SECTION 11826
BRIDGE-SUPPORTING
FINAL SETTLING TANK MECHANISM

PART 1 GENERAL

1.01 SCOPE

A. This Section includes the furnishing and installing of two new final settling tank mechanisms by the Contractor, T-11 and T-12 complete and in place ready for service.

B. The mechanisms shall be furnished complete with rotating spiral rake arms, drive mechanism, center torque tube, overload alarm device, feed well, skimmer, influent pipe supports, and all other accessories required for satisfactory operation. The existing bridge and walkway shall be ~~utilized~~ replaced. **(Addendum 1, Issued 01/06/20)**

C. All work performed under this Section shall comply and be in accordance with all approved trade practices and manufacturer's recommendations.

D. Manufacturer shall be WesTech, Clearstream or Ovivo and shall be the same manufacturer as Section 11825.

1.02 SUBMITTALS

A. Submittals shall be in accordance with the requirements of Section 01300 and shall include:

1. Shop Drawings for Review:

   a. The Contractor shall indicate all variances from the requirements of the Contract Documents.

   b. Scaled dimensional drawings.

   c. Wiring schematics with termination point identification.

   d. Materials of construction.

   e. Manufacturer's catalog data.

   f. General Arrangement Drawings.

   g. Motor information per 11050.

   h. Acceptance test procedures.

2. Operation and Maintenance Manual information.

1.03 ELECTRICAL AND CONTROL COORDINATION

A. If the current requirement of any motor or piece of equipment is increased to such an extent that the wiring, conduit, and/or starter for that motor or equipment must be increased from that shown on the Electrical Drawings, the Contractor shall furnish and install the larger items. The increased wiring, conduit, and/or starter cost shall be included in the motor or equipment cost under this Section and no additional compensation will be allowed.

B. All electrical, instrumentation, and control equipment and panels furnished under this Section shall conform to appropriate Sections of Division 16 of these Specifications. Equipment and panels shall be NEMA 4X unless designated otherwise in this Section.

C. Certain equipment furnished under this Section shall be connected to the plant control system (PCS) as shown on the P&ID Drawings. Mechanical and/or electrical components for these connections shall be furnished as required to provide control functions compatible with the plant control system. Connections and any remote-control connections shall be furnished and wired to clearly labeled terminal strips within the equipment control panel.

D. All electrical motors shall conform to the requirements of Section 11050.

PART 2 PRODUCTS

2.01 SCRAPER TYPE CLARIFIERS - FULL BRIDGE SIDE FEED

A. Provide all labor, material and equipment to furnish and install the circular scraper collector type clarifiers as specified herein.

B. This Section of the specification covers the general requirements for the design, fabrication and installation of two clarifier mechanisms.

C. Work and Components Included (But Not Limited To):

1. The Equipment Manufacturer shall furnish the items listed below:
    a. Drive mechanism complete with reducer, motor, and overload device.
    b. Torque tube with spiral rake arms.
    c. Influent EDI, feedwell, feed pipe and supports.
    d. Two surface skimmers with skimmer blade.
    e. One scum trough and ramp with flushing device.
    f. Associated attachment bolts and anchor bolts for above.
2. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts and manufacturer's service.

D. General:

1. Furnish and deliver scraper type sludge collectors for installation in two existing concrete settling tanks.
    a. Tank diameter to be 60-feet.
    b. Tank side water depth to be 11.45-feet.
    c. Tank freeboard to be 1.42-feet.
    d. Floor slope to be 1-inch per foot.
2. Sludge Collector Mechanism:
    a. Existing bridge supported, side feed type with peripheral overflow.
    b. Provide a center drive mechanism that supports and rotates a torque tube to which two structural steel type scraper arms are attached.
    c. The existing structural steel bridge spans the tank diameter and shall support the entire collector mechanism.
    d. Fabricated steel structures shall be shipped in the largest sub-assemblies permitted by carrier regulations, properly match-marked and identified for ease of field erection.

