevent losing concrete mortar. Locate temporary openings in forms at inconspicuous locations.

E. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

F. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

G. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before placing concrete. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

3.03 VAPOR RETARDER/BARRIER INSTALLATION

A. General: Place vapor retarder/barrier sheeting in position with longest dimension parallel with direction of pour.

B. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended mastic or pressure-sensitive tape.

1. Cover vapor retarder/barrier with sand cushion and compact to depth indicated.

3.04 PLACING REINFORCEMENT

A. General: Comply with Concrete Reinforcing Steel Institute's recommended practice for "placing Reinforcing Bars", for details and methods of reinforcement placement and supports and as specified.

1. Avoiding cutting or puncturing vapor retarder/barrier during reinforcement placement and concreting operations. Repair damages before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved by Engineer.

D. Place reinforcement to maintain minimum coverages as indicated for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.05 JOINTS

A. Construction Joints: Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Engineer.

B. Provide keyways at least 1-1/2 inches (38 mm) deep in construction joints in walls and slabs and between walls and footings. Bulkheads designed and accepted for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as indicated otherwise. Do not continue reinforcement through sides of strip placements.

D. Use bonding agent on existing concrete surfaces that will be joined with fresh concrete.

E. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's printed instructions.

F. Isolation Joints in Slabs-on-Grade: Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants".

G. Contraction (Control) Joints in Slabs-on-Grade: Construct contraction joints in slabs-on-grade to form panels of patterns as shown. Use saw cuts 1/8 inch (3 mm) wide by one-fourth of slab depth of inserts ¼ inch (6 mm) wide by one-fourth of slab depth, unless otherwise indicated.

1. Form contraction joints by inserting pre-molded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface. Tool slab edges round on each side of insert. After concrete has cured, remove inserts and clean groove of loose debris.
2. Contraction joints in unexposed floor slabs may be formed by saw cuts as soon as possible after slab finishing as may be safely done without dislodging aggregate.
3. If joint pattern is not shown, provide joints not exceeding 15 ft. (4.5 m) in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
4. Joint fillers and sealants are specified in Division 7 Section "Joint Sealants".

3.06 INSTALLING EMBEDDED ITEMS

A. General: Set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use

setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

B. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

C. Install dovetail anchor slots in concrete structures as indicated on drawings.

D. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

3.07 PREPARING FORM SURFACES

A. General: Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.

B. Do not allow excess form-coating material to accumulate in forms or come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply according to manufacturer's instructions.

1. Coat steel forms with a nonstaining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.08 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. General: Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete", and as specified.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened sufficiently to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation at its final location.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers no deeper than 24 inches (600 mm) and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete complying with ACI 309.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into

lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix to segregate.

E. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.

1. Consolidate concrete during placement operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.

2. Bring slab surfaces to correct level with a straightedge and strike off. Use bull floats or darbies to smooth surface free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

3. Maintain reinforcing in proper position on chairs during concrete placement.

F. Cold-Weather Placement: Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

G. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

2. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot-Weather Placement: When hot weather conditions exist that would impair quality and strength of concrete, place concrete complying with ACI 305 and as specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement to below 90 deg F (32 deg C). Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

3. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Engineer.

3.09 FINISHING FORMED SURFACES

A. Rough-Formed Finish: Provide a rough-formed finish on formed concrete surfaces not exposed to view in the finished Work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding ¼ inch (6 mm) in height rubbed down or chipped off.

B. Smooth-Formed Finish: Provide a smooth-formed finish on formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or another similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.

C. Smooth-Rubbed Finish: Provide smooth-rubbed finish on scheduled concrete surfaces that have received smooth-formed finish treatment not later than 1 day after form removal.

1. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Grout-Cleaned Finish: Provide grout-cleaned finish on scheduled concrete surfaces that have received smooth-formed finish treatment.

1. Combine one part portland cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint. Blend standard portland cement and white portland cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.

2. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and where indicated.

1. After placing slabs, finish surface to tolerances of F (F)15 (floor flatness) and F(L) 13 (floor levelness) measured according to ASTM E 1155 (ASTM E 1155M). Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and where indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155 (ASTM E 1155M). Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

C. Trowel Finish: Apply a trowel finish to monolithic slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or another thin film-finish coating system. Do not allow air content of hard-trowel-finished floors to exceed 3 percent.

1. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155 (ASTM E 1155M) except where more restrictive tolerances are required for proper operation of installed equipment. Grind smooth any surface defects that would telegraph through applied floor covering system.

D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply a trowel finish as specified, then immediately follow by slightly scarifying the surface with a fine broom.

E. Nonslip Broom Finish: Apply a nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

F. Nonslip Aggregate Finish: Apply nonslip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and where indicated.

1. After completing float finishing and before starting trowel finish uniformly spread dampened nonslip aggregate at a rate of 25 lb per 100 sq. ft. (12 kg/10sq. m) of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as specified.

2. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose nonslip aggregate.

G. Colored Wear-Resistant Finish: Apply a colored wear-resistant finish to monolithic slab surface indicated.

1. Apply dry shake materials for the colored wear-resistant finish at a rate of 100 lb per 100 sq. ft. (49 kg/10 sq. m), unless a greater amount is recommended by material manufacturer.

2. Cast a trial slab approximately 10 ft. (3 m) square to determine actual application rate, color, and finish, as acceptable to Engineer.

3. Immediately following the first floating operation, uniformly distribute with mechanical spreader approximately two-thirds of the required weight of the dry shake material over the concrete surface, and embed by power floating. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material with overlapping applications to ensure uniform color, and embed by power floating.

4. After broadcasting and floating, apply a trowel finish as specified. Cure slab surface with a curing compound recommended by the dry shake material manufacturer. Apply the curing compound immediately after the final finishing.

3.11 CONCRETE FINISH SCHEDULE

	Type Finish
Interior Exposed Walls	Rubbed
Exterior Exposed Walls	Rubbed
Exterior Sidewalks and Drives	Broomed
Interior Exposed Floors	Steel Troweled with Sealer
Interior Covered Floors	Steel Troweled
Interior Beams and Columns	Rubbed
Interior Exposed Ceilings	Rubbed
Clearwell Top	Light Broomed
Other Surfaces	Rubbed, unless otherwise directed by the Engineer

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.13 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.

D. Provide moisture curing by the following methods:

1. Keep concrete surface continuously wet by covering with water.
2. Use continuous water-fog spray.
3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4 inch (100 mm) lap over adjacent absorptive covers.

E. Provide moisture-retaining cover curing as follows:

1. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches (75 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

F. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:

1. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

G. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the

full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

H. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by applying the appropriate curing method.

1. Final cure concrete surfaces to receive finish flooring with a moisture-retaining cover, unless otherwise directed.

3.14 SHORES AND SUPPORTS

A. General: Comply with ACI 347 for shoring and reshoring in multistory construction, and as specified.

B. Extend shoring from ground to roof for Structures four stories or less, unless otherwise permitted.

3.15 REMOVING FORMS

A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.16 REUSING FORMS

A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Engineer.

3.17 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Engineer.

B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh (1.2 mm) sieve, using only enough water as required for handling and placing.

1. Cut out honeycombs, rock pockets, voids over ¼ inch (6 mm) in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch (25 mm). Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the are to be patched with bonding agent. Place patching mortar before bonding agent has dried.

2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discoloration's that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.

1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.

1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.

3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Engineer.

4. Repair defective areas, except random cracks and single holes not exceeding 1 inch (25 mm) in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least ¾ inch (19 mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete.

Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

E. Repair isolated random cracks and single holes 1 inch (25 mm) or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

F. Perform structural repairs with prior approval of Engineer for method and procedure, using specified epoxy adhesive and mortar.

G. Repair methods not specified above may be used, subject to acceptance of Engineer.

3.18 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. Sampling and testing for quality control during concrete placement may include the following, as directed by Engineer.

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

a. Slump: ASTM C 143; one test at point of discharge for each truckload of each type of concrete; additional tests when concrete consistency seems to have changed.

b. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231, pressure method for normal weight concrete; one for each truck load of each type of air-entrained concrete.

c. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4 deg C) and below, when 80 deg F (27 deg C) and above, and one test for each set of compressive-strength specimens.

d. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test, unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens except when field-cured test specimens are required.

e. Compressive-Strength Tests: ASTM C 39; one set for each day's pour exceeding 5 cu. yd. (4 cu. m) plus additional sets for each 50 cu. yd. (38 cu. m) more than the first 25 cu. yd. (19 cu. m) of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

2. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.

3. When total quantity of a given class of concrete is less than 50 cu. yd. (38 cu. m), Engineer may waive strength testing if adequate evidence of satisfactory strength is provided.

4. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.

5. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi (3.4 Mpa).

B. Test results will be reported in writing to Structural Engineer, ready-mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the Project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-day tests and 28 day tests.

C. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted but shall not be used as the sole basis for acceptance or rejection.

D. Additional Tests: The testing agency will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.19 CONCRETE FOR WATER HOLDING BASINS

A. Leakage Testing

1. Leakage testing shall be performed on each basin as soon as practicable.

2. Fill basin to full overflow level.

3. Basin is considered acceptable if:

   a. There are no visible leakage or visible damp areas, and

   b. The volume of leakage is less than one-tenth (1/10) of one (1%) percent of the tank volume in any twenty-four (24) hour period.

