

December 6, 2017

To Whom It May Concern:

ADDENDUM #1
Water Treatment Plant Process Improvements Project
18-0014PW

I. INSTRUCTIONS

- A. The following additions, deletions, revisions, and/or amendments to the original drawings and specifications are hereby made a part thereof, and a part of the contract documents. All provisions of said documents shall remain in force and effect, except as herein amended.
- B. This supplement to the specifications is issued prior to the receipt of bids. All work covered in this supplement shall be included in the original quotation; and the supplement will be considered part of the Contract Documents. Bidder must acknowledge receipt of this Addendum on the Bid Form. Please consider the following and incorporate it into your bid:

II. PRE BID MEETING MINUTES

Location: John W. Pitts Center, 10 Electric Avenue, Dover, DE 19904
Speakers: Peter Gregg - City of Dover Procurement & Inventory
Barry Wolfgang- City of Dover Procurement & Inventory
Kate Mills, E.I.T., Civil Engineer - City of Dover Department of Public Works
Doug Lodge, P.E., Delaware Dept. of Health and Social Services
Date: November 20, 2017
Time: 9:00 A.M. – 10:00 A.M.
Regarding: Pre – Bid Meeting for the Water Treatment Plant Process Improvements Project Bid No.: 18-0014PW

Ms. Kate Mills, E.I.T., City of Dover:

- Ms. Mills began the meeting by stating the name of the project as the Water Treatment Plant Process Improvements Project Bid No.: 18-0014PW.
- She then introduced all speakers at the meeting.

Mr. Barry Wolfgang, City of Dover Procurement:

- Mr. Wolfgang stated that the project is listed as a sealed bid.
- In order for the bid to be acceptable, three (3) paper copies must be submitted in a sealed envelope on the outside of which shall be plainly marked “Sealed Bid: indicated the bid title, Bid Opening date/time, BID No.: 18-0014PW”, together with the name and address of the company submitting the bid.
- Sealed Bids, three (3) paper copies and one (1) electronic “PDF” or Microsoft Word copy will be received by the City of Dover, City of Dover Procurement Office, 710 William Street, Dover, DE no later

than **2:00 P.M. on Friday, December 22, 2017*** for the process improvements of the Water Treatment Plant (WTP).

***Please note that this is the new bid opening date which has been revised since the pre-bid meeting.**

- BID SUBMISSION - All bids should be delivered to:

Peter Gregg
Contract and Procurement Manager
City of Dover Purchasing Office
710 William Street
Dover, Delaware 19904

Electronic copies shall be submitted to bids@dover.de.us

- You must use the bid form included with the bid for your submission.
- The Bid Bond is 10% if the total price required for each bid.
- Bidders are fully responsible for the timely delivery of bids. Late bids will not be accepted and will be returned to the bidder unopened. Telegraph, telephone, facsimile machine, and electronic mail bids will not be accepted under any circumstances.
- All questions must be submitted by **Wednesday, November 29, 2017** at which time they will be compiled and answered in the form of an addendum to this Bid on **December 6, 2017**, if necessary. The questions must be directed to Peter Gregg, email preferred, doverwhse@dover.de.us
- Once opened, the bid status will be posted on the City web site, www.cityofdover.com/bid-tabulation. The status will be updated as required. Once a decision is made, the tabulation will be posted on the website as well.
- Minority owned vendor preference shall be three percent (3%) of the value of the award. The vendor must identify qualification and claim to the preference on the submitted bid documents. The vendor must provide authoritative proof of minority ownership such as identification in the certification directory maintained by the State of Delaware, Department of Administrative Services, Office of Minority and Women Business Enterprises to qualify for this preference. This preference is to be considered as a standalone and cannot be added to any other preference that may be allowed. This preference shall not apply to subcontractors
- Local vendor preference shall be considered for materials, equipment, construction contracts, and utility contracts. Local vendor preference shall be three percent (3%) of the annual value of the award. The term local vendor is defined as a gradually increasing range with preference assigned as follows:
 - Rule 1: Vendor located within the city limits of the City of Dover.
 - Rule 2: Vendor located within Kent County, Delaware (applicable only if no vendor qualifies under rule 1).
 - Rule 3: Vendor located within State of Delaware (applicable only if no vendor qualifies under rule 1 or 2).

If in the event no vendor qualifies under rules 1, 2, or 3, no local vendor preference will be awarded. The vendor must identify qualification and claim to the preference on the submitted proposals documents. This preference is to be considered as standalone and cannot be added to any other preferences that may be allowed.

Ms. Kate Mills, Civil Engineer, City of Dover:

- Ms. Mills provided an overview of the project- scope of work, existing treatment conditions at the WTP, and modifications, new installations and structural improvements at the WTP including a pneumatic lime vacuum feed system, startup and testing of all new equipment, and site restoration. Emphasis was placed on following the demolition phasing plan stated in the plan set and the need for proper erosion and sediment control during work.
- Ms. Mills stated the importance of coordination with the City's WTP staff during construction since the WTP is an active production site.
- The site is located at 802 Long Point Road Road, east of Route 1.
- Ms. Mills stated that noise control, safety requirements, and secure storage of materials are the responsibility of the contractor.
- Because this is an active facility, City employee parking and delivery truck access areas shall not be blocked by the Contractor.
- Residents must have access to driveways at all times.
- The project shall be completed within 360 calendar days from the Notice to Proceed date.
- Work hours are Monday through Friday, 7:30am to 3:30pm. Any work done outside of these normal working hours must be approved by the City of Dover.
- The City requires the AIA G702/G703 Application for Payment form.
- Ms. Mills emphasized that each contractor submit all necessary documentation to satisfy the Statement of Qualification section in the Invitation to Bidders section of the bid specifications (ITB, IV).
- Ms. Mills closed her portion by stating that a site visit was available after the pre-bid meeting. She then introduced Doug Lodge to provide the general information and requirements of the Drinking Water State Revolving Fund aspect of this project.