E. Design Criteria:

1. Hydraulics shall be designed to handle (per basin):

	Min.	Ave.	Max.
Effluent Flow (mgd)	0.5	2.0	3.16
Return Flow (mgd)	0.5	1.0	1.5
Mixed Liquor Flow (mgd)	1.0	3.0	4.46

2. Influent Well size 13-15-inch diameter by 5-feet-0-inches depth.
3. Side feed pipe diameter 16-inch.
4. Drive:
    a. Final gear pitch diameter: 25 to 31.2 inches
    b. Motor horsepower: 1.0 HP.
    c. AGMA rated torque: 9,000-14,700 feet-pounds with a 1.25 service factor.
    d. Speed: 0.06 RPM.

F. Structural Members:

1. Structural steel to conform to ASTM A36.

2. Structural steel components shall have minimum thickness of 1/4-inch unless noted in the specification.

3. All welding to conform to American Welding Society Standard AWS D1.1. Structural support members shall be shop welded for bolted field assembly. A minimal amount of field welding shall be required.

4. Design components so that stresses developed do not exceed allowable stresses, as defined by current AISC standards when designed for the AGMA rated torque.

5. Panel lengths and member sizes shall be selected such that slenderness ratios do not exceed 200 for compression and 240 for tension. For strength, the controlling member force shall be used to determine member size.

6. Maximum deflection in a span under combined live and dead loads shall not exceed L/360.

G. Drive Mechanism

The drive unit shall be designed and manufactured by the clarifier equipment supplier to ensure unit responsibility. The drive unit shall be designed for the torque values listed herein. It shall turn the mechanism at the design collector tip speed. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L 10 life of 50 years or 438,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The drive main gear shall be designed to a minimum AGMA 6 rating when rated in accordance with the latest AGMA standard. Gear teeth shall be designed for proper load distribution and sharing. Stub tooth design and surface hardening of the main gear shall not be allowed. The main bearing shall be capable of withstanding the listed overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.

1. All spur gearing shall be designed to the latest AGMA spur gear standard for strength and surface durability, based on a life of 175,000 hours. The design running torque rating of the drive gearing shall be based on the smaller of the strength and durability values determined from the above AGMA standard. To ensure safety and ease of maintenance, all components of the drive shall be direct coupled.

2. No overhung pinions shall be allowed on the speed reducing unit. The lower pinion bearing shall not be located below the turntable base.

3. Any and all welding on the drive unit shall be done using E70XX weld rod.

H. The drive unit shall consist of a solid internal main spur gear, bearing turntable, pinion, secondary speed reducer, support base, and drive unit bearing. The drive shall be mounted on the center column and support the entire rotating load of the mechanism. The main internal gear shall be forged of alloy hardened steel. The pinion shall be heat treated alloy steel. Support base for the drive shall be of welded steel to assure rigidity.

Dust shields shall be provided. The drive bearing shall include a forged steel precision gear/bearing set, with fully contoured raceways hardened to a minimum 58 62 Rc and protected by a neoprene seal. The drive shall be designed so that the balls and nylon spacers can be replaced without removing the access walkway. The main gear to pinion gear mesh shall be oil lubricated. An oil sight glass, fill pipe, and drain shall be provided for the reservoir. Lubrication fittings shall be readily accessible.

I. The speed reducing unit shall consist of cycloidal, helical, or planetary speed reducers directly connected to a motor without the use of chains or v belts, and shall be keyed to the pinion.

1. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high-speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft. Speed reducer efficiency shall be a minimum of 90% per reduction stage.

2. Speed reducer helical or planetary gearing shall be manufactured to AGMA standards and shall provide at least 95% power transmission efficiency per stage. The speed reducer shall have a minimum service factor of 1.25 based on the output torque rating of the drive.

3. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and be grease lubricated. As a safety feature, the speed reducer shall be back drivable to release any stored energy as the result of an over torque condition.

J. The motor shall be totally enclosed, ball bearing type, of ample power for starting and continuously operating the mechanism without overloading. The motor shall conform to Section 11050 and be suitable for operation on 460 volt, 3 phase, 60 Hertz power.