4. Prior to testing, if the structure has dried out, the water shall be left standing to allow for absorption.

5. Deficiencies shall be corrected and testing repeated until satisfactory results are achieved.

END OF SECTION

SECTION 46 20 00

SBNR PROCESS SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

A. There shall be furnished, as shown on the plans, all operating equipment and special materials complete with all accessories and appurtenances required for a complete SBNR process system.

1.2 WORK SPECIFIED ELSEWHERE

A. The Contractor shall coordinate the work specified in this section with the work of other Contractors in order that all necessary items shall be provided as required for satisfactory operation and that the various items of equipment will properly fit and operate in the spaces allotted to them.

1.3 SHOP DRAWINGS

A. Shop Drawings shall be submitted on all equipment in this Section.

8 . Complete operation and maintenance instructions for all equipment shall be submitted after the Shop Drawings are approved, but prior to shipment of equipment.

1.4 ELECTRICAL EQUIPMENT

A. Wiring shall be as recommended by the equipment manufacturer unless indicated otherwise on the drawings. Horsepower indicated and/or specified is approximate only and shall be adjusted to provide the specified capacities.

1.5 EQUIPMENT INSTALLATION

A. The installation of all equipment including setting anchor bolts and grouting base plates shall be as recommended by the manufacturer to conform to the application involved, in accordance with the details shown on the Drawings. All in basin anchor bolts shall be 304 stainless steel and supplied by the contractor. Installation of equipment and connections to equipment shall be completed in every detail in a first-class workmanlike manner. All bearings shall be properly lubricated. Necessary supports for all equipment shall be provided as required. Shop Drawings for supports shall be submitted. All valves shall be tagged and identified with stamped brass plates attached to the valve body with brass wire. Prior to acceptance of all or any part of the work, the Contractor shall test each piece of equipment and furnish written certification that it has been installed in accordance with the manufacturer's requirements and is ready to begin operation.

1.6 MANUFACTURER'S REPRESENTATIVES

A. The Contractor shall provide the services of a competent factory trained Engineer for the minimum time period specified in each Section. This Engineer shall represent the vendor supplying the equipment, check the installation, and be present for the start-up. A letter certifying that all equipment has been properly installed, lubricated and is in satisfactory operating condition shall be filed by the manufacturer with the Engineer before the installation can be considered complete. Any additional time required to make this certification shall be paid by the Contractor at no additional cost to the Authority.

B. The Contractor shall also provide the services of a qualified representative of the manufacturer supplying the equipment for the time specified in each Section. This manufacturer's representative shall instruct the plant personnel on operation, maintenance and servicing of each unit of equipment. The Contractor shall schedule the Vendor's representatives through the Engineer for coordination.

1.7 PRODUCT SUBSTITUTIONS

A. Product substitutions may be proposed by the Contractor only in accordance with procedures set forth herein and only at the time of bid. For product substitutions to be considered the Contractor must submit with his bid complete written details, calculations, drawings, and modifications required on the proposed product substitutions. Product substitutions must be bid as deductive alternates with appropriate cost deductions given on the bid form. Any proposed substitutions for sequencing batch reactor equipment must be accompanied by a reference list in addition to the information required above. The reference list shall list at least five (5) successful sequencing batch reactor plants that have operated in true sequencing batch reactor mode (volume control) with names and telephone numbers of appropriate operating personnel. In addition, any alternate manufacturer must provide a cash bond or a performance bond guaranteeing performance of the equipment for a three-year period. The amount of the bond shall be equal to 200% of the installed cost of the SBR equipment. The engineer shall have final say in the approval of any proposed substitutions. The engineer's decision on acceptance or rejection of the proposed substitutions shall be final and binding.

8. All products provided for in the contract, whether named product or substitutions, shall be suitable for the intended function and indicated installation. The cost of any redesign or modifications to accommodate products provided shall be borne by the Contractor.

1.8 SCOPE

A. This Section includes a Three-Stage Sequencing Batch Reactor (SBNR) Treatment System configured in a single process train. Provide equipment as specified in Part 2 of this Section in the following tanks, and as shown on the plans:

1. Anaerobic Selector Tank
    a. Constant-level, flow-through
    b. Provides initial sedimentation
    c. Provides anaerobic sludge digestion.
2. Anoxic Equalization Reactor
    a. Receives flow from the Anaerobic Selector Tank and accumulates batches for the SBR Reactor.
    b. Receives mixed liquor returned from the SBR Reactor through a Jet Mixing System.
    c. Provides an anoxic zone for Denitrification.
3. SBR Reactor
    a. Receives batches from the Anoxic Equalization Reactor through a Jet Motive Pump and Jet Aeration/Mixing System
    b. Provides aeration, settling, and decanting on a batch basis.
    c. Provides BOD removal, SS removal, and Nitrification.

C. Each reactor basin shall be equipped with necessary switches, relays, level transducers, valves and timers to automatically perform the following sequence: Fill (Anoxic/Aerobic/ Remove Sludge), Interact (Anoxic/Aerobic,) Settle, Decant.

D . Operation shall be a level/ORP driven control strategy. The control strategy shall automatically adjust the operating cycle to receive and treat influent flows over a range of 0% to 300% of design flow, without bypassing, or additional input from operators.

E. The influent is continuous during all cycles. The SBR reactor basin is sent into a timed settle period when a predetermined level in the anoxic equalization reactor is reached. After the settle period ends, the decanter is energized, the decant period shall be continuous until the basin reaches bottom water level. Once bottom water level is reached, the decant period ends.

F. During the fill, and interact cycles there shall be static, anoxic mixed and aerobic subcycles. These subcycles shall repeat throughout the fill and interact cycles. This feature shall allow the operator to optimize mixing and aeration.

G. The supplier shall provide a stainless-steel distribution box with one inlet and four equal volume weir outlet pipes able to supply the individual trains. A fifth overflow outlet weir shall exit the distribution box at a level to fully supply all trains and any excess flow diverted to the fifth overflow weir. The overflow weir shall handle 200% of the design flow. All outlets shall be able to connect to standard flanged ductile iron flange fittings.

H. The Contractor shall have one supplier furnish and deliver the complete SBNR process system, complete in all detail and in strict accordance with the plans and specifications. All equipment within the treatment reactors shall be capable of full operation under completely flooded conditions. The aeration system shall consist of aerators, air blowers, liquid mixing /fill pumps, and all in-basin air and liquid piping, supports and controls. All components shall be furnished by the SBNR process system manufacturer to insure compatibility of all components. The equipment shall be supplied by ClearStream Environmental, of Sandy, Utah or an approved alternate.

PART 2 OPERATION

2.1 INFLUENT WASTEWATER CHARACTERISTICS AND SITE CONDITIONS

A. Average Dry Weather Flow (ADWF)				0.20 MGD
B. Peak Dry Weather Flow. (PDWF)				0.35 MGD
C. Peak Wet Weather Flow (PVI/WF)				1.00 MGD
D . Peak Day Flow (PDF)				1.5 MGD
E. Peak Instantaneous Flow (PIF)				1,041 GPM
F. Average B0 0_5	300	mg/L		2,502 lb./day
G. Maximum BOD_5	500	mg/L		lb/day
H. Average TSS	200	mg/L		1,668 lb./day
I. Maximum TSS	300	mg/L		lb./day
J. Average TKN	50	mg/L		4171b./day
K. Maximum TKN	10.8	mg/L		lb./day
L. Average NH_3-N	25	mg/L		209 1b ./ da y
M. Maximum **NH_3-N**	35	mg/L		lb./day
N. Average TP	5	mg/L		421b./day
0 . Maximum TP	7	mg/L		lb./day
P. Temperature Range (Water)			10 °C to	20 °C

Q. Temperature Range (Air) . . . . . 5 ° F to 100 °F

R. Site Elevation . . . . . 595 ft. MSL

2.2 EFFLUENT REQUIREMENTS5

A. BODs . . . . . - . 5 mg/L

B. Suspended Solids . . . . . 15 mg/L

C. NH3-N . . . . . 0.5 mg/L

D. Total Nitrogen. . . . . 12 mg/L

E. Total Phosphorus. . . . . 1 mg/L

2.3 PROCESS GUARANTEE

A The SBNR Equipment Supplier shall guarantee system performance and supply any added equipment including pump and/or blower capacity beyond the minimum specified performance requirements.

PART 3 EQUIPMENT

3.1 ANAEROBIC SELECTOR TANK EQUIPMENT

A The General Contractor is responsible for providing covered tanks with two 30-inch square access openings per tank, as specified and as shown on the Drawings.

B. The Manufacturer is responsible for furnishing one 4-inch diameter sludge withdrawal manifold mounted horizontally in each tank, vertical piping, and sludge withdrawal valves to remove digested sludge from the bottom as shown on the Drawings.

