TECHNICAL SPECIFICATION SEAL SHEET

Date of Issue: August 2024

CLIENT:	City of Greater Sudbury	**ISSUED FOR THE FOLLOWING PURPOSE(S) ONLY:**	
PROJECT:	Wanapitei WTP Filter Upgrades	MECP Approval	
CLIENT REF NO.:	ISD24-134	Tender	X
LOCATION:	Wanapitie Water Treatment Plant, Coniston, ON	Building Permit	
		Construction	X

Note: The Professional Seals on this page are in respect to the technical specifications comprising Divisions 1, 2, 3, and 11. Each seal is limited to the discipline as noted below.

Sheet 1 of 2

FOR SITE CIVIL/PROCESS		
FOR STRUCTURAL		

DIVISION 1

GENERAL REQUIREMENTS

PART 1. GENERAL

1.1 DESCRIPTION OF WORK

A. This Section includes:

1. Contract method.
2. Work by others.
3. Contractor's use of premises.
4. Owner occupancy.
5. Partial owner occupancy.
6. Owner furnished items.
7. Available reports.
8. Provision of Contract Documents.

1.2 RELATED SECTIONS

A. All Divisions and Sections are related to this Section.

B. The General requirements listed herein shall be supplemental to the Special Provisions and General Conditions of the City of Greater Sudbury and are related to the filter upgrades at the Wanapitei Water Treatment Plant.

1.3 CONTRACT METHOD

A. Construct the works under a Lump Sum Price Contract.

1.4 WORK BY OTHERS

A. See the Contract Drawings for other Contracts that are expected to be ongoing during this Contract.

1.5 CONTRACTOR USE OF PREMISES

A. The Contractor shall arrange with the Owner for storage and access.

B. Make arrangements with property owners if additional areas are required. Obtain written agreements.

C. Install and maintain snow fencing along working and storage areas and access routes.

D. Carry out work to minimize inconvenience to the occupants and Municipal services of properties adjacent to the works.

E. Store materials separately at locations agreed upon with the Consultant and protect to prevent their deterioration or the intrusion of foreign matter. Remove immediately any material which has deteriorated or been damaged from site at the Contractor's expense.

F. During construction excavation in the vicinity of the facilities, the Contractor shall liaise with the Consultant and Owner to schedule work to minimize impacts on plant operations.

G. The Contractor shall obtain written approval from the Consultant for tie-in work to the existing facilities. Owner staff will operate any valve, switch, or other controls on existing facilities.

H. Permanent utilities installed under this Contract may be used for construction requirements provided that no guarantees are affected thereby. Make good any damage.

1.6 OWNER OCCUPANCY

A. Cooperate with the Owner in scheduling operations to minimize conflict and to facilitate the Client usage.

B. Maintain free access and parking for the Owner.

1.7 PARTIAL OWNER OCCUPANCY

A. Schedule and substantially perform designated portions of work for the Municipality's occupancy before Substantial Performance of entire works.

B. The Municipality will place some equipment into service to maintain operations in accordance with the sequence of construction until issuance of Substantial Performance for the entire works.

C. The Owner will occupy designated areas for the purpose of operation to ensure water quality compliance.

D. In the event of any conflicts between this Section and the General Conditions, more stringent requirements shall apply.

1.8 OWNER FURNISHED ITEMS

A. Incorporate existing infrastructure and materials as shown in the Contract Drawings.

B. The Owner will supply pre-purchased equipment for the filter upgrades as supply by Orthos Liquid Systems. The Contractor shall be responsible for the material handling, storage, complete installation and testing of the equipment. The Contractor shall be responsible for coordinating with the equipment supplier for the installation and testing of the equipment to the satisfaction of the of the Owner.

C. The Owner will provide As-Recorded Drawings of the existing facilities if required by the Contractor.

1.9 AVAILABLE REPORTS

A. Comply with the requirements of the General Conditions and Supplementary General Conditions and Special Provisions.

1.10 PROVISION OF CONTRACT DOCUMENTS

A. The Contractor will be provided by the Owner, without cost, one (1) digital copy of the Contract Documents and Drawings in addition to those that are part of the Executed Contract.

END OF SECTION

PART 1. GENERAL

A. Works for filter upgrades will be completed in different phases. For this Contract, only Filter No. 3 will be upgraded.

1.1 DESCRIPTION OF WORK

A. The following work will be performed for each Contract as follows:

1. Removal and disposal of existing filter media.

2. Demolition and removal of filter false floors and existing nozzle systems along with false floor support piles, etc.

3. Concrete repairs to the existing filter concrete boxes, backwash channel including major cracks and other related concrete repairs as specified and identified during inspections after media and floor removals.

4. Replacement of the existing air distribution header inside filter lower floors (plenum) along with supports, flanged connection spools imbedded in concrete.

5. Refurbishment of blind flanged access inspection connection to underdrain plenum space.

6. Installation, testing and commissioning of the new filter underdrain system supplied by Orthos Liquid Systems (Underdrain System Supplier).

7. Installation of new filter media.

8. Associated electrical and controls.

B. The work of the Contract more specifically consists of, but is not limited to:

1. Decommission and removal of existing gravity Filter No. 3 and perform demolitions and removals.

2. Replacement of existing 200 mm air distribution header underneath of the existing false floor with new header pipe along with fittings, coupling, flanges, supports, fasteners. The length, alignment and air nozzles shall be coordinated with new underdrain system with no conflict with the underdrain nozzle sleave pipes.

3. Installation of new concrete false floor with new underdrain system, concrete repairs, disinfection, testing and commissioning of new systems as well as installation of new filter media.

4. Remove and replace the existing 200 mm DI air spool pipe embedded in concrete, with new S.S. flanges spool piece with water-stop and restore the concrete wall after installations as shown on Contract Drawings.

5. Supply and install bulkheads, and other temporary fittings as needed during removal and installations.

6. All installations, start-up, testing, commissioning, and training.

C. The description of the work is not, nor is it intended to be, complete and all inclusive.

1.2 OPERATIONS PROVIDED BY THE OWNER

A. The Owner will conduct the following operations as per schedule agreed to by the Contractor and the Consultant at no charge to the Contractor:

1. Isolation of the existing filter for removal and/or replacements, when required.

2. Opening and closing of filter related valves, backwash and air scouring blowers prior to commencement of the removals, and upon completion of the installation and disinfection.

3. Assistance with identifying connection point for hoses to be used for housekeeping in the new works.

1.3 COORDINATION CONSTRUCTION WITH OPERATION OF EXISTING FACILITIES

A. The existing Wanapitei Water Treatment and Intake Pumphouse operate on a continuous basis, 7 days per week, 365 days per year. In the event of conflict between construction operations and routine water supply system operations, water supply system operations have priority. Take every precaution to avoid interfering with routine water supply system operation and maintenance. Reschedule construction operations, as required, without change to the Contract Price.

B. Filter upgrades for the selected Filter No. 3 will be completed while the remaining filters are kept in operation. Only Filter No. 3 shall be taken out of service for the complete duration of the upgrades.

C. At least two (2) weeks before the proposed filter shutdown, submit a detailed schedule including work procedures, prepare contingency plans and participate in planning meetings with the Consultant and the City, designate foreman.

D. Where Owner staff is required for co-ordination of works such as filter and equipment demonstrations, commissioning and system integration, this work shall be scheduled during normal operation hours of 8:00 a.m. to 4:30 p.m. Should the Contractor require Owner staff to work beyond normal work hours, overtime costs will be billed and paid by the Contractor within a reasonable timeframe.

E. The Contractor is hereby notified that the City reserves the right to stop work at the Wanapitei Water Treatment Plant at any time. The Contractor will not hold the City responsible for lost time and/or costs associated with a stoppage of work.

F. No extra payment will be allowed for the following:

1. Approved system interruption schedule submission.

2. Schedule resubmissions until approved by the Owner and Consultant.

3. All required co-ordination and liaising.

4. Off-peak hours work, nighttime work, and/or weekend/Statutory Holiday work.

1.4 MANAGEMENT, COORDINATION, SCHEDULING AND CONSTRAINTS

A. The Owner will not permit any change to the constraints listed in this entire Specification Section.

B. Designate an individual to be responsible for management, coordination and integration of the new and existing works. The responsibility of this individual shall include, but is not limited to, the following:

1. To act as a direct liaison with operations staff once approvals have been obtained from the Water Supply System Superintendent and/or Consultant to perform work that will interrupt operation of the existing water supply system.

C. Coordinate activities on the site and in existing facilities including valve, pipe connections and electrical connections with the Owner or his designated staff.

D. Coordinate and schedule all works with the minimum possible disruption and impact to the normal operations of the existing sites.

E. Prior to any partial shutdown of the existing filters and/or water supply facility if required, the following requirements must be observed by the Contractor in completing the work:

1. The Contractor must submit to the Consultant in writing the proposed method, indicating in detail, the procedures proposed to accomplish each portion of the work that requires an interruption to the operation of the existing water supply

system. The proposed method of construction must be forwarded to the Consultant with at least two (2) weeks in advance notice before commencing the work. The Contractor shall not begin any such work until he has received written acceptance of the methodology and approach from the Consultant. The Contractor shall include in his plan the specific number of work hours to complete each facility interruption.

2. Prepare a separate work plan for electrical and control systems tie-ins, if applicable.

3. Prepare and submit a contingency plan for all proposed installations, alterations, and/or removal procedures in the event that working time exceeds what was expected or in the event anticipated operating conditions are changed.

4. All partial shutdowns for filter and equipment installation and/or removal and new piping and/or services and connection work must be approved in advance by the Consultant. Make provisions for temporary diversion piping, temporary pumping, and temporary power supply.

5. All temporary equipment, tools, materials, labour, and miscellaneous equipment must be scheduled and available at the work site in advance of any shutdowns.

6. The Contractor is fully responsible to permanently or temporarily revise proposed or existing works in order to execute the necessary shutdowns and major tie-in work of the Contract.

7. The Owner is responsible for operating all valves and equipment in the existing works. The Operator will only operate equipment, within the boundary of the works, under the supervision of the Contractor. The Contractor shall not operate existing water supply system equipment.

8. The Owner reserves the right to cancel any scheduled shutdown if water supply system or weather conditions dictate, if water demands are excessive and/or if reservoir levels are insufficient, at no additional cost to the Owner and at the sole discretion of the Operator.

9. The Contractor may be required to undertake tie-in/shutdown work in early morning hours, i.e., midnight to 8:00 a.m. inclusive or as otherwise directed by the Owner, to take advantage of low flow water supply periods. The costs for working during off-hours are to be included in the Tender Price.

F. The Contractor is solely responsible for developing appropriate schemes for temporary works, within the constraints, that meet both water supply system operation and construction needs.

G. Coordinate Project Execution and schedule all activities within the above mentioned water supply operating constraints and the items for consideration presented in the next subsection.

1.5 LIMITS OF CONSTRUCTION

A. Provide temporary construction fencing to suit all necessary temporary works.

B. Minimize impacts on current water supply operations.

1.6 CONSIDERATIONS FOR DEVELOPING SEQUENCE OF WORK

A. The Contractor is responsible for developing the sequence of work, within the constraints described in this Section, to meet both water supply system operations and construction needs.

B. The Consultant will review and approve the Contractor's construction sequence and schedule so as to minimize impact on operations, subject to approval of the Owner.

C. Maintain fire and maintenance access/control at all times.

D. In addition to the constraints described herein, the following information on the work to be undertaken is provided to assist the Contractor in developing a sequence of work. The information presented is not prescriptive. Work may proceed concurrently or separately in each area and may need to be adjusted to suit water supply process timing restrictions, seasonal conditions, and equipment delivery restrictions. Work may proceed independently in each area exclusive of constraints and tie-in restriction noted.

1. Ensure strict adherence to the water supply's safety standards and the Occupational Health and Safety Act.

2. Comply with Ministry of Labour requirements.

3. Minimize the number of disruptions to current water supply operations.

4. Contractor is fully responsible for equipment operation until they are fully commissioned. Since this is a phased installation, a tagging system will be employed to delineate the areas of responsibility for equipment and valve operation.

5. Contractor is responsible for cleaning valves, tanks, channels, piping, and other equipment that will be retrofitted.

1.7 COORDINATION OF TRADES AND CORRELATION OF ELECTRICAL CONTROL

A. Coordinate mechanical, electrical, instrumentation and controls, and potential support work for valves being removed, repaired and installed.

1.8 WORK IN EXISTING BUILDINGS

A. Act as a Fire Warden for the Contract.

B. Be responsible for and enforce fire protection methods and procedures and adherence to local fire regulations, including requirements of the Occupational Health and Safety Act.

C. Ensure the existing fire protection and alarm systems are not obstructed, shut-off or made inactive at any time. Do not use any fire hydrant, standpipe or hose system for other than fire protection purposes.

1.9 COOPERATION WITH OTHER CONTRACTORS

A. Other Contracts may be awarded or underway at other locations on the water supply site. The Owner will provide a list of Contracts at the first pre-construction meeting.

B. Ensure strict compliance with the Ministry of Labour requirements governing the completion of multiple Contracts. Each Contractor will have to coordinate their work, to ensure separate time and space.

C. Only use dedicated access gates.

D. Work and mobility of this Contract to stay within the limits of site work shown on the Contract Drawings.

E. Contractor will keep a log book, as per the requirements of the Owner, to record the name of all workers that are working on the site on a daily basis. This is required to notify the workers in the event of a water supply emergency.

F. At the interface with other Contracts, jointly plan and coordinate with other Contractors the work so that the project:

1. Will not be delayed.

2. Will not be endangered in any way.

3. Will be correctly connected.

4. Will not cause the Owner to be designated as the constructor (through Contractor's non-compliance with Ministry of Labour requirements for separation in space and/or time between different Contracts).

1.10 FUTURE WORK

A. The Contract has been designed for future additions where shown. Ensure the work of this Contract avoids encroachment into areas shown for future additions.

B. Where capped services, empty conduit, empty outlet boxes and similar items are shown for future extension, clearly identify and record the terminations for ready access for future use. Where such terminations are concealed, accurately dimension their location on as-built drawings. Equip capped piping, other than drain and vent, with a shut-off valve whether shown on the drawing or not.

END OF SECTION

PART 1. GENERAL

1.1 GENERAL

A. Comply with General Conditions and related Sections.

B. Comply with working procedures as stipulated by the City of Greater Sudbury General Conditions.

C. Comply with applicable Environmental Health and Safety Standards, Legislation and Regulations.

1.2 RELATED SECTIONS

A. Section 01351 – Health and Safety.

1.3 REFERENCES

A. CSA C22.1 Canadian Electrical Code.

B. Health and Safety Regulations.

C. Occupational Health and Safety Act.

D. Environmental Health and Safety Policy of the City of Greater Sudbury.

1.4 HEALTH AND SAFETY

A. Comply with work procedures as per Section 01351.

1.5 EXPLOSIVE-PROOF CONSTRUCTION

A. Certain areas may be designated on the Drawings and Specifications as "explosion proof", "hazardous", or may be classified under Section 18 of CSA C22.1. Where areas have such designation, provide explosion proof electrical equipment, devices, wiring and installation which meets the requirements of CSA C22.1, Section 18 and carry the appropriate CSA approval.

B. In hazardous areas as defined above, provide intrinsically safe mechanical devices and equipment such as non-sparking aluminium wheels for fans, pneumatic operators for dampers and aluminium clappers for check valves on pipelines conveying gaseous fuels.

C. Provide, mount and maintain signs warning of all hazards and the proper procedure required for working in the hazardous areas.

D. Note the existing gas lines passing through the work area may need to be maintained in service during the construction. Take suitable safety precautions to protect personnel and to protect these services from damage during the work.

1.6 WORK NEAR EXISTING FACILITY

A. Carry out all removals, temporary or permanent, and to provide temporary services needed to implement the work included in the Contract as needed to maintain operation as required.

1.7 ASSISTANCE

A. Give reasonable help to the Consultant's services staff in checking the setting out of the work. Arrange for ready access to work.

1.8 HOT WORK PROCEDURES

A. Observe rules of the Occupational Health and Safety Act.

B. Establish and implement written procedures for Hot Work. Provide a copy of these procedures to the Consultant.

C. Prior to starting any work which requires welding, cutting, open flame or heat, submit Hot Work Notice to plant operations for review of location and timing.

D. Provide and maintain suitable firefighting equipment when performing hot work. Train Contractor's personnel working in these areas in the use of firefighting equipment.

E. Whenever soldering, welding or any open flame work is performed, ensure the area is suitable for such work, ensure the proper incombustible shields are provided to protect combustible products and materials and have an observer present at all times to ensure adjacent products and materials are not ignited and welding, soldering or open flame work do not produce a hazardous condition.

F. A copy of the Hot Work Notice is attached to the end of this Section.

1.9 HOLES IN EXISTING CONCRETE

A. When it is required to make new holes in existing concrete for piping, conduit, cables, or equipment, using either method described below:

1. Accurately and carefully mark out the locations and the extent of cutting required and coordinate with the trade (s) involved.
2. Prior to drilling any openings, determine the location, if any, of existing services concealed in and/or behind the construction to be drilled. X-ray the walls or slabs, if required.
3. Chip with an electric hammer with chisel point. Adjust the location of holes as necessary to avoid electrical conduits if encountered. Cut reinforcing steel after permission is received.

B. Radiograph the existing concrete for 3 diameters around the centreline of the proposed penetration. If no structural steel, piping or electrical conduits are found, core the hole. If structural steel, piping or electrical conduits are found, select an alternative location and radiograph it. If structural steel, piping or electrical conduits are found, do not core unless written permission from the Engineer is received.

C. Prior to commencing work, submit to the Consultant a photocopy of the license issued under the Atomic Energy Control Board Regulations for radiography. Perform work in accordance with current Atomic Energy Control Board Regulations for radiography. Be responsible for boundary controls, signs that protect the personnel and others from hazards in the radiograph work area. Inform the Consultant in writing 48 hours prior to commencing any radiography.

D. Unless otherwise noted, where drilling is required in waterproof slabs, size the openings to permit snug and tight installation of a pipe sleeve, which is sized to leave 12 mm clearance around the pipe or pipe insulation. Provide a pipe sleeve in the opening. Pipe sleeves are to be schedule 40 galvanized steel pipes with a flange at one end and a length to extend 100 mm above the slab. Secure the flange to the underside of the slab and caulk the void between the sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a watertight installation.

1.10 PROTECTION, SOUNDNESS, AND REPAIR OF NEW CONSTRUCTION

A. Protect newly constructed work from damage. Prevent heavy loading of newly constructed work and repair damage. Construct works watertight and correct rejected work.

B. If, in the final inspection, deficiencies are found, repair or replace defective work. Be responsible for satisfactory maintenance and repair of work undertaken for the specified guaranteed maintenance period. Protect and store equipment supplied under this Contract.

1.11 UNWATERING EXISTING STRUCTURES AND PIPELINES

A. Be responsible for unwatering existing structures, channels, pipelines and tanks as required to facilitate construction.

B. Provide and install bulkhead plates in existing guides. Provide connections and seals for bulkheads where guides are not available. Provide temporary pumps to unwater and control water levels in existing structures, channels, and tanks. Discharge pump flows to tanks or channels in service as directed by Consultant.

C. Empty pipelines by draining to existing sumps, if available. Provide temporary sump and pump if an existing sump is not available. Flush pipelines clean of sludge prior to making connections.

1.12 STORAGE AND PROTECTION OF MATERIALS AND EQUIPMENT

A. The Contractor shall be governed by the direction of the Owner or Consultant in all matters connected with or concerning storage of machinery, materials and supplies along the line of Work and shall at his own cost shift or remove such machinery, materials and supplies immediately upon notice from the Owner or Consultant and to location or locations acceptable to the Owner or Consultant.

B. Arrange for delivery to the site, and protection of materials and equipment:

1. Schedule delivery of equipment only when building is far enough advanced to protect units from weather and construction dust and debris.

2. Provide equipment and labour to unload, move and place units in final position.

3. Protect materials and equipment from damage.

C. Specification Sections may contain additional requirements for delivery, storage and handling. Provide additional delivery, storage and handling requirements to meet these additional requirements.

D. Protect materials and equipment after unloading from weather, dust, dirt, and moisture both before and after erection and placing. Observe Manufacturer's written instructions for temporary storage.

E. Provide dry heated 10^{O}C temporary housing for pumps, motors, valves and other equipment or materials which may be injured by weather, dust, dirt or moisture.

F. Maintain shafts and bearings in good condition by rotating weekly.

G. Provide Manufacturer's written instructions for the storing of equipment during the construction period well in advance of equipment delivery.

H. Store specially items to ensure protection from damage to materials or finish.

I. Store materials subject to water absorption off the ground. Protect materials from other damage due to environmental conditions under waterproof covers.

J. Promptly as work proceeds and upon completion, clean up and remove from site surplus materials resulting from foregoing work.

1.13 PROTECTION OF EXISTING STRUCTURES AND PROPERTY

A. The Contractor will be held fully responsible by the Owner for any damage to utilities, equipment, properties, buildings, homes or structures adjacent to or in the general area of the work, through settlement of ground, vibration or shock, flooding resulting from any cause relating to the work carried out under this Contract. Make good and repair such damage at own expense.

B. Should the Contractor require the use of Owner's equipment located on site, the equipment will be handed over only after being certified by the Owner. The Owner will not be responsible for the equipment once in the Contractor's use. Any lifting equipment, etc., will be the Contractor's responsibility to have re-certified to ensure that the equipment's condition is the same as when it was originally given to the Contractor. Any damage to the equipment will be the sole responsibility of the Contractor to repair or replace at no cost to the Owner.

C. Control of Vibrations:

1. Control vibration levels to prevent damage to concrete work during construction, existing structures, equipment, and utilities.

2. Control use of vibration producing construction techniques or equipment so that the ground adjacent to concrete has a resultant peak particle velocity (P.P.V.) not exceeding the following limits:

Age of Concrete (Hours)	Maximum Permissible Resultant P.P.V. (mmlS)
Less than 4	50
4 to 60	10
Over 60	50

3. Schedule and execute placing of concrete so that, for concrete 4 to 24 hours old, a minimum distance of 40 m between the source of vibration and the concrete is maintained.

4. The Owner may retain the services of an independent inspection agency to monitor vibration effects.

5. The Consultant reserves the right to require additional restrictive limits for vibration control if recommended by the inspection agency.

D. Sustain in their places and protect from direct or indirect injury, water and gas mains, public and private sewers and drains, conduits, cables, service pipes, poles, sidewalks, curbs, embankments, structures, equipment and other property in the vicinity of the work.