K. An overload device shall be provided in a stainless steel, weatherproof enclosure. The device shall be actuated by torque generated from the main drive, which shall operate two independently adjustable switches (the alarm switch at 100 percent of design running torque and the motor cutout switch at 120 percent of design running torque). Devices that require the worm to float and measure the thrust of the worm gear shall not be acceptable. These two switches shall be factory adjusted to accurately calibrate the alarm torque value and the overload position. A visual torque indicator shall be provided and oriented so that it may be read from the walkway. It shall be calibrated from 0 to 160 percent of design running torque.

L. A space heater shall be provided in the overload housing for condensate control. 120 volt connecting wiring and controls shall be furnished by the Contractor.

M. A visual torque dial indicator shall be provided and oriented so it may be read from the walkway.

N. The microswitches shall be factory set to: 1) sound an alarm when the load on the mechanism reaches 100 percent of the AGMA rated torque capacity of the drive; and 2) stop the motor when the load reaches 120 percent of the AGMA rated torque capacity. The alarm shall be provided by the equipment manufacturer.

O. A shear pin device, set for 130 percent of the AGMA rated torque shall be furnished.

P. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. It shall have a maximum allowable deflection in accordance with the bearing specifications. The allowable modulus of elasticity shall be a minimum of 29 x 106 psi. The center cage shall be fastened to and supported from the gear casing. Ball bearings shall be of high carbon chrome alloy 52100 steel running in fully contoured races, as part of a precision gear/bearing set. The balls shall be grease lubricated and protected by elastomer seals. Felt seals that allow the entrance of moisture from outside the drive (i.e. rain water, condensate, etc.) will not be allowed.

Q. A heat trace tape and controls shall be provided to prevent freezing of the condensate pipe by the mechanism manufacturer. 120 volt connecting wiring shall be furnished by the Contractor. The controls shall include a push to test light in a NEMA 4X control box.

R. Torque Tube and Scraper Arms:

1. The steel torque tube shall be bolted to the final reduction gear and shall support two structural steel rake arms. Manufacturer shall visit the site to review the existing concrete bottom connection and recommend modifications as necessary for their torque tube arrangement to be made by the contractor.

2. Equip sludge collecting arms with spiral scraper blades set and spaced to scrape settled sludge from the tank bottom to a sludge hopper located at the center of the tank. The collecting arms shall be attached to and rotated by the torque tube.

3. Fabricate the collecting arms of structural steel with a minimum thickness of 1/4-inch and adequately brace with struts.

4. Space blades so that the entire tank bottom is scraped twice for each revolution of the mechanism.

5. Provide adjustable spring stainless steel squeegees, for all blades, that project 1-1/2-inch below the bottom of the blade.

S. Influent feedwell flocculation baffles.

1. A rotating circular energy dissipating inlet shall be supported by the bridge and be designed to diffuse the liquid into the rotating feedwell in an impinged flow direction without excessive disturbance or formation of vertical velocity currents. The EDI shall be designed to positively prevent sludge from depositing within the EDI and shall include bottom drain holes.

2. The diameter, depth, and detention time of the EDI shall be included in the submittal with the design calculations and shall show proper process application as evidenced by the required successful operating installations.

3. The rotating EDI shall be designed with a full bottom extending to within 1 inch of the torque tube. It shall include an upper rim angle for stiffness. Multiple, discharge ports shall be provided to induce impinged flow. The gates shall have a fixed bottom to prevent vertical currents as the flow exits the EDI.

4. The EDI shall be made of not less than 3/16-inch-thick steel plate with necessary stiffening angles.

5. The flocculating rotating feedwell shall be located outside of the EDI to diffuse the liquid into the tank without disturbance or formation of velocity currents. Baffled openings shall be provided near the water surface to allow scum to exit the feedwell.

6. The supports for the feedwell shall be located either above the liquid extending from the bridge, or on the rake arms. Submerged supports from the rake arms shall be designed so as to minimize horizontal flow disruption.

7. No feedwell support or feedwell spliced connection shall be contained within the annular space formed between the feedwell and EDI. The depth of the feedwell shall be such as to provide proper detention time and an exit velocity at maximum flow that will not scour the settled sludge. The diameter, depth, detention time, and exit velocities shall match the process application calculations as evidenced by the required successful operating installations.