1. Sludge Withdrawal Valves: Plug Valves as specified in Section 4.0.

3.2 JET AERATION SYSTEM

A The aeration system in each SBR basin shall be designed to transfer adequate pounds of standard oxygen per hour (SOR) to the wastewater. Four identical aeration headers shall be provided. Each jet aeration header shall be comprised of integrally fabricated air and liquid ducts, and a minimum of 4 air /liquid jet nozzles. The jet nozzles shall be mounted on one/both sides of the liquid duct, equally spaced along the length of the duct as shown on the drawings. Recirculated mixed liquor shall enter the liquid header through a 10”-inch flanged connection. Low pressure air shall enter the air header through a 6”-inch flanged connection. The jet header shall be designed to provide uniform distribution of the motive liquid and low-pressure air to each jet nozzle. The motive liquid and low-pressure air shall be combined in the jet nozzle, and the resulting air/liquid stream shall be discharged horizontally as a high-energy jet in the lower portion of the reactor basin.

B. The liquid duct shall be a cylindrical member, internally smooth and free of protrusions which might collect stringy material. The jet nozzles shall be longitudinally spaced along the perimeter of the liquid duct and aligned on a common horizontal plane.

C. The air duct shall also be a cylindrical member located above, and parallel to, the liquid duct. The air duct shall be attached to and supported by the air feed manifolds located at each jet location. The provision of individual air feed manifolds for each jet shall ensure uniform air distribution.

D. The air and liquid ducts shall be fabricated Schedule 10 304 stainless steel.

E. Each jet nozzle assembly shall consist of an inner liquid nozzle, and an outer air/liquid discharge nozzle fabricated from 304 stainless steel. The jet nozzles shall be assembled to

be concentric with the inner and outer nozzles in axial alignment. The outer nozzles shall be of constantly reducing cross-sectional area in the direction of flow; with an included angle of at least 20° for at least six inches along the horizontal flow path to increase the velocity of the air/liquid stream. Both inner and outer nozzles shall be of a non-clog design, free from all protrusions which might collect stringy material, and shall be capable of passing a 1.5 inch spherical solid. The diameter of the outlet of the outer nozzle shall be 1.7 to 1.9 times that of the inner nozzle.

F. Air feed manifolds shall be enclosed conduits of common wall construction with the liquid duct which carry the low-pressure air from the air duct to the air/liquid discharge nozzle. Air feed manifolds shall be fabricated from 304 stainless steel minimum schedule 10.

G. The aeration equipment shall be capable of producing fine bubbles to increase the oxygen transfer efficiency. All materials must be resistant to a complete range of operating temperature, salinity, hardness, corrosiveness, and abrasives experienced in domestic wastewater treatment. The equipment must further be capable of continuous operation over extended periods with compressed air temperatures up to 180°C. The aeration system shall be designed to accomplish the design oxygen transfer and to provide rapid dispersion of oxygen throughout the liquid mass.

H. The aeration system shall be designed to provide mixing such that when operated under design conditions, it shall suspend all biological floe and mixed liquor suspended solids throughout the liquid mass. The aeration system shall be able to suspend all biological floe and mixed liquor suspended solids with the air flow off.

3.3 HYDRO-PNEUMATIC BACKFLUSH SYSTEM

A One positive hydro-pneumatic flushout system shall be provided for each jet header. The minimum size of the flushout line shall be 12 inches. The system shall be of the air lift type, activated by turning off the motive liquid pump, allowing the manifold to fill with air, and opening the flushout valve. The initial surge of liquid through the liquid nozzle shall be sufficient to dislodge any partially formed plugs. The air lift shall then carry all foreign material out of the aeration header. The aeration system supplier shall provide all necessary piping, valves, and support for the flushout system.

3.4 DISTRIBUTION PIPING

A All in-basin air and liquid distribution piping shall be provided as a part of the aeration system. All piping shall be fabricated of Schedule 10 304 stainless steel. Flanged connections shall be provided for connection to the jet aeration manifold, and the out-of-basin piping (provided by others).

3.5 SUPPORTS

A All necessary supports for the aeration header, air and liquid piping, and the flush out system shall be provided as a part of the aeration system. All supports shall be constructed of 304 stainless steel.

B. Header and pipe supports shall consist of dual leg angle welded to a supporting base. The support base shall be leveled and anchored with anchor bolts and grouted in place as necessary. A cross brace shall be provided and field welded for additional support. The support angle shall be field welded directly to the jet manifold by the installing contractor.

3.6 SUBMERSIBLE MOTIVE LIQUID PUMPS

A The jet motive liquid pumps shall be submersible non-clog pumps capable of being used for jet aeration. An adequate length of Hypalon Jacketed Type SPL cable suitable for

submersible pump applications shall be supplied. Each unit shall be provided with the required length of lifting chain of adequate strength to permit raising and lowering the pumps.

B. IMPELLER The impeller shall be dynamically balanced non-clogging type made of close-grained cast iron conforming to ASTM A48 Class 30. The impeller shall be of one-piece, single suction, enclosed, radial flow design with well-rounded leading vanes and tapered toward the trailing edge for a circular flow pattern. The waterways through the impeller will have extremely smooth contours, devoid of sharp corners, so as to prevent rags or stringy, fibrous material from catching or clogging. The clearance between the impeller outside diameter and cutwater shall be capable of passing a minimum 3-inch sphere. The impeller is to be statically balanced and secured by means of a bolt, washer, and key. The arrangement shall be such that the impeller cannot be loosened from torque in either forward or reverse rotation. Wiper vanes on the back-impeller shroud are not allowed.

C. VOLUTE AND SLIDING BRACKET The volute shall be matched to the impeller and made of close-grained cast iron conforming to ASTM A-48 Class 30. The volute is to be of one-piece circular constant flow, equalizing pressure design with smooth fluid passages large enough to pass any size solid that can pass through the impeller. The volute shall be side flanged tangential discharge. The volute shall be furnished with large clean-out openings located at the impeller centerline, to allow access to the impeller. The sliding bracket assembly shall be a part of the pumping unit constructed so that when lowered onto the straight through discharge base, the knifing of the vertical metal-to-metal seal provides a self-cleaning , non-clogging, UL listed non-sparking assembly. Two guide rails shall be included.

0. GUIDE RAIL /BRACKET Guide rails shall be provided on which the pump rides when being raised or lowered in the basin. Guide rails shall mount on the straight through discharge base. The rails shall align the pump with the straight through discharge base as it is lowered into place. An upper guide rail bracket shall be provided to support and align the rails at the top of the basin.

E. DISCHARGE BASE The discharge base shall be permanently installed in the basin along with the discharge piping. The pumps shall be automatically connected to the discharge connection when lowered into place and shall be easily removed for inspection *or* service. Sealing of the pumping unit to the discharge connection shall be accomplished by a simple linear downward motion of the pump. A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by no less than two guides. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet. The base shall connect to the discharge piping with a 125 lb. ANSI flange.

F. SUBMERSIBLE MOTOR Each submersible solids handling pump shall be driven by a completely sealed, electric submersible squirrel cage induction motor of 15 Hp, 1.15 service factor, 460 volts, 3 phase, 60 Hz power. The motor nameplate horsepower rating shall not be exceeded by the brake horsepower requirements of the specified head and capacity conditions. The submersible motor shall be UL listed for Class 1, Division 1, Group C and D explosion-proof hazardous locations as defined by the air filled cast-iron, water-tight enclosure which is sealed by the use of O-rings and shall have rabbit joints with an extra-large overlap. The stator winding and lead shall be insulated with moisture resistant Class F insulation for continuous duty in 40° C rise liquids. The motor shall be designed for continuous duty capable of a minimum of ten (10) starts per hour. At the design point the motor shall draw not more than 15 Hp at rated voltage. Motor shaft shall be 416 stainless steel; the rotor is to be dynamically balanced to meet **NEMA** vibration limits; all hardware shall be stainless steel. Cable leads shall allow the connection of a cable to the motor in the field without soldering. All leads are to be sealed and designed to prevent cable wicking to conduit box located on top of the motor.

G. SEALS EACH pump shall be provided with a tandem mechanical seal system. The

mechanical seal chamber shall be oil filled and equipped with a moisture detection device wired internally to the control cable. Each seal shall be held in contact by its own spring system, and shall require neither maintenance not adjustment, but shall be easily inspected and replaceable. The lower seal shall include a protective cup to prevent solids or stringy material from lodging in the seal spring.

H. BEARINGS The pump shall rotate on a minimum of two bearings permanently lubricated, but capable of being regreased, suitable for a minimum L10 bearing life of 40,000 hours. Lifting lugs shall be supplied on the motor, sufficient to carry the load of the motor, pump, cable and pull-up attachment. All mating surfaces shall be machined and fitted and sealed with O-rings. Fittings shall be accomplished by metal-to-metal contact between each machine surface, resulting in controlled compression of O-rings without requirement of a specific torque limit. No secondary sealing compound shall be used.

I. QUALITY ASSURANCE PUMPS are to be engineered and manufactured under a written Quality Assurance program. The Quality Assurance program is to be in effect for at least five (5) years, to include a written record of periodic internal and external audits to confirm compliance with such program.

J. Pumps shall be Sulzer ABS xfp 200G-CB!.2 PE110/6 or approved equal.

K. JET MOTIVE LIQUID/FILL PUMP CHARACTERISTICS:

1. Quantity: 4
2. Flow: 1400 GPM at 24ft TOH
3. Motor: 15 BHP Max

3.7 POSITIVE DISPLACEMENT BLOWERS

A. The blowers shall be of rotary positive displacement design with two lobe volute type rotors complete with accessories. All blowers and accessory valves, piping, and gauges shall be mounted on a common base plate and completely assembled for shipment as a single unit ready for operation. Inlet filters may be shipped separately for roof mounting. Blowers shall be manufactured by Sutorbilt, Roots or an approved alternate .