Mr. Doug Lodge, P.E.- Delaware Dept. of Health and Social Services, Office of Engineering:

- Mr. Lodge discussed the disadvantaged business enterprises (DBEs) requirement. All bidders must provide in their bid submission at least three (3) solicitations to businesses meeting the DBE program requirements. Solicitation may be completed by e-mail, letter, or fax.
- Bidders must also note in their bid submission if they will *not* be subcontracting specific work included in the contract.
- The State of Delaware Prevailing Wage Rates and Davis Bacon Wage Rates shall be utilized for the project. The higher of the two (2) wage rates shall be used for each specific task included in the contract work.
- Ms. Mills stated that the State of Delaware Prevailing Wage Rates provided in the Specifications includes a "debarment list." No public construction contract in the State of Delaware shall be bid on, awarded to, or received by contractors or individuals on this list for a period of three (3) years from the date of debarment.
- Signage- The contractor shall provide and erect a sign at a prominent location at the construction site. The sign and location shall be approved by the Owner. The sign shall be prepared in accordance with the instructions provided in the DWSRF Program Requirements located in the Specifications. It shall be the responsibility of the Contractor to maintain the sign in good condition throughout the life of the project.
- American Iron and Steel- For products to be installed for this project which are included in the American Iron and Steel Requirement of the Specifications, the Contractor shall provide to the Owner proof that the product was produced in the United States.

- As part of the project, monthly progress meetings shall be attended by the Contractor, the Owner and DHSS representative.

Questions/Answers:

Q: Can the bid date opening change?

A: The bid opening will not be changed.

Q: Is there a cost estimate available for review?

A: There is no cost estimate available for review.

Q: Do the three (3) solicitations need to be submitted with the bid?

A: Yes.

Q: Do all contacts as part of the DBE solicitation need to be included in the bid submission?

A: Yes.

Q: Is there contact information to schedule a site visit to the Water Treatment Plant?

A: Please contact the City of Dover Department of Public Works Administration Office at 302-736-7025 to schedule a visit.

There were no further questions at this time. Ms. Mills stated that all submitted questions shall be sent to the City for review at the dooverwhse@doover.de.us address.

Meeting was adjourned at 9:30am.

Submitted Questions:

Q: Is there filter media on this bid?

A: Yes, it is listed in the Pressure Filters section of the Specifications, Section 11226.

Q: Would the City of Dover accept Rockwell/Allen Bradley MCCs, panelboards, and PLCs as approved equals?

A: With exception to the Water System Control Panel, which shall be a Siemens Intra-Link LC3000, the City will only be accepting an approved equal for those products listed as having the option of an approved equal in the Specifications. The product selected by the bidder shall meet all requirements listed in the Specifications and Drawings.

Q: Specification 03480 Precast Post Tensioned Concrete Tanks:

- a. The description of work indicates that there are two tanks. Should we assume one of them is the Backwash Tank? What is the other tank?
- b. The Specification Title includes "(Option)". Would we be safe to assume that you will accept "cast-in-place" tanks in lieu of the precast post-tensioned precast tanks?

A: The two (2) precast post tensioned concrete tanks are the Backwash Tank and the Residuals Tank. The basis of the current design drawings indicate design is for Precast Post-Tensioned concrete tanks. However, Cast-in-Place concrete tanks would be considered an acceptable alternate method. For Cast-in-Place tanks, the Bidder will need to prepare detailed calculations and Professional Engineering Sealed drawings including plans/sections and details for approval as a submittal prior to commencement of

work. See attached “structural basis of design for concrete tanks” for guidance on the requirements for the cast-in-place design.

Q: Specification 15800 Air Distribution: Can you please provide specifications for the FRP duct?

A: Specifications can be found on Drawing M-02. An updated Specification 15800-Air Distribution R1 is attached providing specifications for the FRP Duct.

Q: Specification 16920 Water System Control Expansion: The specification discusses the pre-bid procedure for getting someone other than the pre-approved system supplier approved, but cannot find the name of the pre-approved system supplier. Can you please offer the name(s) of the pre-approved system supplier?

A: The City will only be accepting the Siemens Intra-Link LC3000 control system.

Q: Drawing S-04: Can you please provide the specifications and manufacturer’s name for the liner?

A: The liner is referenced in Drawing D-13 and is called out as an HDPE Liner. An updated Specification Section 02950 Sand Drying Beds is attached.

Q: Dwg. S-05: Can you please provide the name(s) of approved metal building manufacturer/supplier?

A: Kent Construction Company – 302-653-6469
Building Concepts of America – 302-292-0200
Kaiser Martin Group – 717-336-2965

Q: Will the City take ownership of salvageable material removed from the WTP?

A: Pieces of equipment with salvage value, such as the ozonators, stainless steel pipe and valves, contactors, compressors, and the cooling water pumps may be salvaged by the Contractor. The City has the right to claim any removed material or equipment. Material or equipment which are not claimed by the City shall be disposed of properly by Contractor.

Q: Can Prominent be an approved equal for the Polymer feed system?

A: The Polymer Feed System is a complete Polymer dosing system consisting beyond the polymer metering pump of but not limited to polymer mixing chamber, dilution water inlet assembly, solution preparation and aging tank, solution metering system and control panel. This is further described in Specification 11335-2 (Chemical Feed Equipment Systems) 2.05 Polymer Feed System. An alternative equipment to be an “approved equal” must be submitted by the Contractor and follow the procedures contained within the Specification Section Information for Bidders, Part E, and Section 01600: Materials and Equipment, Paragraph 1.07 Substitutions.

Q: Drawing. D-12: Acid Room: Please confirm the curb is new work and the gratings are existing and not to be replaced.

A: Yes the proposed curb and fiberglass grating are new work.

Q: Drawing. D-05: Where is the Tank Mixer specified?

A: Section 11332 Hydrated Lime Equipment

Q: Dwg. D-08: Are there any existing shop drawings available for the pump motor replacements?

A: No.