HOT WORK NOTICE

FOR OPEN FLAME OR HOT WORK.

THIS NOTICE IS ISSUED SUBJECT TO THE OBSERVATION OF THE RULES SHOWN ON THE REVERSE SIDE.

THE JOB LOCATION HAS BEEN EXAMINED AND FOUND TO BE SAFE. A SUITABLE FIRE EXTINGUISHER HAS BEEN INCLUDED WITH THE HOT WORK EQUIPMENT FOR THIS JOB.

1.	A Workman trained in the use of Fire	Yes	☐
	Extinguishers have been provided.	Not Required	☐
2.	Continued forced air ventilation	Yes	☐
	Has been provided.	Not Required	☐
3.	Continued monitoring and testing	Yes	☐
	Has been provided	Not Required	☐

The use of this equipment was authorized by:

Signed: _____

Supervisor/Foreman

Work Order

No. _____ Date _____

Time Started _____ a.m. _____ p.m.

Time Finished _____ a.m. _____ p.m.

Location of Job _____

Welder: _____

Signature

WARNING

THE USE OF THIS WELDING AND CUTTING EQUIPMENT OUTSIDE OF THE AUTHORIZED LOCATION REQUIRES ANOTHER NOTICE.

RULES:

1. Remove combustible materials within 9 metres or cover with fire resistant materials.

2. Immediately before the commencement of work, a competent person shall determine the contents of tanks, piping systems, containers, etc., by testing the atmosphere for:

a.	combustibility	_____ %	
b.	oxygen deficiency		
c.	toxicity	Yes _____	No _____
d.	continuous forced air ventilation is required	Yes _____	No _____
e.	continuous testing for a. b. c. is required	Yes _____	No _____

Tested by: _____

Signature

3. The results of such tests must be recorded in compliance with the occupational Health and Safety Act and regulations that apply.

4. Should tests indicate a contaminated atmosphere, then no hot work shall commence until the atmosphere has been rendered safe by a competent person.

5. Warn persons working at lower level before starting. If necessary, evacuate area.

6. After the hot work has been completed, the work location shall again be checked for fire hazards and shall not be vacated until no fire danger exists.

7. Do not weld or cut over wooden floors unless they are covered with fire resistant material.

END OF SECTION

PART 1. GENERAL

1.1 PRECONSTRUCTION MEETING

A. Following award of the Contract and the instruction to commence the work, the Consultant will convene a preconstruction meeting with the Owner's Representative, the Consultant and the Contractor.

B. The meeting agenda will include:

1. The designation of official representatives of participants in the work.
2. Requirements for temporary facilities, storage sheds, site access and use.
3. Site security.
4. Contractor's work schedule, indicating clearly the proposed order and time allowance for various phases of the work in sufficient detail to show weekly progress including the Products delivery schedule.
5. A listing of Subcontractors and Suppliers that the Contractor wishes to utilize for completing work on the contract. Provide a schedule for submission of Shop Drawings, samples and similar documents.
6. A schedule for site meetings.
7. A review of administrative procedures, including change notices, change directives, change orders, site instructions, Record Drawings, maintenance manuals, take-over procedures, progress claims.
8. The appointment of inspection and testing agencies or firms.
9. Other items as arise at the meeting.

C. The Consultant will arrange facilities for the meeting, document the responsibilities and necessary activities of the participants during construction as discussed, and prepare and distribute minutes of the meeting to each attendee.

1.2 SITE MEETINGS

A. Site meeting frequency shall be bi-weekly at no additional cost to the Contract if performance and schedule are not to the satisfaction of the Owner and Consultant. Otherwise, site meetings shall be on a monthly basis.

B. The Owner, Consultant and Contractor will be in attendance. The purpose of these meetings is to discuss the progress of the work and related matters including:

1. Review and acceptance of previous meeting minutes.
2. Field observations and any problems or conflicts.
3. Any problems that may impede work progress and the construction schedule and corrective measures required.
4. Revisions to the construction schedule and the Products delivery schedule.
5. Review of submittal schedules.

1.3 CONTRACTOR'S REPRESENTATIVE AT PROJECT MEETINGS

A. The Contractor shall attend Progress and Co-ordination Meetings as directed by the Consultant.

B. The Contractor's representative at these meetings shall be site Supervisor or Project Manager/Engineer and/or a competent and reliable person who is familiar with the work. The Contractor's representative shall have full authority to make decisions on the Contractor's behalf.

1.4 CONTINGENCY ALLOWANCE AND CASH ALLOWANCE

A. A contingency allowance is allowed in the Form of Tender to cover extra work approved by the Owner. Some, all, or none of the allowance may be used; Contractor shall have no claim on the allowance not used.

B. The Contingency allowance includes unit prices and a lump sum. The basis for payment of the unit price items and the costing of the unit price items are stated in the Form of Tender.

C. A cash allowance is allowed in the Form of Tender to cover known purchases of equipment, and services. The following services and supplies are anticipated to be purchases within the allowance:

1. Independent inspections.

1.5 FEES AND CHARGES

A. Pay fees and charges imposed for disposal of waste materials.

B. Pay engineering fees for review of substitutions and similar items.

1.6 CONTRACT DRAWINGS

A. Read the Drawings as a whole as details applicable on one Section may appear on the Drawings of another Section.

B. The Contract Drawings provide general routing of piping and general location of equipment unless specific dimensions are indicated. Locate piping and equipment to avoid interference with walkways, other equipment and required headroom.

END OF SECTION

PART 1. GENERAL

1.1 WORK INCLUDED

A. This Section includes the submission of the following data:

1. Schedules for construction, Shop Drawing submittal and product delivery submittal.
2. Shop Drawing for permanent works.
3. Site progress records.
4. Progress photographs.
5. Equipment operating and maintenance instruction manuals.
6. Mock-ups.
7. Shop Drawings for any temporary works.
8. Tender breakdown.
9. Operation and Maintenance Manual.

1.2 SUBMITTALS

A. Unless otherwise noted, make submittals to the Consultant for review.

B. Make submittals with reasonable promptness and in an orderly sequence to avoid any delay in the work. Failure to submit in ample time is not considered cause for an extension of Contract Time, and no claim for extension by reason of such default will be allowed.

C. For submittals, facsimile transmissions will not be acceptable.

D. Do not proceed with work affected by submittals until review is complete.

E. Review submittals prior to submission to the Consultant. This review represents that the necessary requirements have been verified, checked and coordinated with the Contract Documents. Stamp, sign, date and identify all submissions. The Contractor's responsibility for errors and omissions for providing the specified products and for the construction of the work in accordance with the Contract Documents is not relieved or diminished in any way by the Consultant’s review of submittals.

1.3 CONSTRUCTION AND SUBMITTALS SCHEDULES

A. Submit one (1) digital copy of the proposed construction schedule in accordance with the requirements of the Special Provisions and the City's General Conditions. Update schedules as required.

B. Submit with the construction schedule, one (1) digital copy of each of the following schedules:

1. Shop Drawing submittal schedule.

2. Product delivery schedule.

3. Sample submittal schedule.

C. Construction Schedule shall be computerized bar chart type schedules as specified hereinafter.

D. Prepare the Construction Schedule as specified below. The schedule requirement herein is the minimum required. The Contractor may prepare a more sophisticated schedule if such will aid him in the execution and timely completion of the work:

1. Computerized bar chart type schedule showing work logic sequences, restraints, delivery windows, Shop Drawing submittal and review times, Contract Time, and milestones and shall begin with the date of Notice to Proceed and conclude with the date of Final Completion.

2. Base schedule on standard 5-day, 40-hour work week. With provisions to show both Base and adjusted schedules as required.

3. The bar chart schedule, on maximum 11-inch by 17-inch size paper, must indicate the Critical Path of the work and include the following, as a minimum:

a. Identification and listing in chronological order of those activities reasonably required to complete the work, including, but not limited to: move-in and other preliminary activities; all subcontractor work; major equipment design, fabrication, factory testing, and delivery dates; equipment system testing and start-up activities; project closeout, cleanup, and site restoration; and specified work sequences, constraints, and milestones, including Substantial Completion date(s).

b. Identify: (i) horizontal time frame by year, month, and week, (ii) duration, early-start, and completion for each activity and sub-activity, and (iii) critical activities and project float.

c. Sub-schedules shall further define critical portions of the work.

d. Activity duration for submittals review shall not be less than the review time specified unless clearly indicated and prior written acceptance has been obtained from the Consultant.

E. In addition to other requirements of the Contract, submit the following with each monthly Application for Payment:

1. A revised Construction Schedule or confirm validity of current schedule to reflect: (i) progress of work to within five (5) working days prior to submission; (ii) changes in work scope and activities modified since the previous submission; (iii) delays in submittals or resubmittals, deliveries, or work; (iv) adjusted or modified sequences of work; (v) other identifiable changes; and (vi) revised projections of progress and completion.

2. Submit with the Construction Schedule, Contractor's certification that the progress schedule is the actual schedule being utilized for execution of the work and certification by all subcontractors with 5 percent or more of the work that they concur with the Contractor's progress schedule submission.

3. A cash flow diagram showing by month the actual work performed to date and the predicted progress to the end of the project. The amounts will be the total including HST and will include contingency funds as expenditures of them become known.

F. If the Contractor fails to complete an activity by its latest scheduled completion date and this failure may extend Contract Time (or Milestones), the Contractor shall, within seven (7) days of such failure, submit a written statement as to how he intends to correct non-performance and return to the original current progress schedule.

G. The Owner may order the Contractor to increase his plant, equipment, labour force or working hours if the Contractor fails to: (i) complete a critical scheduled activity by its latest Milestone complete date, or (ii) satisfactorily execute work as necessary to prevent delay to the overall completion of the project at no additional cost to the Owner.

1.4 SHOP DRAWINGS (EXCEPT FOR TEMPORARY WORKS)

A. Drawings required to be submitted include but are not limited to:

1. Catalogue Drawings include reprints of Catalogue Drawings of proprietary articles of standard fabrication and manufacture for the work.

2. Shop Drawings include Dimensioned Line Drawings and related Specifications, information and literature for custom fabricated articles and equipment.

3. Method of construction and attachment or anchorage, erection diagrams and connections. Where products attach or connect to other products, indicate such items have been coordinated, regardless of the Section under which the various products have been specified. Identify by cross references to Design Drawings and Specifications.

B. Submit one (1) digital copy of Shop Drawings and Catalogue Drawings for review. One (1) stamped digital copy will be returned to the Contractor after review.

C. Submit all Drawings in SI metric units.

D. Submit Shop Drawings well in advance of the time when the material is required for use. Coordinate Shop Drawings prepared by different trades so that information is available to allow proper review and sufficient review time where the work of one trade interfaces with or affects the work of another. Recognize extensive engineering review time required for certain complex equipment or systems.

E. Clearly identify each submission as to the project description, Contract number, Specification Section, paragraph number, Equipment Schedule number, if applicable, and component.

F. The Consultant will review the Shop Drawings and Product Data Sheets and will indicate the review status by stamping Shop Drawing and Product Data Sheet copies as follows:

1. "Reviewed" or Reviewed as Noted" – If the Consultant's review of a Shop Drawing or Product Data Sheet is final, the Consultant will stamp the Shop Drawing or Product Data Sheet "Reviewed" or "Reviewed as Noted" (appropriately marked) and keep the required number of copies. Two white prints will be returned to the Contractor.

2. "Revise and Resubmit" – If the Consultant's review of a Shop Drawing or Product Data Sheet is not final, the Consultant will stamp the Shop Drawing or Product Data Sheet "Revise and Resubmit", mark the submission with comments, keep one record copy and return two marked prints to the Contractor. Revise the Shop Drawing or Product Data Sheet in accordance with the Consultant's notations and resubmit.

G. The Shop Drawing and the Product Data Sheet reviews do not authorize changes in cost or time. Changes involving cost or time are authorized only by a signed change order.

H. It is understood that the following is to be read in conjunction with the wording on the Consultant's Shop Drawing review stamp applied to each and every Data Sheet or Drawing submitted:

1. "This review by the Consultant is for the sole purpose of ascertaining general conformance with the Contract design concept. This review does not mean that the Consultant approves the detail design inherent in the Shop Drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the Shop Drawings or of its

responsibility for meeting all requirements of the Contract Documents.
Be responsible for confirming and correlating dimensions at the place of the work, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all sub-trades".

I. Identify changes on re-submissions and include revision dates.

J. Material and equipment delivered to the site of the works will not be paid for until pertinent Shop Drawings have been reviewed and accepted.

K. If the Consultant requests details or items on Shop Drawings which the Contractor believes require extra payment or contract time, make any claims promptly and receive acceptance of extra work, before proceeding with fabrication.

L. The Consultant will review the Shop Drawings or Contractor's design only for conformance with the Contract Document design concept and general arrangement. The Consultant's review does not relieve the Contractor from compliance with requirements of the Contract Documents nor relieve him from errors in the Shop Drawings or Contractor's design.

M. Where work is to be designed by the Contractor comply with applicable codes and submit Shop Drawings signed and sealed by a Licensed Professional Engineer.

N. Submit three (3) digital sets of the final Shop Drawings in CD format.

1.5 SAMPLES

A. Submit samples of materials to be used in the work for review in accordance with the requirements of the City of Sudbury General Conditions and Special Provisions.

B. Do not use material in the work which is in any way inferior to the samples submitted and reviewed. Match accepted samples.

C. Review of samples notwithstanding, materials that are unsound or imperfect when delivered to site will be rejected.

D. Identify samples by project name and number, date, name of Contractor and all other pertinent information.

E. Retain reviewed samples on site readily available to the Consultant.

F. In so far as practical, test materials and equipment on site. Where shop test is necessary, give two weeks' notice in writing of shop test date.

G. Provide test reports for each test performed as specified in Section 01800 – Cleanup, Start-up, Commissioning and Training. Submit the reports for inclusion in the Installation, Operation and Maintenance Manual.

H. Submit, in duplicate unless otherwise noted, samples as specified in Specification Sections. Label samples as to origin and intended use in the work.

I. Deliver samples prepaid to the Consultant's business address or testing company as directed.

J. Notify the Consultant in writing, at the time of submission, of any deviations in samples from requirements of the Contract Documents and state the reason for such deviations.

K. Adjustments made on samples by the Consultant are not intended to change the Contract Price. If adjustments affect the value of work, state such in writing to the Consultant prior to proceeding with the work.

L. Make changes in samples which the Consultant may require, consistent with the Contract Documents.

M. Where changes or modifications of the products for which samples are submitted are required, re-submit samples embodying the required changes or modifications.

N. Where colour, pattern or texture is a criterion, submit a full range of samples.

O. Reviewed samples will become the standard of workmanship and material against which they performed work will be verified and accepted.

1.6 SITE PROGRESS RECORDS

A. Maintain at the site a permanent written record of progress of the work. Make the record available to the Consultant upon request and provide a copy if requested. Include in the record for each day:

1. The weather conditions with maximum and minimum temperatures.

2. The conditions encountered during excavation.

3. The commencement and the completion dates of the work of each trade in each area of the Contract.

4. The erection and removal dates of formwork in each area of the Contract.

5. The dates, the quantities, and the particulars of each concrete pour.

6. The dates, the quantities, and the particulars of roofing installation.

7. The dates on which major items of equipment are installed.

8. The numbers and classifications of the Contractor's and the Subcontractor's trades people working at the site and the numbers and classifications of construction machinery and equipment and the number of hours each is operated.

9. The visits to the site by the Owner, the Consultant, the regulatory authorities, the testing companies, the Subcontractors and the Suppliers.

1.7 PRECONSTRUCTION AND PROGRESS PHOTOGRAPHS

A. Provide preconstruction photographs in digital format prior to commencement of work on the site. Deliver to the Owner/ Consultant before starting any construction two electronic copies on CD-ROM or DVD-ROM. The Owner/Engineer may direct the Contractor to obtain additional photographic records of structures and features within the site limits. The pre-construction records will be compared to the post-construction records to assess damage or displacement of existing structures.

B. Obtain pre-construction photos of the existing:

1. Access roads, parking areas, drainage ditches, perimeter fencing and additional areas that will be affected by the site works.

2. Existing building(s) at construction sites.

3. Existing electrical and control system hardware.

4. Existing process mechanical equipment.

5. Existing structures where modifications are planned.

C. On commencement of work and at monthly intervals, thereafter, provide two (2) copies of six (6) different view photographs to illustrate the progress of the work. Photographs are to be taken by a professional photographer from locations selected by the Consultant.

D. Photographs are to be in digital format. Photographs must be legibly identified on the back with project name, date and location of exposure.

E. Submit progress photographs with monthly application for payment.

1.8 OPERATION AND MAINTENANCE MANUAL

A. Submit one (1) digital copy of the “Draft” table of contents of the Operation and Maintenance Manuals for each item of equipment after approval of Shop Drawings for review and approval by the Consultant.

B. Submit one (1) digital copy of the “Draft” Operation and Maintenance Manuals for each item of equipment after approval of the table of contents for review and approval by the Consultant.

C. Submit three (3) hard copy sets of the “Final” Operation and Maintenance Manuals for each item of equipment a minimum of eight (8) weeks prior to the scheduled start-up of the equipment or the application for a certificate of substantial performance, whichever occurs first.

D. Contractor is required to coordinate binder naming convention, labeling, organization and structure with the Consultant and City’s Plants Maintenance Manager.

E. Submit three (3) copies of electronic Operation and Maintenance Manuals in a CD/USB Key Format. The CDs/USBs shall be indexed by trade (i.e., Mechanical, Electrical and Instrumentation, and General). Each of the trades shall be indexed by equipment and specification number. The electronic format shall be in Adobe Acrobat form. The manuals shall contain all of the information referenced in Section C (items 1-25) with all shop and field test reports scanned into the individual equipment items. Electronic Operation and Maintenance Manual information will be submitted so that the Owner can access, save and paste relevant information directly into its Computerized Operation and Maintenance Manual System.

F. Each manual is to contain operational information on equipment, cleaning and lubrication schedules, maintenance data, overhaul and adjustment schedules parts list and similar maintenance information. Instructions are to be in simple language so as to guide the Owner in the proper operation and maintenance of the equipment.

G. In addition to information specified above or in other Divisions of the Specification, include the following in each binder:

1. A title sheet shall have the City’s logo affixed and labelled "NAME OF THE FACILITY” followed by “MAINTENANCE MANUAL" and four (4) int/ext. photos. Specific layout to be coordinated with the City.

2. A "Table of Contents" page.

3. Binder Edging indicating City’s logo, naming convention, label and Volume 1 of xx.

4. The names and addresses of the Subcontractors, and the Contractor's name and address.

5. A complete list of the names, addresses and telephone numbers of firms and Suppliers from whom parts may be purchased and who can affect repair or maintenance on equipment.

6. Copies of the hardware schedule and room finish schedule.

7. Copies of approvals, certificates, and similar documents from governing authorities.

8. A final, reviewed copy of all Shop Drawings and Product Data Sheets.

9. A complete list of instructions and names of products to be used for the cleaning of and the maintaining of finished building surfaces.

10. Complete explanation of operation principles and sequences.

11. City's "Add Equipment Forms" including complete parts list with numbers, Manufacturer and contact information. Contract is required to coordinate Add Equipment Forms with the Consultant and the City.

12. Instructions for installation, adjustment and operation, lubrication and maintenance of each item of equipment.

13. Equipment, valve and hardware schedules.

14. Recommended spare parts lists.

15. Lubricants list with the designated application and where they may be purchased. Use lubricants, if possible, from a Company whose products are already being used by the Owner.

16. Manufacturer's representative signed reports.

17. Equipment reports for rotating equipment.

18. Material safety data sheets.

19. Shop and field test certificates and reports.

20. Balancing reports.

21. Written warranties and guarantees.

22. Recommended maintenance practice and precautions.

23. Shop Drawings revised to show construction revisions, one set to be reproducible. Bind in appropriate section in each volume.

24. Wiring Loop Connection and Control Drawings revised to show construction revisions, one set to be reproducible.

25. Name and telephone number of both factory and local Manufacturer's representative.

H. Catalogue and bind information for each item and equipment in order or Specification Sections include:

1. An overall table of contents in front of each binder. Indicate in the table of contents each binder volume.

2. Provide divider and tab for each item listed in the table of contents.

3. Use separate binders for each manual set and for mechanical, electrical and instrumentation equipment. Indicate the General Contractor and Subcontractor in each volume.

I. Do not overfill binders.

J. Provide binder quality to Consultant's acceptance. Binder features:

1. ACCO binder P5436E.

2. Spine label showing project name, volume number.

3. Dividers with rip-proof, three-hole punched strip, typed tab label, numbered to correspond to table of contents.

4. Store Drawings folded into individual pockets.

K. Do not install or operate any equipment before Manufacturer's instructions have been submitted.

L. Where Specifications require installation in accordance with Manufacturer's instructions:

1. Submit three copies of such instructions.

2. Submit instructions in a written form.

M. If, during the Consultant's review of the manuals, revisions are required, the manuals will be returned with details of the revisions required. Revise the manuals accordingly and resubmit them for further review.

N. Submit the “Final” operating and maintenance manuals to the Consultant prior to the application for a Certificate of Substantial Performance as noted in Section 1.10 above.

O. The submission of the "Equipment Operating and Maintenance Instruction Manual" is a condition precedent to the commissioning of the facility and certification of substantial performance.

1.9 ADD EQUIPMENT INVENTORY SPREADSHEET

A. Submit one (1) digital copy of the City's "ADD EQUIPMENT FORMS" for each item of equipment a minimum of eight (8) weeks prior to the scheduled start-up of the equipment or the application for a certificate of substantial performance, whichever occurs first. The Contractor will be required to complete all relevant fields for each item provided within the equipment inventory file as a prerequisite to commissioning and a component of substantial completion. The EXCEL spreadsheet is provided with notes to direct the Contractor in completion of the spreadsheet.

1.10 PREVENTATIVE MAINTENANCE TASK SPREADSHEET

A. The Contractor will be required to complete all relevant fields for each item provided in the add equipment inventory EXCEL spreadsheet. The Contractor will transfer all Manufacturer's recommended preventative maintenance tasks and frequencies into the spreadsheet. The electronic file is provided with notes to direct the Contractor in completing the above information.

B. The electronic files will be reviewed and 'marked-up' in a similar fashion as the hard copy Operations & Maintenance Manual.

1.11 MOCK-UPS

A. Prepare mock-ups for the work designated in the Contract Documents. Include for the work of all Sections in which mock-ups are specified.