B. The impeller case shall be strongly ribbed to prevent distortion when operating at rated pressure. The unit shall be equipped with four heavy duty anti-friction bearings. The impellers shall be close grain cast iron strongly ribbed internally. The impellers shall be machined on all exterior surfaces. The impellers shall be dynamically balanced. The shafts shall be made of machined steel and securely fastened to the impellers. The unit shall have two timing gears accurately machined to position the impellers in the impeller housing. The gears shall be enclosed in an oil tight housing and shall be lubricated by a splash oiling system from oil maintained in the gear housing. The gear and bearings shall be splash lubricated through grease fittings located in each bearing housing. The grease vents shall be located in the bearing housing to prevent rupture of greased seals from over greasing.

C. The air vents shall be located between the seals and the impeller chamber to the Blower Assembly to the extent shown on the Drawings.

D . DRIVE

1. Each blower shall be furnished with a V-belt, or flexible coupling drive, and belt, or coupling guards of sheet metal and expanded mesh conforming to OSHA and applicable safety codes.

2. The V-belt drive shall be of the high-capacity matched belt, multiple groove type, oil and heat resistant and static dissipating with a 1.5 service factor. The pulleys shall be of the split hub taper lock design dynamically balanced.

3. The coupling shall be flexible all steel, dynamically balanced coupling equal to Falk Steelflex and shall provide for axial movement and shaft misalignment.

E. **INTAKE AIR** FILTERS

1. The manufacturer shall provide an inlet filter for each blower suitable for mounting on the roof with a weather hood. The filters shall be arranged for bottom connection to a 125 lb. ASA pipe flange. The filter elements shall be of the dry, washable, synthetic media type, selected to filter 99% to 10 micron and above particles. The filter shall be complete with a filter restriction indicator. Two extra filters shall be provided.

F. INLET AND DISCHARGE SILENCERS

1. The manufacturer shall provide an inlet and discharge silencer for each blower, designed for maximum silencing. The silencers to be of the chamber absorption type and shall be complete with matching 125 lb. drilled flanges and shall be of an all-welded steel construction, with connections sized and located as shown on Contract Drawings.

G. PRESSURE RELIEF VALVES

1. Each blower shall be provided with spring-loaded, or weight type, pressure relief valve, set at 0.5 psig above the maximum working pressure and capable of discharging total blower output with 10% pressure accumulation.

H. CHECKVALVES

1. Each blower discharge line shall be furnished with a counter weighted swing disc-type, check valve, designed for heavy on-duty type shut-off service. The valves shall be located approximately eight pipe diameters downstream from the blowers.

I. BUTTERFLY VALVES

1. Each blower discharge shall be provided with a 6 inch lever operated butterfly valve, flanged or wafer, per blower manufacturer's recommendations as indicated on the plans.

J. FLEXIBLE CONNECTION

2. Each blower suction and discharge line shall be provided with a 125-lb ASA flanged single arch type, multiple-ply rubber or synthetic elastomer, reinforced flexible connection shall be complete with steel backing rings.

K. PRESSURE AND TEMPERATURE GAUGES

1. Each blower shall be furnished with one inlet and one discharge temperature gauge and one discharge pressure gauge. Gauges shall be 4½ inch dial face type with NPT fittings for pipe insertion.

L. BASE

1. Each blower shall be mounted with its motor on a common base. The motors shall be horizontally mounted on an adjustable slide base for maintaining rated speeds, belt adjustment , and future changes in capacity. Vibration pads shall be installed between blower base and flooring.

M. OPERATING AND DESIGN REQUIREMENTS FOR EACH BLOWER:

1. Quantity: 4
2. Capacity: 432 SCFM
3. Pressure: 30 PSIG
4. Maximum Temperature Rise: 140°F
5. Motor Size: 30 HP
6. Service Factor: 1.15

7. Motors shall have capacitors and be furnished with the blowers as a complete unit and shall meet the following requirements
8. Enclosure: TEFC
9. Volts: 460
10. Phase: 3
11. Hertz: 60

3.8 SBR DECANT EQUIPMENT:

A The decanter shall be a stationary decanter of the solids excluding type which prevents solids from accumulating in the decanter header.

B. The decanter shall be constructed of 304 stainless steel.

C. The decanter shall be capable of decanting supernatant within a 10 minute period. Maximum withdrawal rate shall not exceed 100 gpm/foot of collector length.

D. The decanter shall be air operated so as to exclude mixed liquor solids and liquid from entering the decanter during the aerated and/or mixed segments of the SBR operating cycle. The decanter shall be a model as manufactured by ClearStrean Environmental, Sandy, UT.

E. All mounting brackets and hardware shall be provided by the Supplier. Hardware shall be stainless steel. Mounting brackets shall be ¼ inch stainless steel.

F. A one (1) inch decant vent valve for automatic decant shall be provided. It shall be housed in a Nema 4 enclosure with a thermostatically controlled heater.

3.8 WASTE SLUDGE MECHANISM:

A A waste sludge mechanism shall be supplied including all piping, valving and supports. Each jet motive pump shall be equipped with a sludge bleed line to allow wasting of sludge back to the trash trap. A 2-inch manual ball valve, and a 2-inch electric ball valve shall be included on each line.

4.0 VALVES AND ACTUATORS

A. DECANT FLOW CONTROL VALVE

1. Furnish one 12-inch diameter electrically operated butterfly valve for each basin to control the decant rate. Valve shall be BAW AVVWA C-504 Class 1508 butterfly valve with ANSI Class 1 25 flanged end ASTM A-1 26 Class 6 cast iron body. EPDM seat, cast iron disk with 31 6 stainless steel edge, 304 stainless steel shaft assembled and tested with a 460 volt, 3 phase, 60 cycle open/close service electric actuator. Valve actuator shall include a compartment heater. Each valve shall include manual override with limit switch feedback to the micro-processor in both the open and closed positions. Electrical wiring of the valve shall be in accordance with NEC code requirements.

B ECCENTRIC PLUG VALVES

1. All eccentric, permanently lubricated plug valves shall be of the tight-closing, rubber seat type. Valves shall be suitable for sewage and wastewater applications. Valves shall be bubble-tight at the full rated pressure in either direction. Valves shall be suitable for throttling service and/or operation after long periods of inactivity. Valve manufacturers shall have a minimum of five (5) years' experience.

2. Valve bodies shall be constituted of cast iron ASTM A-126 Class B. Flanges shall fully conform to the drilling and thickness requirements of ANSI B16.1, Class 125. Body wall thickness shall conform to AVVWA C504-80.

3. Plug shall be of the balanced type, cast iron, ASTM A-126, Class B or ASTM A-436

(Ni- Resist) or Ductile Iron ASTM a-536.

4. Port passage size shall be at least 80% of the full port area for valves 20 inches and smaller, and 70% of the full port area for valves 24 inches and larger, for minimum pressure drop. Valve must be capable of passing the same solids requirements as the pump specifications.

5. Seating surfaces shall meet the requirements of AWWA C509-80.

6. Upper and lower bearings shall be stainless steel, permanently lubricated.

7. U-cup or V-type, self-adjusting, wear compensating packing. Packing shall be replaceable without removing the valve bonnet or plug.

8. Valves shall be rated 150 lb. WOG or 400 lb. WOG as required.

9. Interior epoxy coated, 8 mil minimum per AWWA 550-81.

10. All valves shall be leak tested to their full rating prior to shipment. Actuator mechanism must be fully isolated from line media.

11. Valve schedule: per plans

Quantity	Size		Service
Quantity (#)	4"	Manual	Waste sludge
Quantity (#)	6"	Manual	Backflush
Quantity (#)	10"	Manual	Recirculation
Quantity (#)	10"	Electric	Recirculation
Quantity (#)	12"	Manual	Basin isolation

C MOTOR OPERATORS

1. The electric motor operator shall consist of motor, reduction gearing, position limit switches and torque limiting switches mounted in a NEMA IV housing. Actuators shall be rated for 50 PSI working pressure.

2. The motor shall be of the high torque type, designed for continuous duty rating. Motors and wiring shall have Class "B" or better insulation. Overload protection shall be provided by auto-reset thermal trip circuit breakers embedded in the motor windings. All motor leads shall be terminated at an internal terminal strip. The motor will operate on an AC power supply of 120 volts, single phase, 60 cycle for valves 14 inch and smaller and 460 volts, three phase, 60 cycle for valves 16 inch, and larger.

3. Reversing starters for 460 volt, three phase motors will be located in the MCC and provided by the MCC supplier.

4. The integral self-locking power gearing shall be compound epicyclic or combined helical and worm gear type only. Motor breakers are unacceptable. Gearing shall be grease or oil lubricated with high-speed parts running on anti-friction bearings. Motor shall be UL recognized. Motor shall operate from open to full close in 60 seconds. Disassembly of gears shall not be required to remove the motor.