Q: Dwg. S-10: Are there any silo painting requirements?

A: Drawing S-10 calls for the coating of the structural repairs to the existing silo. Contractor shall scrape all loose paint in repair regions and coat with something compatible with the existing coating and in accordance with Specification Section 09900 Painting.

Q: Dwg. M-02: Can you please provide specifications for the PVC duct?

A: Specifications can be found on Drawing M-02.

Q: In specification section 16920-19, D, it is mentioned that the operator shall be able to view and operate the new processes from any of the three new control panels. Does this mean that all the Operator Interface terminals would have all plant information?

A: All operator interface terminals (OITs) will have all of the plant information.

Q: In specification section 16920-19, would each operator interface terminal require matching terminals or could there be a Main terminal that would have a larger graphical display and the other 2 panels have smaller alphanumeric display interface?

A: All OITs shall match.

Additional Information:

Two Air Release Valves, ARV, (in total) are to be added at the high point piping on the piping to the horizontal pressure filters located in the Proposed Filter Building. One ARV will be added to the influent piping to Filter #1 and one ARV will be added to the influent piping to Filter #2. On Drawing D-09 Filter Building Plan these ARVs will be added to callout 29 (16" FJ DIP) on both influent lines to filters.

Project Coordination:

Please take note of the phasing of the work to be done for this project, which is detailed in the Construction Plans. Because this is an active facility, certain demolition, rehabilitation, and new work has to be completed in specific time frames.

The water treatment plant will be active during the city-wide water system flushing. The tentative time frames for this flushing is April 8, 2018 to April 27, 2018 and again from October 7, 2018 to October 26, 2018. During these flushing periods, the plant cannot be taken offline and construction work is limited. In lieu of these site constraints, extensions to the three-hundred sixty (360) day contract due to these timing constraint may be available. All coordination efforts will be discussed in the pre-construction meeting and monthly progress meetings to follow.

III. ATTENDANCE ROSTER

CITY OF DOVER

WATER TREATMENT PLANT PROCESS IMPROVEMENTS (18-0014PW)

The following is a list of attendees for the mandatory pre-bid meeting for the Water Treatment Process Improvements Project Wednesday, November 20, 2017 at 9:00 a.m. The meeting was conducted at the JW Pitts Center, 10 Electric Avenue, Dover, DE

PRINTED NAME, COMPANY	ADDRESS	PHONE	FAX	E-MAIL
Kate Mills, E.I.T., City of Dover	P.O. Box 475 Dover, DE 19903	304 736-7562	302-736-4217	kmills@dover.de.us
Peter Gregg, City of Dover	710 William Street, Dover, DE 19904	302-736-7795	302-736-7178	pgregg@dover.de.us
Barry Wolfgang, City of Dover	710 William Street, Dover, DE 19904	302-736-7795	302-736-7178	bwolfgang@dover.de.us
Jason Lyon, P.E., City of Dover	P.O. Box 475 Dover, DE 19903	302-736-7025	302-736-4217	jlyon@dover.de.us
Chris Curran, P.E., AECOM	625 West Ridge Pike, Suite E-100, Conshohocken, PA 19428	610-832-3500	610-832-3501	chris.curran@aecom.com
Doug Lodge, P.E., DHSS	43 South DuPont Hwy, Dover, DE 19901	302-741-8644		doug.lodge@state.de.us
Mike Cox	P.O. Bx 65, Barclay, MD 21607	410-438-2720	410-438-3004	niloelec@yahoo.com
Paul Dagostino, Stone Hill Contracting	252 West Swamp Rd, Doylestown, PA 18901	215-340-1840	215-340-1991	padagostino@stonehillcontracting.com
Bob Corvino, Stone Hill Contracting	252 West Swamp Rd, Doylestown, PA 18901	215-340-1840	215-340-1991	estimating@stonehillcontracting.com
Bearing Construction	805 Shine Smith Road, Sudlersville, MD 21668	410-556-6100	410-550-6574	jim@bearingconstruction.net
Power Plus Elec Contracting	P.O. Box 199, Cheswold, DE 19936	302-363-5069	302-736-5021	mattB337@gmail.com
Chris Evans, Kershner Environmental	724 South 11 th Street, Philadelphia, PA 19147	215-668-1746		c.evans@ketllc.com
Mike Sturgis, Allan Myers	1805 Berks Road, Worcester, PA 19490	410-977-9326		micheal.sturgis@allanmyers.com
Greg Hilher, Johnston Construction Co	4331 Fox Run Road, Dover, PA 17315	717-292-3606	717-292-7569	bids@jcc-ri.com
Andrew Mattson, M2 Construction LLC	901 Stony Battery Road Landisville, PA 17538	717-305-8801	717-823-6979	andrew@m2constructionllc.com
Nate Leyburn, Dutchland/Chesapeake Environmental Equipment	3524 Mill Green Road, Street, MD 21154	443-993-3007		nleyburn@chesequip.com
Kuhn Construction Co	P.O. Box 1419, Hockessin, DE 19707	302-239-4344	302-239-2816	wkuhniii@kuhnconstr.com

End of Addendum #1

If you have any questions, please contact me at (302) 736-7795 or email pgregg@dover.de.us.

Sincerely,

Peter K. Gregg
Contract and Procurement Manager
City of Dover
(302) 736-7795
Fax (302) 736-7178
Pgregg@dover.de.us
www.cityofdover.com

Addendum Receipt Record

ITB 18-0014PW

We have received and reviewed the following Addenda (if applicable):

1. Addendum #1, dated December 6, 2017.
2. _____, dated _____.
3. _____, dated _____.

FIRM NAME: _____

BY: _____

PRINTED: _____

TITLE: _____

DATED: _____

ADDRESS: _____

PHONE: _____

FAX: _____

FEDERAL: _____

ID#

SECTION 15800

AIR DISTRIBUTION

PART 1 - GENERAL

1.01 NOTICE

- A. The requirements of Division 1, the General Conditions, the Supplementary General Conditions and the Contract Drawings are hereby made a part of this section as fully as if repeated herein.
- B. The Contractor shall consult these sections in detail as he will be responsible for and governed by the conditions set forth therein and the work indicated.
- C. Product descriptions listed herein contain the characteristics of a general series or model. Contractor shall direct his attention to the Contract Drawings for specific sizes or capacities listed in equipment schedules contained herein.

