c. Filter cloth drive

d. Filter media

e. Press cylinder

f. Blower and air lance system

g. Conveyor/compactor and drive

h. Level switches

i. Control panel

## 2.2 Acceptable Manufacturers

.1 Salsnes Filter - Model SF6000

## 2.3 Capacities and Performance

| | | |
|---|---|---|
| Number of Units | | 1 |
| Equipment Tag | | PF-108 |
| Peak Instantaneous Flow | L/s | 160 |
| Influent Total Suspended Solids Concentration (Average) | mg/L | 260 |
| Influent Total Suspended Solids Concentration (Max) | mg/L | 500 |

## 2.4 Materials

.1 All submerged components to be construct 304L stainless steel. All non-wetted components to be epoxy steel or 304L stainless steel.

## 2.5 Filter Cloth

.1 Provide filter cloth as recommended by manufacturer suitable for intended service.

## 2.6 Electrical

.1 Make all power and signal wiring between sub-systems suitable for wet and corrosive locations in accordance with applicable codes. Refer to Division 16.

.2 Power will be supplied at 600/575 volt, 3 phase, 60 Hz and 120 volt, single phase, 60 Hz.

.3 Control system voltages are to meet plant standards.

## 2.7 Motors

.1 All drive motors are to be suitable for installation in Class 1 Division II Group environment. Drives to be 600 volt, 3 phase, 60 Hz, with TEFC enclosure complying with Section 11205.

## 2.8 Control Panel

.1 Provide a control panel for the filter capable of operating the system without operator intervention. Provide all controls, hand switches to allow the equipment to be operated in Hand-Off-Auto mode.

.2 Provide an Allen Bradley PLC -Series 505.

.3 The PLC shall communicate using Ethernet protocol.

.4 The control panel is to be CSA approved in accordance with Division 16.

.5 Provide the following auxillary contacts:

.1 High level alarm

.2 Multivariable alarm

## 2.9 Equipment Classification

.1 The filtration equipment and drives are to be suitable for installation in a Class 1 Division II Group D environment.

.2 The control panel and blower will be installed in a separate unclassified room adjacent to the Headworks.

## 2.10 Spare Parts

.1 Provide two spare filter cloths.

.2 Provide spare set of bearings for all drives.

.3 Provide other small parts and special tools as recommended by the manufacturer.

.4 Provide list of all spare parts that would be expected and required under normal conditions for a period of 5 years. Provide a price for these parts.

# 3. EXECUTION

## 3.1 Manufacturer's Representative

.1 Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and supervise the testing of the system, to be conducted by the Contractor, for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the manufacturer's recommended procedures.

.2 The minimum periods of site attendance are identified in the following table along with the form to be completed on each of these trips. A "day" is defined as eight working hours on site.

.3 The total number of trips will depend on the Contractor's schedule. The cost of additional trips, to be determined by the Engineer, will be borne by the Contractor.

## 3.2 Installation Training

.1 Conform to the requirements of Section 01650.

.2 Instruct the installer in the methods and precautions to be followed in the installation of the equipment. Certify the installer's understanding by completing Form 101, illustrated in Section 01650.

## 3.3 Installation Witnessing

.1 The Contractor and Manufacturer's Representative shall verify that the channel and filter basin dimensions are within the manufacturer's stated tolerances.

.2 The Contractor shall ensure that equipment is installed plumb, square and true within tolerances specified by the Supplier and as indicated in the Contract Documents.

.3 The Contractor shall ensure the equipment is installed as required to provide satisfactory service.

.4 Conform to the requirements of Section 01650, as documented by Form 102.

## 3.4 Testing and Commissioning

.1 Attend during commissioning of the filtration system to ensure it functions as intended by the manufacturer.

## 3.5 Operator Training

.1 Provide one 8 hour day of classroom training. The training session is to take place the day after Form 103 is signed.

.2 Allow for a total of 4 days on-site for testing, commissioning and training.

**END OF SECTION**

# CENTRE-DRIVE, SPIRAL SCRAPER SLUDGE COLLECTOR SECONDARY CLARIFIERS

## 1. GENERAL

### 1.1 Work Included

.1 This Section specifies the supply and supervision of installation, testing and commissioning of centre-drive spiral scraper sludge collector circular secondary clarifier mechanisms.