8. The feedwell shall be made of not less than 3/16-inch-thick steel plate.

T. Truss, and sludge rake arms.

1. The mechanism shall include two long sludge rake arms of steel truss construction with spiral steel scraper blades and adjustable stainless-steel squeegees. Squeegees shall be fastened to the rake blades with stainless steel fasteners.

2. Scraper blades shall be designed for sufficient sludge transport capacity to handle the design solids loading rate, with the depth of the blade varying from a minimum at the tank periphery to a maximum at the tank center.

3. Blades shall properly convey settled sludge to the sludge withdrawal.

4. The arms shall be adjustable at the cage to assure an even grout thickness over the tank bottom.

5. The rake speed shall be sufficient to transport the necessary volume of sludge to the sludge outlet, but shall not re-suspend settled sludge.

6. The tank floor slope and sludge withdrawal pit design shall be verified by the clarifier equipment manufacturer.

U. Access bridge, and handrailing.

~~1. The existing walkway and platform with handrails shall be supported by the tank walls at its outer end. The drive unit shall mount on the bridge.~~

~~2. The clarifier supplier shall field measure the bridge and it's components prior to shop drawing submittals to ensure all connections to their mechanism are compatible with the existing bridge. The connections shall be designed by the clarifier manufacturer and all steel components necessary shall be supplied and installed. The minimum thickness shall be one quarter inch. Manufacturer to verify the existing bridge will support the new internals.~~

1. An all-welded structural steel access bridge consisting of two channels or flange beams shall be anchored to the tank walls The bridge shall be designed to support, in addition to the dead load, a live load of 150 pound per lineal foot, with a deflection not exceeding 1/360 of the span.

2. A 3-foot wide walkway with 1/4-inch checkered aluminum floor plate shall extend over the entire bridge length. A three-rail aluminum handrail, shall be furnished for both sides of the walkway and around the center mechanism. Use grating, it's safer no ice buildup lower maintenance. New stairs shall also be provided.

3. Walkway at the center of the mechanism shall be constructed with a removable plate to allow access to the slip tubes below the plate or the slip tubes shall be mounted so they are not under the walkway, but easily accessible. The center area shall produce a minimum of 2-feet-6-inch clearance around the drive parts.

4. It may be necessary to raise the elevation from the existing bridge elevation to accommodate the new equipment. Clarifier manufacturer is responsible for the connection of the bridge and platform to the existing clarifier walls and replacing the existing stairs. **(Addendum 1, Issued 01/06/20.)**

V. Surface skimmer.

1. The clarifier manufacturer shall furnish two skimming devices as part of each mechanism. The skimming mechanism shall be arranged to sweep the surface scum between the feedwell and scum baffle into a full radius scum trough cantilevered from the tank wall.

2. Each skimmer arm shall be supported by a suitably designed truss, tube, or pipe assembly connected to the center cage and cantilevered over the scum trough. Tie rods shall be properly located to allow adjustment of the skimmer arm as well as to hold the skimmer in horizontal alignment. Each skimmer arm shall be equipped with a 1/4 inch 50-60 durometer neoprene wiper blade extending the full width of the scum trough. Steel back-up bars shall be fastened to the back of the wiper with stainless steel fasteners.

3. A submerged portion of the wiper shall form a C-cup shape to trap and carry surface scum and water up the beach ramp and deposit the contents into the

trough. The C-cup assembly shall be fully submerged to minimize scum from escaping underneath the wiper as the scum is transported to the scum trough.

4. The full radius trough shall be supported from the tank wall and fabricated from 3/16 inch steel plate and structural steel angles to form a trough. The scum trough shall span the distance between the feedwell and the scum baffle. The trough and supports shall be designed for a 200-hundred-pound point load at the feedwell end of the trough in addition to all dead loads and shall not deflect more than 2 inch in an empty tank. The feedwell end of the trough shall be 6 inches deep and slope down to the wall end with a 6 inch Schedule 40 stub pipe. A flexible coupling shall be provided for connection from the 6 inch Schedule 40 stub pipe to the scum withdrawal piping in the tank wall. The front side of the trough shall include a minimum 12 inch wide ramp for removal of scum. The scum is trapped as the wiper meets the ramp and is conveyed up the ramp to be dumped into the scum trough for disposal. The feedwell end of the trough shall have a vertical steel plate extending 1 foot out in front of the ramp to help trap the scum as the skimmer approaches the ramp and to prevent the scum from flowing around the outside edge of the trough. Fabrication of the scum trough shall be true and free from any warpage.