1.02 DESCRIPTION

- A. Description of System(s): Perform all work necessary and/or required and furnish all materials for a complete installation of the system(s) indicated and specified. Such work shall include, but not be limited to, the following:
 - 1. Provide wall, roof and FRP fans.
 - 2. Provide wall louvers and motor operated dampers.
 - 3. Provide wall mounted dehumidifiers
 - 4. Provide PVC pipe duct.
 - 5. Provide FRP duct in Fluorosilicic Room.

1.03 QUALITY ASSURANCE

- A. Acceptable Manufacturers: Unless otherwise specified or indicated, all materials and equipment shall be the products of a manufacturer regularly engaged in the production of air distribution devices.
- B. All design, fabrication and erection shall be performed in full compliance with all applicable laws, ordinances, rules, regulations and the latest edition of the following codes and standards:
 - 1. IMC
 - 2. ASHRAE
 - 3. SMACNA
 - 4. UL
 - 5. NFPA

1.04 SUBMITTALS

- A. Furnish shop drawings and descriptive data, complete with project designation, for the following:
 - 1. Panel wall Propeller Fans

2. Motor Operated Dampers
3. Louvers and Screens
4. Rain Hood and wall cap
5. Dehumidifiers
6. FRP Duct
7. FRP Centrifugal Fans
8. Shutter Damper

- B. Shop drawings shall be in accordance with the General and Supplementary Conditions of this Specification.
- C. Obtain approval of submittals prior to ordering or fabricating materials.

1.05 PRODUCT DELIVERY, HANDLING & STORAGE

- A. Delivery: Deliver materials to project site in manufacturer's unopened original packaging.
- B. Handling: During loading, transporting and unloading exercise care to prevent damage to materials.
- C. Storage: Store materials in area protected from weather, moisture and mechanical damage

1.06 AIR SYSTEM TESTING & BALANCING

- A. Contractor shall procure the services of an independent balancing and testing firm approved by the Engineer. The agency selected shall abide by the procedures set forth by the Associated Air Balance Council.
- B. The contractor shall submit six (6) copies of a complete report, on a form approved by the AABC, signed and sealed by a registered engineer, and stating that all supply, return and exhaust systems have been balanced to specified air flows as follows:
 1. Test and adjust fan rpm to design requirements.
 2. Test and record motor full load amperes.
 3. Test and record system static pressures, suction and discharge.
 4. Test and adjust system for design cfm of recirculated air, where applicable.
 5. Test and adjust system for design cfm of outside air.
 6. Test and adjust each exhaust inlet to within 5% of design requirements.
 7. In cooperation with the control manufacturer's representative, set adjustments of automatically operated dampers to operate as indicated or specified.

PART 2 - PRODUCTS

2.01 FIBERGLASS SHUTTER

- A. SHUTTER (SD-23).

1. Shutter 4" deep with end-pivoted automatic shutter.
2. Fabricate of .070" thick fiberglass reinforced polyester with 1/8" fiberglass reinforced polyester angle.
3. Finish in factory standard color.
4. Manufacturer: Hartzell Fan Inc. model FEP, MK Plastics.

2.02 CENTRIFUGAL FIBERGLASS FANS (EF-23, EF-24)

- A. Fan shall be constructed of fiberglass reinforced plastic, aerodynamically designed with high efficiency inlet. The casing exterior shall be smooth and resin rich interior.
- B. Fastening bolts holding the casing to the support plate are to be encapsulated in FRP.
- C. Fans are to be supplied with a graphite liner and grounding strap to remove static electricity, as well as a flame redundancy of 25 or less.
- D. Fan impeller shall be solid molded FRP with radial tip curved blades. FRP hub shall have a tight fitting to protect the shaft end. The impeller shall be statically and dynamically balanced per AMCA 204 standard.
- E. Motors to be TEFC with 1.15 service factor.
- F. Manufacturer: IPF COLASIT or approved equal.

2.03 VOLUME CONTROL DAMPER

- A. Fabricate in accordance with SMACNA Duct Construction Standard, latest addition.
- B. Fabricate frame of extruded aluminum channel with corner brace.
- C. Fabricate blades of 8 inches maximum width of extruded aluminum.
- D. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12 x 72 inches. Assemble center and edge crimped blades in prime coated frame with suitable hardware.
- E. Provide locking, indicating Quadrant Regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.
- F. On insulated ducts mount Quadrant Regulators on stand off mounting brackets, bases or adapters.
- G. Sizes: Shown on drawings.

2.04 MOTOR OPERATED DAMPERS

- A. Construction: Dampers shall be constructed of minimum 16 gauge steel with maximum blade width of 8". Bearings shall be self-lubricating type. Blades shall have interlocking edges and shall be provided with blade seals. All multi blade two-position dampers shall

be parallel blade type. Control contractor shall furnish and install motors of adequate capacities to operate dampers described and where shown on contract drawings.

- B. Normal Application: Leakage rate shall be less than 14cfm/sq.ft. at 4" W.G.
- C. 120 volt cast aluminum actuator: power closed, spring open.
- D. Size: Consult contract drawings for damper location and size.
- E. Manufacturers: Penn Ventilation model "PCD20S", Ruskin, Greenheck, Cesco or equal.

2.05 LOUVERS

- A. Louvers 4" deep with 45° drainable blades, birdscreen with 3/4" square mesh for intake. Mount birdscreen on the inside face of blades.
- B. Fabricate of .125" thick extruded aluminum.
- C. Finish in factory color anodized finish. Color to be selected by Architect.
- D. Manufacturers: Green Heck Model ESD-403, Ruskin, Arrow, Louvers & Dampers, Inc. or equal.