### 1.2 Submittals

.1 Shop Drawings: Submit in accordance with Section 01300 and Section 11005. In addition to the requirements of Section 11005, submit the following:

.1 Fabrication drawings for the clarifier mechanism including truss arms, centre torque cage, etc., signed and sealed by a Professional Engineer.

.2 List of which components and materials that are shipped pre-assembled and parts list for the other components and materials. Indicate weights and physical dimensions for each part, assembly and/or package to be shipped.

.2 Operation and Maintenance Data: Provide data for incorporation in the Operation and Maintenance Manual as specified in Section 01730. Include complete operation description together with general arrangement and detailed drawings, wiring diagrams for power and control schematics, parts catalogue with complete list of repair and replacement parts with Section drawings illustrating the connections and identifying numbers.



### 1.3 Coordination

.1 Coordinate with other Divisions to ensure there are no conflicts in the work.

### 1.4 Shipment, Protection, and Storage

.1 Ship pre-assembled to the degree possible.

.2 Provide storage instructions indicating specific requirements to ensure there is no uneven wear, distortion, or weathering of components.

.3 Identify all other special storage requirements.

## 2. PRODUCTS

### 2.1 Description

.1 Design the secondary clarifier mechanism to remove settleable biological floc from mixed liquor from the bioreactor. Mixed liquor enters through pipe installed below the tank floor and flows up the centre column through inlet ports into the centre energy dissipating

compartment. Ports in this compartment direct mixed liquor to the outer flocculating well. Settled solids are collected by a spiral blade collector and conveyed to a central hopper from where they are piped to an external RAS pump.

.2 The secondary clarifiers each have dedicated return secondary sludge (RAS) pumps to return RAS to the bioreactor's pre-anoxic zones.

.3 Clarified effluent overflows the V-notch weir plate, located along the perimeter of the clarifier, and discharges into the effluent launder.

.4 Provide clarifier mechanisms capable of continuous operation.

.5 Design the complete package to have sufficient strength to sweep in the 50 mm grout on the tank bottom under its own power.

.6 Structurally design assembly so that when it runs dry, the mechanism maintains level operation so that the clearance between the clarifier floor and sludge collection device does not vary by more than plus/minus 5 mm.

## 2.2 Acceptable Manufacturers

.1 Envirex/US Filter

.2 HiTech

.3 WesTech Engineering

.4 Dorr-Oliver Eimco



## 2.3 Materials

.1 Conform to ASTM material specifications where possible; state all deviations.

.2 Steel truss type construction for sludge removal arms with steel raking blades and spring brass squeegees. Secure squeegees with brass bolts and nuts.

.3 Fabricate the submerged rotating trusses as all-welded construction to provide a support framework for the scrapers and skimmers.

.4 Stainless steel 316 bolts and nuts, dipped in "moly" to prevent galling.

.5 Welded steel scum beach; 6 mm minimum thickness.

.6 Neoprene wipers and a removable steel wearing strip for end blades of surface skimmers.

.7 Aluminum open grating platform and structural members for access ladders.

.8 Neoprene seals between the stationary centre column and any rotating elements.

.9 **Carbon Steel**

.1 All structural carbon steel shall conform to the requirements of ASTM A36.

.2 Steel pipe used for structural members shall conform to the requirements of ASTM A53.

.10 **Stainless Steel**

.1 Stainless steel shall be type AISI type 304L or 316.

.2 All structural members shall conform to the requirements of ASTM A666.

.3 Stainless steel pipe used for structural members shall conform to the requirements of ASTM A312.

## 2.4 Capacities and Performance



| | | |
|---|---|---|
| Number of Units | | 2 |
| Tag Number | | CM-301, 303 |
| Diameter | m | 13.6 |
| Depth at Centre | m | 5.57 |
| Side Water Depth | m | 5.0 |
| Overflow Rate | | |
| Average Flow | $m^3/m^2/d$ | 11 |
| Peak Hourly Flow | $m^3/m^2/d$ | 33 |
| Solids Loading Rate | | |
| Maximum | $kg/m^2/d$ | 6.4 |
| Maximum SVI at Average Flow | mL/g | 200 |
| Weir Length per Clarifier | m | 42.7 |
| Diffusion Well | | |
| Retention Time at Peak Hourly Flow | s | 5 |
| Port Velocity at Peak Hourly Flow | m/s | 0.5 |
| Depth | m | 1.0 |
| Diameter | m | 0.67 |
| Flocculation Well | | |
| Retention time @ ADF x 2.0 | min | 20 |
| Depth of floc well | m | 2.75 |
| Diameter | m | 3.2 |
| Bottom Slope (approx) | | 1:12 |

## 2.5 Centre Column

.1 Material: carbon steel, factory-coated with high-build epoxy.