B. Construct mock-ups in locations acceptable to the Consultant or in locations designated in the Contract Documents.

C. Prepare mock-ups for the Consultant's review with reasonable promptness and in an orderly sequence to avoid any delay in the work.

D. If requested, the Consultant will assist in preparing a schedule fixing the dates for preparation.

E. Reviewed and accepted mock-ups will become the standards of workmanship and material against which performance of the work will be verified and accepted. Remove from the site when they have served their purpose, all mock-ups that are not a permanent part of the work.

1.12 SHOP DRAWINGS FOR TEMPORARY WORKS

A. Submit for review Shop Drawings of temporary works which:

1. Control the dimensions and locations of any part of the structures to be constructed under the Contract.

2. Impose loads on parts of the works which are still under construction or on existing structures.

B. Have the work designed by a Professional Engineer licensed in Ontario. Show the Engineer's seal and signature on the Shop Drawings.

C. Submit one (1) copy of Shop Drawings for review. Payment will not be made for work started or completed without the required drawing review. Submit Shop Drawings well in advance of the time when they are required for construction. Coordinate Shop Drawings prepared by different trades so that information is available to prevent conflict or errors where the work of one trade affects the work of another.

D. One (1) digital copy will be returned to the Contractor after review.

E. Shop Drawings will be reviewed for conformity with the required arrangement and dimensions of the permanent structures and for general conformity with the specifications.

F. If re-submittal is requested, discuss the comments made and resolve all issues raised by them, then resubmit the Shop Drawings amended accordingly.

G. Do not begin construction of temporary works until after the completion of review of the Shop Drawings.

H. Review of the Contractor's Drawings does not relieve the Contractor of the responsibility for the results arising from errors or omissions of design or from the use or abuse of the temporary works.

I. Keep one copy of each stamped, reviewed drawing at the site of the work for reference during the time the construction work is in progress.

J. Make no change in Drawings after they have been reviewed.

K. Submit Shop Drawings in SI metric units.

1.13 TENDER BREAKDOWN

A. The Tender Breakdown provided in the Form of Tender will be used for progress payment draws. The Consultant may, at his discretion, require a further detailed breakdown for payment purposes.

1.14 PROFESSIONAL ENGINEER

A. Where specifications required professional engineer design, such engineer is required to be licensed in the related discipline in the Province of Ontario, unless otherwise accepted by the Consultant in writing.

END OF SECTION

PART 1. GENERAL

1.1 GENERAL

A. Comply with the requirements of the General Conditions, Supplementary General Conditions and the Special Provisions.

1.2 CONSTRUCTION SAFETY MEASURES

A. Contractor shall submit a site-specific Health and Safety Plan within five (5) working days after the date of Notice to Proceed or prior to mobilization on site, whichever occurs first. The site-specific Health and Safety Plan must address the requirements of the Acts.

B. The Contractor shall meet the requirements of the following:

1. Occupational Health and Safety Act, Regulations for construction projects, O.Reg. 213/91 (as amended by O.Reg. 631/94), part II General Construction.

2. Occupational Health and Safety Act, Industrial Establishments Regulation, R.R.O. 1990, Reg. 851 (as amended by O.Reg. 516/92; 630/94; 230/95; and 450/97), Part I Safety Requirements.

3. Revised Statutes of Ontario 1980, Chapter 321, Revised Regulation of Ontario 1980, Regulation 691 as amended by O.Reg. 156/84 and O.Reg. 645/86, and Ontario Regulation 714/82.

4. Workers Safety & Insurance Board (WSIB) and Municipal Statutes and Authorities.

C. In event of conflict between any provisions of above authorities, the most stringent provision governs.

D. Where applicable, the Contractor shall be designated “Constructor” as defined by Ontario Act.

1.3 SPECIAL PROTECTION AND PRECAUTIONS

A. Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handing, storage and disposal of hazardous materials and regarding labeling and the provision of Material Safety Data Sheets (MSDS) acceptable to Labour Canada.

B. Conform to the Ministry of Labour requirements for work in hazardous locations. Establish and implement written procedures to assure compliance.

C. Comply with the Owner's Health and Safety Procedures. An Owner's staff member will provide one hour of orientation to a specified representative of the Contractor. The Contractor is responsible for providing training to all of his staff on-site.

D. Smoking is not permitted in hazardous areas or other areas as designated by the Owner. Post "No Smoking" signs as required.

1.4 SAFETY EQUIPMENT AND HAZARDOUS AREAS AND MATERIALS

A. Safety equipment such as gas detection equipment for explosive or toxic gases or oxygen deficiency, safety belts, ropes, etc., are to be made available to the resident inspection staff. When it is required for the resident inspection staff to enter manholes or other potentially hazardous areas, a Contractor's personnel have to enter the said areas with him and accompanying personnel with safety ropes, etc., shall be present as required.

B. Post warning signs at hazardous areas or where hazardous materials are stored and install protective barriers. Instruct personnel in proper safety procedures.

C. Identify all areas considered to be hazardous locations and comply with all requirements of the Ministry of Labour.

D. Comply with the requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of material safety data sheets acceptable to Labour Canada.

E. The Contractor shall inform the Owner of the location of these materials and shall ensure that these materials are not kept stored or used on site without the Municipality's prior consent or approval.

F. Note that certain gas lines passing through the work area will continue in service during this construction. Take suitable safety precautions at all times.

1.5 SITE CONDITIONS

A. Work at the site may involve contact with:

1. Diesel fuel.

2. Chlorine gas.

3. Hydrofluorosilicic Acid (HFS).

4. Other process chemicals as a requirement of the plant.

5. Pumping and rotating equipment.

6. Confined spaces.

7. Heavy equipment.

8. Unstable soils, trenches and stockpiles of material.

9. Hot and cold weather conditions.

1.6 WORK IN HAZARDOUS AREAS AND CONFINED SPACES

A. Test for explosive, toxic gases, oxygen deficiency before commencing the day's work and while working in areas which may contain an explosive, toxic or oxygen deficient atmosphere. If a hazardous condition is found, make the work area safe before commencing or continuing work.

B. Use non-sparking tools in areas where an explosive atmosphere may exist.

C. Hazardous Locations in Nearby Existing Structures:

1. The following areas in or near existing structures for the purpose of this Contract is considered Class I Division 1 Group D hazardous locations:

   a. Sanitary sewer catch basins.

   b. Manholes and diversion structures.

D. Work Procedures for Hazardous Locations/Confined Spaces:

1. Conform to Ministry of Labour requirements for work in hazardous locations. Establish and implement written procedures to assure compliance.

2. Construction activities, except wire pulling and cleaning, that occur in hazardous locations require continuous combustible gas monitoring, by the Contractor.

3. Provide documentation of tests for gas and oxygen deficiency prior to starting work in hazardous locations.

4. Ensure that all personnel engaged in confined space work or work in hazardous locations that require the use of respiratory equipment, comply with the requirements of the Ministry of Labour and must be clean shaven.

5. It is the Contractor's responsibility to provide all necessary gas detector equipment, ventilation, other safety devices required by law.

6. Smoking is not permitted in hazardous areas or other areas as designated by the Owner. Post "No Smoking" signs as required.

E. Metering for Toxic Gas, Combustible Gas, Oxygen Deficiency:

1. Monitor toxic gas, combustible gas, and oxygen deficiency at all levels in hazardous locations as per requirements of Ontario Occupational Health and Safety Act.

F. Meter Operator:

1. Have a competent person trained to operate and read the portable meter continuously while construction activities occur in the designated hazardous locations. All levels of hazardous location are to be monitored. This meter operator is not permitted to assist in the construction activity in any way. Locate meter operator in the immediate vicinity of construction activity. If work in two or more different hazardous locations is required at the same time, provide additional meter operators and meters.

G. Hazardous Event Procedure:

1. If the meter indicates 5% of the Lower Explosive Limit (LEL) or 19.5% oxygen, discontinue construction activity, evacuate area, and notify Engineer.

H. Log Book:

1. Maintain a log book with:

   a. Date.

   b. Name of meter operator.

   c. Explosive gas, toxic gas, and oxygen deficiency readings at all levels every ½ hour.

   d. Construction activity type.

   e. Location of construction activity.

2. Submit log book to the Owner when construction is complete.

3. Firefighting equipment.

4. Provide and maintain suitable firefighting equipment when working in the designated hazardous locations. Train Contractor's personnel working in these areas in the use of firefighting equipment.

1.7 WHMIS

A. The Contractor shall provide a complete list of all controlled products, hazardous materials, products containing hazardous materials, and all biological or chemical agents or devices or equipment producing or emitting a physical agent and any substance, compound, product or physical agent that is deemed to be or contains a designated substance as defined under the Act and the Regulations, which will be or may be used for the work, prior to the commencement of the work. The Contractor shall provide appropriate information and Material Safety Data Sheets, where required, for the substances used in the performance of the work.

B. Where hazardous materials, biological or chemical agents and/or designated substances are used in the performance of the work, the Contractor shall ensure that the requirements of the Act and the Regulations are complied with, including any requirement to train workers, provide appropriate labels and Material Safety Data Sheets or to implement a control program.

C. The Contractor shall take steps to inform the Owner of the location of these materials and to ensure that these materials are not kept stored or used at a location where an employee of the Owner could be working with or exposed to the substance, without the Owner's prior consent or approval.

D. Comply with the requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials, and regarding labeling and provision of material safety data sheets acceptable to Labour Canada.

1.8 SAFETY EQUIPMENT

A. Provide safety equipment such as ropes, safety harness, combustible/hazardous gas and oxygen depletion meter for the use of the resident inspection staff. Provide competent staff to resident inspection staff when entry is required to manholes or other areas which may be hazardous. Resident services staff are not allowed to enter such areas alone.

1.9 INDOCTRINATION

A. The City of Greater Sudbury requires that all Contractors working on City property be indoctrinated in accordance with the requirements of the Special Provisions of the Contract.

B. Develop a site-specific indoctrination procedure.

C. The site-specific indoctrination shall contain the following basic components:

1. Site specific training of workplace hazards, designated materials and work conditions.

2. Site specific training of safe work procedures, required safety equipment, and sign-in/sign-out requirements.

3. Location of all safety equipment, sanitary facilities, and rest areas.

4. Training on requirements of the environmental controls plans and emergency response plan.

5. Suitable record system for documenting training, record of personnel trained, and record of companies trained.

6. Any other components as deemed necessary for compliance with applicable laws and statues, or as directed by the Engineer.

D. Ensure all personnel performing work or visiting the site have received site specific indoctrination, or are accompanied by a competent supervisor:

1. Provide all trained staff with a certificate of attendance at the site-specific indoctrination.

2. Provide all visitors with an appropriate tag and safety equipment as deemed necessary.

END OF SECTION

PART 1. GENERAL

1.1 ACCESS TO THE SITE

A. Provide construction entrances to the site and assure normal operation of the Water Supply System is maintained.

B. Under no circumstances shall the existing water plant parking facility and other areas to the plant facility be used for any construction activity or construction related vehicular parking or delivery.

C. Inspect the existing access drives roads, walkways and culverts to be used for construction and provide all necessary material and labour to upgrade existing to be suitable for the construction activities. Remove temporary access facilities and restore to its original condition.

D. Provide and maintain temporary service roads, walkways and culverts to ensure safe, convenient and adequate access, and as required for construction of the works including work related to demolition activity, site clearing, excavating and backfilling.

E. No access via any other entrance except as mentioned above will be allowed. The Contractor is responsible to maintain a log documenting the date, name, company, entry times, and exit times of all people passing through the access gate who are related to the construction activities encompassed in these works.

F. The area for sitting the Contractor's trailer and parking to be approved by Consultant.

G. The existing entrances and exits will need to remain clear and accessible at all times.

H. The Contractor will be responsible for maintaining the cleanliness of the plant roads from the entrance to the Contractor's work area.

I. Neighboring and adjacent site shall be maintained in good condition at all times.

J. The Contractor will be responsible for maintaining access for the Owner's operations and maintenance personnel at all times during construction. Normal operation and maintenance for the existing facility may require extensive occupation and duration by both Owner and the Operations Contractor and any current or future Subcontractors retained by the Owner for normal operation and maintenance requirements.
The Owner will make all efforts to notify the Contractor of ongoing maintenance and operations activities. However, the Owner will make no warranty regarding the accuracy of quantity and duration of maintenance and operational activities.

K. Where not indicated on Contract Drawings, the Contractor shall maintain vehicular and pedestrian access to all access doors, chambers, maintenance holes within the site. When requested by the Owner, provide unabated access to each access point for required duration.

1.2 TEMPORARY BUILDINGS

A. Provide temporary buildings and hygienic facilities which meet the requirements of O.Reg. 659/79.

B. Maintain all temporary buildings clean and free from nuisances so as to avoid danger to plant property or structures prevent complaints from plant personnel and prohibit interferences with the operation of the existing plant.

1.3 SITE WORKING AREAS

A. Site working areas are as indicated on Contract Drawings.

1.4 SECURITY

A. Provide lockable truck gates. Maintain the enclosure in good repair.

B. Provide and maintain security and surveillance in order to provide a measure of security as well as safety, against injury to persons not concerned with construction. The Owner does not assume liability for breaches of security on the jobsite.

1.5 TEMPORARY UTILITIES

A. The Contractor is responsible for making his own arrangements for telephone access on the site.

B. Potable water from designated outlets may be used and metered. Provide hoses as required including proper installation and certification of any required backflow prevention systems. Repair any damage caused during use of existing water outlets.

C. Existing electrical power may be used and metered. Replace any blown fuses or damaged breakers and repair any damage caused. Provide extension cords as required. Do not overload circuits beyond their rated capacities.

D. The Contractor shall reimburse the Owner for all metered utilities at the completion of the Contract.

E. Provide ground fault protection for all electrical equipment.

F. Temporary electrical wiring on this project shall meet the requirements of the "Temporary Wiring Standard" dated May 1, 1973, published by the Construction Safety Association. For the purpose of the Temporary Wiring Standard, the Contractor is designated the "Constructor".

1.6 TEMPORARY LIGHTING

A. The existing lighting systems may be used at no cost to the extent possible during construction. Provide additional lighting as required. When work is complete, clean all fixtures and lamps that have become soiled by the performance of the work.

B. Provide all temporary electrical lighting to provide uniform, well-lit work areas at all times.

C. Secure all temporary lighting and wiring from damage. Falling or tripping hazard.

1.7 EQUIPMENT

A. The Contractor shall provide at his own expense all manner of materials, labour, scaffolding, ladders, hand tools and appliances necessary for the due execution and proper completion of the work described herein, unless otherwise specified in the tender specifications. Equipment will not be loaned by Owner.

1.8 SITE STORAGE SPACE

A. Provide and maintain outside storage. Locate storage facilities where directed by the Consultant. Provide enclosed storage space for the storage of products that cannot be stored in the open unprotected.

B. Do not schedule delivery of products that require protective storage on the site until suitable site storage space is available.

C. Remove from the site products that have been damaged by reason of improper storage or otherwise and replace with new products.

D. Store products on site in accordance with the Manufacturer's instructions.

1.9 SANITATION FACILITIES

A. Do not use existing plant washroom facilities. Provide temporary sanitary facilities in accordance with the Occupational Health and Safety Act.

END OF SECTION

PART 1. GENERAL

1.1 INTENT OF SECTION

A. This Section covers the flushing and disinfection of water retaining structures (filter concrete box, underdrain and plenums, troughs and installed related pipes and components), and all potable water piping (process piping) installed under this project.

B. The Contractor shall employ qualified specialists to flush, test and sterilize all water retaining structures and pipe work in such lengths or sections as the Engineer shall direct, and provide all labour, water, chemicals and chemical metering equipment, pumps, gauges, caps, stoppers, air release cocks, pipe work and other apparatus required to complete the tests.

1.2 RELATED SECTIONS

A. Section 01040 – Summary of Works and Coordination.

B. Section 11530 – Filter Underdrain.

1.3 MEASUREMENT AND PAYMENT

A. Work outlined in this Section is included in the Lump Sum Tender Price.

1.4 ACCEPTABLE SPECIALIST SUBCONTRACTOR

A. The specialists shall be fully experienced in providing disinfection services of water retaining structures, water treatment facilities and potable water process piping and shall provide proof of certification of disinfection work completed in Ontario Water Treatment Plants.

PART 2. PRODUCTS (NOT USED)

PART 3. EXECUTION

3.1 DISINFECTION OF TREATMENT FACILITIES

A. Water treatment facilities shall be disinfected in accordance with the requirements of the following most recent edition of ANSI/AWWA Standards:

ANSI/AWWA Standard	Standard Name
C651	AWWA Standard for Disinfection of Watermains
C652	AWWA Standard for Disinfection of Water-Storage Facilities

B. Should there be conflicts between the above-noted standards or with the Specifications, the more stringent provisions shall apply.

C. Where disinfection procedures are not provided in the above-noted standards for water storage facilities, disinfection procedures shall be carried out in accordance with the Manufacturer's recommendations and as approved by the Engineer.

3.2 DISINFECTION OF WATER RETAINING STRUCTURES

A. The Contractor shall prepare and submit a detailed disinfection plan for review and approval by the Owner and the Engineer at least four (4) weeks in advance of the disinfection work. An initial draft of an overall commissioning and disinfection plan to incorporate the Filter No. 3 and all related systems will be submitted three (3) months after the Contract Award and be reviewed monthly until the work is complete.

B. The Contractor shall notify the Engineer at least two (2) weeks before disinfection is carried out to allow for inspection.

C. The Contractor shall be responsible for installing any temporary flush sample points required for disinfection. Sample points shall be brought to the surface in confined spaces.

D. Prior to placing filter media over filter underdrain and completed filter structure, underdrain and installed related pipes and components into service, the Contractor shall disinfect the water retaining filter structure. All disinfection operations shall be supervised by the Engineer.

E. Disinfection of water retaining filter structure(s) shall be carried out in accordance with the requirements of the appropriate standard referenced in the table above. There are three disinfection methods provided in the Standard, however only Method One or Method Two is to be used by the Contractor.

F. Disinfection shall not commence until components have been cleaned and thoroughly flushed, inspected and approved by the Engineer and Owner.

G. After the disinfection procedure is completed and before the upgraded filter(s) are placed in service, water shall be sampled and tested for coliform organisms in accordance with the relevant standard.

3.3 BACTERIOLOGICAL SAMPLING AND TESTING

A. Before filter media is loaded to upgraded filter(s) with new underdrains and isolation valve are opened, bacteriological sampling and testing shall be performed in accordance with the above-noted respective AWWA Standard.

B. The water samples for bacteriological testing shall be taken by the qualified specialists performing flushing and disinfection procedures. Additionally, Water Plant Operations may also choose to gather their own samples. In this case, the contractor is to provide any support necessary for the Owner's Operations staff or designate to collect their samples.

C. The qualified specialists performing flushing and disinfection procedures shall be responsible for sending the samples to a registered laboratory for testing.

D. Analytical fees for the initial round of sampling will be absorbed by the Region. The Contractor will be responsible for fees related to additional samples submitted due to failed results plus any costs associated with providing additional water.

E. Plant Operations must receive a written copy of all results of chlorine residual tests and all results of bacteriological testing prior to final commissioning.

3.4 DISCHARGE OF CHLORINATED WATER

A. A reducing agent to neutralize residual chlorine shall be applied to the chlorinated water used for the disinfection of the water retaining structures and piping prior to discharge, in accordance with environmental standards. The Contractor will bear all associated costs with the discharge.

END OF SECTION

PART 1. GENERAL

1.1 SECTION INCLUDES

A. Administrative procedures preceding preliminary and final inspections of the Works for the purpose of issuance of Substantial Performance of the Works.

1.2 INSPECTION AND DECLARATION OF SUBSTANTIAL

A. Contractor's Inspection: The Contractor and all Subcontractors shall conduct an inspection of the Work, identify deficiencies and defects, and repair as required to conform to the Contract Documents.

B. Notify the Engineer in writing of satisfactory completion of the Contractor's inspection and that corrections have been made and request the Engineer's inspection.

C. The Engineer's Inspection: The Engineer and the Contractor will perform the inspection of the Work to identify obvious defects or deficiencies and the Contractor will correct the Work accordingly.

D. Completion: Submit a written certificate that the following has been performed:

1. Work has been completed and inspected for compliance with Contract Documents.
2. Defects have been corrected and deficiencies have been completed.
3. Equipment and systems have been tested, adjusted and balanced and are fully operational.
4. Electrical inspections and approvals are complete and submitted.
5. All required documentation has been submitted including final Operations and Maintenance Manuals and As-Constructed Drawings.
6. Operation of systems has been demonstrated to the City's personnel.
7. All required training has been delivered.
8. Work is complete and ready for final inspection.

E. Final Inspection: When items noted above are completed, request final inspection of the Works to be conducted by the Engineer and the City.

F. Complete the outstanding work or deficiencies arising out of the final inspection that are deemed to affect the issuance of Substantial Performance.

G. Agree to a list of outstanding work and deficiencies that do not affect Substantial Performance with the Engineer.

H. Apply for Substantial Performance.

PART 2. PRODUCTS – NOT APPLICABLE

PART 3. EXECUTION – NOT APPLICABLE

END OF SECTION

PART 1. GENERAL

1.1 SECTION INCLUDES

A. As-Built Drawings, samples and Specifications.

B. Equipment and systems.

C. Product data, materials and finishes, and related information.

D. Operation and maintenance data.

E. Spare parts, special tools and maintenance materials.

F. Warranties and bonds.

G. Final site survey.

1.2 Submission

A. Prepare instructions and data by personnel experienced in the maintenance and operation of described products and one (1) digital copy for the Engineer's review.

B. One (1) digital copy will be returned with comments and a duplicate copy will be retained to assist the Engineer and will be returned after delivery of the final copies.

C. Revise the content of documents as required prior to final submittal.

D. Ensure spare parts, maintenance materials and special tools provided are new, undamaged and not defective, and of the same quality and manufacture as products provided in the Works.

E. If requested, furnish evidence as to the type, source and quality of products provided.

F. Defective products will be rejected, regardless of any previous inspections by the Engineer or other agents of the Region. Defective products are to be replaced at the Contractor's expense.

G. Pay the costs of transportation related to the replacement of defective products.

H. Holdback monies will be retained by the owner until an acceptable final manual submission is received.

1.3 Record Drawings and Samples

A. Site Records:

1. The Engineer will provide one set of reproducible Contract Drawings at the beginning of the project for Record Drawings. Provide sets of white prints, as required, for each phase of the work. Mark thereon all changes as work progresses and as changes occur including Change Orders. (This shall include changes to existing systems, control systems, low voltage control wiring, etc.)