2.06 WALL PANEL FANS (EF-21, EF-22)

- A. General: factory assembled wall mounted, direct driven, steel propeller fan, including housing, wheel and damper.
- B. Standards: rated in accordance with AMCA standards and bear the AMCA certified rating seal.
- C. Construction: the fan shall be bolted and welded construction utilizing corrosion resistant fasteners. The motor, bearings, and drives shall be mounted on a tubular steel power assembly minimum 14 gauge wall panel with continuously welded corners.
- D. Motor: heavy duty with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.
- E. Bearings: heavy duty regreasable ball type in cast iron pillow block housing for a minimum 150 life in excess of 200,000 hours.
- F. Accessories:
 - 1. Wall sleeve
 - 2. Motor guard
 - 3. Gravity shutter
 - 4. Rain Hood
- G. Manufacturer: Green Heck, Cook, Penn vent, Continental Air or equal.

2.07 CENTRIFUGAL FIBERGLASS FANS (EF-23, EF-24)

- A. Fan shall be constructed of fiberglass reinforced plastic, aerodynamically designed with high efficiency inlet. The casing exterior shall be smooth and resin rich interior.
- B. Fastening bolts holding the casing to the support plate are to be encapsulated in FRP.
- C. Fans are to be supplied with a graphite liner and grounding strap to remove static electricity, as well as a flame redundancy of 25 or less.
- D. Fan impeller shall be solid molded FRP with radial tip curved blades. FRP hub shall have a tight fitting to protect the shaft end. The impeller shall be statically and dynamically balanced per AMCA 204 standard.
- E. Motors to be TEFC with 1.15 service factor.
- F. Manufacturer: IPF COLASIT or approved equal.

2.08 FAN MOTORS AND DRIVE.

- A. Motors to be premium efficiency, standard NEMA frame, Direct Drive, TEFC with a 1.15 service factor.
- B. Drives up to 5 HP shall be provided with variable pitch sheave.
- C. Shaft to be ANSI C-1045 steel, and be protected with TECTYL 822B protective coating.
- D. Shafts to be AISI -1045 carbon steel. The shaft shall not be in the corrosive air stream.

2.09 FIBERGLASS DUCTWORK

- A. Material: Rigid Fiberglass duct board with flame attenuated surface to air flow.
- B. Construction: Conform with SMACNA recommended standards for low pressure ducts having a maximum velocity of 2000 FPM and a positive or negative pressure of 2" w.g. or less.
- C. Minimum Thickness: 1"
- D. Comply with manufacturer's recommendations regarding methods and materials to join at transverse and longitudinal joints including heat sealing tapes.

2.10 PVC DUCTWORK

- A. Material shall be standard Schedule 40 PVC pipe and fittings.

PART 3 - EXECUTION

3.01 GENERAL EQUIPMENT INSTALLATION

- A. Except as indicated on Contract Drawings, all equipment shall be installed in accordance with the manufacturer's recommended installation procedures.

- END OF SECTION 15800 -

SECTION 02950

SAND DRYING BEDS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:

1. Construction of geosynthetic clay liner (GCL) lined sand drying beds.

1.02 REFERENCES

A. Abbreviations and Acronyms

1. GCL – Geosynthetic clay liner.

B. Reference Standards

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. ASTM International (ASTM)
 - a. ASTM D5261 Measuring Mass Per Unit Area of Geotextiles
 - b. ASTM D5887 Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter
 - c. ASTM D5888 Storage and Handling of Geosynthetic Clay Liners
 - d. ASTM D5889 Quality Control of Geosynthetic Clay Liners
 - e. ASTM D5890 Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
 - f. ASTM D5891 Fluid Loss of Clay Component of Geosynthetic Clay Liners
 - g. ASTM D5993 Measuring Mass Per Unit of Geosynthetic Clay Liners
 - h. ASTM D6072/D6072M Obtaining Samples of Geosynthetic Clay Liners
 - i. ASTM D6243 Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method
 - j. ASTM D6496 Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners
 - k. ASTM D6768 Tensile Strength of Geosynthetic Clay Liners

1.03 ADMINISTRATIVE REQUIREMENTS

Not Used

1.04 SUBMITTALS

Engineer review is required for submittals designated as “Action Submittals”. Submittals not designated as "Action Submittals" are for Contractor Quality Control approval and are to be submitted to Engineer for information only. The following shall be submitted in accordance with Section 01340 – SUBMITTAL PROCEDURES:

A. Action Submittals

1. Product Data
 - a. GCL Properties
2. Shop Drawings
 - a. Layout and Detail Drawings

B. Informational Submittals

1. Certificates
 - a. GCL Subgrade Preparation
2. Test and Evaluation Reports
 - a. GCL Conformance Tests
3. Manufacturer Instructions
 - a. GCL Manufacturer’s installation instructions.
4. Source Quality Control Submittals
 - a. Within 24 hours of conclusion of physical tests, provide copies of test results, including calibration curves and results of calibration tests.
5. Field Quality Control Submittals
 - a. Within 24 hours of conclusion of physical tests, provide copies of test results, including calibration curves and results of calibration tests.
6. Manufacturer Reports
 - a. Manufacturer's quality control (QC) manual describing test procedures, frequency of testing and acceptance/rejection criteria for QC testing at least 14 days prior to delivery of the GCL.
7. Qualification Statements
 - a. Contractor's validated testing facilities.
 - b. GCL manufacturer