.2 Provide stationary centre column.

.3 Use standard weight, steel pipe, mounted over mixed liquor inlet so centre column acts as influent pipe.

.4 Flange base of column for bolting to clarifier floor and top of column for bolting to base of drive.

.5 Design and anchor centre column to withstand the specified Design Torque and to carry all vertical loads as well as any unbalanced loads, whether the clarifier is empty or full.

.6 Provide a suitable number of ports that remove no more than 50 percent of the circumference of the centre column to allow the exit of mixed liquor into the energy dissipating inlet. The exit velocity shall be designed for no greater than 3.0 m/s at the peak hourly overflow rate plus RAS. Extend openings a minimum of 150 mm above water surface to allow escape of floatables and scum.

## 2.6 Centre Drive Mechanism

.1 Centre drive mechanism to consist of a primary gear reduction unit, an intermediate gear reduction unit (if required), and a final reduction unit enclosed in a turntable base.

.2 Design the mechanism and drive unit for a continuous operating load of 100 N per metre of width. Supply calculations to show that these torque conditions are met:

| | | |
|---|---|---|
| .1 | Alarm Torque: | 120% of continuous operating torque |
| .2 | Cut-out Torque: | 130% of continuous operating torque |
| .3 | Design Torque: | 300% of continuous operating torque |
| .4 | Maximum tip speed: | 100 mm/s |



.3 As a backup mechanical disconnect, provide a shear pin to disconnect the motor at 140% of the continuous operating torque.

.4 Enclose gear reduction and turntable units in cast iron housings.

.5 Design gears to meet AGMA Standards for standard duty, 24 hour continuous service.

.6 Run all gears and bearings in an oil bath. Provide readily accessible lubricant fill and drain pipes with necessary fittings and oil indicators.

.7 Design the drive main bearing for the total rotating weight with a minimum ABFMA B10 bearing life of 200,000 hours, suitable for 24 hour continuous operation.

.8 Design all main drive components to provide a minimum wear life of twenty (20) years.

.9 Design all bearings other than the drive main bearing for a minimum ABFMA B10 bearing life of 100,000 hours, suitable for 24 hour continuous operation.

.10 Design the entire drive mechanism, including turntable, to be serviced without removal of the walkway.

.11 Heat trace the drive mechanism to prevent freezing.

## 2.7 Drive Motor

.1 Provide a motor adequately sized to continuously carry all loads which may be imposed.

.2 TEFC, designed for a maximum ambient temperature of 40°C.

.3 Mount the motor on top of the drive mechanism unit.

.4 Motor is to be 1800 RPM, 60 Hz, 575 Volt.

.5 Comply with requirements of Section 11205.

## 2.8 Protection and Alarm

.1 Equip the drive mechanism with a weatherproof torque indicator and electro-mechanical overload contacts.

.2 Provide and arrange micro-switches to provide an alarm signal when torque overload starts to develop and to stop the motor when the torque becomes excessive. Mount the switches in weatherproof enclosures and pre-wire the switches to a weatherproof enclosure.

.3 Pre-wire the micro-switches to a numbered terminal strip. Provide the following dry contacts for each drive unit:

- .1 Unit Running (Status)
- .2 Motor Overload
- .3 Alarm-Torque
- .4 Cut-out Torque

.4 Rate contacts at 5 amp, 120 V AC. Configure as normally open, to close on alarm condition.

## 2.9 Walkway

.1 Provide walkway with minimum clear width of 1,000 mm and a minimum of 600 mm working space around the equipment mounted above the operating platform.

.2 Support the walkway at the centre column and by the clarifier wall. Design the walkway for a live load shall be 6.0 $kN/m^2$, and a maximum deflection of the walkway shall not be more than 1/360 of the span when all relevant loads are included.

.3 Provide the walkway with access doors over the drive mechanism.

.4 Fabricate walkway using welded aluminum grating.

.5 Provide suitable insulation at the connection points between aluminum members and any steel members to prevent galvanic corrosion.

.6 Provide access stairs from the walkway to ground level. Use aluminum structural members for access stairs.

**2.10 Centre Cage**

.1 Material: 304L stainless steel.

.2 Design the centre cage to support the energy dissipating inlet, flocculation well, sludge rake arms and all other rotating appurtenances.