5. The handwheel shall not rotate electrical operation. When the unit is being operated manually, it shall automatically return to electric operation when the handwheel is released. The transfer from electrical operation to manual operation shall be accomplished by a declutching mechanism, which will disengage the motor mechanically . The unit shall be capable of being clutched or declutched while the motor is energized with no damage to the clutch or gear mechanism. Clockwise rotation of the handwheel shall close the valve. If the motor is energized during manual operation, the unit shall remain in manual mode without endangering personnel operating the unit.

6. Failure of the motor or motor gearing shall not hinder operation. Two (2) sets of limit switches set at the open and close positions shall be provided and are to be geared directly to the valve to follow its position at all times, including during manual operation. Additional switches shall be provided, if required.

7. A double-acting torque limiting switch shall be provided, which is responsive to the mechanical torque developed by seating or an obstruction.

5.0 SBR INFLUENT DIFFUSER

A. The contractor shall provide a stainless steel influent diffuser as shown on the plans to disburse the incoming sewage into the sludge blanket at a velocity not to exceed 0.75 fps. The unit shall be 12 inch radius making up 1/2 of a circle. It shall have integrally molded mounting flanges for securing the unit to the walls of the basin.

B. The influent diffuser shall be constructed of 304 stainless steel

5.1 SBR OVERFLOW WEIR/ SKUM SKIMMER:

A A stainless steel overflow weir shall be provided to allow flow from the SBR compartment to overflow back to the anoxic equalization/selector basin during the interact cycle. The weir shall also provide scum skimming of the SBR portion of the tank. The weir shall also provide flow diffusion during periods of high flow.

6.0 SBR CONTROLS

A. The control panel shall be metal enclosed indoor-type and meet the requirements of NEMA Enclosure Type 12. The panel shall be designed, manufactured, and tested in accordance with the latest applicable standards.

B. The cycle drives and sequences for the SBNR shall be controlled by an industrial grade programmable controller. The PLC shall be an Allen-Bradley SLC 5/05 with Ethernet port to allow information to be monitored remotely through a SCADA system (provided by others). PLC's shall be housed in the control panel supplied by the SBNR manufacturer to provide unit responsibility. The control panel shall be shipped completely factory wired, assembled and factory tested simulating all inputs and outputs.

C. Switches and lights shall be supplied to operate all valves, mode selection, and cycle indication in both manual mode or automatic mode. All lights and switches shall be industrial grade, oil tight Square D or equal. Included shall be an alarm horn, with test and acknowledge button to sound on high tank level or should a blower or pump fail to start or run after 15 seconds.

D. The PC shall contain a central processing unit, a CMOS RAM memory power supply, inputs and outputs. The unit shall have five diagnostic indicators; PC Run, Communication, CPU Fault, Forced 1/0 and Battery Low. The unit shall have a 16K word user memory contained within CMOS RAM with capacitor and battery back-up capable of 2 to 3-year memory back-up. The unit shall be equipped with removable EEPROM non-volatile memory back-up.

E. Expansion units to provide additional input and output capacity shall be provided as required.

F. The PLC unit shall be provided with an Allen-Bradley PanelView 1000 Plus mounted on the front of the control panel. The Panelview shall allow the operator to monitor and/or modify the timer-counter and ORP set points for all adjustable SBNR functions. The unit shall have a colored display. The keyboard shall be a 9-place pressure sensitive keyboard to access and enter data and addresses.

G. Panelview screens shall show provide the following for each flow train:

1. Effluent Valve Status (open, closed, transition, FTO, FTC)
2. Vent Valve Status (open, closed, transition, FTO and FTC)
3. Waste Valve Status (open, closed, transition, FTO, FTC)
4. SBR Feed Pump Status (stop, manual run, auto run, fault)
5. Blower Status (stop, manual run, auto run, fault)
6. System Mode Status (Independent or Alternating)
7. Cycle Status (out of service, fill, interact, settle, decant)
8. Sub-cycle Status (Aerobic, Static, Anoxic)
9. Aeration Mode Status (ORP or Time)
10. Current ORP level
11. Anoxic Equalization Reactor (EAL): LWL (bottom water level), SWL (cycle water level), HWL (high water level), SBR mode: BWL {bottom water level) and TWL (top water level)

H. Additional Panelview screens shall include:

1. Motor run times for all pumps and blowers both during cycle and accumulative
2. Alarm indication for all pumps, valves , blowers, ORP and level
3. Blower status
4. SBNR adjustable set points
5. SBNR Mode - ORP or timed aeration/mixing
6. Alarm History

I. The information from the Panelview screens can be sent through the Ethernet connection to a SCADA system (provided by others) for remote monitoring data logging and trending .

J. The control system shall provide automatic sequence of SBNR including ORP mode.

K. The control panel shall be equipped with UPS and a modem to allow monitoring from a remote location. The modem requires a dedicated phone line be brought to the panel by the installing contractor .

L. Motor Control Center with motor starters and VFDs, Remote SCADA system, any disconnects , junction boxes, conduit and any wiring between motorized equipment and control panel or motor starters NFDs is by the installing contractor.

6.1 SUBMERSIBLE PRESSURE TRANSDUCERS (OPTIONAL)

A Submersible pressure transducers shall be designed for direct submergence in wastewater. Units shall be constructed of stainless steel and shall be maintenance free. Transducers shall utilize a diffused silicone semiconductor sensor protected by an integral stainless steel diaphragm with seal fluid. Split body design and integral terminal block shall permit transducer rewiring. A threaded connection and "O" ring seal shall provide positive moisture protection and ease of assembly and disassembly.

B. Transducers shall have an operating range of O to 35 ft. of water, with a temperature range of -40° C to 80° C, with a compensated range of 0° C to 50° C. The maximum output deviation shall be± 0.2% over the compensation range. Accuracy of measurement shall be ± 0.5% including linearity, hysteresis, and repeatability.

C. Transducer output signal shall be 4 to 20 mA. Output sensitivity shall be 50 mVN. Impedance shall be Oto 50 mV output, with 10 VDC input. Electrical connection shall be to an attached four wire, 20-gauge polyethylene shielded cable.

D. Transducer shall be suspended within a four-inch diameter stilling well attached to the reactor wall. The stilling well shall contain equalization ports spaced as recommended by the manufacturer. The stilling well shall be continuous from a point six inches above the reactor floor to a point six inches below the top of the reactor wall.

6.2 SBR LEVEL CONTROL FLOATS:

A. Tank level controls shall be of a non-invasive type suitable for the intended purpose in a hostile environment. Each detector shall be independently adjustable and provide a distant signal at the selected level. Level sensors shall have a load capability of 5 A each 117 VA. The level sensors shall be of the weighted suspended float type suitable for use in sewage.

B. Five (5) floats shall be furnished for each SBR Tank with initial settings as follows:

1. High-Water Level - Emergency Shutdown

2. Top Water Level- Close influent valve, open opposite tank influent valve

3. Settle Water Level - Initiates settle, independent mode

4. Cycle Water Level - Starts settle in opposite tank and initiates storm flow- Batch mode

5. Bottom Water Level - Stops Decant

6.3 0 .0 . CONTROLLED AERATION (OPTIONAL)

A. Each reactor basin shall be equipped with an analyzer to monitor DO levels to provide operator selectable aeration based on D.O. demand. The microprocessor based analyzers shall be housed in Nema 4X weatherproof corrosion resistant flame retardant enclosures suitable for wall or pipe mounting. The unit shall continuously monitor dissolved oxygen over the entire range of 0 to 20 PPM. The front panel shall have a membrane keyboard with tactile feedback and user selectable security. Also, there shall be a LCD digital display, black on gray. There shall be dual programmable alarms for high and low contacts. Both alarms shall feature independent set points, adjustable hysteresis and time delay action.

B. Each analyzer shall be supplied with a dissolved oxygen sensor. The sensor shall be constructed of highly durable molded Kynar and PVC. The amperometric sensor shall consist of a gold cathode, silver anode, buffered potassium chloride electrolyte and a 2 mil Teflon membrane. The unit shall be supplied with 25 feet of sensor cable and a handrail assembly unit.

6.4 ORP CONTROLLED AERATION (OPTIONAL)

A In addition to the standard static, anoxic, aerobic timed sub-cycles, there shall be an oxygen demand driven system. The programmable logic controller shall receive inputs from the ORP analyzers to start the anoxic and then aerobic cycle and to stop the aerobic cycle and start the static cycle.

B. Each SBR tank shall be equipped with an ORP analyzer to monitor ORP levels to provide operator selectable aeration based on ORP.

C. The microprocessor-based analyzers shall be housed in Nema 4X weatherproof corrosion resistant flame retardant enclosures suitable for wall or pipe mounting. The unit shall

continuously monitor oxygen reduction potential over the entire range of -1500mV - +1500mV. The microprocessor-based analyzer shall accept any GLI Differential Technique pH or ORP sensor, or any conventional combination electrode. The analyzer shall accept NTC 300-ohm thermistor, Pt 1000 RTD , and Pt 100 RTD temperature compensators.

D. The analyzer shall be menu selectable to measure pH or ORP, and operate in multiple languages.

E. The analyzer shall have a graphical dot matrix LCD display with at least 128 x 64 pixels and LED backlighting. The main display character height shall be 1/2 inch (13 mm). Auxiliary information character height shall be 1/8 inch (3 mm). Menu screens shall contain up to six text lines.