1. On a weekly basis, transfer information to reproducible, revising reproducible to show all work as actually installed.

2. Use different colour waterproof ink for each service.

3. Make available for reference purposes and inspection at all times.

4. Store record documents and samples in the field office apart from documents used for construction.

5. Label record documents and file in accordance with the Specification Section number. Label each document “CONSTRUCTION RECORD” in neat, large printed letters.

6. Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

7. Keep record documents and samples available for inspection by the Contract Administrator on a monthly basis.

B. Record Drawings:

1. Prior to the start of Testing, Adjusting and Balancing (TAB), finalize the production of Record Drawings.

2. Identify each Drawing in the lower right-hand corner in letters at least 12 mm high as follows: “RECORD DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW SYSTEMS AS INSTALLED” (Signature of Bidder) (date).

3. Submit to the Engineer for approval and make corrections as directed.

4. TAB to be performed using Record Drawings.

5. Submit completed reproducible Record Drawings with Operating and Maintenance Manuals. Provide a memo referencing the documents and with signatures and dates of the Contractor (Supplier) and the Engineer (Recipient) provided on the memo with copies of this memo kept by both the Contractor and the Engineer.

C. Submit copies of Record Drawings for inclusion in the final TAB Report to the Engineer from all disciplines.

D. Holdback monies will be retained by the Owner until a complete set of As-Built Drawings are submitted.

1.4 Recording Actual Site Conditions

A. Record information on a set of Drawing prints provided by the Engineer.

B. Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

C. Record information concurrently with construction progress. Do not conceal Work until the required information is recorded.

D. Contract Drawings and Shop Drawings: Legibly mark each item to record actual construction, including:

1. Measured depths of elements of the foundation in relation to the finished first-floor datum.

2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

3. Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

4. Field changes of dimensions and details.

5. Changes made by Contract Change Directives.

6. Details not on original Contract Drawings.

7. References to related Shop Drawings and modifications.

E. Specifications: Legibly mark each item to record actual construction, including:

1. Manufacturer, trade name, and catalogue number of each product actually installed particularly optional items and substitute items.

2. Changes made by Addenda and Contract Change Directives.

F. Other Documents: Maintain Manufacturer's certifications, inspection certifications, and field test records, required by individual Specifications Sections.

1.5 Equipment and Systems

A. Each Item of Equipment and Each System: Include a description of the unit or system and its component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

B. Panel board circuit directories: provide electrical service characteristics, controls, communications, and final as-constructed diagram.

C. Include as-constructed installed colour-coded wiring diagrams in the Manual and also provide an electronic copy in AutoCAD 2010 Version.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include the Manufacturer's printed Operation and Maintenance Instructions.

H. Include a sequence of operation by controls Manufacturer where appropriate.

I. Provide the original Manufacturer’s parts list, illustrations, Assembly Drawings, and diagrams required for maintenance.

J. Provide installed control diagrams by the controls Manufacturer where appropriate. Include copies in the manuals and provide an electronic version in AutoCAD 2010 version.

K. Provide coordination Drawings, with installed colour-coded piping diagrams.

L. Provide charts of valve tag numbers, with the location and function of each valve, keyed to flow and control diagrams.

M. Provide a list of the original Manufacturer’s spare parts, current prices, and recommended quantities to be maintained in storage.

N. Include test and balancing reports from Equipment Start-up and Performance Testing and Facility Commissioning.

O. Additional Requirements: As specified in individual Specification Sections.

1.6 Spare Parts

A. Provide spare parts, in quantities specified in individual Specification Sections.

B. Provide a list/label accompanying spare parts to identify the associated equipment.

C. Provide items of the same Manufacture and quality as items in Work.

D. Deliver to site location and place in storage as directed by the Engineer.

E. Obtain receipts for all delivered products and submit these receipts prior to Substantial Performance.

F. Provide an inventory list of spare parts.

G. Contractor to turn overall spare parts complete with inventory list prior to substantial completion.

1.7 Maintenance Materials

A. Provide maintenance and extra materials, in quantities specified in individual Specification Sections.

B. Provide items of the same Manufacture and quality as items in Work.

C. Deliver to site location and place in storage as directed by the Engineer.

D. Obtain receipts for all delivered products and submit these receipts prior to Substantial Performance.

1.8 Special Tools

A. Provide special tools, in quantities specified in the individual Specification Section.

B. Provide items with tags identifying their associated function and equipment.

C. Deliver to site location and place in storage as directed by the Engineer.

1.9 DELIVERED PRODUCTS

A. Obtain receipts for all delivered products and submit these receipts prior to Substantial Performance.

1.10 Storage, Handling and Protection

A. Store spare parts, maintenance materials, and special tools in a manner to prevent damage or deterioration.

B. Store in an original and undamaged condition with the Manufacturer's seal and labels intact.

C. Store components subject to damage from weather in weatherproof enclosures.

D. Store paints and freezable materials in a heated and ventilated room.

E. Remove and replace damaged products at the Contractor's own expense and to the satisfaction of the Engineer.

F. Exercise all equipment in strict conformance with the equipment Manufacturer's written instructions during storage and following installation. Provide all equipment exercise logs to the Engineer for review.

1.11 Warranties and Bonds

A. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing.

B. List the Subcontractor, Supplier, and Manufacturer, with the name, address, and telephone number of the responsible principal.

C. Obtain warranties and bonds, executed in duplicate by Subcontractors, Suppliers, and Manufacturers.

D. No warranty will commence until issuance of Substantial Performance on respective work components. The warranty on items used during construction, with the City's permission, for the safe and orderly completion of the works will not commence until Substantial Performance.

E. Verify that documents are in proper form, contain full information, and are notarized.

F. Co-execute submittals when required.

G. Retain warranties and bonds until the time specified for submittal.

PART 2. PRODUCTS – NOT APPLICABLE

PART 3. EXECUTION – NOT APPLICABLE

END OF SECTION

PART 1. GENERAL

1.1 INTENT

A. This Section contains requirements for the Contractor in carrying out and documenting testing work and training of Operations staff, as required under this Contract.
In addition, this Section contains requirements for the Contractor during compliance, operational and performance testing for all mechanical, electrical, instrumentation and controls equipment provided under this Contract. This Section also contains site clean-up (progressive and final) requirements of the Contractor under this Contract.

B. This Section supplements but does not supersede testing requirements found elsewhere in the specifications.

C. This Specification shall be applied to all Divisions in the Tender Document.

1.2 PROGRESS CLEANING

A. Maintain the work in tidy condition, free from accumulation of waste products and debris, other than that caused by the Owner.

B. Make arrangements with and obtain permits from authorities having jurisdiction for the disposal of waste and debris.

C. Remove waste material and debris from the site at the end of each working day.

D. Clean interior areas prior to the start of finish work, maintain areas free of dust and other contaminants during finishing operations.

1.3 FINAL CLEANING

A. In addition to the progressive removal of rubbish from buildings, structures and site, and leaving the buildings broom clean, perform the following work before acceptance and prior to applying for a Certificate of Substantial Performance of the Work:

1. Remove waste products and debris other than that caused by the Owner and leave the work clean and suitable for occupancy by the Owner.

2. Remove surplus products, tools, construction machinery and equipment. Remove waste products and debris generated or caused by the construction activities.

3. Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

4. Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.

5. Vacuum clean and dust building interiors, behind grills, louvres and screens.

6. Clean all ducts.

7. Flush all heating piping.

8. Clean all washroom fixtures and fitments.

9. Wax, seal, shampoo or prepare floor finishes, as recommended by the Manufacturer.

10. Broom clean and wash exterior walks, steps and surfaces.

11. Clean all glass and replace broken glass.

12. Remove stains, spots, marks and dirt from all finished work, electrical and mechanical fixtures, furniture fitments, etc.

13. Clean hardware.

14. Remove paint spots and smears from all surfaces.

15. Vacuum and clean all building interiors affected in construction operations.

16. Make a thorough inspection of all finishes, fixtures, and equipment to make sure of proper workmanship operation.

17. Ensure two coats of wax are applied to resilient floor surfaces.

18. Broom clean exterior walks, steps and platforms and remove dust, dirt and other disfigurations from exterior surfaces.

19. Vacuum inside and outside of all new and existing MCC, control panels, prior to turning over the facility to the Owner.

20. Vacuum inside and outside of all new and existing electrical panels, MCCs, variable speed drives, etc. which have been affected by dust or dirt due to construction activities.

21. Repair any damage to the existing roadway, fencing, etc. due to construction activities.

B. Remove all temporary work from the site including but not limited to fencing, sign board, samples, and any other items not considered to be part of the permanent works.

C. After successful completion of leakage tests, clean debris and foreign matter from the structures.

1.4 START-UP AND COMMISSIONING OF EQUIPMENT AND SYSTEMS

A. Definitions:

1. Start-up (or Compliance Testing): a test or tests in the presence of the Consultant and the Owner to demonstrate that the installed equipment or system meets the Manufacturer's installation and adjustment requirements and other requirements specified including, but not limited to, noise, vibration, alignment, speed, proper electrical, instrumentation and control, mechanical connections, thrust restraint, proper rotation, initial servicing, and instrumentation calibration.

2. Commissioning (Operational and Performance Testing): a test performed in the presence of the Consultant and the Owner and after any required start-up specified, to demonstrate and confirm that the equipment and/or system meets the specified operational performance requirements while simulating actual operating conditions to the greatest extent possible.

3. System: the overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment. Examples of systems on this Contract are as follows:

   a. Process Mechanical and Electrical Equipment.

   b. Instrumentation and Controls.

   c. HVAC System.

B. Submittals:

1. Submit five (5) copies of the proposed start-up and commissioning schedules and work plan for equipment units and systems four (4) weeks prior to start of related testing for approval by the Consultant. Revise the schedule based on the Consultant's review and resubmit five (5) copies of the approved schedule.

2. Include in the start-up and commissioning schedule the following items as a minimum:

   a. A list of all equipment to be tested.

   b. Tests which will be performed for each related piece of equipment.

c. Test plan.

d. Test procedure.

e. Plan for calibration of instruments.

f. Time and date for each test in daily stages.

g. List of Subcontractors and Equipment Suppliers which will be present for each test.

C. Testing Preparation:

1. General:

a. Complete work associated with the unit and related processes before testing, including related Manufacturer's representative installation inspection services.

b. Provide related Operating and Maintenance Manuals, complete City's required "ADD EQUIPMENT FORMS" and provide spare parts and special tools as specified before testing any unit or system.

c. Document start-up and commissioning procedures and when necessary contingency plans.

d. Designate and provide one or more persons to be responsible for coordinating and expediting Contractor's facility start-up duties. The person or persons shall be present during facility start-up period. The Consultant will also designate a person to interface with the Contractor's facility start up person. Coordinate all start-up activities with the Consultant's designate. The Owner will also designate a person(s) to interface with the Consultant's and Contractor's designates.

e. Coordinate with the Consultant and City staff any Public Service Announcements (PSA) as required. PSA, Sudbury & District Health Unit and the Ministry of the Environment notifications will be managed by the Consultant and the City of Greater Sudbury.

f. Provide services of qualified Manufacturer's representatives to assist in testing.

g. Provide all electrical power, fuel, lubricants, water, temporary piping, temporary instrumentation and labour for testing, start-up and commissioning.

h. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required to conduct testing.

2. Cleaning and Checking: Prior to start-up complete the following work. Start-up will not proceed until all cleaning and checking is completed:

    a. Calibrate testing equipment for accurate results.

    b. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.

    c. Provide all oils and grease for pre-purchased equipment. Lubricate all equipment in accordance with the Manufacturer's instructions.

    d. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.

    e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

    f. Check the power supply to electric-powered equipment for the correct voltage.

    g. Adjust clearances and torques.

    h. Test piping for leaks.

    i. Balance HVAC systems, measuring airflow (cfm) static pressure, and component pressure losses. Provide a typed report documenting the results of balancing.

    j. Obtain completion of applicable of Manufacturer’s Certificate of Proper Installation.

3. Ready-to-test determination will be based on full compliance with all of the following:

    a. Notification by Contractor of equipment and system readiness for testing.

    b. Acceptable testing plan.

    c. Acceptable ADD EQUIPMENT FORMS, Operation and Maintenance Manuals incorporating

    d. Review comments.

    e. Receipt of Manufacturer’s Certificate of Proper Installation, where specified.

    f. Adequate completion of work adjacent or, to interfacing with, equipment to be tested.

    g. Availability and acceptability of Manufacturer’s representative, when specified, to assist in the testing of respective equipment.

h. Equipment and electrical tagging complete.

i. All spare parts and special tools are delivered to the Owner.

D. Start-Up:

1. Begin testing on time based on the approved test schedule.

2. For Start-up Activities in Confined Space locations, provide at least two (2) Contractor's staff who are trained and certified for confined space entry procedures. Provide all necessary confined space entry equipment and conform to the Owner's confined space requirements.

3. Without exception, all rotating equipment shall be checked, witnessed by the Consultant and Owner's staff, and tested for:

   a. Vibration level to be within specified limit. The peak vibration velocity shall not exceed 1 mm/sec (0.04 inches/sec) measured in the filter-in mode. Measurement shall be carried out with a Real Time analyzer, Nicolet 100 Aa or equal. Provide a hard copy Vibration Signature Spectrum showing vibration velocities over a frequency range of 0 to 2000 Hz, measured in filter-in and filter-out modes. Include this in each set of the Maintenance Manual.

   b. Equipment base is to be true and levelled.

   c. Alignments of shafts, soft foot of motor and couplings shall be performed by reverse dial, rim to rim, and face to face. Soft foot shall be rim to rim vertical and horizontal mode.

   d. Soft foot motor shall be demonstrated by the Contractor to be within a tolerance of $\pm$ 0.0375 mm ($\pm$ 0.0015 inch).

   e. Shaft to be aligned and demonstrated by the Contractor to be within a tolerance of $\pm$ 0.025 to 0.0075 mm ($\pm$ 0.001 to 0.003 inch).

   f. Piping strains to pump shall be demonstrated by the Contractor to be within a tolerance of $\pm$ 0.025 to 0.0075 mm ($\pm$ 0.001 to 0.003 inch).

   g. Check equipment for:

      1. Soundness (without cracked or otherwise damaged parts).

      2. Correctness of setting, alignment and relative arrangement of various parts of system.

   h. Additional start-up tests as specified in each specific equipment sections included but not limited to the testing specified in Division 11, Division 13, Division 15 and Division 16.

i. Conduct start-up until each individual component item or system has achieved one continuous hour of satisfactory operation. Demonstrate all operational features and controls function during this period while in automatic modes where applicable.

j. For Control Loop Checkout/Verification, arrange for the Contractor, electrical, instrumentation and control Subcontractors for testing of loop wiring between instrument and field devices and advise the Consultant to be present for the procedure.

k. When testing instrumentation loops, perform the testing of each loop in sequence and in groups. The testing of instrument loops will be graded on a pass/fail basis. If more than two instrument loops within a group fail the loop checkout, the entire group of loops will be deemed to have failed the checkout. When the failed loops have been repaired, the entire group must be retested.

l. Complete the Owner's/Consultant's Standard Installation/Start-Up Check out forms in the Appendix and ensures all parties sign the respective forms. Provide five (5) copies. The forms presented are a minimum and additional forms will be provided as required:

    1. Installation Checklist – Equipment.
    2. Installation Checklist – Piping.
    3. Installation Checklist – Valves.
    4. Installation Checklist – Tanks/Vessels.
    5. Installation Checklist – Instruments (Various).
    6. Installation Checklist – Panel/PLC/Computer.
    7. Instrumentation Checklist – Termination and Continuity.
    8. Installation Checklist – Electrical.
    9. Calibration Checklist – Instruments.
    10. Alignment Data Record Sheet.
    11. Test Report – Equipment.
    12. Test Report – Piping Pressure.
    13. Test Report – Valves.

14. Test Report – Tanks/Vessels.

15. Control Loop Check out/Verification Form.

16. Electrical Equipment Inspection Report.

17. HVAC Checkout/Verification Form.

18. Manufacturer's Installation Certification.

19. Manufacturer's Instruction Certification.

m. Provide written documentation of all tests not covered by above Forms.

n. Provide the services of a qualified Manufacturer's service representative to assist in the start-up of the equipment.

o. In addition to the test reports specified above, submit the Manufacturer's representative's signed report describing in detail the findings of the start-up inspection, tests and adjustments made, quantitative results and suggestions for precautions to be taken for correct maintenance, if any, and a Manufacturer's certificate stating that the installation of the equipment has been inspected, is installed in accordance with the instructions, has been started and adjusted as necessary and that the equipment is ready for operation and is in warranty condition.

p. Complete all necessary modifications or adjustments to the system based on the start-up. Verify that the equipment and its installation conform to the requirements of the Contractor the service intended and is ready for permanent operation.

q. When all corrections and adjustments have been made to the equipment, provide the services of the Manufacturer's representative to reverify the modifications and/or adjustments made and certify that the equipment is ready for continuous operation. Submit five (5) copies of the revised check out forms.

r. Submit five (5) copies of the revised check out forms.

s. Submit five (5) copies of the Manufacturer's Certificate that the equipment is ready for Operation and Maintenance Manuals.

t. Equipment will only be accepted after receipt of the Manufacturer's representative is scheduled to perform these services.

u. Modify or replace equipment or materials failing required tests.

v. Perform additional testing required due to failure of materials or construction to meet specifications. Provide additional services of the Manufacturer's representative for inspection and start-up to meet specification.

w. If, in Consultant's opinion, each system meets the start-up requirements specified, such system will be accepted as conforming for purposes of advancing to commissioning phase, if required. If, in Consultant's opinion, start-up results do not meet requirements specified, the systems will be considered as non-conforming.

x. Commissioning shall not commence until the equipment or system meets start-up test requirements specified.

E. Commissioning:

1. General:

a. Begin commissioning after satisfactory completion of all start-up tests.

b. Unless otherwise indicated, provide services specified or required, all labour, materials, and supplies for conducting the test and taking all samples and performance measurements.

c. Prepare commissioning report summarizing test method. Include test logs, pertinent calculations, and certification of performance.

d. Any analytical laboratory work required for commissioning will be performed by the Owner.

e. Conduct commissioning as required to demonstrate system performance.

f. In addition to the general mechanical and electrical commissioning, complete commissioning as specified in each specific equipment section included but not limited to testing specified in Division 11, Division 14, Division 15 and Division 16.

g. The Owner may conduct independent testing to verify test results. If through the independent testing, the testing fails, the Contractor to correct deficiencies retest and pay for retesting.

2. Construction/Operation Delineation during Commissioning Construction:

a. Contractor to identify all equipment and/or systems that are being installed with a red tag to indicate that the Contractor is installing and responsible for the equipment.

b. After the equipment has been installed, aligned, start-up, tested and certified by the Manufacturer/vendor as having been installed properly, remove the red tag from this equipment and/or system and replace with a green tag only as directed by the Consultant.

c. All equipment and/or systems identified with a green tag will indicate that the equipment is fully functional and may be used by the Owner for operation of the facility.

3. Operational Testing:

a. Following the demonstration of all systems and subsystems as specified above under Start-up or Compliance Testing, the Contractor is required to operate the equipment for a test period not exceeding five (5) days but not less than two (2) days, or as directed and determined by the Consultant at normal operating levels with water. If the demonstration is not successful, reschedule for another test period under the direction of the Consultant. Obtain all necessary permits from the applicable regulating bodies to allow for the temporary withdrawal and discharge of water if this demonstration procedure requires withdrawal and discharge of water.

b. Instruct the Owner's staff in the operation and maintenance of designated equipment and instrumentation. Provide the services of a qualified Manufacturer's representative for training of the Owner's staff. Include for trade specific operation and maintenance instructions. Provide for this training in two sessions on different days. Provide copies of all information presented to operating staff during instruction.

c. Correct deficiencies revealed during initial operation. Correct and adjust equipment operation.

4. Performance Testing:

a. Prior to turning over the operating facility to the Owner, place the new, refurbished and reconstructed works in operation starting on a designated Monday. The performance testing shall be undertaken.

b. For a period of 14 continuous days, the Contractor will operate the facility to demonstrate the proper operation of each sub-system in the facility in a sequential manner starting at the last unit process in the facility. Performance testing of HVAC may be complete outside of the sequence required for process and control equipment/systems. If everything is not satisfactory after 14 continuous days, continue until the operation of the work is satisfactory or reschedule a new 14-day start-up program.

c. The Contractor is to have supervisory personnel, mechanics, electricians, instrument technicians and other workmen on site during the normal working day and as required at other times to ensure the safe continuous operation of the facility. During other times, the Contractor is to have the above personnel on call to attend to any adjustments and corrections required.

d. The Contractor shall install temporary piping, bulkheads and control that may be required during performance testing and shall perform all works necessary to commission the system to render it fully operational.

e. Performance testing includes operation of equipment using initially simulated interlock and alarm signals where necessary, to check functionality. It also requires completion of loop checks from field instruments by simulated or quantifiable process inputs to the terminals in the Local Control Panel, for interface with the PLC/RPU. These checks may require further calibration of field instruments.

5. Facility Commissioning and Performance Testing:

a. Pre-requisite for Facility Commissioning and Performance Testing:

1. Successful completion of start-up, operational testing, performance testing and training as specified herein.

2. Submission of five (5) copies of the proposed start-up and commissioning schedules and work plan for equipment units, and systems four (4) weeks prior to start of related testing for approval by the Consultant.

b. Once all equipment and sub-systems have been tested individually and completed to the satisfaction of the Owner and the Consultant, the Contractor shall perform performance testing on the completed Facility as a whole.

c. A significant interruption will require the test then in progress to be stopped and restarted after corrections are made. Significant interruptions include any of the following events:

1. Failure of the Contractor to maintain qualified on-site personnel as scheduled.

2. Failure of any equipment item or system component to meet specified performance requirements for more than two (2) consecutive hours.

3. Failure of any critical unit, system, or subsystem that is not satisfactorily corrected within six (6) hours after failure.

4. As may be determined by the Owner and Consultant.

d. Acceptance Criteria:

1. The Facility has operated satisfactorily for 14 days, after performance testing of individual sub-systems, at the rated capacity, on a continuous basis.

2. Successful demonstration of all four levels of operation/control, as defined herein.

3. Chemical feed pumps – dosage delivery as specified.

4. Pumps – flows and pressures as specified.

5. Successful demonstration of all interlock operation and start-up and shutdown sequences.

6. Successful demonstration of pressure relief.

7. Acceptable system responses to simulated abnormal/emergency conditions, including, but not limited to, localized power failure, specific hardware failure.