.3 Suspend the centre cage from the turntable, which will rotate with the attached energy dissipating inlet, flocculating well, sludge rake arms and the scum skimmer mechanism.

.4 Design the centre cage to withstand the specified Design Torque.

**2.11 Energy Dissipating Inlet (EDI)**



.1 Material: 304L stainless steel.

.2 Provide closed bottom, rotating, energy dissipating inlet with a minimum of four (4) discharge ports for diffusing the mixed liquor from the EDI into the flocculation zone.

.3 Provide each discharge port with adjustable diffuser gate. Size gates to provide an exit velocity no greater than 0.6 m/s with all gates fully open.

.4 Hinge the gates on one side and provide adjusting arm that can be locked in position when an appropriate gate setting is found.

.5 Mount the top edge of the well 50 mm above the no-flow water level, plus or minus 3 mm. Mounting at this elevation allows the passage of scum and foam without compromising the flow pattern. Provide threaded stainless steel ready-rod supports to allow the well to be raised or lowered by 50 mm in either direction.

.6 Extend gate opening above water level to allow scum and floatables to exit the EDI.

.7 Provide neoprene seal between energy dissipation compartment and centre column.

**2.12 Flocculation Well**

.1 Material: 304L stainless steel or corrugated fibreglass for well panels; 304L stainless steel for framing members.

.2 Support from truss arms and/or centre cage.

.3 Fabricate flocculation well as a circle or as a polygon with a minimum of 8 equal sides.

.4 Connect adjacent pieces and the frame with neoprene gaskets between to minimize leakage.

.5 Mount the well level with the top edge of the frame at 50 mm below the no-flow water level, plus or minus 3 mm. Mounting at this elevation allows the passage of scum and foam without compromising the flow pattern. Provide threaded stainless steel ready-rod supports to allow the well to be raised or lowered by 150 mm in either direction.

## 2.13 Truss Arms

.1 Material: 304L stainless steel.

.2 Support rotating truss arms from centre cage.

.3 Fabricate truss arms using steel rods, structural sections, turn buckles, clevises, and lock nuts.

.4 Design to hold the sludge and scum collection devices in a horizontal and vertical plane when subjected to the specified Design Torque.



## 2.14 Sludge Scrapers

.1 Material: 304L stainless steel.

.2 Provide two (2) scraper blades arranged to form a spiral extending from the outer wall to beyond the centre column.

.3 Provide a bottom blade with squeegees attached, projecting a minimum of 38 mm below the bottom of the blade. Squeegees to be of spring brass construction, connected to the bottom blade with stainless steel fasteners and dielectric insulator fittings.

.4 Connect the bottom blades to the truss arms via welded support arms fabricated of hollow steel sections.

.5 Extend the scraper mechanism into the centre hopper.

.6 Slopes of the arm and blades shall conform to the slope of the tank bottom.

## 2.15 Effluent Weir

.1 Material: aluminium, 304L stainless steel, FRP.

.2 Clarifier to be provided with 50 mm deep V-notch weirs located on 150 mm centres. Weir to be located one inboard side of the peripheral effluent launder. Weir to be slotted to allow up to 100 mm vertical adjustment.

## 2.16 Launder Brush System

.1 Attach the brush system to the skimmer arm.

.2 Design the brush system to have flexibility and with adjustment capability to ensure proper cleaning of the effluent launder and V-notch weir plates.

.3 Fabricate the brush assembly from 304L stainless steel.

.4 Acceptable manufacturer: Ford Hall

## 2.17 Welding

### .1 General

.1 Members shall be fully welded. Welds and sharp edges shall be ground to a smooth contour.

.2 All welded connections shall develop the full strength of the connected elements and all joined or lapped surfaces shall be completely seal welded with a minimum 5.0 mm (3/16") fillet weld. Intermittent welding is not permitted. All welding shall be done in accordance with the latest edition of NACE RP0178.

.3 All edges of ferrous metals shall be ground to a radius by multiple passes of a power grinder as required to ensure satisfactory coating adherence. Fillets and corners must be accessible for grinding. All rough welds shall be ground to remove sharp edges, undercuts, pinholes, weld splatter and other such surface flaws and irregularities. Provide a minimum radius of 6 mm on all edges and corners.

.4 Butt-welded joints shall be used whenever possible. The use of internal bolted connections shall be avoided. Continuous lap-welded joints are permissible, but not preferred.