5. A valve shall be attached to the scum box which automatically opens and allows clarified liquid into the scum box to flush out solids. The valve shall actuate at every pass of the scum skimmer over the scum box, allowing sufficient delay after deposit of the solids before flushing begins. Delay and flush duration shall be adjustable. The opening and closing of the scum flushing valve shall be one smooth continuous movement. The valve shall provide 2 to 5 gallons of flush water per each pass of the skimmer assembly.

W. Surface preparation and painting.

1. All surfaces shall be prepared in accordance with Section 01350.

2. The Contractor shall have the option of field painting or galvanizing all supplied steel components

X. Anchor bolts.

1. All equipment anchor bolts shall be stainless steel. The equipment manufacturer shall furnish a steel template and grout shield to accurately locate the center pier anchors and to allow grouting beneath the pier and manifold seal plate.

Y. Control panel.

1. A complete control panel shall be furnished for clarifier operation. Panel will accept three phase 480VAC, and include the following: NEMA 4X SS enclosure with disconnect handle.

2. Main circuit breaker and control power transformer sized for controls and overload housing and panel heater.

3. Motor starter and overloads.

4. HAND-OFF-AUTO switch, green running light, amber torque warning light, amber torque overload light, torque reset pushbutton, alarm horn and strobe light, and alarm acknowledge/silence pushbutton, and panel heater with thermostat. Indicator lights shall be LED push-to-test type.

5. Typical panel internals including but not limited to breakers, fuses, relays, terminals, wireway, cable and wire markers, ground bar, etc.

6. For interface to existing plant SCADA the control panel shall accept start signal, and provide dry contacts for motor running, HOA status, and torque warning.

PART 3 EXECUTION

3.01 INSTALLATION

A. The equipment shall be erected in accordance with the manufacturer's recommendations. Manufacturer shall field measure prior to submittals.

3.02 ACCEPTANCE TEST

A. The purpose of the test shall be to verify the structural integrity of the mechanism and drive. The manufacturer shall provide a qualified service representative to supervise the testing

B. The clarifier mechanism shall be field torque tested. The testing shall be carried out under the supervision of the equipment manufacturer’s representative before each mechanism is approved and placed into operation.

C. The torque test shall consist of securing the rake arms by cables to anchor bolts installed by the Contractor in the tank floor at locations specified by the equipment manufacturer. A torque load shall be applied to the scraper arm by means of a rachet lever and cylinder connected to the cable assembly.

D. The magnitude of the applied load shall be measured by calculating the torque from the distance of the line of action of each cable to the center line of the mechanism. Readings shall be taken at 50 percent, 85 percent, and 100 percent of design torque value. The test load shall be applied and noted on the torque overload device.

E. The manufacturer’s service representative shall certify that the alarm and motor cut-out torque of the drives as calibrated in the manufacturer’s shop are in proper operation to shut down the units as specified.

F. All equipment required for the test shall be provided by the manufacturer. After the successful test, the equipment shall be returned to the equipment manufacturer.

G. A written report of the test results shall be provided after satisfactory testing is complete.

PART 4 SPECIAL PROVISIONS

4.01 CONTROL PANEL

A. A Nema 4X control panel shall be supplied and installed for each clarifier with all wiring, controls and outputs as shown on the Drawings.

B. The panel shall be designed in accordance with Division 16.

4.02 INFLUENT PIPE AND SUPPORT

A. The manufacturer shall supply the influent pipe arranged to connect to the existing wall sleeve and proceed under the rotating feedwell and into the EDI including all necessary supports for the influent pipe. Influent pipe support method to be determined by the manufacturer.

4.03 DBS DRIVE ALTERNATICE BID ITEM

A. General: The drive mechanism shall consist of an electric motor, primary hydraulic reduction unit, and an enclosed final reduction unit consisting of a pinion and an internal tooth gear.