8. Trending of monitored process variable, equipment parameters and modes of operation of control equipment during testing period.

9. The operations do not violate any laws, rules, regulations, or other permit conditions.

10. The operations create no materially unsafe or nuisance conditions or risks.

11. Operations are in compliance with the Contract.

12. If pre-purchased equipment does not meet performance criteria, modify the operation and/or equipment to achieve required performance.

e. System commissioning shall be considered complete and successful when, in the opinion of the Owner and Consultant, the process system operates in the manner intended at plant design for the specified period.

f. Should the operation be halted for any reason related to the facilities constructed or the equipment furnished, the system commissioning program must be restarted and repeated until the specified continuous period has been accomplished without interruption.

g. Any defects found during the commissioning period must be repaired or the specific part or entire equipment item must be replaced to the complete satisfaction of the Owner and Consultant and at no cost to the Owner. This also applies to pre-purchased equipment.

h. Equipment and process parameters must be archived during system commissioning for the Owner's reference and records.

i. The above procedures shall be satisfactorily completed prior to the facility being considered ready for use as set out in the Construction Lien Act.

j. Correct deficiencies revealed during initial operation. Correct and adjust equipment operation.

1.5 TRAINING

A. Prior to handing over process and control systems, pieces of equipment or devices to the facility for operation and maintenance, the Equipment Supplier is to provide training to Operations and Maintenance staff. The training sessions are to be given specific to the respective operation or maintenance trade, group or staff. Training is not to be initiated prior to the full installation of the process system in each process train, each building, piece of equipment or device and is demonstrated to be functioning in the context of normal operations, without relying on other non-functioning devices or processes.

B. Provide the services of factory representative, who has complete knowledge of proper operation and maintenance of the equipment to instruct representatives of the Owner and Consultant on proper operation and maintenance, including start-up and shut-down procedures, proper lubrication practices and troubleshooting of all equipment.

C. Submit all on-site Training Program outlines to the Consultant for approval prior to any on-site training. Prepare and distribute 20 copies of handout materials required to ensure an effective training program. As a minimum include the following general information and instructions as well as specific trade information in each on-site Training Program. Each training session shall encompass the following topics as a minimum:

1. Function of the equipment.

2. Theory of the equipment operation.

3. Start-up, shutdown, normal operation, and emergency operating procedures of the equipment.

4. Identify and discuss safety items and procedures.

5. Safety concerns and safe operation of the equipment.

6. Preventative maintenance procedures including lubrication requirements.

D. Provide operator training for each process, electrical, instrumentation and control, and mechanical (HVAC) system and piece of equipment to the Owner's staff.

E. The training is to be conducted in a room at the plant and at the equipment or system.

F. Training is to begin a minimum of seven (7) full working days after the Operating and Maintenance Manuals have been delivered to the Consultant.

G. Training sessions are to be scheduled with the Owner's operating staff and are to continue until all the Owner's staff is completely familiar with all operating and maintenance procedures. Note that sessions will have to be repeated to ensure that staff members performing their normal duties will also be trained.

1.6 SPECIAL TOOLS

A. Supply with each piece of equipment all special tools and accessories required for repair and adjustment.

B. Turn such tools over to the Owner as specified above.

1.7 INERT GAS

A. Supply inert gas as required for testing of pressure control devices.

1.8 LUBRICANTS

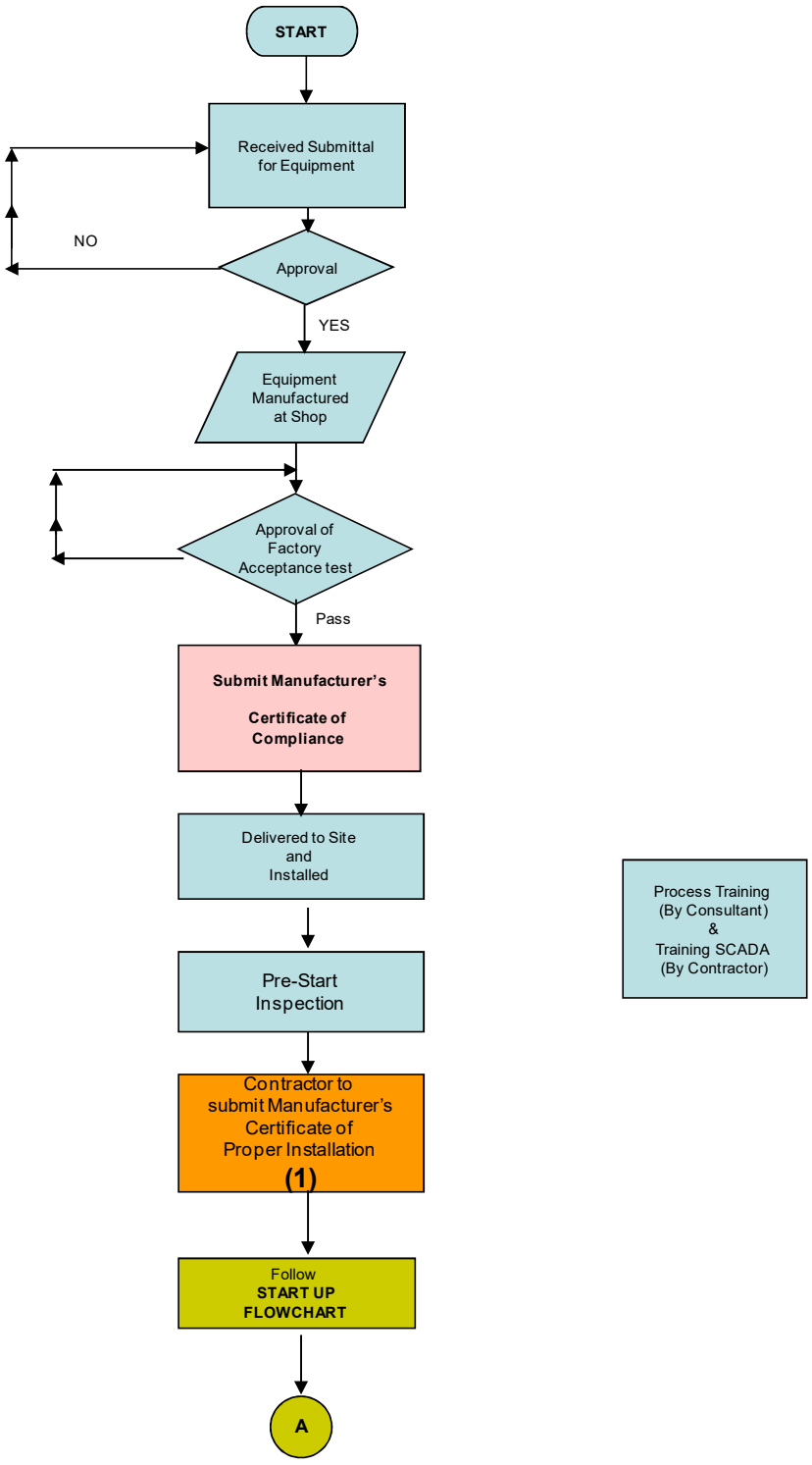
A. For all equipment, furnish all lubricants used in installation testing and prior to testing. All lubricants shall be compatible with the lubricants presently used in the Owner's maintenance operations.

B. Furnish lubricants for this supply in the original sealed containers correctly identified as to brand, grade and with reference to the particular piece of equipment for which it is intended.

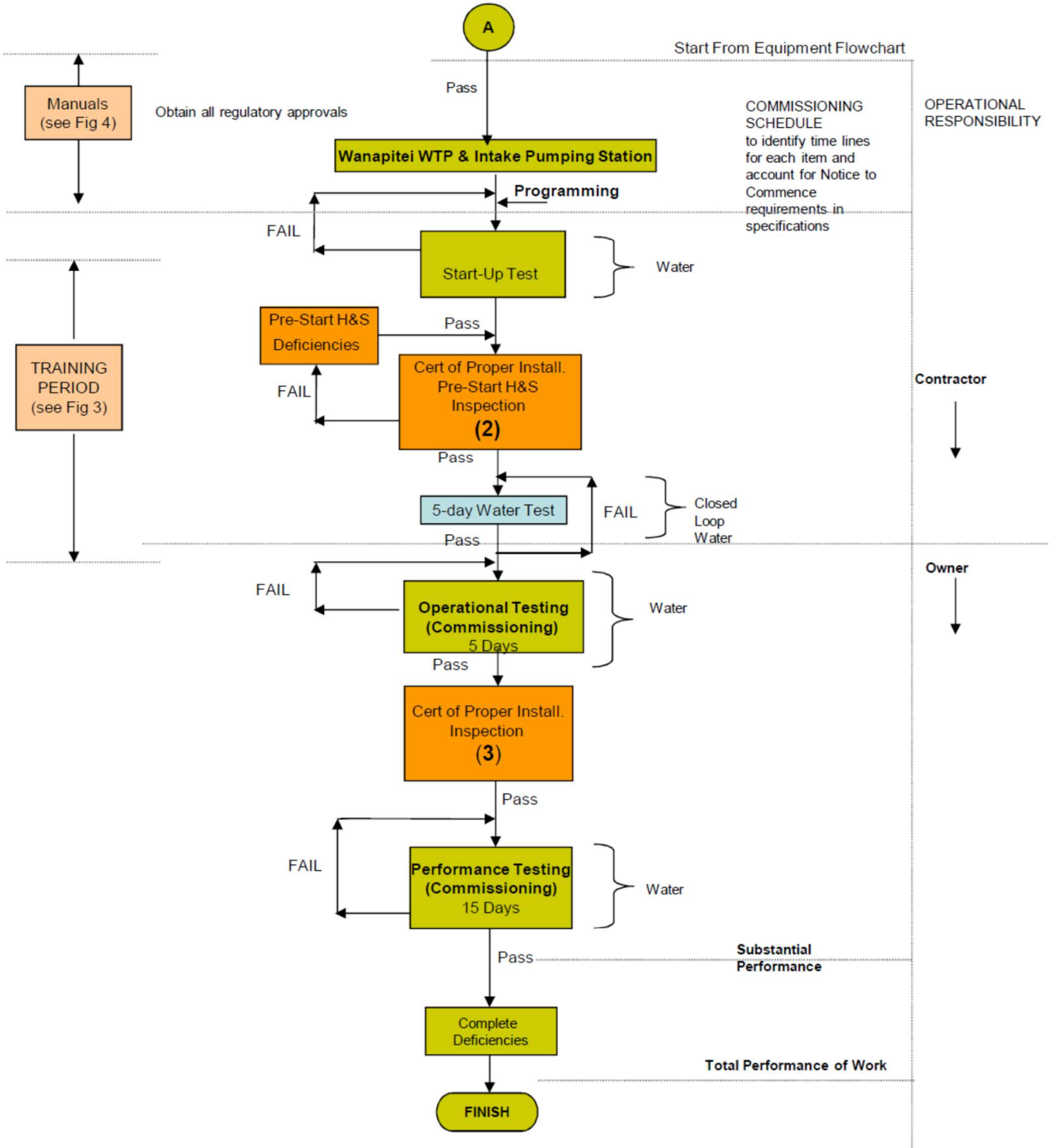
C. Furnish Canadian made lubricants or products readily available in Canada from a Canadian Supplier.

D. Provide a complete listing of recommended lubricants with designated application as an integral part of the Instruction and Maintenance Manuals.

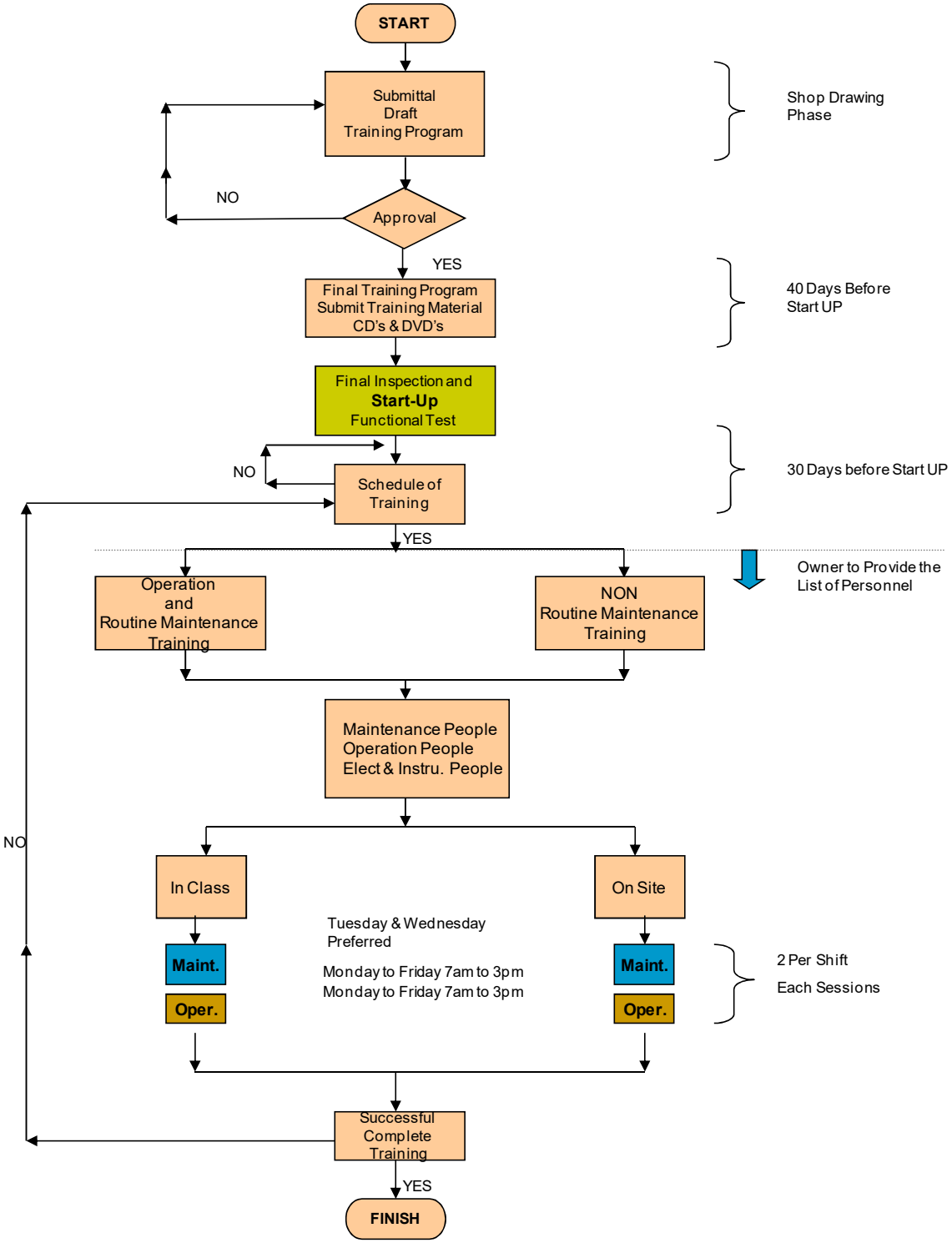
SUPPLEMENT TO SECTION 01800
FIGURE 1 – EQUIPMENT/SYSTEM



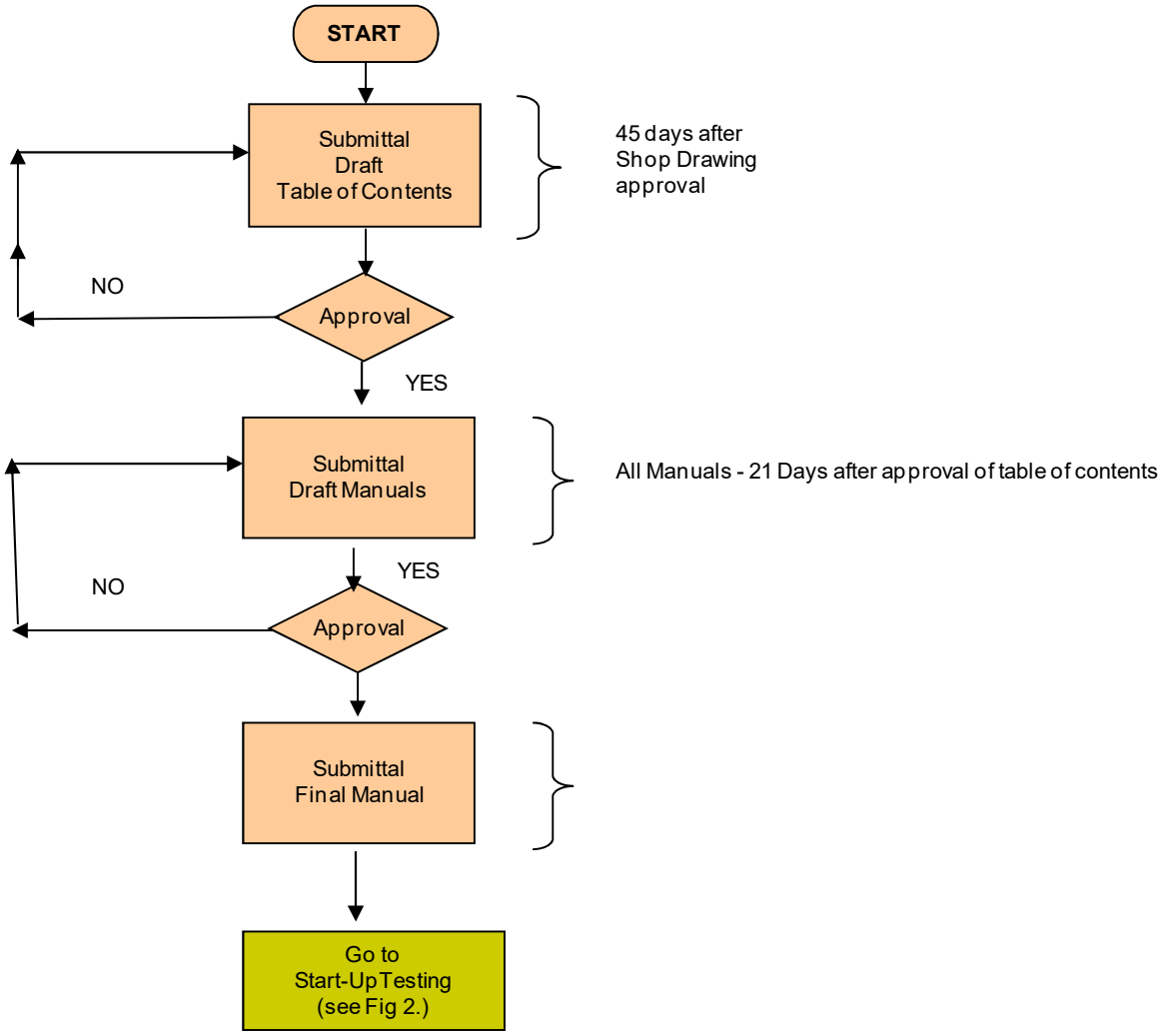
SUPPLEMENT TO SECTION 01800 -
FIGURE 2 – START-UP AND COMMISSIONING



SUPPLEMENT TO SECTION 01800
FIGURE 3 – TRAINING



SUPPLEMENT TO SECTION 01800
FIGURE 4 – MANUALS



END OF SECTION

DIVISION 2

SITE WORKS

PART 1. GENERAL

1.1 INTENT OF SECTION

A. Section includes demolition, salvage, and modifications of existing structures, piping, and equipment as indicated on the Drawings.

1.2 GENERAL

A. Coordinate the work with the Engineer, Operator, and City officials to minimize disruptions to operations of the existing treatment plant. Include the sequence of removals in the project schedule for review by the Engineer.

B. Do not begin removals except in accordance with the approved sequence of construction and until approval has been given by the Engineer in writing three (3) weeks prior to removal.

C. All removed equipment, piping, materials, fixtures, hardware, supports, etc., to be disposed of by the Contractor unless marked in the field by the Authorities concerned. The Authorities has the first right of refusal. The Contractor is to request that the Owner mark items to be salvaged, at least three (3) weeks prior to removal.

D. All equipment to be removed by the Contractor is to remain in good working order.

E. Materials to be turned over to the Authorities shall be delivered and off loaded into storage.

F. All facilities in the work area which are not to be removed must remain in continuous use during the work.

G. Demolition and salvage work shall create a minimum of interference with the Owner's operation and inconvenience to the Owner and to allow continuous, uninterrupted operation of the existing facility.

H. Perform Non-Destructive Testing (NDT) (scanning and/or x-ray) of all concrete slabs and walls schedule prior to demolition and get Engineer approval as applicable.

J. Perform Non-Destructive Testing (NDT) scanning or x-ray on all portions of concrete walls or slabs that are specified to have holes/penetrations or sufficient modifications made to them.

K. Demolition with jack hammering is not permitted.

L. Provide and design temporary supports, beams, jack supports prior to demolition as required. All design must be carried out by a Professional Engineer licensed in the province of Ontario with minimum five (5) years' experience in similar works.

1.3 REGULATORY REQUIREMENTS

A. Obtain and pay for demolition permits, as required. Give required notices.

B. Comply with applicable requirements of CSA S350-M1980 "Code of Practice for Safety in Demolition of Structures."

D. Comply with applicable regulations of jurisdictional authorities governing waste management.

1.4 SUBMITTALS

A. Submit for approval Drawings, diagrams or details showing sequence of disassembly work or supporting structures. Drawings for structural elements shall bear seal and signature of Professional Engineer licensed to practice in Ontario.

B. Prepare and submit a Waste Reduction Work Plan. Describe management of demolition wastes. Identify materials which can be reused, recycled and indicate method proposed for reducing and reusing recycling wastes.

1.5 PROTECTION

A. Prevent uncontrolled movement, any part of building being demolished; provide temporary shoring and bracing required.

B. Take steps to positively prevent uncontrolled falling of demolished materials.

C. Ensure that no part of existing structure is overloaded due to work carried out under this Section.

D. Prevent debris from blocking drainage systems.

E. Ensure the temporary guards, hoardings are provided during and upon completion of work in accordance with applicable safety regulations.

1.6 EXAMINATION

A. Visit the site and the existing facility so as to fully understand all existing conditions and extent of work required. No increase in cost or extension of performance time will be considered for failure to know conditions.

B. Take over buildings and structures to be demolished based on their condition at time of bid submission, except where indicated otherwise.