.5 All connections shall be shop welded or field bolted. Field welds are not permitted.

.6 Provide continuous seal welds on both sides of all welded joints.

.7 Provide minimum clearance between members in accordance with NACE RP0178.

.8 Continuously weld all welded connections to seal the mating surfaces completely.

.2 **Steel**

.1 Welding shall be done to written procedures tested and qualified in accordance with AWS D1.1, CSA W47.1 or ASME IX.

.2 Welders and welding operators shall be qualified in accordance with AWS D1.1, CSA W47.1 or ASME IX.

.3 Welding workmanship shall conform to CSA W59.1

.4 For pipe less than 75 mm in diameter, butt-weld to develop full strength, full penetration joints.

.5 For pipe equal to or greater than 75 mm in diameter, where not specified or shown otherwise, butt-weld to develop full strength, full penetration joints or furnish flanges, conforming to ANSI B16.5, Class 150. Where disassembly is required, flanges are sufficient.

.6 Use manual shielded metallic arc (SMAW), submerged arc (SAW), inert gas shield arc welding (GMAW), or gas tungsten arc welding (GTAW).

.7 Bevel plain pipe ends prior to welding.

.8 Joints to be welded shall be clean and dry for a distance of at least 50 mm on each side of the joint.



.9 Maintain flanges, pipes, fittings, etc. in alignment during welding. Ensure that no part of the weld is offset by more than 20% of the pipe wall thickness.

.10 Make tack welds material equal to the root pass. Tack welds which have not cracked may be incorporated in the root pass.

.11 Ensure the first bead obtains full root penetration with a minimum of weld material projecting within the pipe.

.12 Use welding materials conforming to CSA or AWS specifications.

.13 Provide electrodes compatible with the material welded and which deposit metal with strength and corrosion resistance properties at least equivalent to the base metal.

.3 **Stainless Steel**

.1 Conform to stainless steel welding procedures tested and qualified in accordance with ASME IX.

.2 Welders and welding operators shall be qualified in accordance with either AWS D1.1, CSA W47.1 or ASME IX.

## CENTRE-DRIVE, SPIRAL SCRAPER SLUDGE COLLECTOR SECONDARY CLARIFIERS

.3 For all stainless steel pipe intended to convey liquids, use inert gas backing for field and shop welds. For these services, Solar Flux or similar granular backing will not be permitted.

.4 Pickle and wash all stainless steel to remove discolouration and iron particles. Following assembly, treat all welds with pickling paste, scrub with stainless steel brushes and wash until clean. Wash the completed assembly with clean water to remove all dirt and other foreign matter.

.5 Swab all welds with a passivation solution of six percent nitric and three percent hydrochloric acids.

.6 Neutralize and/or rinse as appropriate the joint after passivation.

.7 The Supplier shall maintain a welding record which identifies all welds related to the welder or the welding operator.

.8 The chemical analysis of the material used, as supplied by the stainless steel manufacturer, shall be available to the Consultant upon request.

.9 All equipment used in welding preparation shall be covered or faced with material that will prevent mild steel particles from contaminating the surfaces and joints of the stainless steel material.



.10 Equipment used to prepare joints such as ground clamps, wire brushes, steel wool, chisels, files and peen hammers shall be made from stainless steel. Mark these items "Stainless Steel".

.11 Grinding wheels shall be correctly selected for use on stainless steel and grinders shall be identified by a distinguishable colour to prevent accidental contamination.

.12 All metal that is to be fused during welding shall be clean of lubricants, grease, paint, fillings, and cuttings. Cleaning may be done only with alcohol or acetone. Chlorinated solvents shall not be used for cleaning purposes.

.13 Joint alignment shall be done with mechanical devices and shall be free of depressions and bumps. Under no circumstances shall heat be used in the alignment of joints.

.14 Tack welds shall be made of the same quality as the final weld. It shall be made small enough to allow them to be absorbed into the following beads, and they shall have oxides removed in advance of making the finishing weld.

.15 All scale, oxides, and discoloration shall be removed from the pipe and welds.

.16 Provide electrodes compatible with the material welded and which deposit metal with strength and corrosion resistance properties at least equivalent to the base metal.

### 2.18 Protective Coating

.1 Factory prime and paint all ferrous components of the equipment with high build epoxy in accordance with Section 09905.

### 2.19 Spare Parts and Maintenance Materials

.1 In addition to what is required in Section 11005, provide a spare secondary bearing for each mechanism.