F. The analyzer shall have these calibration methods:

1. 2-point Buffer Method (pH only): Automatic calibration and buffer recognition using two buffers from a selected buffer set

2. 1-point Buffer Method (pH only): Automatic calibration and buffer recognition using one buffer from a selected buffer set

3. 2-point Sample Method (pH only): Enter known values of two samples (determined by laboratory analysis or comparison reading) or two pH buffers.

4. 1-point Sample Method (pH and ORP): Enter known value of one sample (determined by laboratory analysis or comparison reading), one pH buffer or, for ORP measurement, one reference solution.

G. The analyzer shall have a passcode to restrict access to configuration settings and calibration to authorized personnel only.

H. The analyzer shall have user-test diagnostics for outputs, relays, and alarm annunciators without requiring special test equipment.

I. The analyzer shall be configurable using its RS-232 port and optional GLI software tool kit, or through HART protocol.

J. The analyzer shall have two isolated 0/4-20 mA analog outputs. Each output can be assigned to represent the measured pH or ORP or temperature . Parameter values can be entered to define the endpoints at which the minimum and maximum mA output values are desired. During calibration, both outputs can be selected to hold their present values, transfer to preset values to operate control elements by an amount corresponding to those values, or remain active to respond to the measured value.

K. The analyzer shall be GLI International, Inc. Model P53.

7.0 FIELD SERVICE AND TRAINING

A The Contractor shall provide the services of a factory trained Engineer who has at least three years factory experience in jet aeration equipment. The factory engineer shall be qualified to supervise installation, test for proper installation, conduct start-up, and train operator in the operation of the equipment and the process. A minimum of 40 hours on the job site in a minimum of 2 trips shall be provided.

AQUA-AEROBIC SYSTEMS, INC.
SPECIFICATION FOR AQUADISK® TERTIARY PACKAGE FILTER
PILE CLOTH
For
Owens Cross Roads WWTP, AL
May 01, 2023 / Design #171313

AQUADISK TERTIARY FILTER

There shall be one (1) Model ADFSP-54X4E AquaDisk® filter(s) as manufactured by Aqua-Aerobic Systems, Inc., of Loves Park, Illinois. Filter shall be factory tested and ready for operation. Contractor shall furnish all labor, materials, equipment and incidentals required for installation of the AquaDisk as shown on the drawings and as specified herein.

Each unit will include:
Tank Assembly
Drive Assembly
Centertube Assembly with Cloth Media Disks
Backwash System
Backwash/Waste Pump Assembly(ies)
Valves
Pressure Transmitter
Float Switch
Vacuum Transmitter
Electrical Controls with Internal Components

Each filter unit will be shipped fully assembled and wired from the factory, unless noted otherwise herein. All motors, pumps, and bearings shall be designed for continuous duty and long operating life in a high humidity atmosphere. All motors and pumps shall be 460 volt, 60 hertz, 3 phase.

SPECIFICATION PRECEDENCE

The specifications for equipment and controls under this section supersede specifications for equipment and controls specified elsewhere in the contract documents and drawings. Purchased components such as gear reducers, pumps, motors, valves, and actuators shall be provided with standard recommended manufacturers paint, unless otherwise specified within this section.

SERVICE

The equipment manufacturer shall furnish the services of a factory trained representative for a maximum of 2 trips and 6 eight hour days at the jobsite to inspect the installing contractor's equipment installation, supervise the initial operation of the equipment, instruct the plant operating personnel in proper operation and maintenance, and provide process assistance.

If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.

The selected manufacturer shall have a free troubleshooting help line available 24 hours a day, 365 days per year for the life of the plant.

WARRANTY

The Manufacturer shall provide a written warranty against defects in materials and workmanship. Manufacturer shall warrant the goods provided by the Manufacturer to be free from defects in materials and workmanship under normal conditions and use for a period of one (1) year from the date the goods are put into service, or eighteen (18) months from shipment of equipment, whichever first shall

occur. This warranty shall not apply to any goods or parts which have been altered, applied, operated or installed contrary to the Manufacturer's instructions or subject to misuse, chemical attack/degradation, negligence or accident.

MANUFACTURING QUALIFICATIONS

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.

SUBMITTAL REQUIREMENTS

Drawings
Cut sheets
Media area calculations
Hydraulic loading rate calculations
Solids loading rate calculations
Hydraulic profile through the filter showing the following:

- Influent weir length
- Influent weir elevation
- Influent weir nappe at design and peak flow
- Effluent weir length
- Effluent weir elevation
- Effluent weir nappe at design and peak flow

Elongation and breaking strength test report from ISO certified textile laboratory
Title 22 Conditional Approval letter

PERFORMANCE AND DESIGN PARAMETERS

The AquaDisk filter shall be capable of filtering effluent from a Secondary process. Design shall be for:

0.9 MGD Average Daily Flow
1.545 MGD Maximum Daily Flow

Filter influent total suspended solids (TSS) concentration shall be 15 mg/l daily average and 25 mg/l maximum at average daily flow rate.

Filter effluent total suspended solids concentration shall not be greater than 30 mg/l based on a monthly average.

With the growing concern of microplastic pollution, 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.

FILTER DISK TANK

Each tank assembly shall be painted steel. Entire tank construction shall have a minimum thickness of 10 gauge. Each tank shall have a rounded bottom to ensure deposition of solids does not occur in the corners of the tank. Due to concerns with solids deposit, tanks without rounded bottoms shall not be accepted. Each tank shall be provided with an integral solids waste collection manifold. Waste manifolds that are not integral to the tank shall not be accepted. Each tank drain shall be provided with a manually operated brass ball valve. Valve shall be provided loose for installation by the installing contractor. Tank interior shall be blasted per SSPC-10 and coated with one epoxy basecoat and one epoxy topcoat for a total DFT of 8-12 mils. Tank exterior shall be blasted per SSPC-6 and coated with two epoxy basecoats

and one polyurethane topcoat for a total DFT of 8-12 mils. Coating shall be the color “safety blue”, manufactured by Sherwin Williams or Tnemec.

DRIVE ASSEMBLY

Each filter shall include an adjustable drive assembly with a gearbox, nylon drive sprocket, acetal drive chain with 304 stainless steel link pins, and a 304 stainless steel chain guard. The gearbox shall be parallel in-line helical type, with a 1/2 HP drive motor rated for 460 volt, 3 phase, 60 Hz. Gear reducer shall be Nord or approved equal. Drive motor shall be Nord, Weg, Baldor, or approved equal.

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. Belt drive systems or systems with multiple drive units per filter will not be acceptable.

If motors and gearboxes require routine maintenance, and are not accessible from the outside tank side walls, the equipment manufacturer shall provide an internal access platform between the tank side walls and motors and gearboxes.

CENTERTUBE ASSEMBLY

Each centertube assembly shall include a minimum 3/16”, 304 stainless steel centertube weldment, driven sprocket, wheel assemblies, 304 stainless steel disk segment rods, and frame and cloth assemblies. 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. Systems with swivel joints requiring routine lubrication are not acceptable. The driven sprocket shall be multi segment made of UHMW polyethylene. All fasteners shall be stainless steel.

CLOTH FRAME

Each cloth disk assembly shall be comprised of six (6) individual segments, each consisting of a cloth media sock supported by an injection molded glass filled polypropylene frame with corrosion resistant assembly hardware. The cloth / frame assembly must be installed in direct contact with the centertube without adaptors. 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. Disks shall be spaced a minimum of 8 inches from center to center and have a minimum 5 inches of open space between adjacent disks.

FILTER MEDIA

Each cloth disk assembly shall have a minimum of 53.8 square feet of effective submerged filtration area. Each disk shall be divided into no more than six (6) 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.

Each basin shall include four cloth disk assemblies.

Each filter unit shall have a total of**:** 215.2 square feet of minimum effective submerged filtration area.

Cloths shall be of fiber pile construction having a nominal filtration rating of 10 microns. Granular media and screens having structured identical openings shall not be allowed.

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.

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.

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.

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.

To avoid excessive media movement, deformation and folding during backwash, the maximum distance between cloth restraints must not exceed 36 inches.

FILTER HYDRAULICS

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 will not be acceptable.

Only media area below the effluent weir elevation will be considered in the filtration area calculation since this is the only area that is submerged and available for filtration 100% of the time.

Submittal information shall include 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

The operator shall be able to bring a drained filter on line by simply opening the influent isolation device. If the filter design is such that it must be filled with water before the influent isolation device is opened to prevent damage to the filter media, an automated process that sequentially brings the filter back on line with a single switch shall be provided to prevent accidental media damage. The automated process shall activate a minimum 6" diameter motorized valve to fill the filter with effluent or other clean water source in not more than five minutes, verify that the filter is full, and open the motorized influent isolation device.

Because of the frequency of the backwash and misting associated with spray systems, designs that utilize high pressure spray or a moving vacuum head as the sole means of solids removal will not be acceptable.

BACKWASH SYSTEM

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. 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. 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. 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.

The backwash system shall include 304 stainless steel backwash shoe supports with UHMW backwash shoes, 316 stainless steel springs reinforced PVC flexible hose with stainless steel hose clamps, 304 stainless steel backwash manifolds.

BACKWASH/WASTE PUMP ASSEMBLY

Each backwash/waste pump assembly shall include one backwash/waste pump(s), valves and gauges external to the basin. System utilizing internal backwash pumps shall not be permitted. In the external piping shall be backwash and solids waste valves, recirculation ball valve(s), 3" manually operated flow control gate valve for each pump, vacuum gauge(s), and pressure gauge(s).