C. Closeout Submittals

- 1. Warranty Documentation
- D. Maintenance Material Submittals
Not Used

1.05 QUALITY ASSURANCE

- A. Qualifications
 - 1. Manufacturer
 - a. Geosynthetic Clay Liner: documented production of the proposed GCL using the same bentonite, polyethylene geomembrane, geotextiles, sewing thread, and adhesive for at least 5 completed projects and production of a minimum of 2,000,000 square feet of the proposed GCL.
 - 2. Testing Agency
 - a. Perform testing by an Owner validated commercial testing laboratory or the Contractor's validated testing facility.
 - b. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Owner validated and approved by the Resident Project Representative.
 - c. Provide GCL QC laboratory that is accredited via the Geosynthetic Accreditation Institute's Laboratory Accreditation Program (GAI-LAP).
- C. Certifications
 - 1. Submit GCL manufacturer's certified raw and roll material data sheets.
 - 2. If needle punching or stitch bonding is used in construction of GCL, indicate that the GCL has been continuously inspected for broken needles using an in-line metal detector and broken needles have been removed.
 - 3. Ensure the certified data sheets have been attested to by a person having legal authority to bind the GCL manufacturing company.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle the GCL in accordance with ASTM D5888.
- B. Delivery and Acceptance Requirements
 - 1. Notify the Resident Project Representative in advance of delivery so that they can be present during unloading of the GCL.
 - 2. Package rolls in an opaque, waterproof, protective covering and wrap around a central core.

3. Repair tears in the packaging to restore a waterproof protective barrier around the GCL.
 4. Unload rolls from the delivery vehicles in a manner that prevents damage to the GCL and its packaging.
- C. Storage and Handling Requirements
1. Provide field storage in flat dry areas where water cannot accumulate and the GCL rolls can be protected from damage.
 2. Do not store rolls on blocks or pallets unless the GCL rolls are fully supported as approved by the Resident Project Representative.
 3. Do not stacks GCL rolls greater than three high.
 4. Cover rolls with a water proof tarpaulin or plastic sheet if stored outdoors.
 5. Do not drag, lift by one end, drop to the ground, or otherwise damage rolls.
 6. Use a pipe or solid bar of sufficient strength to support the full weight of the roll without significant bending for unloading and handling activities.
 7. If recommended by the manufacturer, use a sling handling method utilizing appropriate loading straps.

1.07 WARRANTY

- A. Manufacturer Warranty
1. Provide manufacturer's warranty that the GCL materials meet all requirements of the contract documents and that for the intended use, the GCL is warranted for 25 years against deterioration.
- B. Special Warranty
1. Provide installer's warranty that the GCL will not fail due to improper installation within 1 year.

PART 2 – PRODUCTS

2.01 OWNER-FURNISHED PRODUCTS

Not Used

2.02 GEOSYNTHETIC CLAY LINER

- A. Manufacturers
1. CETCO, 2870 Forbs Avenue, Hoffman Estates, Illinois 60192, Phone: 800-527-9948, Fax: 847-851-1899, www.cetco.com.

2. GSE Lining Technology, LLC, 19103 Gundle Road, Houston, Texas 77073, Phone: 800-435-2008, 281-443-8564, Fax: 281-875-6010, www.gseworld.com.

B. Description

1. Provide manufactured GCL product consisting of a sodium montmorillonite clay (bentonite) layer evenly distributed between two geotextiles.

C. Performance

1. Conform to the property requirements listed in Table 1
2. Ensure GCL is free of tears, holes, or other defects that may affect its serviceability.

D. Assembly/Fabrication

1. Mechanically bond encapsulating geotextiles together using a needle punch or stitch bonding process.
2. Continuously inspect needle punched and stitch bonded GCLs for broken needles using an in-line metal detector and remove broken needles.

2.03 AGGREGATES

- A. Sand: Clean sand, effective size of 0.3 to 0.5 mm, uniformity coefficient not greater than 3.5.
- B. Rice Gravel: Clean, graded gravel, 1/8 inch to 1/4 inch.
- C. Pea Gravel: Clean, graded gravel, 1/4 inch to 1/2 inch.

2.04 ACCESSORY PRODUCTS

- A. Wood Battens: meeting the requirements for Miscellaneous Lumber and pressure treated in accordance with Section 06100 CARPENTRY.

2.05 SOURCE QUALITY CONTROL

A. Tests

1. Sample and test GCL and its components in accordance with the manufacturer's approved QC manual.
2. Ensure the manufacturer's QC procedures are in accordance with ASTM D5889.
3. Test results not meeting the requirements specified in Table 1 will result in the rejection of applicable rolls.

4. Ensure the manufacturer's QC manual describes procedures used to determine rejection of applicable rolls.
5. As a minimum, test rolls produced immediately prior to and immediately after the failed roll for the same failed parameter.
6. Continue testing until a minimum of three successive rolls on both sides of the original failing roll pass the failed parameter.
7. Shear Strength Testing
 - a. Perform mid-plane shear strength testing in accordance with ASTM D6243.
 - b. Use potable water as the hydration fluid for mid-plane shear strength testing.
 - c. Include the final moisture content of the GCL at the center of each specimen with the test results.
 - d. Orient GCL and adjacent geosynthetics such that the shear force is parallel to the down slope orientation of the geosynthetics in the field.
 - e. Submit modifications to the test procedures described in this section and have approved prior to use.
 - f. Perform one set of mid-plane direct shear tests.
 - g. Allow specimens to hydrate prior to shearing for a minimum of 24 hours.
 - h. Provide free drainage along both sides of the GCL to aid in hydration.
 - i. Allow specimens to consolidate prior to shearing for a minimum of 24 hours.
 - j. Use a normal stress of 200 psf during hydration, consolidation, and shearing.
 - k. Do not relieve the normal stresses prior to or during shearing of the specimens.
 - l. Use a shear rate of 1 mm/min.
 - m. Tests shall be run until peak strength is determined.

PART 3 – EXECUTION

3.01 EXAMINATION

Not Used

3.02 PREPARATION

- A. Surface Preparation
 - 1. Compact the subgrade in accordance with Section 02223 BACKFILLING.
 - 2. Ensure the subgrade surface is smooth and free of vegetation, standing water, and angular stones or other foreign matter that could damage the GCL.
 - 3. At a minimum, roll the subgrade surface with a smooth-drum compactor of sufficient weight to remove any wheel ruts, footprints, or other abrupt grade changes.
 - 4. Remove, crush, or push into the surface each protrusion extending more than 0.5 inches from the subgrade surface (or less if recommended by the manufacturer) with the smooth-drum compactor.
 - 5. Each day during placement, inspect the surface on which GCL is to be placed with the installer and Resident Project Representative and certify in writing that the surface is acceptable.