## 3. EXECUTION

### 3.1 Manufacturer's Representative

.1 Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the manufacturer's recommended procedures.

### 3.2 Installation



.1 Ensure the equipment is installed as required to provide satisfactory service.

.2 Instruct installer in the methods and precautions to be followed in the installation of the equipment. Certify the installer's understanding by completing Form 101, illustrated in Section 01650.

.3 Cooperate with the installer to fulfill the requirements for a successful installation, as documented by Form 102, illustrated in Section 01650.

### 3.3 Testing

.1 Ensure the equipment, including all component parts, operates as intended.

.2 Test level of clarifier to ensure clearance from floor does not very by more than ±5 mm.

.3 Load test clarifier to 150 percent of continuous torque. Verify torque settings of protective devices.

.4 Cooperate with the installer to fulfill the requirements for successful testing of the equipment as documented by Form 103, illustrated in Section 01650.

### 3.4 Commissioning

.1 Attend during commissioning of the process system which includes the equipment specified in this section to ensure the equipment functions as intended.

## 3.5 Training

.1 Provide one 8 hour day of classroom training. The training session is to take place the day after Form 103 is signed.

**END OF SECTION**

# 1. GENERAL

## 1.1 Work Included

.1 This section specifies the design, install, testing and commissioning of the fine bubble aeration devices. To the extent possible, components of the existing fine bubble aeration system, including piping, diffusers, membranes and associated appurtenances are to be re-used in the wastewater treatment plant. In the event that the quantity of existing equipment is not sufficient or the existing equipment has been damaged and therefore not suitable for re-use, refer to Section 01601 for payment of additional items. The cost of installing any additional equipment, and any delays or other costs associated with supplying the additional equipment, will be included in the Contract Price.

.2 The Supplier shall design components and mechanisms and all other associated equipment, appurtenances and controls required to install the existing fine bubble aeration system components in Aerobic Cells 2 and 3 of Bioreactors 1 and 2. In addition, the existing fine bubble system components shall be installed in the TWAS Vault. New aeration system components (including membranes, diffuser heads and associated appurtenances) shall be provided in Aerobic Cells 1 of Bioreactors 1 and 2 and none of the existing diffusers heads nor membranes shall be used in these cells.

.3 The Supplier shall also provide Site Services for the components and all other associated equipment and appurtenances related to the installation of the fine bubble aeration system:

.1 Witnessing of equipment installation.

.2 Operation, maintenance and training.

## 1.2 Definitions

.1 Normal cubic metres per minute ($nm^3$/min.): the volumetric flow rate in cubic metres per minute at 20°C, 36% relative humidity and 101.3 kPa absolute pressure.

.2 Dynamic Wet Pressure: pressure required to operate the diffuser in tap water at the specified flow rates minus any losses for submergence and flow control devices.

.3 Absolute pressure, kilopascals: kPaA.

.4 Gauge pressure, kilopascals: kPa.

.5 All terms in the description of the aeration system guaranteed performance testing (SOTE Testing) are as described in "A Standard for the Measurement of Oxygen Transfer in Clean Water," ASCE, June 1992.

## 1.3 Submissions

.1 Performance Guarantee: Provide a written guarantee indicating the specified minimum Standard Oxygen Transfer Efficiency (SOTE) that will be achieved by the aeration system in each zone of the bioreactor.

.2 Equipment Submittals

.1 All drawing submittals shall include electronic copies in AutoCAD 2000 format.

.2 Shop Drawings: Submit in accordance with Section 01300 and Section 11005. In addition to the requirements of Section 11005, include the following:

.1 A copy of this Section with check to indicate conformance or acceptance of each clause. Non-conformance shall be indicated by a cross "X".

.2 Dimensioned drawings showing the aeration piping system including the location and elevation of diffusers, manifolds and laterals, pipe supports, expansion joints, droplegs, purge system, and dynamic wet pressure monitoring system.

.3 Manufacturers catalogue information including diffuser type designation and operating characteristics.

.4 Details of the dynamic wet pressure monitoring system, including connection details.

.5 Details of anchorage and support design.

.6 Maximum anticipated dropleg loads which must be supported by the upper connection.

.7 Calculations establishing the maximum air flow to each cell, in $nm^3/min.$, based on the specified maximum Actual Oxygen Requirement (AOR), alpha and beta factors for each tank, the required diffuser depth and the specified Standard Oxygen Transfer Efficiency. Calculations to be signed and sealed by a professional engineer.