The backwash/waste pump(s) shall be shipped loose for field installation by the installing contractor. Backwash piping between the filter tank and pump(s) as well as piping following the pump(s) shall be supplied by the installing contractor. Installing contractor shall supply unions or flanges for service, wiring, and factory installed conduit shall be provided within 3 feet of the pump(s).

The backwash/waste pump(s) shall be a Gorman Rupp model 12B20-B, externally mounted centrifugal pump. Pump shall be provided with a 2 HP, 460 volt, 3 phase, 60 Hz motor and operate at 1750 RPM. Pump shall be rated for 130 gpm at 23.2 ft TDH with 12.2 ft allowable discharge head after losses in internal filter piping have been accounted for. Motor shall be Baldor, Teco, Weg or approved equal. Backwashing shall be initiated by tank water level, timer, or manually through the operator interface. 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. Backwash pumps using a belt drive shall not be acceptable due to routine tensioning and other maintenance requirements.

Pump manually operated 3" threaded gate valve shall be class 125 bronze with screw in bonnet, non-rising stem, and solid wedge. Valve shall conform to MSS SP-80 and shall be Nibco or approved equal.

The 2 inch 3-way ball valve shall be threaded with bronze body, chrome plated ball, RPTFE seats and stuffing box, and rated for 400 psig. Valve shall be Apollo or approved equal.

The vacuum gauge(s) shall have a minimum 2.5" dial with all stainless steel welded construction, 0-30" Hg vacuum range, liquid filled, ¼" NPT process connection, 316 stainless steel bourdon tube and tip material, and bronze socket material, Ashcroft or approved equal.

The pressure gauge(s) shall have a 2.5" dial with a black painted steel case, 0-15 psi, heat resistant polycarbonate window, ¼" NPT process connection, "C" shaped bronze bourdon tube, and brass socket material, Ashcroft or approved equal.

Filtering shall not be interrupted during normal backwashing and solids waste discharge.

VALVES

Each filter shall include two 2" backwash valve(s). Valve(s) shall be 3 piece, grooved end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, installed with painted cast iron Victaulic couplings, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall

include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.

Because of fouling that can be caused by stringy material, non full port valves such as butterfly valves or plastic valves shall not be acceptable.

Each filter shall include one 2" solids waste valve. Valve shall be 3 piece, grooved end, ASTM A351 Grade CF8M stainless steel body, 316 stainless steel ball and stem, fullport, "installed with" painted cast iron Victaulic couplings, with a 115 volt, single phase, 60 Hz, open / close service electric actuator. Valve / actuator combination shall be TCI / RCI (RCI, a division of Rotork), Nibco, or equal. Valve actuator shall include a compartment heater and limit switch feedback to the microprocessor in both the open and closed positions.

Each filter shall include a solids waste removal system in the floor of the filter tank. The manifold shall be designed to siphon settled solids waste for discharge through the backwash/waste pump. 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.

INDIVIDUAL FILTER ISOLATION

Each filter shall include isolation upstream provided by the installing contractor.

PRESSURE TRANSMITTER

The pressure transmitter shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of 0 psi to 5 psi. Unit shall monitor the water level of each filter tank. Transmitter shall be flush mounted to the tank wall. Transmitter shall be an IFM Effector PX series or approved equal.

FLOAT SWITCH

A float switch shall be furnished to indicate emerging overflow level. The float switch shall be Anchor Scientific Model GSI 40NONC-STO or approved equal. The float shall contain a non-mercury switch, chemical resistant polypropylene casing and a PVC #18 AWG three conductor cable. Switch rating shall be minimum 4.5 amps non-inductive at 120 VAC.

VACUUM TRANSMITTER

The vacuum transmitter shall have stainless steel wetted parts and provide a 4-20 mA signal over a range of -30 to 0 inHg. Transmitter shall be an IFM Effector PX series or approved equal.

CONTROL SYSTEM

The automatic and manual controls for operation of the Aqua Disk® Filter system shall be furnished fully assembled, wired and pre-programmed in a UL 508A Certified Industrial Control Panel. Controls shall be provided to control or monitor equipment as described in the contract drawings. The control program shall be written in-house by the filter manufacturer. The control system shall include the following control components and practices:

CONTROL PANEL WIRING AND ASSEMBLY

All control enclosures shall be custom assembled and wired in an Underwriters Laboratories (UL) certified cabinet shop using quality materials and labor. Short circuit rating of control enclosure shall be 5 kA RMS symmetrical @ 480VAC maximum.

All control panel single conductor wire shall be 16 AWG multi-strand machine tool wire (MTW) minimum, with PVC insulation.

Wire colors are as follows:

208 VAC or higher	-	Black
120 VAC control power	-	Red
Neutral	-	White
Ground	-	Green with Yellow Stripe
Power from remote source	-	Orange
Neutral from remote source	-	White with Orange Stripe
24 VDC (+)	-	Blue
24 VDC (-)	-	White with Blue Stripe
Intrinsically Safe	-	Light Blue

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 approved equal.

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.

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.

CONTROL PANEL QUALITY ASSURANCE

All Control panels shall be UL certified. Testing by manufacturer's electrical engineering prior to releasing for shipment shall be completed. Testing shall consist of the following:

Point to point testing of all wiring prior to application of power
Intended supply voltage shall be applied to the enclosure
All components shall be tested for proper operation and calibration
The PLC and operator interface program shall be loaded and functionally checked
All components shall be checked to confirm proper mounting specifications have been followed
Enclosure shall be inspected for defects and repaired if necessary
All labeling of wires and devices are correct, properly installed and clean

The manufacturer shall finalize the factory checkout by completing a control panel checklist to document all testing completed above.

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.

PVC NON-METALLIC CONDUIT

All wiring of pre-assembled and mounted external electrical components to control panels or junction boxes shall be protected with rigid PVC nonmetallic schedule 40 conduit and fittings. Conduit shall be sized for adequate spare capacity. All conduit unions and fittings shall be solvent cemented in accordance with instructions from the manufacturer. All conduits shall be supported at maximum 3 foot intervals.

Conduit shall be impact, corrosion and sunlight resistant and be rated for a maximum ambient temperature of 122°F (50°C). It shall be rated for use with 194°F (90°C) conductors and shall be UL Listed for exposed or outdoor usage. Conduit shall be manufactured by Carlon or approved equal.

CONTROL ENCLOSURE

The automatic controls shall be provided in a UL listed, NEMA Type 4X 304 stainless steel (14 gauge) wall mounted enclosure that provides insulation and protection for electrical controls and components from highly corrosive environments indoors and outdoors. Enclosure shall include a seamless foam-in-place gasket to assure watertight and dust-tight seal. An internal 3-point latch and 316SS padlocking POWERGLIDE® handle shall be provided. Enclosures shall be unpainted, with a smooth #4 brushed finish. Enclosure shall include a painted white mild steel (12 gauge) sub-panel mounted with collar studs. Enclosure shall be manufactured by Hoffman or approved equal.

ENCLOSURE SUN SHIELD

A 304 10 gauge stainless steel sun shield shall be included. A sunshield shall over hang the front of the panel a minimum of 10".

The control panel will be factory installed, wired, tested then removed for shipping. The installing contractor shall mount the control panel and re-connect the wiring.

CORROSION INHIBITOR

Each control enclosure assembly shall be provided with corrosion inhibitors to protect interior electrical components from damage caused by high humidity. The corrosion inhibitors shall be installed prior to shipment to provide protection during shipment and storage of the enclosure.
The corrosion inhibitor shall be Hoffman AHCI5E or approved equal.

AIR CONDITIONER

A thermostat controlled air conditioner with noise suppression shall be supplied to protect control components mounted inside the enclosure from high temperatures, humidity and ambient air contaminants. The air conditioner shall be constructed of brushed finish stainless steel 304 material and provide NEMA 4X Type protection from outdoor and hose-down applications. The air conditioner unit shall use CFC-free or environmentally safe refrigerant that is universally accepted. The air conditioner shall be manufactured by Hoffman or approved equal.

MAIN DISCONNECT CIRCUIT BREAKER

A UL listed, automatic molded case 3-pole disconnect breaker shall be provided in the control enclosure(s). 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. The disconnect breaker shall have a door mounted operating mechanism with trip indication. Power distribution connectors shall be mounted integrally to the circuit breaker for multiple load connections. Integral connectors shall be provided. The disconnect circuit breaker shall be a Square D/HDL, JDL, LDL, MDL, PDL or approved equal.

MOTOR STARTER

A full voltage non-reversing Integrated Motor Starter-Controller shall be provided for motor applications up to 15 kW. Each starter shall provide control, protection and monitoring functions for the motor. The starter shall be IEC rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a 42kA @ 480 VAC rated breaking capacity on short circuit. The starter shall have a mechanical durability of 15 million operations. The starter shall provide short circuit trip, thermal overload trip with selectable tripping class, under current trip and phase imbalance trip.