3.03 GCL INSTALLATION

- A. Installed GCL as soon as practical after completion and approval of the subgrade.
- B. Deliver rolls to the work area in their original packaging.
- C. Immediately prior to deployment, carefully remove the packaging without damaging the GCL.
- D. Remove and replace GCL that has been hydrated prior to being covered by an overlying minimum of 12 inches of cover materials. Hydrated GCL is defined as having become soft as determined by squeezing the material with finger pressure or material which has exhibited swelling.
- E. Minimize dragging of GCL panels over the ground surface.
- F. The Resident Project Representative has the option of requiring the use of a slip sheet.
- G. Ensure deployed GCL panels lie flat on the subgrade surface, with no wrinkles or folds.
- H. Anchorage
 - 1. Anchor the GCL to the sand drying bed wall using 2-inch by 4-inch pressure treated battens and 3/8-inch stainless steel anchor bolts.
 - 2. Eliminate sharp corners that could damage the GCL.

3. Extend the GCL down the wall and across the bottom of the sand drying bed.

I. Seams

1. Place GCL with seams oriented parallel to the line of maximum slope and free of tension or stress upon completion of installation.
2. Position panels with the overlap recommended by the manufacturer, but not less than 6 inches for panel sides or 18 inches for panel ends. Overlap panels 24 inches at intersection with vertical walls of the sand drying bed.
3. Remove soil and other foreign matter from the overlap area immediately prior to seaming.
4. If recommended by the manufacturer, place granular bentonite of the same type as the bentonite used for the GCL along the entire overlap width at a minimum rate of 0.25 lbs/linear foot or as recommended by the manufacturer.
5. Use construction adhesive or other approved seaming methods recommended by the manufacturer for horizontal seams on slopes.
6. Construct overlaps that occur on slopes with the up slope GCL shingled over the down slope GCL.
7. Alternate seaming methods may be approved if recommended by the manufacturer.

J. Penetrations

1. Submit penetration details as recommended by the GCL manufacturer.
2. As a minimum, provide pipe penetrations incorporating a collar of GCL wrapped around the pipe and securely fastened.
3. Place dry bentonite or bentonite paste around the penetration as recommended by the GCL manufacturer.

3.04 PLACEMENT OF AGGREGATE MATERIALS

- A. Do not cover GCL prior to inspection and approval by the Resident Project Representative.
- B. Install pipe as indicated on the Drawings and in accordance with Section 15000 Piping and Valving.
- C. Place aggregate in layers as indicated on the Drawings.
- D. Ensure initial aggregate cover is free of angular stones or other foreign matter that could damage the GCL.

- E. Do not be drop aggregate directly onto the GCL from a height greater than 3 feet.
- F. Push the aggregate out over the GCL in an upward tumbling motion. Hand place aggregate under haunches of pipe to prevent damage to and displacement of the pipe.
- G. Proceed with backfilling in the direction of down gradient shingling of GCL overlaps.
- H. Place aggregate such that it does not enter the GCL overlap zone and tensile stress is not mobilized in the GCL.
- I. Do not operate equipment on the top surface of the GCL without permission from the Resident Project Representative.
- J. Minimize equipment traffic within the sand drying bed during placement of aggregate. If equipment operation within the bed is necessary, provide an initial loose lift thickness of 12 inches and use equipment with ground pressures less than 7.0 psi to place the first lift over the GCL.
- K. Maintain a minimum of 24 inches of cover between construction equipment with ground pressures greater than 7 psi and the GCL during the covering process.
- L. Do not stop abruptly, make sharp turns, spin equipment wheels, or travel at speeds exceeding 5 mph.

3.05 REPAIR

- A. Repair holes or tears in GCL by placing a patch of GCL extending a minimum of 12 inches beyond the edges of the hole or tear on each side.
- B. If recommended by the manufacturer, apply granular bentonite or bentonite mastic in the overlap area.
- C. Secure patches with a construction adhesive or other approved method as recommended by the manufacturer.

3.06 FIELD QUALITY CONTROL

- A. Field Tests
 - 1. Samples
 - a. Collect QC samples at approved locations upon delivery to the site at a frequency of one test sample 100,000 square feet.
 - b. Collect, package, and transport samples in accordance with ASTM D6072/D6072M.
 - c. Identify samples with a waterproof marker by manufacturer's name, product identification, lot and roll number.

- d. Note the date, a unique sample number, the machine direction, and the top surface of the GCL on the sample.
 - e. Discard the outer layer of the GCL roll prior to sampling a roll.
 - f. Collect samples by cutting the full-width of the GCL sheet a minimum of 3 feet wide in the machine direction.
 - g. Collect, label, and submit an additional 24 by 24 inch QA sample to the Resident Project Representative each time QC samples are collected.
2. Conformance Tests
- a. Provide QC samples to the QC laboratory to determine bentonite mass per unit area (ASTM D 5993), peel strength (ASTM D 6496), flux (ASTM D 5887) and tensile strength (ASTM D 6768) at a frequency of once per 100,000 square feet of GCL placed.
 - b. Tests not meeting the requirements specified in Table 1 shall result in the rejection of applicable rolls.
 - c. Determination of applicable rolls shall be as described in paragraph Tests, Inspections and Verifications.

3.07 PROTECTION

- A. Unpackage and install only those GCL panels that can be anchored and covered in the same day.
- B. If exposed GCL cannot be permanently covered before the end of a working day, temporarily cover with plastic or other waterproof material to prevent hydration.