1.7 CO-ORDINATION

A. Coordinate all demolition and modification work with any new work to be performed to facilitate completion. Demolition work cannot start until approved by Engineer. Coordination is required with the Engineer and the City of Greater Sudbury's operation staff.

B. Coordinate modification work and demolition to allow continuous, uninterrupted operation of the existing facility.

PART 2. PRODUCTS – NOT USED

PART 3. EXECUTION

3.1 PREPARATION

A. Ensure that affected structures and building areas are unoccupied and discontinued in use and that required screens, partitions, hoardings are in place prior to start of demolition work.

B. Verify that existing services in areas affected by demolition are disconnected, capped or removed, prior to start of work.

C. Ensure that all process equipment within demolition areas, either to be removed or retained, is appropriately protected from damage, dust or anything else which may cause damage during the demolition works.

3.2 GENERAL DEMOLITION REQUIREMENTS

A. The general area in which the demolition work is to be performed shall be left clean and free of debris at the end of each shift; access routes must always be kept clear. If required, the general area shall be graded as required to provide a uniform appearance.

B. Demolish existing work as indicated and as required to accommodate new work.

C. Demolish work in a safe and systematic manner, from top to bottom.

D. Do not throw or drop demolished materials from heights. Use chutes, conveyors, or hoisting equipment to lower materials.

E. Demolish in a manner to minimize dusting. Keep dusty materials wetted but prevent flooding or contaminated runoff.

F. Demolish masonry and concrete elements in small sections. Carefully remove and lower structural framing and other heavy and large objects.

G. At all times leave work in safe condition, so that no part is in danger of uncontrolled toppling or falling.

H. Install temporary supports as required to prevent uncontrolled collapse of structures. Design of support to be completed by Professional Engineer licensed to practice in province of Ontario with minimum five (5) years' experience in similar works. Submit stamped Plans and Drawings for review and record.

I. Security of the facility and operation must always be provided.

3.3 CONCRETE STRUCTURES DEMOLITION

A. Existing concrete structures, as noted, shall be removed to the limits indicated.

B. Existing concrete to be removed shall be cut into fragments and reduced in size as required to facilitate removal and disposal.

C. Disassembly and removal of all structural elements shall be carried out under the supervision of a Professional Structural Engineer licensed to practice in Ontario hired by the Contractor.

3.4 PIPING AND EQUIPMENT DEMOLTION

A. Be responsible for the removal of equipment and associated piping and valves, and all other appurtenances associated with the item being removed.

B. Existing piping shall be cut, removed, abandoned, disconnected, and/or salvaged as indicated on the Drawings or as required.

C. Piping and equipment shall be disconnected, dismantled and removed as required and in such a manner as to minimize disturbance or damage to adjacent construction.

D. At any point or location where new work is to be connected or installed, the removal of existing work shall be done so as to facilitate the new installation work to the maximum possible extent.

3.5 REPAIR OF EXISTING CONSTRUCTION

A. Where structures to be demolished are connected to structures to remain, remove the existing construction in a careful manner so that adjacent construction, piping or facilities to be left in place are not cracked or otherwise damaged.

B. The Contractor will be held responsible for any damage thereto because of his operations.

C. Use temporary supports designed by a Professional Engineer, where and as required for the support of existing facilities.

D. Holes and damage resulting from removal operations shall be filled, reconstructed, repaired, and finished to match and conform to adjacent surfaces and construction as determined by the Engineer.

3.6 ITEMS TO BE SALVAGED BY CONTRACTOR

A. Removal and salvage of any item of equipment or facility includes removal and salvage of all accessories, piping, wiring, supports, associated electrical starters and devices, base plates, and frames and all other appurtenances, unless otherwise directed.

B. Existing materials and equipment removed, and not reused as a part of the work, shall become the Contractor's property, except for the items indicated by the Owner shall remain the Owner's property and shall be delivered to the Owner to a designated area by the Contractor in good condition.

C. Existing materials and equipment to be removed by the Contractor, and reused as a part of the work shall remain the property of the Owner.

D. The Contractor shall carefully remove, in a manner to prevent damage, all materials and equipment specified herein or indicated to be salvaged and reused or to remain the property of the Owner.

E. The Contractor shall store and protect salvaged items specified or indicated to be reused in the work.

F. Any items damaged in removal, storage, or handling through carelessness or improper procedures shall be replaced by the Contractor in kind or with new items.

G. The Contractor may, at his option, furnish and install new items in lieu of those specified or indicated to be salvaged and reused, in which case such removed items will become the Contractor's property.

H. All other existing materials and equipment removed by the Contractor shall not be reused in the work, shall become the property of the Contractor, and shall be removed from the jobsite.

3.7 INSTRUMENTATION

A. Any mounting brackets, enclosures, stilling wells, piping, conduits, wiring or holes that remain after removal of equipment and associated support hardware shall be removed or repaired in a manner acceptable to the Engineer.

B. Transmitters or switches shall be removed and reinstated in an approved manner and by personnel knowledgeable about appropriate methods of handling such equipment.

3.8 CONCRETE MODIFICATIONS

A. Remove existing concrete where such removal is indicated on the Drawings or directed by the Engineer.

B. Remove all dust, grease, curing compounds, impregnations, waxes, foreign particles and disintegrated material.

C. If chipping is necessary, the edges shall be perpendicular to the surface or slightly undercut. Feather edges will not be permitted.

D. Remove all defective existing concrete down to sound concrete where indicated on the Drawings or as directed by the Engineer.

E. Where existing concrete is to be removed, fill, repair and finish the surfaces smooth and flush with adjacent undisturbed surfaces.

F. Unless otherwise indicated on the Drawings or directed by the Engineer, clean and leave in place existing reinforcing exposed during concrete removal operations.

G. Where indicated on the Drawings, extend existing reinforcing into the new construction by mechanical connection to the existing reinforcement. Mechanical connections shall be as specified in on the Contract Drawings.

H. Any reinforcement bars the Engineer allows to be cut shall be cut off not less than 50 mm inside the finished and repaired surface. All anchor bolts, piping and other hardware projecting from concrete surfaces after piping and equipment have been removed shall be cut 50 mm inside the finished or repaired surface. Reinforcement bars and other steel construction to be removed by flame-cut.

I. Remove concrete bases of existing equipment that have been relocated or removed, down to the reinforcing steel of the supporting slab. Initiate removal of curb base with a concrete saw, cutting around the perimeter, taking care not to chip or spall the surface of remaining structure. After existing materials have been removed, exposed reinforcing steel and structural slab shall be cleaned and filled with new concrete, finished to match the surrounding surface.

J. Concrete materials and placement shall be in accordance with the Cast-In-Place Concrete Section.

K. Provide dust control by water systems or vacuum systems and tarping to limit any dust migration during any concrete demolition works.

3.9 DISPOSAL AND CLEAN-UP

A. With the exception of items designated for salvage or reuse, all materials, rubbish and debris resulting from demolition work shall become the Contractor's property and shall be removed from site and legally disposed of unless specifically indicated otherwise.

B. Do not allow demolished materials to accumulate on site. Promptly, as work progresses, remove and legally dispose of materials away from site.

C. Separate and salvage materials suitable for reuse and/or recycling from general waste stream or non-salvageable items. Transport and dispose of non-salvageable items to licensed disposal facility.

D. Provide on-site facilities for collection, handling and storage of anticipated quantities of reusable and/or recyclable materials.

E. Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

F. Collect, handle, store on-site and transport off-site, salvaged materials, salvaged for reuse and/or recycling in separate condition. Transport to authorized reuse/recycling location.

G. Burying, burning, selling waste materials on site is prohibited.

H. Disposal of liquid wastes into waterways, sewers is prohibited.

I. Clean-up work, storage and waste collection areas as work progresses.

J. Contractor shall be responsible for all cleaning of existing piping, equipment, and structures that is required to properly remove and dispose of items to be demolished.

3.10 FIELD QUALITY CONTROL

A. Disassembly, removal of structural elements shall be carried out under the supervision of a Professional Engineer licensed to practice in Ontario.

END OF SECTION

DIVISION 3

CONCRETE

PART 1. GENERAL

1.1 RELATED SECTIONS

A. Section 01330 – Submittals.

B. Section 11530 – Appendix A Orthos Liquid Systems.

C. Section 03730 – Concrete Repairs and Restoration.

1.2 INTENT OF SECTION

A. Section covers Cast-In-Place Concrete Work including:

1. Formwork and Falsework.
2. Reinforcing.
3. Joints and Waterstops.
4. Setting of Anchor Bolts and Inserts.
5. Concrete Mixes, including High Performance Concrete.
6. Concrete Placing.
7. Watertightness Test.
8. Finishing and Curing.
9. Protection.
10. Quality Assurance.
11. Encasements and Concrete Fill.
12. Concrete Work for Other Trades and Co-ordination between Trades.
13. Grouting.
14. Modifications to Existing Concrete Structures.
15. Concrete Repairs.

1.3 STANDARDS

A. Comply with the latest edition of the following Statutes, Codes and Standards, and all amendments thereto:

1. The Ontario Building Code (OBC) and National Building Code (NBC).

2. Canadian Standards Association (CSA):

   a. A23.1, Concrete Materials and Methods of Concrete Construction.

   b. A23.2, Test Methods and Standard Practice for Concrete.

   c. A23.3, Design of Concrete Structures.

   d. A3001, Cementitious Materials for Use in Concrete.

   e. S269.3-M, Concrete Formwork.

3. American Concrete Institute (ACI):

   a. ACI 304.2R, Placing Concrete by Pumping Methods.

   b. ACI 350M, Code Requirements for Environmental Engineering Concrete Structures and Commentary.

   c. ACI 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary.

   d. ACI 214R, Recommended Practice for Evaluation of Compression Test Results of Concrete.

4. American Society for Testing and Materials International (ASTM):

   a. C260, Standard Specifications for Air-Entraining Admixtures for Concrete.

   b. C494/C494M, Standard Specifications for Chemical Admixtures for Concrete.

   c. C900-14, Standard Test Method for Pullout Strength of Hardened Concrete.

   d. C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

5. National Lumber Grades Authority (NLGA):

   a. Standard Grading Rules for Canadian Lumber.

1.4 PAYMENT

A. Concrete work will be valued for payment in accordance with the following schedule, subject to any applicable holdbacks:

1. 30 percent at completion of casting.

2. 50 percent at completion of curing.

3. 20 percent at completion of finishing.

1.5 CERTIFICATION OF MATERIALS AND CONCRETE PRODUCER

A. Submit to the Consultant for review the following information:

1. Statements identifying the sources and certifying that:

a. Aggregates comply with CSA -A23.1 and are from MTO designated sources; Submit gradations of aggerates for review.

b. Materials, plant and equipment to be used in concrete work comply with the requirements of CSA-A23.1.

c. The concrete Supplier is a certified member of the Ready-Mix Concrete Association of Ontario (RMCAO).

d. Calculations showing the standard deviation for the concrete producer in conformance with ACI 214.

1.6 CONCRETE DESIGN MIXES

A. Concrete Mix Designs:

1. Submit proposed performance mix design data, and the Supplier's applicable standard deviations.

2. Tabulate concrete mixes. Indicate the types of cement, size of coarse aggregate, compressive strength, water/cementing material ratio, admixtures used, air content, slump and the locations of use for each mix.

3. For high slump flowing concrete submit a mix that will not result in segregation.

4. Concrete mix designs will be reviewed for conformance with the requirements of the Specifications and will be returned with the Consultant’s comments.

1.7 TRIAL MIXES

A. Undertake trial mixes of each structural concrete mix design.

B. Undertake trial mix testing well prior to the start of on-site concrete construction, to allow time for evaluation and any necessary modifications.

C. Submit test results from trial mixes at the same time as the mix designs, confirming workability, linear shrinkage, Chloride Ion Penetrability and concrete strength.

D. Adjust mixes that do not provide adequate performance, and re-test.

1.8 REGULAR CONFIRMATION OF LINEAR SHRINKAGE PERFORMANCE OF MIXES

A. Repeat linear shrinkage testing of each structural concrete mix every three (3) months, utilizing the current sources of materials and mix designs. Confirm appropriate re-testing dates and mixes to be included with the Consultant prior to re-testing.

B. Submit test results from repeat tests confirming linear shrinkage performance within 40 days of casting the specimens.

C. Adjust mixes that do not provide adequate performance and re-test.

1.9 TESTING OF CONCRETE

A. Testing will be performed by a testing agency arranged by the Consultant/Owner.

B. To Facilitate Testing Services:

1. Furnish such casual labour as is necessary to obtain and handle samples at the project and at the sources of materials.

2. General Contractor provides and maintain facilities for storing and initial curing of test cylinders and provide suitable crates for shipping test cylinders.

3. Provide and maintain for the use only of the testing agency, facilities conforming to CSA-A23.1 and CSA-A23.2 acceptable to the agency for storing and curing of test cylinders.

4. Advise the testing agency sufficiently in advance of the operation to allow for the desired quality tests and for the assignment of personnel.

C. Routine testing of materials and resulting concrete for compliance with the technical requirements of the specifications, will be paid for by the Owner.

D. Engage the testing agency and pay costs associated with testing required because of changes in materials or proportions of the mix requested by the Contractor, and extra testing of concrete or materials occasioned by their failure to meet the specification requirements.

E. The use of testing services does not relieve the Contractor of his responsibility to furnish materials and construction in compliance with the Contract Documents.

1.10 DRYING SHRINKAGE TESTS (ONLY FOR WATERTIGHT STRUCTURES)

A. Drying Shrinkage Tests:

1. Perform laboratory trial mixes of concrete used on the Contract. Make two (2) sets of three (3) specimens for each shrinkage test.

2. Prism Specimen Size: 100 mm by 100 mm by approximately 285 mm with an effective gauge length of 250 mm.

3. Specimens: Fabricate, cure, dry and measure as specified in ASTM C157 and modified as follows:

   a. Remove specimens from molds aged 23 hours, ± 1 hour after trial batching.

   b. Place immediately in water at 22.8 degrees Celsius ± 2 degrees Celsius for at least 30 minutes.

   c. Measure within 30 minutes thereafter to determine the original length and then submerge in saturated limewater at 22.8 degrees Celsius, ± 2 degrees Celsius.

   d. Measure specimens at age seven (7) days to determine expansion expressed as percentage of the original length. Length at age seven (7) days shall be the base length for drying shrinkage calculations (0 days drying age).

   e. Store specimens immediately in a humidity control room maintained at 22.8 degrees Celsius, ± 2 degrees Celsius and 50 percent, ± 4 percent relative humidity for the remainder of the test.

   f. Measure to determine shrinkage expressed as percentage of base length and report separately for 7, 14, 21 and 28 days of drying after seven (7) days of moist curing.

B. Computing Drying Shrinkage Deformation of Each Specimen:

1. Difference between the base length (at 0 days-drying age) and the length after drying at each test age.

2. Compute average drying shrinkage deformation to the nearest 0.001 percent at each test age.

3. If drying shrinkage of any specimen departs from the average of that test age by more than 0.04 percent, disregard the results obtained from that specimen.

C. Maximum Allowable Concrete Shrinkage at 28 Day Drying Age:

1. 0.040 percent maximum for laboratory trial mixes of proposed concrete.

2. If shrinkage specimen tests for concrete exceed the shrinkage limits, modify the concrete mix to reduce shrinkage. Repeat tests with the new mix.

1.11 FORMWORK AND FALSEWORK

A. Design formwork and falsework in accordance with CSA S269.2-M, S269.3-M and CSA A 23.1. Formwork type to provide the specified finishes.

B. Design formwork and falsework to carry dead loads and construction live loads.

C. When a high range water reducer (superplasticizer) is used in concrete mix, design forms for the full hydrostatic pressure.

D. Make joints in forms watertight.

E. Design formwork to meet variations from the reference system specified in CSA A23.1 and as specified herein.

1.12 PRE-CONCRETE CONFERENCE

A. Prior to concrete construction hold a meeting to review the procedures for producing proper concrete construction.

B. Have responsible representatives of every party who is concerned with producing quality concrete work attend the conference, including but not limited to the following:

1. Contractor's Superintendent.

2. Concrete Subcontractor's Foreman and Cement Finisher.

3. Concrete Floor Finishing Subcontractor.

4. Ready-Mix Concrete Producer.

5. Admixture Manufacturer(s).

6. Laboratory responsible for the concrete design mixes and trial mixes.

7. Concrete pumping equipment Supplier.

8. Laboratory responsible for field quality control.

C. Provide a description of the intended procedures and Quality Assurance for:

1. Concrete mix production, delivery and discharge.

2. Formwork construction and alignment.

3. Concrete handling, pumping, and placement.

4. Concrete finishing and curing.

5. Concrete protection in hot, cold, or windy weather.

D. Ensure that each party's interests are discussed, and procedures refined to provide optimum concreting practices for this project.

E. The Owner and Consultant will attend the conference. Coordinate with the Consultant at least ten (10) days prior to the scheduled date of the conference.

F. Distribute minutes of the meeting to all parties present and/or concerned within five (5) days of the meeting.

G. Ensure that procedures established and agreed at this meeting are carried out during construction.

H. If additional procedures are required, meet again, discuss, develop, submit and follow agreed procedures.

1.13 CONCRETE SLAB FINISHING QUALITY ASSURANCE

A. Concrete Slab Finish Subcontractor shall be a member in good standing with the Concrete Floor Contractors Association of Canada.

B. Concrete Finishers: Skilled personnel with a minimum of five years of proven satisfactory experience finishing concrete of a comparable size and scope.

C. Engage the Manufacturers' representative for on Site Supervision prior to, during, and after applications. Verify that the specified Products are correctly applied and that the amount and finishing procedures comply with the Manufacturer's printed instructions for the Contract.

D. Conference prior to slab placement:

1. Conducted by the Contractor.

2. Conference Agenda:

   a. Concrete mix design.

   b. Placing techniques.

   c. Finishing techniques.

   d. Product application procedures.

   e. Equipment required for the procedures.

3. Attendees:

   a. Contractor's superintendent.

   b. Subcontractor's representative involved in installation and finishing.

   c. Consultant/Owner.

1.14 CO-ORDINATION

A. Openings, bases, anchorage and similar items sized on the Contract Drawings for mechanical, process and electrical equipment specified are for tendering purposes only.

B. Adjust the work to suit the actual equipment being supplied. Verify all sizes with the trade supplying and installing the equipment. Obtain, utilize and submit data on relevant sizes to suit any change in equipment. Confirm the adjustments with the Consultant.

C. Coordinate the supply and installation of the Structural Precast Concrete:

1. Assist in the installation and alignment of the units.

2. Assist in the position of the rebar, dowels and waterstops.

3. Complete the expansion and construction joints, the sealing and the grouting at the cast in place walls.

1.15 SUBMITTALS

A. Submittals in accordance with Section 01330 – Submittals.

B. Review Submittals.

C. Shop Drawings:

1. Prepare and submit Shop and Layout Drawings, as necessary for construction or as requested by the Consultant.

2. Review Shop Drawings prior to submission. Assume responsibility for confirming and correlating quantities and dimensions, selecting fabrication processes and techniques of construction, and coordinating the work of all trades.

3. Highlight every change made from the Contract Documents.

4. Do not commence work in items covered by Shop Drawings before the Consultant has reviewed the Drawings.

5. The Consultant will review the Drawings only to check conformance with the design concept of the project. Reviewed Drawings will be returned marked 'Reviewed', 'Reviewed as Noted', or 'Revise and Resubmit'.

6. Review of Shop Drawings does not relieve the Contractor from compliance with requirements of the Contract Drawings and Specifications nor relieve him of responsibility for errors made in the Shop Drawings.

D. Concrete Mix Designs and Trial Mix Results:

1. Submit as noted above.

E. Concrete Placing Schedule:

1. Submit concrete placing schedule.

2. Detail layout of construction joints.

F. Shop and Erection Drawings for Formwork and Falsework:

1. Submit Formwork and Falsework Drawings.

2. Show design loads and material Specifications.

3. Show layout and dimensions of construction joints in the structure.

4. Show materials and layout of panels for formwork.

5. Show seal and signature of a Professional Engineer, licenced in the jurisdiction of the construction, responsible for the formwork and falsework design and inspection during construction.

6. Formwork and falsework Shop Drawings will not be reviewed for structural adequacy.

7. Submit Manufacturer's Product Data Sheets including materials, allowable loading, installation, application and maintenance instructions for products and materials used in the falsework and formwork, and for form ties.

G. Reinforcement Placing Drawings and Bar Lists:

1. Submit Reinforcement Placing Drawings and bar lists.

2. On Placing Drawings, indicate sizes, spacing, location and quantities of reinforcement and mechanical splices with identifying code marks to permit correct placement without reference to Structural Drawings. Indicate lengths of laps and show layout of construction joints. Indicate sizes, spacing and location of chairs, spacers and hangers. Do Drawings in accordance with Reinforcing Steel Manual of Standard Practice – by Reinforcing Steel Institute of Canada.

3. Bar lists may be used as reference but will not be reviewed or stamped.

4. Submit Shop Drawings of dowel bar splicers detailing the locations, size and type.

H. Shop Drawings for Joints:

1. Joints: Construction:

   a. Submit detailed Shop Drawings of each joint type. Submit an elevation or section taken through the plane of the joint showing the walls and slabs at the joint.

2. PVC Waterstops:

   a. Submit details of the waterstop system, sizes, types, splices, method of securing and supporting the waterstop to maintain proper orientation and location during concrete placement.

3. Details of joint fillers, sealant, adhesives, and other appurtenances.

I. Samples for Joint Materials:

1. Submit Samples of:

a. Regular bulb and large bulb PVC waterstops, waterstop splices, joints, and fabricated crosses and tees of each size, shape, and fitting of waterstop(s).

2. Joint fillers and their adhesives.

J. Product Data Sheets for Joint Materials:

1. Submit Manufacturer's Product Data Sheets including installation, application, and maintenance instructions for the following items (as applicable):

a. PVC waterstops.

b. Hydrophilic waterstops.

c. Preformed joint filler.

d. Adhesive for joint filler and adhesive for rebar dowels.

K. Winter Protection Systems:

1. Submit written descriptions of proposed methods of providing appropriate concreting conditions, and preventing cold weather damage together with Drawings or Sketches for:

a. Subgrades prior to placing concrete.

b. Freshly placed concrete being cured.

c. Completed structures and parts of structures subject to frost or ice damage.

d. Anchorages being installed into existing concrete and gaining strength.

e. Concrete being cast against existing concrete.