B. Primary Hydraulic Reduction Unit: The primary hydrostatic reduction unit shall drive the intermediate gear reducer.

1. The primary reduction unit shall consist of a hydraulic gear pump and a hydraulic motor.
2. The primary reduction unit shall have an integral hydraulic manifold that shall incorporate a hydraulic pressure relied calve to give protection against overload, flow control calve, a dual function cartridge cavity for uni-directional or bidirectional operation, a 4-20 mA transducer port, a pressure gauge port, and a hydraulic filter port.
3. A minimum service factor of 3.0 shall be applied to the catalog rating of any commercial hydraulic component.
4. All hydraulic components shall be enclosed in a steel housing of sufficient size to contain the minimum volume of 6 gallons of hydraulic fluid. The housing shall serve as the reservoir for the hydraulic oil.
5. Internal oil circulation in the event of any hydraulic pump or motor seal leakage.
6. A disposable “spin-on” type hydraulic filter shall be provided to filter the hydraulic oil.
7. Hydraulic pump drive shaft must be vertical to permit vertical mounting of electric motor.
8. Individual hydraulic control components plumbed together with pipe or hose fittings shall not be allowed.

C. Intermediate Gear Reducer: The intermediate gear reducer shall be mounted on the top of the final reduction unit and properly registered to maintain accurate centers for the final reduction gearing.

1. The intermediate reduction unit shall have sufficient bearing capacity to fully the pinion gear without a lower support bearing.
2. The L_{10} life of the intermediate gearbox bearings shall be in excess of 100,000 hours at 16,000 ft. lbs. operating torque.
3. The Service Factor shall be greater than 2.5.
4. The intermediate reducer shall be AGMA rated for 10 million cycles, when drive is operating at continuous output torque of 16,000 ft. lbs.

D. Final Reduction Unit:

1. The final reduction housing shall be manufactured from A36 steel plate. All welds shall conform to applicable specifications of the AWS. After welding, all mounting and mating surfaces shall be machined to insure proper fit and alignment of the drive pinion and mating gear. The base plate on which the gear and bearing is mounted shall be flat within 0.008". The steel plate to which the intermediate pinion drive gearbox is mounted shall be a minimum of 1.5" thick.
2. The final reduction housing shall employ a fluid hermetic seal and a Neoprene seal between the housing and the main gear driven rotating member to prevent passage of air or water into the final reduction housing.
3. The final reduction unit internal tooth gear shall be machined to AGMA grade 6 or higher. Gear teeth shall have a core hardness of 250 to 300 BHN, and be induction hardened to 55Rc. The main gear set shall be rated per AGMA Standard 2001-C95 for 20 years at a continuous torque load of at least 40,000 ft. lbs. Gear pitch diameter shall be a minimum of 30".
4. The main gear support bearings shall have an L_{10} life in excess of 100 years.
5. The final reduction unit pinion shall be made of heat-treated alloy steel and shall be mounted on the output shaft of the intermediate reduction gearbox. The gear teeth shall be induction hardened to 55 to 60 Rc.

E. Electric Motor: The drive motor shall be Mill & Chemical Duty TEFC, 1.15 Service Factor, Class F insulation.

F. Overload Device: The overload protection device shall have two independent switches, which may energize an alarm circuit when the load on the mechanism approaches overload and pen the motor circuit when and excessive overload occurs. The switches shall be enclosed in NEMA 4x HOUSING. Overload device shall have a 6" diameter stainless-steel torque gauge indicating torque load on drive unit in ft. lbs. Overload alarm, and overload cut off torque settings shall be factory preset per customer specifications.

G. The entire drive unit shall be designed for a maximum duty torque of at least 32,000 ft. lbs., and the final reduction unit main gear set shall be designed for a momentary peak torque of at 94,000 ft. lbs. All calculations of gear & bearing life shall be made in accordance with the latest AGMA and AFBM standards.

H. All lubrication shall be of the totally enclosed grease or oil bath design.

I. The drive mechanism shall be manufactured by DBS Manufacturing, Model D30-AF.

END OF SECTION