A full voltage non-reversing IEC Style motor starter shall be provided for motor applications over 15 kW. Each starter shall consist of a circuit breaker, contactor and overload relay. The starter shall be IEC rated and shall have certifications according to UL and CSA standards and shall bear the CE marking. The starter shall have a maximum rated operational voltage of 690V and provide a minimum 18 kA @ 480VAC and 25 kA @ 240 VAC interrupt rating on short circuit when used in combination with a PowerPact circuit breaker. The starter shall have a mechanical durability of 15 million operations. The solid state overload relay shall have class 10 tripping characteristics with trip current adjustment, phase loss and unbalance protection.

TRANSFORMER

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. The transformer power wire connections (incoming and outgoing) shall be protected with a finger-safe cover to protect against accidental contact. Primary and secondary fuse protection shall be provided. Transformer shall be UL listed and of continuous wound construction with vacuum impregnated with non-hygroscopic thermosetting varnish. Transformer shall be Square D 9070T or approved equal.

TRANSFORMER PRIMARY AND SECONDARY FUSE

Properly rated fuses and fuse blocks shall be provided for primary and secondary protection of the transformer. Each fuse shall be equipped with a thermoplastic cover to protect against accidental contact. 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. Fuse blocks and fuses shall be UL listed. Fuses shall be Littelfuse Class CC or approved equal. Fuse blocks and fuse covers shall be manufactured by Marathon or approved equal.

CIRCUIT BREAKER

All single phase branch or supplementary circuits shall be protected with a single-pole, C-Curve rated circuit breaker. Circuit breakers shall be rated for 240 VAC maximum, 50/60 Hz and UL 489 listed. Supplementary and branch protection circuit breakers shall be Merlin Gerin Multi 9 or approved equal.

FUSE

Properly rated fuses and fuse holders shall be provided for protection of individual control devices (discrete and analog signals) mounted outside of the enclosure. Each fuse shall be housed in a hinged type fuse block to protect against contact with the fuse. Fuses shall be rated up to 250 VAC and be Littelfuse or approved equal. Fuse holders for discrete devices shall be rated to 600 VAC and 30 Amps. Fuse holders for analog devices shall be rated to 300 VAC and 15 Amps. Fuse holders shall be Allen Bradley 1492 or approved equal.

OPERATOR DEVICE

Operator devices (pushbuttons and selector switches) shall be mounted through the control enclosure door for manual operation of the filter. Transformer type pilot lights and illuminated pushbuttons shall be provided for indication of an operation status. Lights shall be a 6 VAC incandescent type lamp. Color coding shall be applied as required and is as follows:

Amber – Alarm active, caution
Green – Valve open, motor running
Red – Valve closed
White - Information

All operator 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. Operator

device function shall be identified with an engraved white Gravoply nameplate with black letters. Operator devices shall be Square D 9001 or approved equal.

HIGH FREQUENCY NOISE FILTER

A UL listed active tracking filter shall be provided to protect the PLC and HMI power feeds from high-frequency noise and low-energy transients. It shall be designed for a single phase input voltage of 120VAC operating at 50/60 Hz. The unit shall provide surge capacity of 25,000 amps and provide transient protection in all modes (Line to neutral, line to ground and neutral to ground). The noise filter shall be a SolaHD STFV or approved equal.

GROUND FAULT DUPLEX RECEPTACLE

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. The receptacle shall be protected with a 5 Amp circuit breaker. The receptacle shall carry a 20A / 120VAC rating. The electro-mechanical circuit interrupter shall be double-pole and trip free (GFCI protection and shall not be overridden by holding reset button). Built-in transient suppression shall protect GFCI's internal circuitry from voltage transients. Receptacle shall be Hubbell DRUBGFI20 or approved equal.

24 VOLT DC POWER SUPPLY

A UL listed, industrial grade, compact power supply shall be supplied to provide 24 VDC power to such rated components. The power supply shall be DIN rail mounted and functional with input voltage of 100 to 240 VAC (single-phase) incoming control power. The power supply shall have a green LED which shall be illuminated when output voltage is "OK". The power supply shall be an Allen Bradley 1606 or approved equal.

CONTROL RELAY

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. The relay socket shall be panel or DIN rail mounted inside the enclosure. The relays shall provide the following ratings: 120VAC coil, 10A contact rating (thermal), 250 VAC insulation rating and 5 million mechanical life cycles. Relays shall be Allen Bradley 700-HK, Square D, or approved equal.

TERMINAL BLOCK

Standard feed-through screw terminal blocks, DIN rail mounted, shall be supplied for all point to point wiring connections. All terminals shall be numbered per the wiring schematic with printed markers. Terminals shall carry a 600V AC/DC voltage rating. Terminal blocks shall be Allen-Bradley 1492-J4 (35A max) and 1492-J16 (85A max) or approved equal.

PROGRAMMABLE LOGIC CONTROLLER

Automatic operation of the Filter shall be controlled through a programmable logic controller (PLC) mounted inside the main control panel. The PLC components shall consist of a power supply, CPU, discrete input and output modules and analog input and output modules. The processor unit shall include built-in USB and two (2) Ethernet IP communication ports. All input and output points supplied (including unused) shall be wired to terminal blocks. Processor design characteristics shall include: 1.0MB user memory size, real-time clock and calendar, battery backed RAM and an operating temperature range between 32 °F and 140°F. The PLC processor shall be an Allen-Bradley CompactLogix 1769-L30ER or approved equal.

Modular equipment shall be provided to complete the PLC system. These Allen-Bradley components include: 1769-PA4 – Power Supply, 1769-IA16 – Discrete input (16 point) modules, 1769-OW16 – Discrete output (16 point) modules and 1769-IF8 – Analog input (8 point) modules, 1769-OF4CI – Analog output (4 point) modules.

PLC POWER SUPPLY
Input voltage range of 85-265 / 170-265 VAC, 47-63 Hz, maximum inrush current of 30 amps, backplane output current of 4 amps @ 5V or 2 amps @ 24V, internal fuse protection, ambient operating temperature of 32°F to 140°F, Class I, Division 2 hazardous location certified, UL Listed.

DISCRETE INPUT MODULE
Operating voltage of 79 to 132 VAC at 47 to 63 Hz, backplane current draw at 5VDC = 115mA , off-state current 2.5mA maximum, maximum inrush current 250mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

DISCRETE OUTPUT MODULE
Operating voltage of 5 to 265 VAC at 47 to 63 Hz / 5 to 125 VDC, backplane current draw at 5 VDC = 205mA , at 24VDC = 180mA, off-state current leakage is 1.0mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

ANALOG INPUT MODULE
Backplane current draw at 5 VDC = 120mA, at 24VDC = 70mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

ANALOG OUTPUT MODULE
Backplane current draw at 5 VDC = 120mA, at 24VDC = 170mA, LED status indication of each point, ambient operating temperature of 32°F to 140°F, UL Listed.

ETHERNET SWITCH
An unmanaged Ethernet switch shall be provided inside the control enclosure to provide connectivity between the PLC, operator interface and plant networking. The switch shall support both 10 and 100 Mbit/s operation. The switch shall have five (5) 10/100Base-T ports with RJ-45 sockets and shall support auto-crossing, auto-negotiation and auto-polarity. Maximum distance between devices shall be 100m.

The unit shall be DIN rail mounted and require 24VDC power. Diagnostic LEDs for power and connection status shall be included. The Ethernet switch shall be UL listed and manufactured by Allen-Bradley Stratix 2000 1783-US5T, or approved equal.

HUMAN MACHINE INTERFACE OVERVIEW
The control system shall be equipped with a UL listed operator interface that provides control display screens. These screens shall be used by the operator to monitor and control filter status, setpoint and alarm information.

The Interface shall allow the Operator access to adjust the following operating parameters:

- Backwash interval, Backwash duration, Solids Waste interval, Solids Waste duration, Number of Backwashes between Solids Waste interval.

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:

- 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.

The operator interface shall allow the Operator to:

- Initiate Backwash
- Control all electric actuated valves

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.

The interface shall also display current alarms, including the date, time and a description of the alarm.

As a diagnostic aid to the Operator, the interface shall display the time between Backwashes for the most recent 40 Backwashes.

HUMAN MACHINE INTERFACE

The operator interface shall be a NEMA Type 12, 13, 4X rated, 6.5" diagonal, color touchscreen display with Ethernet and serial communications. The interface shall be a liquid crystal display (LCD). The display type shall be color active matrix thin-film transistor (TFT) with 640 x 480 pixel resolution. The rated operating temperature shall be 32° to 131° F (0° to 55° C). The operator interface shall be an Allen Bradley PanelView Plus 7 Performance 7".

HUMAN MACHINE INTERFACE SUN SHIELD

A sun shield constructed of 304 stainless steel shall be mounted over the operator interface to provide protection and visibility of operator screens in outdoor applications.

JUNCTION BOX

UL listed, type 4X NEMA rated 304 stainless steel wall mounted junction box shall be provided pre-mounted and wired to the tank when the main control enclosure is remotely mounted from the disk filter. The junction box will contain terminal blocks for terminating electrical controls and components. Field wiring from the junction box to the main control enclosure will be the responsibility of the electrical contractor at site. The j-box shall provide for seams which are continuously welded and ground smooth. Stainless steel door clamp assemblies and a seamless foam-in-place gasket shall assure a watertight and dust-tight seal. A hasp and staple shall be provided for padlocking. J-box shall be unpainted with a smooth brushed finish and include a white polyester powder coated sub-panel.