2. Await approval of protective measures before placing concrete.

L. Hot Weather Protection Schemes:

1. Submit written descriptions of proposed methods of providing appropriate concreting conditions, and preventing hot weather damage together with Drawings or Sketches for:

a. Concrete in the truck.

b. Freshly placed concrete.

c. Completed structures and parts of structures subject to heating damage.

d. Anchorages being installed into existing concrete and gaining strength.

e. Concrete being cast against existing concrete.

1.16 STANDAR DETAILS

A. For standard details refer to Contract Drawings.

B. A standard Concrete Pour Release Form is appended to this Section.

PART 2. PRODUCTS

2.1 MATERIALS FOR CONCRETE MIXES

A. Use materials conforming to CSA-A23.1

B. Cement:

1. Normal Portland Cement (Type GU) blended with Cementitious Hydraulic Slag (Type S) for all classes of exposure except C1 exposure. Portland Cement (Type HS or HSb) blended with Cementitous Hydraulic Slag (Type S) for C1 exposure. Use cements conforming to CSA-A3001.

2. Comply to the following conditions and requirements:

a. For structural concrete mixes, use slag as a replacement for 20 percent to 35 percent by mass of the quantity of cement.

b. For lean concrete slag is not acceptable.

C. Aggregates:

1. From M.T.O. approved designated sources.

2. Fine aggregate – natural sand to CSA A23.1.

3. Coarse aggregate – gravel or crushed stone to CSA A23.1.

D. Additives:

1. Conform to CSA A23.1.

2. Water Reducing Agents:

   a. Superplasticizer (NSF61) (Plant Added).

   b. Mid-Range Water Reducers.

   c. Normal Rate – Water Reducing Agent.

3. Air-Entraining Agents:

   a. Use except in skim slabs, fill concrete and Class N exposure mixes.

4. Ensure admixtures are compatible with each other and with construction materials used in contact with concrete.

5. Do not use calcium chloride nor admixtures containing chlorides.

E. Water: Use only potable water.

F. Do not use materials that are toxic in their installed condition. Do not use volatile organic compounds where not permitted by law. Where the use of volatile organic compounds is permitted, provide adequate ventilation and take all necessary safety precautions.

2.2 CONCRETE MIXES

A. Proportion concrete for structures to create high-performance concrete, with improved durability, reduced shrinkage and reduced cracking.

B. Proportion in accordance with CSA – A 23.1:

1. Concrete Compressive Strengths: See Table below (2.2.D).

2. Linear Shrinkage:

   a. Limit linear shrinkage to 0.040 percent after 28 days drying.

   b. All high-performance concrete mixes are subject to linear shrinkage tests.

3. Density:

   a. Normal density.

4. Durability Design Life:

    a. The pumping station facility to be upgraded and will be kept in continuous service. Provide concrete produced under this Section with an expected design life of at least 70 years for the service conditions defined by the usage, and the exposures specified in the Contract Documents.

C. General:

1. Establish the proportions of cementing materials, aggregates, water, and admixtures required to produce consistent, workable concrete that is watertight, durable concrete with the strength and other properties specified in the Contract Documents.

2. Comply with CSA A23.1 for Volume Stability Considerations.

3. Provide mixes that meet the most stringent requirements of each of the exposures as specified in CSA A23.1.

4. Use the same types and brand of cement throughout the Contract.

5. Comply with and allow for the Supplier's Standard Deviation as specified in CSA A23.1 for Compressive Strength Requirements.

D. Mixes for Normal density High-Performance Concrete:

Note: For all C1 exposure mixes the Chloride ion penetrability test shall be less than 1500 coulombs within 91 days.

1.	High-Performance concrete for subdrain structural slab and supporting pedestals inside Filter Tank (with reduced shrinkage, reduced cracking, and increased durability)	Class F1 exposure. 35 MPa at 28 days Max. W/C=0.40	Maximum Coarse Aggregate Size – 13 mm. Slump 150 mm
2.	Concrete for benching, duct banks and pipe encasements	Class C1 exposures. 35 MPa at 56 days	Maximum Coarse Aggregate Size – 20 mm Slump 100 mm
3.	Concrete for site structures, curbs, sidewalks and approach slabs	Class C1 exposure 35 MPa at 56 days Max. W/C=0.40	Maximum Coarse Aggregate Size – 20 mm. Slump 100 mm
4.	Concrete for fill concrete, skim slabs, underpinning and, pipe bedding	Class N exposure 20 MPa at 28 days	Maximum Coarse Aggregate Size – 20 mm Slump 100 mm Self-consolidating concrete (SCC)

2.3 REINFORCEMENT

A. Reinforcement – Deformed billet steel bars complying with CSA G30.18-M92, Grade 400R.

B. Welded wire mesh – Comply with ASTM A1064.

C. Chairs:

1. Use only approved bar supports of strong, durable and non-corrodible materials that fasten or tie securely to the reinforcement and strictly adhere to specified concrete cover requirements.

2. Precast concrete blocks with tie wires or dowels, cast-in, especially made for this purpose from matching concrete mix.

3. Do not use masonry brick or concrete block as rebar chairs.

D. Mechanical Reinforcement Splices:

1. Provide threaded couplers with a minimum tensile capacity of 125 percent of the bar yield strength only where shown.

2. Conform to CSA A23.3.

3. Acceptable products are:

   a. Dayton Richmond dowel bar splicer.

   b. Acrow Richmond dowel bar splicer.

   c. Bar-Lock lock shear bolt coupling sleeves by Bar-Lock (MBT) Coupler Systems.

   d. Lenton Couplers by Erico Products Inc.

4. Provide a thread in plastic plug to protect the threads.

5. Clip the mounting washer, if provided, to maintain cover without displacing the bar.

2.4 ACCESSORIES

A. Anchor Bolts:

1. Anchor Bolts – ASTM F1554 quality.

2. Stainless Steel – Alloy 304 or 316, or as indicated on the Contract Drawings.

B. Joints:

1. PVC Waterstop:

a. Arctic Grade PVC waterstop conforming to Ontario Hydro Specification No. M-264 to the sizes noted on the Contract Drawing.

b. Use sizes as shown on the Standard Details.

c. Provide factory made Tee's, Crosses, and laterals for all interconnections. Field welding of tees and laterals is not acceptable.

d. Have the Manufacturer clearly print his name, the product name and the place of Manufacture in 6 mm high (minimum) letters of a contrasting colour on the waterstop repeating every 3 m or less along its length.

e. Submit certified test results prepared by an Independent Testing Company to indicate conformity to the standard specified in (1) above.

f. Testing will be undertaken periodically by the Owner to confirm the quality and consistency of the material.

2. Cold Joint Waterstops:

a. Hydrotite CJK-0725, or larger, & RSSK 080P, 1006P, or larger hydrophilic rubber waterstops and Leakmaster hydrophilic caulking by MME Multiurethanes. Install all hydrophilic waterstop with adhesive and mechanical fasters (galvanized nails) with steel mesh as per Manufacturer recommendation.

b. Use in joints between existing and new concrete, around pipes through concrete, precast concrete and mounting frames, in conjunction with steel waterstops, or where future removal is planned.

3. Joint Filler:

a. Foam/Cork:

.1 Rodofoam PR with Rodofast Adhesive by Sternson.

.2 Cermar by W. R. Meadows.

.3 Cork by W.R. Meadows.

b. Rope:

.1 with diameter 50 percent larger than joint width.

.2 Ethafoam by Dow Chemical.

.3 Backer Rod by Acrew Richmond.

4. Sealant at isolation two-component polysulphide sealant applied according to the Manufacturer's instructions or recommendations:

   a. Duoflex by Sika.

   b. Primer – as recommended by sealant Manufacturer.

   c. Bond Breaker – an inert film such as polyethylene sheet or masking tape.

5. Materials used in joints – compatible with each other and with the concrete.

C. Drill-in Anchors/Rebar:

1. HILTI HY200/Hilti HIT-RE500 V3 Adhesive Fastening System or Hilti Ice Adhesive fastening system.

2. Type 316 stainless steel HILTI HIT ROD.

3. 400 grade reinforcement for rebar dowels.

D. Non-Shrink Grout:

1. Sika Grout 212 by Sika.

2. In-Pakt Precision Grout by King.

3. NC Grout Eucclid Chemical Company.

E. Epoxy Grout:

1. Sikadur 35, Hi-Mod LV by Sika Inc.

2. Brutem 19 by BASF Chenney.

3. Talygrout 100 by Sika.

2.5 FORMWORK

A. Use plastic coated plywood forms for surfaces required to have a Class 1 and 2 finish. Use full sheets, if possible, with a minimum of filler pieces. Use forms a maximum of 5 times, to the approval of the Consultant. Remove and replace rejected areas or panels.

B. Use plywood or steel forms for surfaces required to have a Class 3 or 4 finish.

C. Where different classes of finish are required to different areas of the same surface, extend the formwork for the Class 1 or 2 areas 1.2 m into the Class 3 or 4 areas.

D. Remove and replace any pieces of formwork rejected by the Consultant.

E. Form 20mm x 20mm fillets and chamfers at all corners and concrete edges.

F. In water/earth retaining structures use only water-tight types of formwork ties and spacers. Do not use formwork ties or spacers that leave holes through the concrete and require grouting of the holes later.

G. The contractor may propose alternative type of formwork when using formliner for Consultant's approval.

2.6 GROUT FOR BASES, ANCHORS, EQUIPMENT MOUNTING, PIPE OPENINGS IN WALLS

A. Use proprietary non-shrink grout (min. 40MPa) ('INPAKT' by C.C. Chemicals, Embeco 636 by Master Builders, M-Bed Standard by Sternson Ltd.) as approved by the Consultant. Where grout is of such a nature as to cause discoloration or staining on exposure, leave it 25 mm shy of the finished surface and purge with cement mortar to match the surrounding material.

2.7 MORTARS

A. Sika Repair 223 by Sika Canada.

B. Emaco R300 by Master Builders.

C. Associated bonding agents as recommended by the Manufacturer.

D. Or approved equal mortar product.

PART 3. EXECUTION

3.1 STANDAR OF WORKMANSHIP

A. Comply with CSA A23.1 'Concrete Materials and Methods of Concrete Construction'.

B. Undertake all aspects of the work to meet watertight requirements.

C. Have the formwork designer inspect forms before use to ensure conformity with the design.

3.2 CO-ORDINATION

A. Determine the requirements of other trades, inform concerned trades and assume responsibility for location, installation and quality of all items which affect the work of this Section.

B. Have all box-outs, inserts and form ties placed in the formwork before reinforcing steel is placed. Divert reinforcement around inserts and box-outs as shown on the standard detail. Do not allow other trades to cut reinforcing steel to clear inserts.

C. Examine existing construction. Determine accurate dimensions of existing construction. Where the Work involves modification of, and/or connections to, the existing structures, the dimensions shown on the Drawings are taken from the original Design Drawings and variations may exist.

D. Adjust the Work to fit existing construction. Advise the Consultant of the adjustments and obtain acceptance. Record the adjustments on the Construction Record Drawing Set.

3.3 RELEASES

A. Obtain the Consultant's release for:

1. Rebar reinforcement, formwork and inserts as placed.

2. To commence placing of concrete.

B. Provide notice of intent to pour between 24 hours and seven (7) days prior to the pour.

C. Provide a completed Concrete Pour Release Form (appended) prior to each pour and allow the Consultant two hours for his inspection.

D. Do not order concrete until the Concrete Pour Release Form has been signed by the Consultant.

3.4 TOLERANCES FOR CONCRETE

A. Variation from Level or Plumb:

1. For wall, slab, beam, concrete pad and column surfaces:

   a. In 3 m – plus or minus 6 mm.

   b. In any storey or bay or 6 m max. – plus or minus 10 mm.

2. For exposed corners, lines and tops of walls:

   a. In any storey or bay or 6 m max. – plus or minus 6 mm.

B. Variation from a reference system and general dimensions:

1. less than 2.4 m – + 5 mm.

2. 2.4 m to 9.6 m – + 12 mm.

3. 9.6 m to 14.4 m – + 20 mm.

4. over 14.4 m – + 25 mm.

C. Variation in size and location of sleeves and openings – plus or minus 6 mm.

D. Variation in cross-sectional dimensions of columns, beams and in the thickness of slabs, concrete pad and walls:

1. Minus – minus 6 mm.

2. Plus – plus 13 mm.

3. Maximum step or offset in wall surface or underside of slab surface in Class 1 areas – 1.5 mm.

E. Variation in size and location of hardware and other embedded items:

1. 3 mm c/c of any bolts within an anchor bolt group or groups.

2. 5 mm from the centre of any anchor bolt group or other embedded items to established layout line dimension.

F. Variation in Steps:

1. A flight of stairs:

   a. Rise – plus or minus 3 mm.

   b. Tread – plus or minus 6 mm.

2. In consecutive steps:

   a. Rise – plus or minus 1.5 mm.

   b. Tread – plus or minus 3 mm.

3.5 FORM SURFACE PREPARATION

A. Remove water, snow, ice, laitance, curing compound, loose soil and other debris.

B. Thoroughly clean form surfaces that will be in contact with concrete or that have been in contact with previously cast concrete, dirt and other surface contaminants prior to coating the surface.

C. Examine the form face on any form proposed for re-use. Remove and replace any damaged sections.

D. Exposed Wood Forms in Contact with Concrete: Apply a form release agent as recommended by the Manufacturer.

3.6 ASSEMBLY AND ERECTION OF FORMS

A. General:

1. Conform with the submitted designs.

2. Unless specified otherwise in the Contract Documents, follow the applicable recommendations of CSA, S269.2-M and S269.3-M.

3. Align form joints and make watertight. Keep the number of joints to a minimum.

4. Laterally brace formwork and falsework and prevent displacement during concrete placement.

5. Form chases, openings, projections, recesses, expansion joints and construction joints.

6. Form around pipes, mechanical, and electrical equipment which penetrate the concrete structure.

7. Incorporate frames, castings, pipes, sleeves, and similar items into the formwork.

8. Do not re-use damaged formwork which may not provide a uniform, consistent finish.

9. Do not use forms more than a maximum of five (5) times.

B. Beveled Edges (Chamfer):

1. Form 15 mm bevels at concrete edges, unless shown otherwise on the Drawings.

2. Where beveled edges on existing adjacent structures are other than 15 mm, obtain the Consultant's approval of the size prior to placement of the beveled edge.

C. Wall Forms:

1. Locate form ties and joints in an uninterrupted uniform pattern.

2. Inspect form surfaces prior to installation to ensure conformance with the specified tolerances.

3. Do not use through-the-wall removable form ties for walls of liquid holding structures and exterior walls which are below grade.

4. Joint Filler Attachment:

a. Use attachments to secure premolded joint filler to one side only.

b. Secure premolded joint filler without gaps and separations keeping concrete from the second wall pour from penetrating the thickness and space occupied by the premolded joint filler. Seal all premolded joint filler joints by taping.

c. Do not use form ties, or other devices which permanently penetrate premolded joint filler, or produce a rigid connection between pours.

3.7 CONCRETE MIX DESIGN AND QUALITY ASSURANCE

A. Supply concrete to meet the project requirements. Structural Concrete is generally required to be "High Performance Concrete" for increased durability and reduced shrinkage and cracking, compared to regular structural concrete. Adjust poorly performing concrete mixes to meet the project requirements. Adjust concrete mixes to provide improved performance with less cementitious materials if the opportunity identified below is available. Provide changes to the mix proportions required, or for improved performance with less cementitious materials. Follow the requirements outlined below.

B. Prepare concrete mix designs in accordance with the specified requirements. Proportion to provide concrete with enhanced durability, and reduced shrinkage and cracking.

C. Ensure excellent handling, placing and finishing characteristics.

D. Undertake laboratory testing to confirm the suitability and performance of the mixes. Provide concrete standard test, consisting of 4 cylinders, for each 50 m^3 of concrete of each type placed in any day. For remaining concrete or if the amount placed for each type/area of concrete, is less than 50 m^3, provide one set of 4 cylinders for strength test as verified by the Consultant on site. Respectively, one cylinder at seven (7) days, two cylinders at 28 days and one cylinder at 56 days will be tested. The Owner may test the concrete on site for linear shrinkage. Provide concrete, initial curing facilities, and casual labour for these tests.

E. Submit proposed mix designs and test mix results.

F. After review of the mix designs, supply concrete in accordance with the reviewed mixes.

G. Monitor the performance of each concrete mix as work proceeds. Where performance remains appropriate maintain the mix proportions and continue the monitoring. Where performance is less than desired or acceptable, propose and test revised mixes to improve performance or correct deficiencies. Submit proposed revised mixes and laboratory test results for review.

3.8 TOLDERANCES

A. Rebar Tolerances:

1. Straight bars – plus or minus 25 mm.

2. Stirrups, ties or spirals – plus or minus 13 mm.

3. Bent bars – length – plus or minus 25 mm.

4. Truss bar height – plus 0 mm to minus 13 mm.

5. Where increases cause interference with waterstop – plus 0 mm.

B. Concrete Placing Tolerance:

1. Concrete protection of reinforcement – + 8 mm.

2. Place steel to the tolerance given in the table below related to the depth of a flexural member, the thickness of a wall, or the smallest dimension of a column:

a. Member Dimension Tolerance.

b. Less than or equal to 300 mm – + 8 mm.

c. 300 mm to 600 mm – + 12 mm.

d. greater than or equal to 600 mm – + 20 mm.

3. Lateral Spacing – + 30 mm.

4. Longitudinal Location:

a. Bends and Ends of Bars – + 50 mm.

b. Bends and Ends of Bars at discontinuous ends of members – + 20 mm.

3.9 DEVELOPMENT FOR REINFORCEMENT

A. Splice reinforcement as per the standard details shown on the Drawings, unless otherwise noted.

B. Hook reinforcement as per the standard details shown on the Drawings, unless otherwise noted.

C. Where reinforcement laps between construction joints, stagger laps. Lap no more than 50 percent of bars at one point.

3.10 ANOCHOR BOLTS

A. Make anchor bolts conform to the standard anchor bolt details shown on the Contract Drawings.

3.11 CONSTRUCTION JOINTS

A. Make construction joints conform to the standard details shown on the Drawings unless otherwise indicated.

B. Fabricate waterstop in accordance with the Manufacturer's recommendations. Provide welded joints to make a continuous ribbed barrier to water. Provide waterstop to all construction joints and to other joints as shown.

C. Leave the surface of horizontal construction joints rough with 6 mm deep ridges and valleys.

D. Blast clean joints of loose material, laitance and form oil before the next pour is made.

3.12 PREPARATION OF SURFACES

A. Remove water, snow, ice, loose soil, laitance, curing compound, wood, and other debris from surfaces on or against which new concrete will be placed.

B. Roughen and clean surfaces of previously placed concrete against which subsequent concrete will be placed.

3.13 CONCRETE BONDING

A. Horizontal Construction Joints in Reinforced Concrete Walls:

1. Thoroughly clean and saturate the surface of the joint with water.

2. For walls and columns, place bedding layer of starting concrete (mix 5) onto the existing concrete before starting regular concrete placement. Limit wall and column starting concrete placement to a maximum thickness of 150 mm and a minimum thickness of 100 mm.

3. Do not deposit concrete from pump hoses or large concrete buckets, unless the specified placement thickness can be maintained and verified through inspection windows close to the joint.

4. Limit concrete placed immediately on top of slurry concrete to 300 mm of thickness. Thoroughly vibrate to mix concrete and starting concrete together.

B. To Existing Concrete:

1. Thoroughly clean and mechanically roughen existing concrete surfaces to a roughness profile of 6 mm or as indicated on the Contract Drawings.

2. Saturate surface with water for 24 hours prior to placing new concrete.

3.14 SETTING ANCHOR BOLTS FOR EQUIPMENT, FITTINGS AND STRUCTURAL STEEL

A. Receive, handle, and set anchor bolts in accordance with the requirements of the Supplier. Protect anchor bolts after setting to maintain the correct alignment and level.

3.15 INSTALLATION OF ELECTRICAL CONDUITS IN SLABS AND WALLS

A. Generally, install electrical services surface mounted or in trays.

B. Only conduits providing service local to the pour that cannot be surface mounted may be installed in a concrete slab or wall:

1. Do not install conduit in exterior slabs or walls.

2. Obtain written acceptance from the Consultant prior to installation in slabs or walls.

3. Coordinate the installation of any conduit in slabs and walls with the electrical installation requirements.

4. Displace less than 1 percent of the concrete at any cross section. Space conduits a minimum of 100 mm and at least 3 diameters apart. Do not cross conduits.

5. Install conduits where allowed in slabs and walls in accordance with the requirements of CSA A23.1 for Conduits and Pipes Embedded in Concrete.

6. Do not embed aluminum conduits in concrete.

3.16 FRAMES FOR COVERS AND OPENINGS

A. Set frames at the locations and elevations as required on the Drawings.

3.17 EQUIPMENT CASTINGS AND PIPE FITTINGS

A. Set castings and pipe fittings at the locations and elevations as required on the Drawings.

B. Repair hot-dip galvanized surfaces which are damaged by welding, cutting, handling during shipping or erection, or otherwise, in accordance with ASTM A780 using a zinc-rich coating. Dry film thickness on repairs shall exceed the original coating thickness by a minimum of 25 percent.

C. Ensure pipes passing through concrete have a waterstop or puddle flange.

3.18 EXTENT OF CONCRETE POUR

A. The horizontal limit for base slab pours is 24m as maximum. The vertical limits for wall pours are 6 m max.

B. Break work into approximately equal units. Add waterstopped construction joints as necessary to suit pour sizes. Confirm joint location with the Consultant and adjust as necessary. Consider beams, girders, brackets, column capitals, and haunches as part of the floor or roof system above and place monolithically with the floor or roof system.

C. Allow three (3) days between pours of adjacent panels.

D. Submit details of the joint layout for review.

3.19 PLACING CONCRETE

A. General:

1. Do not commence concrete placing until sufficient manpower and equipment is available to complete the placement expeditiously preventing the formation of cold joints, and to produce the specified surface finish.

2. Provide standby equipment for critical items in case of equipment failure.

3. Verify that cast in place accessories, inserts, and reinforcement are set correctly and are not disturbed during concrete placement.

4. Place concrete on dry and clean substrate.

5. Start placing concrete for sloping slabs at the lowest point and work upwards to prevent concrete tears.

6. Place concrete within 1.0 m of its final position. In formed sections, provide sufficient elephant trunks to meet this requirement.