3.08 ATTACHMENTS

A. Tables

1. Table 1 – GCL Properties

Property	Test Method	Test Value
Bentonite		
Swell Index Test, minimum	ASTM D5890	24 mL
Fluid Loss, maximum	ASTM D5891	18 mL
Upper Geotextile Properties		
Material Type		Woven
Mass per Unit Area, min.	ASTM D5261	3 ounces/square yard
Lower Geotextile Properties		
Material Type		Nonwoven
Mass per Unit Area, min.	ASTM D5261	6 ounces/square yard
Composite		
Bentonite Mass/Unit Area, minimum, Note 1	ASTM D5993	0.75 lbs/sq foot
Moisture Content, maximum	ASTM D5993	40 percent
Tensile Strength, minimum, (MD)	ASTM D6768	23 lbs/in
Peak Mid-Plane Shear Strength (hydrated), minimum at a normal stress of 200 psf	ASTM D6243	500 psf
Index Flux, maximum	ASTM D5887	1×10^{-6} (cm ³ /sec-cm ²)
Peel Strength, MARV MD Note 2	ASTM D6496	2.1 lbs/inch

Note 1: Bentonite mass/unit area shall be computed at 0 percent moisture content.
Bentonite mass/unit area is exclusive of glues added to the bentonite.

Note 2: The peel test applies to geotextile backed GCL products only.

END OF SECTION

Structural basis of design for concrete tanks

The design of environmental engineering concrete structure as well as any members will be in accordance with ACI 350. One of the vital considerations for design of tanks is that the structure has adequate resistance to cracking and has adequate strength. For achieving these following assumptions are made:

- Concrete is capable of resisting limited tensile stresses the full section of concrete including cover and reinforcement is taken into account in this assumption.
- To guard against structural failure in strength calculation the tensile strength of concrete is ignored.
- Reduced values of permissible stresses in steel are adopted in steel are adopted in design.

Environmental engineering concrete structures for the containment, treatment, or transmission of liquid such as water and wastewater will be designed and constructed to be essentially liquid-tight, with minimal leakage under normal service conditions. To assure the liquid-tightness of a structure will be reasonably assured if:

- The concrete mixture is well proportioned, well consolidated without segregation and properly cured.
- Crack widths and depths are minimized.
- Joints are properly spaced, sized, designed, water-stopped, and constructed.
- Adequate reinforcing steel is provided with proper details, fabricated and placed.
- Impervious protective coatings or barriers are used where required.

Detailed calculations and Professional Engineering Sealed drawings' including plans/sections and details are required to be submitted prior to commencement of work.

Minimum permeability of the concrete will be obtained by using water cementitious material ratios as low as possible, consistent with satisfactory workability and consolidation.

Impermeability increases with age of the concrete and is improved by extended periods of moist curing. Air entrainment reduces segregation and bleeding, increases workability and provides resistance to the effects of freeze-thaw cycles.

Joint design will account for movement resulting from thermal dimensional changes and differential settlements. Joints permitting movement along predetermined control planes and which form a barrier to the passage of fluids shall include water-stops.

When using the LRFD (strength or limit states design approach), the load factors and combinations from ACI 318 can be used directly with one major adjustment. The load factors for both the lateral earth pressure and the lateral liquid pressure should be taken as 1.7. The factored load combination U as prescribed in ACI 318 must be increased by durability coefficients developed from crack width calculation methods:

- In calculations for reinforcement in flexure, the required strength should be 1.3 U

- In calculations for reinforcement in direct tension, including hoop tension, the required strength should be $1.65 U$
- The required design strength for reinforcement in shear should be calculated as $fV_s > 1.3 (V_u - fV_c)$
- For compression use $1.0 U$
- Large reinforced concrete reservoirs on compressible soil may be considered as beams on elastic foundations.
- Sidewalls of rectangular tanks and reservoirs can be designed as either: (a) cantilever walls fixed at the bottom, or (b) walls supported at two or more edges.
- Circular tanks normally resist the pressure from contents by ring tension
- Walls supporting both interior water loads and exterior soil pressure must be designed to support the full effects of each load individually
 - Cannot use one load to minimize the other, because sometimes the tank is empty.
- Large diameter tanks expand and contract appreciably as they are filled and drained.
 - The connection between wall and footing should either permit these movements or be strong enough to resist them without cracking
- Reinforced concrete walls at least 10 ft. high that are in contact with liquids should have a minimum thickness of 12 in.
 - The minimum thickness of any minor member is 6 in., and when 2 in. cover is required then it is at least 8 in.
- For crack control, it is preferable to use a large number of small diameter bars for main reinforcement rather than an equal area of larger bars
 - Maximum bar spacing should not exceed 12 in.
 - The amount of shrinkage and temperature reinforcement is a function of the distance between joints in the direction
 - Shrinkage and temperature reinforcement should not be less than the ratios given in ACI 350

When heavy machines are involved, an appropriate impact factor of 1.25 will be used in the design. Most of the mechanical equipment such as scrapers, clarifiers, flocculators, etc. are slow moving and will not cause structural vibrations. Machines that cause vibration problems are forced-draft fans and centrifuges for dewatering clarifier sludge or digester sludge.

The cement should conform to:

- Portland cement ASTM C150, Types I, IA, II, IIA,
- Blended hydraulic cement ASTM C595
- Expansive hydraulic cement ASTM C845
- They cannot be used interchangeably in the same structure
- Portland blast furnace slag cement (C595 may be used)
- Portland pozzolan cement (C595 IP) can also be used
- But, pozzolan content not exceed 25% by weight of cementitious materials

Mix proportioning – all material should be proportioned to produce a well-graded mix of high density and workability

- 28 day compressive strength of 5000 psi where the concrete is exposed to severe weather and freeze-thaw
- Maximum water-cement ratio = 0.45
 - 1.5 in. aggregate max
- Air entrainment requirements
 - 5.5 ± 1 % for 1.5 in. aggregate
- Slump requirements
 - 1 in. minimum and 4 in. maximum
 - Concrete placement according to ACI 350