.8 Calculations establishing the number of diffusers proposed for each cell based on the maximum air flow per cell established above, and the proposed maximum air flow per diffuser and/or any other factors. Clearly state any other factors considered which impact the number of diffusers. Calculations to be signed and sealed by a professional engineer.

.9 Calculations establishing the distribution of laterals and diffusers to achieve uniform dissolved oxygen (D.O.) concentrations through the aerated cells.

.10 Calculations verifying that the air flow per diffuser will not vary by more than 2.5 percent within a grid at the minimum and maximum specified air flow rate. Calculations to be signed and sealed by a professional engineer.

.11 The name(s) of the manufacturer's qualified technical representative, who will be responsible for witnessing installations, testing and commissioning. Provide a list of projects on which they have worked, and their responsibility on these projects. Acceptance of the manufacturer's representative is subject to the approval of the Engineer.

.12 Start-up, testing and adjustment procedures.

.13 Installation instructions indicating assembly and mounting requirements, alignment and assembly tolerances, and points of connection for service.

.14 List of which components and materials to be shipped pre-assembled and parts lists for the other components and materials. Weights and physical dimensions to be indicated for each part, assembly and/or package to be shipped.

.3 Operation and Maintenance Data: Provide for incorporation in operating and maintenance manual, as specified in Section 01730. Include complete description of operation together with general arrangement and detailed drawings; parts catalogues, with complete list of repair and replacement parts with section drawings, illustrating the connections and identifying numbers.

.4 Detailed Aeration System Design: Based on the basic design parameters contained in this section and the verified performance characteristics of the aeration devices proposed, undertake detailed design of the aeration system and submit the calculations, drawings and any other explanatory information. Ensure the design calculations are signed and sealed by a professional engineer.

## 1.4 Atmospheric Service Conditions

| | | |
|---|---|---|
| .1 | Ambient air temperature (maximum) | 20°C: |
| .2 | Ambient air temperature (minimum) | -40°C |
| .3 | Relative humidity at maximum temperature | 45 percent |
| .4 | Relative humidity at minimum temperature | 100 percent |
| .5 | Barometric pressure | 101.1 kPa |
| .6 | Process air temperature differential | 75 °C |
| .7 | Site elevation above MSL | 8 m |

### 1.5 Shipment, Protection and Storage

.1 Ship equipment pre-assembled to the degree, which is practicable.

.2 Provide storage instructions indicating specific requirements to ensure there is no uneven wear, distortion, weathering of components or any other deterioration of the components.

.3 Identify all other special storage requirements.

## 2. PRODUCTS

### 2.1 Function

.1 Fine bubble aeration transfers oxygen to the mixed liquor in the secondary biological reactor(s).

.2 Furnish equipment under this section to supply diffused air for removal of carbonaceous and nitrogenous BOD from municipal wastewater.

.3 Ensure that the diffused air equipment provides adequate mixing of the tank contents to prevent solids deposition and assure uniform distribution of the mixed liquor.

### 2.2 Acceptable Manufacturers

.1 Supply products modified as necessary by the manufacturer to provide the specified features and to meet the specified operating conditions.

.2 Acceptable manufacturers are:

.1 Sanitaire

.3 Provide all fine bubble aeration devices by one manufacturer.

### 2.3 Capacities and Performances

.1 Design equipment for the conditions listed below:

.1 Design the aeration system to achieve a minimum Standard Oxygen Transfer Efficiencies (SOTE) for each mode in each cell when operating at the most severe condition. The most severe condition is defined as the maximum oxygen demand (SOTR), the minimum residual dissolved oxygen, maximum ambient temperatures, and maximum mixed liquor temperatures. Exceed the following minimum SOTE's in the aerated cells in each bioreactor:

| | | |
|---|---|---|
| **Dimensions of Cells** | | |
| **Bioreactor 1** | | |
| Aerobic Cell 1 | m | 6.00 L x 4.93 W |
| Aerobic Cell 1 SWD (from bottom of tank) | m | 4.08 |
| Aerobic Cell 2 | m | 5.90 L x 4.93 W |
| Aerobic Cell 2 SWD (from bottom of tank) | m | 4.08 |
| Aerobic Cell 3 | | 6.00 L x 4.93 W |
| Aerobic Cell 3 SWD (from bottom of tank) | | 4.08 |
| **Bioreactor 2** | | |
| Aerobic Cell 1 | m | 6.00 L x 4.93 W |
| Aerobic Cell 1 SWD (from bottom of tank) | m | 4.08 |
| Aerobic Cell 2 | m | 5.90 L x 4.93 W |
| Aerobic Cell 2 SWD (from bottom of tank) | m | 4.08 |
| Aerobic Cell 3 | | 6.00 L x 4.93 W |
| Aerobic Cell 3 SWD (from bottom of tank) | | 4.08 |
| | | |
| **TWAS Vault** | | |
| Dimensions (approximate) | m | 8 L x 4.1 W |
| Side Water Depth (Maximum) | m | 3.31 |
| Side Water Depth (Minimum) | m | 0.60 |
| | | |
| **Aeration System Design Parameters** | | |
| Aerobic Cell 1 Alpha Factor | | 0.50 |
| Aerobic Cell 2 Alpha Factor | | 0.55 |
| Aerobic Cell 3 Alpha Factor | | 0.60 |
| Aerobic Cell 1 Beta Factor | | 0.95 |
| Aerobic Cell 2 Beta Factor | | 0.95 |
| Aerobic Cell 3 Beta Factor | | 0.95 |
| Aerobic Cell 1 SOTE (Minimum) | % | 30 |
| Aerobic Cell 2 SOTE (Minimum) | % | 30 |
| Aerobic Cell 3 SOTE (Minimum) | % | 30 |
| Height of diffusers above floor | m | 0.3 |
| Min Residual DO Concentration Peak AOR | mg/L | 1.0 |
| Min Residual DO Concentration Avg AOR | mg/L | 2.0 |
| Minimum Mixed Liquor Temperature | °C | 12 |
| Maximum Mixed Liquor Temperature | °C | 20 |
| | | |
| **TWAS Vault Design Parameters** | | |
| Minimum air flow per minute / volume of tank | $m^3$ / min / $m^3$ | 0.03 |
| | | |
| **Actual Oxygen Requirement (AOR), Peak** | | |
| Bioreactor 1 | | |

| | | |
|---|---|---|
| Aerobic Cell 1 | kg/$O_2$/d | 340 |
| Aerobic Cell 2 | kg/$O_2$/d | 283 |
| Aerobic Cell 3 | kg/$O_2$/d | 204 |
| Bioreactor 2 | | |
| Aerobic Cell 1 | kg/$O_2$/d | 340 |
| Aerobic Cell 2 | kg/$O_2$/d | 283 |
| Aerobic Cell 3 | kg/$O_2$/d | 204 |
| | | |
| **Actual Oxygen Requirement (AOR), Avg** | | |
| Bioreactor 1 | | |
| Aerobic Cell 1 | kg/$O_2$/d | 151 |
| Aerobic Cell 2 | kg/$O_2$/d | 126 |
| Aerobic Cell 3 | kg/$O_2$/d | 91 |
| Bioreactor 2 | | |
| Aerobic Cell 1 | kg/$O_2$/d | 151 |
| Aerobic Cell 2 | kg/$O_2$/d | 126 |
| Aerobic Cell 3 | kg/$O_2$/d | 91 |

.2 Minimum mixing requirement: 0.03 $nm^3$/min/ $m^2$ tank floor.

.2 Allowance for diffuser fouling or aging, maximum: 1.4 kPa.

.3 Maximum aeration system headloss at maximum air flow, dropleg through diffuser exclusive of static head and allowance for diffuser fouling or aging: 5.0 kPa.

.4 Design the aeration system to achieve guaranteed minimum Standard Oxygen Transfer Efficiencies (SOTEs) under the most severe condition. The most severe condition is defined as the maximum oxygen demand, the minimum residual dissolved oxygen, maximum ambient temperatures, average relative humidity and maximum mixed liquor temperatures.

.5 A low speed mixer shall be used in Aerobic Cell 3 (Bioreactors 1 and 2) to ensure the contents of the cell are mixed during conditions of minimum oxygen demand. Design the aeration system in Aerobic Cell 3 (of Bioreactors 1 and 2) to withstand the forces imposed by the mixer.

## 2.4 Materials

.1 General

| Component | Material |
|---|---|
| Flexible Membrane Diffusers | EPDM |
| Diffuser Holders | Polypropylene or PVC |
| Droplegs | Stainless steel, Type 304 L to ASTM A774 and ASTM A778, Flanged |