7. Plan placement frequency such that lift lines will not be visible in exposed or architectural concrete finishes.

B. Depositing:

1. Deposit concrete in a manner that prevents segregation in accordance with CSA A23.1.

C. Wall and Column Grout:

1. Deposit 20 mm to 40 mm of wall and column grout evenly along horizontal construction joints in the bottom of forms through an elephant trunk immediately before placing wall or column concrete.

D. Consolidation:

1. Consolidate the concrete during and immediately after depositing, thoroughly and uniformly by means of tamping, hand tools, finishing machines, and vibrators in order to obtain dense, watertight, homogeneous concrete well bonded to reinforcing bars.

2. Carefully vibrate concrete around piping, inserts, conduits, and waterstops, to ensure thorough contact.

3. At horizontal waterstops, ensure that concrete flows under and completely fills the space below the waterstop. Verify that no air is trapped below the waterstop and that the concrete is in contact with the waterstop over its entire surface area.

4. Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.

5. Do not move concrete laterally with the vibrators. Lower the vibrators vertically and vibrate within 1.0 m of the point of placement.

3.20 HOT WEATHER WORK

A. Take hot weather precautions when the concrete temperature at any time exceeds 25 degrees C.

B. Do not place concrete, whose temperature exceeds 25 degrees C. in the mixer.

C. Concrete, whose temperature in the mixer is between 25 degrees C and 30 degrees C must:

1. Contain a retarder which reduces mixing water requirements and increases strength.
2. Not contain high early strength cement.

D. Protect forms and equipment, including both mixing and placing equipment, from the rays of the sun and cool by wetting as necessary to maintain a temperature of not more than 5 degrees C in excess of ambient temperature nor more than 40 degrees C.

E. Prior to placing concrete, wet down forms and reinforcement and the area surrounding the work.

F. Keep mixing time to the minimum, consistent with the production of the quality of concrete specified and place mixed concrete immediately.

G. Use sufficient qualified personnel for rapid placing and finishing of concrete.

H. Provide wind breaks, fogging, sunshades, plastic sheeting or other materials as required by CSA-A23.1 when the evaporation is expected to exceed the limits shown.

I. Commence continuous wet curing as soon as the concrete has hardened sufficiently to prevent surface damage.

3.21 COLD WEATHER WORK

A. Take cold weather precautions whenever the ambient temperature is, or is expected to be, at or below 5 degrees C.

B. Protect subgrades below proposed concrete work. Ensure that subgrade temperatures are at least 10 degrees C when the concrete is placed.

C. Have protective measures in place, or adjacent to the work, and reviewed by the Consultant before any concrete is mixed or ordered.

D. Maintain concrete temperatures between 10 degrees C and 20 degrees C for a minimum of three (3) days for unloaded areas, and six (6) days for areas receiving partial load.

E. Where the work is enclosed, and heaters are used to provide heat:

1. Provide an access strip at least 1.0 m wide between the work and the nearest heater.

2. Do not discharge heater outlets directly toward the work.

3. Duct heater exhausts outside enclosure.

4. Install a minimum – maximum thermometer inside the enclosure at a location approved by the Consultant.

5. Maintain the humidity within the enclosure at or above 40 percent and install a suitable measuring device, or employ wet curing terminated 12 hours before the termination of heating.

F. Removal of forms, shores and protection to conform to ACI 306 for structural concrete bearing load. Remove only after tests indicate sufficient concrete strength and the release of the Consultant is obtained.

G. At the termination of the protection period, do not drop the concrete temperature more than 20 degrees C in the first 24 hours.

3.22 REMOVAL OF FORMS

A. Be responsible and utilize testing as per CSA-A23.1 before removing forms.

B. Do not remove forms without the acceptance of the Consultant.

C. The minimum length of time for forms to remain in place (unless otherwise directed by the Consultant) is:

1.	Walls, columns, sides of beams, base slabs and footings	7 days
2.	Floor slabs, roof slabs	7 days
3.	Beam and girder soffits, shores for floor slabs and roofs	14 days

D. Have curing equipment and materials available prior to removal of the forms, install within four (4) hours and put into operation.

3.23 INITIAL PROTECTION AND CURING

A. Take special precautions to control and eliminate initial drying shrinkage and plastic shrinkage for slabs.

B. Provide wind breaks or shades. In addition, provide a continuous fog mist when drying shrinkage is likely due to heat or wind. Do not wet the concrete surface.

C. Immediately cover the concrete with wet burlap when the finishing is complete and begin the continuous wet curing.

3.24 CURING AND PROTECTION

A. Continuously wet cure concrete for a minimum of seven (7) days in accordance with CSA-A23.1. Provide the equipment necessary for the proper curing adjacent to the work before commencing pouring.

B. A curing compound may be used as an alternative to wet curing provided:

1. Finishing work is completed and the compound is compatible with the finish.

2. The rate of evaporation of surface moisture is less than 0.750 kg/(sq.m.h) as per Figure D1 of CSA-A23.1.

3. The compound is approved by the Consultant.

C. Be responsible for protection of concrete from damage by all trades. Do not pile or store materials on slabs nor wheel nor handle materials over slabs until concrete has been in place for at least seven (7) days (under normal conditions).

D. Be responsible for and provide adequate winter protection to completed or partly completed structures to prevent frost or ice damage.

3.25 FLOOR FINISHES

A. Types of finishes for the various concrete floors are shown on the Drawings.

B. The structural slab thickness shown is a minimum. Slope floors to floor drains and sump pits.

C. Do not place floor toppings in buildings until equipment is installed and mechanical and structural work is complete.

D. Where interior slabs are to bear foot traffic, provide emery shake finish.

E. Have finishing work done by an experienced floor Contractor specializing in this type of work and approved by the Consultant.

3.26 FINISHING FORMED SURFACES

A. Four classes of areas require finishing:

1. Class 1 – Architecturally sensitive areas which consist of the inside of buildings, ceilings and exteriors and where indicated on the Drawings.

2. Class 2 – Surfaces which are not backfilled against.

3. Class 3 – Surfaces which are backfilled against and waterproofed.

4. Class 4 – Surfaces which are backfilled against and not waterproofed.

B. Finish surfaces in accordance with the requirements of CSA-A23.1 for treatment of formed surfaces. Read appropriate Sections of CSA-A23.1 before submitting tender and again before commencing work.

C. For Class 1 and 2, machine grind the surface to a smooth texture upon completion of the treatment in B. above.

D. Finish surfaces in Class 1 as an architectural finish with a first-class sack rubbed finish to produce a uniform appearance. Prepare sample sections for approval prior to proceeding with the work.

E. Finish surfaces in Classes 2 and 3 as exposed concrete and provide a sack rubbed finish.

F. Finish surfaces in Class 4 areas above as non-exposed concrete and do not provide a rubbed finish.

G. Any surface repair work identified under Clause 3.26.2, when form liner is used, shall obtain Consultant's acceptance.

3.27 REPAIR OF TEMPERATURE AND SHRINKAGE INDUCED CRACKS

A. Repair cracks in the completed structures employing a suitable polyurethane injection technique to make such cracks completely watertight after repair. For non-liquid or non-earth retaining structures, a suitable epoxy injection to repair the cracks maybe considered.

B. Remove surface injection materials following completion of the work and finish affected areas to match surrounding concrete.

3.28 PATCHING OF AREAS OF UNSOUND CONCRETE

A. Prime exposed reinforcing bars with epoxy bonding adhesive in accordance with the Manufacturer's printed instructions.

B. Use mix of various consistencies of repair mortar for application to horizontal, vertical, and overhead applications in accordance with the Manufacturer's printed instructions.

C. Use aggregates in repair mortar consisting of clean, washed, uniformly graded silica sand and pea gravel where required in accordance with the Manufacturer's printed instructions.

D. Patch deteriorated areas.

E. Fill voids, between the underside of the roof slab and supporting walls and columns.

F. Where required, apply repair mortar in suitable, self-supporting layers permitting adequate heat dissipation. Build layers up gradually to a thickness matching the original concrete surface.

G. Cure patches in accordance with the Manufacturer's printed instructions.

H. Finish patches to match the surrounding adjacent concrete surface.

3.29 ALTERATIONS TO EXISTING CONCRETE

A. General:

1. Cut out, remove, or modify parts of existing concrete structures, roughen surfaces, cut keys, weld bars, and carry out other items of work as required.

2. Use satisfactory methods which will not result in damage to equipment or other parts of the structures by vibration, dust, water, or other contaminants.

3. Verify existing conditions before beginning alterations.

4. After alterations are done, repair any surface defects and damaged areas and finish surface to match the adjacent areas.

A. Saw Cut Prior to Breaking-Out:

1. Check the perimeter of any area to be broken out with a cover meter to ensure that the reinforcing steel that is to remain is known in position and depth.

2. Sawcut the perimeter to a depth of 25 mm, or less locally where the retained rebar is closer to the surface.

3. Breakout concrete square to the surfaces.

B. Construction Joints to Existing Concrete:

1. Roughen the existing concrete surface to a texture of +6 mm and provide thoroughly bonded concrete.

2. Install a cold joint waterstop and seal to the exposed face. Inject after casting, as required above.

C. Finishing of Existing Concrete Surfaces:

1. As a result of alterations where previous exterior faces become interior, finish the surface to achieve a Class 1 finish as follows:

a. Abrasive blast cleans the entire surface.

b. Patch surface depressions with sand-cement mortar.

c. Grind smooth fins and protrusions.

d. Apply a sack–rubbed finish to the entire exposed surface to match the adjacent interior surfaces.

D. Refinishing:

1. Refinish cut edges of openings flush and smooth, with a bonding agent and concrete or with a non-shrink, non-ferrous, pre-blended hydraulic cement grout of the same colour as the adjacent concrete.

2. Cut back exposed reinforcing bars 50 mm from the finished surface level and apply corrosion inhibitor to cut rebar. Fill/patch voids at each bar with non-shrink grout. Grind edges smooth after repairs and modifications have been completed.

E. Existing Reinforcing Dowels Encased in Lean Concrete or Lime Mortar:

1. Break out existing encasement and expose reinforcing dowels and waterstops. Clean individual bars to bare metal by abrasive blast cleaning. Straighten bars as required.

2. Report any missing or damaged reinforcing bars to the Consultant before proceeding further.

3.30 CLEAN-UP

A. Promptly as the work proceeds and upon completion, clean-up and remove from the site, rubbish and surplus material resulting from the work of this Section.

CONCRETE POUR RELEASE FORM	**Submission No.**
Wanapitei Water Treatment Plant **Greater City of Sudbury** **Contract No.**	

LOCATION OF POUR .....

DATE OF POUR ..... TIME OF POUR .....

* NOTE: Consultant is to be given 24 hours' notice before time of pour

MIX #: **VOLUME ORDERED:**

1. All items of work have been completed for this pour and the following foremen have approve their work ready for inspection:

LINE AND LEVELS: ..... DATE : ..... TIME : .....

STRUCTURAL INSERTS & ANCHORS ..... DATE : ..... TIME : .....

REBAR STEEL: ..... DATE : ..... TIME : .....

MECHANICAL SLEEVES
INSERTS AND PIPING: ..... DATE : ..... TIME: .....

ELECTRICAL SLEEVES AND
INSERTS: ..... DATE : ..... TIME : .....

ARCHITECTURAL INSERTS: ..... DATE : ..... TIME: .....

2. The formwork and falsework has been inspected by the formwork and falsework design engineer or his authorized designate for conformance to the formwork and falsework design.

Formwork and Falsework Design Engineer DATE……. TIME…….

FINISH REQUIRED ----------

EQUIPMENT AND FINISHERS READY ----------

PART 1. **CURING REQUIRED** ----------

FOGGING REQUIRED ----------

EQUIPMENT READY ----------

5. I have checked all items for this pour and request your inspection before pouring.

6. The items of work have been inspected:

The pour may proceed subject to the Contractor being responsible for the work in accordance with the Contract: (Check) ☐

or

Corrections are required as noted below: (Check) ☐

Resident Supervisor DATE TIME

NECESSARY CORRECTIONS AND REMARKS:

END OF SECTION

PART 1. GENERAL

1.1 INTENT

A. This Section covers repairs and restoration of existing concrete surfaces at the following areas:

1. Existing Filter tanks (walls and slabs).

2. Other locations where shown on the Contract Drawings.

B. The areas of concrete repair shall be determined by the Consultant and shall include any location where erosion of concrete or acidic attack of the concrete surfaces has reached a depth of 10 mm (or deeper) and at any air voids, bug-holes or poorly consolidated concrete areas where the specified filler/surface materials cannot be used for filling or surfacing of the concrete.

C. The repair work specified herein is intended to cover the requirements for repair of concrete only, to a maximum depth of approximately 100 mm. If after cleaning, an area is discovered that requires a repair greater than 100 mm deep, or an area is discovered that requires repair or replacement of reinforcing steel notify the Consultant so that details may be provided to the Contractor to complete the repair.

D. Section Includes:

1. Preparation/cleaning of existing concrete surfaces.

2. Crack repair by polyurethane material injection.

3. Crack repair by epoxy material injection.

4. Patching spalled and unsound areas with non-shrink cementitious grout or mortar products as applicable.

E. Scope of Work:

1. The following items shall be the base scope of work:

a. Crack Repair: Preparation and sealing of cracks per Consultant's direction. Supply and installation of approved polyurethane/epoxy material by injection. Contractor shall allow for crack repair per Contract Provisional items.

b. Concrete Spall Repair: Supply and installation of repair mortar/grout/concrete including surface preparation of spalled and unsound concrete. Contractor shall allow for removal and replacement of unsound concrete per Contract Provisional Items.

c. Expansion/Isolation Joint Repair: Cleaning and preparation and sealing of joints. Supply and installation of joint filler, backer rod and joint sealant as applicable to waster water exposure. Contractor shall allow joint repair per Contract Provisional Items.

d. Include for mobilization, scaffolding, heating, curing, ventilation, testing, and tools required to carry out work as specified, and demobilization, in the unit rate of Contract Provisional Items.

F. Measurement:

1. Crack Repair: The quantities in linear meters to be measured for payment shall be the actual length of cracks repaired by the methods and materials specified under:

   a. Epoxy crack repair.

   b. Flexible polyurethane crack repair.

   c. Rigid polyurethane crack repair.

2. Concrete Spall Repair: The quantities in square meter to be measured for payment shall be the actual square meter of spalled concrete repaired by the method and materials specified under spall repair.

3. Expansion joint Repair: The quantities in meters to be measured for payment shall be the actual length of joints repaired by the methods and materials specified under joint repair.

1.2 RELATED SECTIONS

A. Related work in this Section is specified in, but not limited to, the following Sections:

1. Division 1 Sections.

2. Section 03300 – Cast-in-Place Concrete.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330 – Submittals.

B. Include: Manufacturer's surface preparation requirements, MSDSs, coating specifications, application instructions, application equipment's specification, applicator's experience and acceptance as required herein.

C. Prior to the start of the project, provide the Consultant with certified copies of the Manufacturer's quality control testing records.

D. Submit a detailed description of the equipment, grouting, and patching operations, including but not limited to:

1. Procedures proposed for the accomplishment of repair work. Include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations to be coordinated with other works in progress.

2. Manufacturer's recommendations and Product Data Sheets for all repair materials including performance criteria, surface preparation, ambient condition requirements and applications, curing requirements, Volatile Organic Compound (VOC) data, and safety requirements.

3. Material Safety Data Sheets (MSDS) for any materials brought on-site including all repair system materials, solvents, and abrasive blast media.

4. Qualifications of applicators demonstrating compliance with the minimum requirements specified.

5. Quality control during installation including heating, mixing methods and control of variable pressures.

G. Submit certification that the repair materials are suitable for use in continuous submergence in wastewater applications.

1.4 QUALITY ASSURANCE

A. Services of Manufacturer's Representatives:

1. Provide the services of a qualified Manufacturer's technical representative to instruct the Contractor's personnel in the mixing, proper use and application of the epoxy, polyurethane, polymer-modified and cement-based compounds.

2. The Manufacturer's service representative shall provide on-site inspection services as follows: (a) Before application, to examine suitability of the substrate, and (b) during and after application, to verify that specified products are properly applied and cured.

3. Provide written certification from the Manufacturers' representative that materials have been mixed and applied properly and surfaces to receive these products have been prepared properly, all in conformance with Manufacturer's requirements.

B. Employ only applicators authorized by material Manufacturer and who specializes in this type of repair work:

1. Ensure that all Work is performed by an experienced, competent applicator licensed and/or approved by the concrete repair material Manufacturer. Submit the Manufacturer's certification of this approval along with a list of similar projects and references where the proposed Subcontractor has installed the same concrete repair works.

2. Ensure that the applicator's installation equipment and methods are approved by the concrete repair material Manufacturer. Submit proof of this approval.

C. Adhere strictly to the Manufacturer's recommendations regarding temperature at time of application for all work. Do not use epoxy materials when either the temperature of the concrete to be repaired or the minimum ambient temperature recommended by the Manufacturer, 24 hours before, during, or for a period of 48 hours after the completion of the repair. Temporary heat may be used to meet the specified requirements.

1.5 SEQUENCING AND SCHEDULING

A. Schedule work such that the repair work under this Section is completed prior to the commencing of process upgrades or other works of the Contract.

1.6 CONCRETE REPAIR PERFORMANCE REQUIREMENTS

A. The injected epoxy/polyurethane repair resins shall fill the cracks and joints and in no case shall the depth of penetration of the injection material be less than 90 percent of the full thickness of the concrete section for cracks.

B. The cured injected epoxy/polyurethane injection resin shall form a dense rubber-like flexible foam compression gasket-type seal.

C. Any repair mortar used shall be deemed compatible with applied coating or toppings by Manufacturers of both products. Preparation of concrete and application of mortar shall be done in accordance with ACI, ICRI and Manufacturer's recommendations.

1.7 PRE-REPAIR MEETING

A. Required Meeting Attendees:

1. Consultant and Owner.

2. General Contractor.

3. Repair Subcontractor responsible for concrete repair.

4. Technical representative for repair materials Manufacturer.

B. Schedule and conduct meeting prior to incorporation of respective products into project. Notify Consultant of location and time.

C. Agenda shall include:

1. Review of field conditions. Conduct field observations of work to be performed.

2. Based on above observations, repair material Manufacturer's technical representative shall make material selection and repair method written recommendations.

3. Technical representative for repair material Manufacturer shall review proposed surface preparation, material application, consolidation, finishing, curing, and protection of repair material from weather conditions.

4. Other specified requirements requiring co-ordination.

1.8 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping: Package of material in new sealed containers and label with the following information.

1. Manufacturer's name.

2. Product name and lot number.

3. Mix ration by volume instructions.

4. Generic type of material.

5. Hazardous material identified label.

6. Shelf-life date.

PART 2. PRODUCTS

2.1 MATERIALS

A. Concrete Protective/Waterproofing Coating:

1. Cem-kote flex CR with Cem-kote barrier cote 100, by W.R. Meadows of Canada.
2. SikaTopSeal107, by Sika Canada Inc.

B. Polyurethane Injection Grout:

1. Sika® Injection-310 US, by Sika Canada Inc.
2. Resfoam HB 45, by Mapei Canada.
3. Multiurethanes Limited, Mississauga, ON.
4. Or approved equal.

C. Epoxy Crack Repair: Epoxy crack repair binder shall be a two-component, 100 percent solids, high-modulus, low viscosity epoxy adhesive suitable for crack grouting by injection or gravity feed:

1. Sikadur 53, by Sika Canada Inc.
2. Epojet LV epoxy, by Mapei Canada.
3. Or approved equal.

D. Epoxy Bonding Adhesive:

1. Sikadur 32 Hi Mod, by Sika Canada Inc.
2. Planibond AE, by Mapei Canada.
3. Or approved equal.

E. Repair Mortar:

1. Sikatop 123 Plus Polymer Modified, Cementitious, Non-Sag Mortar, by Sika Canada Inc. (for surfaces not in contact with water).

2. MasterEmaco S 488CI, by Sika Canada Inc.

3. Planitop 12 SR, by Mapei Canada.

4. Or approved equal.

F. Repair Grout

1. SikaGrout 212-SR, by Sika Canada Inc.

2. MasterEmaco S 488CI, by Sika Canada Inc.

3. Planigrout 712, by Mapei Canada.

4. Or approved equal.

G. Anti Corrosion Coating and Bonding Agent: Thermally compatible with substrate concrete and compatible with repair mortar.

1. SikaTop Armatec 110 Epocem, by Sika Canada Inc.

2. Or approved equal.

H. Joint Repair:

1. Joint Filler-Foam/Cork:

a. Rodofoam PR with Rodofast Adhesive by Sternson.

b. Cermar by W. R. Meadows.

c. Cork by W.R. Meadows.

2. Rope: With diameter 50 percent larger than joint width:

a. Ethafoam by Dow Chemical.

b. Backer Rod by Acrew Richmond.

3. Sealant at Isolation: Two-component polysulphide sealant applied according to the Manufacturer's instructions or recommendations:

a. Sikaflex-2CNS / Sikaflex-2cSL / Sikaflex-2c NS EZ Mix by Sika as applicable.

b. Primer: As recommended by sealant Manufacturer.

c. Bond Breaker: An inert film such as polyethylene sheet or masking tape.

PART 3. EXECUTION

3.1 GENERAL

A. Various materials used for the repair work may emit toxic fumes during the application and curing stage. Handle with care and adequately ventilate work area.

B. Provide suitable protective clothing, gloves, breathing apparatus for persons working with restoration materials.

C. During installation and curing of restoration materials, if the ambient temperature is expected to go below the recommended minimum temperature provide enclosures and heat as required.

D. Use restoration materials in accordance with Manufacturer's printed instructions, and as specified.

E. Provide access platforms as required.

F. Continuously check materials and applications for correct use.

3.2 GENERAL CLEANING AND SURFACE PREPARATION

A. Use power wash with minimum 4000 psi pressure to clean and remove existing sludge, residue, stain, mold, etc. and prepare concrete surfaces for inspection of repair works and gas proofing, waterproofing (where required). Do not damage any existing structures.

B. Do not use abrasive blast cleaning on stainless steel.

C. Repair any damage caused by the cleaning process.

D. Remove and dispose cleaning water and waste outside the site.

3.3 PREPARATION OF CRACKS FOR POLYURETHANE GROUT INJECTION

A. Free cracks from loose matter, dirt, laitance, oil, grease, salt, and other contaminants.

B. Clean cracks in accordance with polyurethane Manufacturer's instructions.

C. Clean surfaces adjacent to cracks from dirt, dust, grease, oil, efflorescence, and other foreign matter to expose the full extent of cracks.

D. Do not use acids and corrosives for cleaning, unless neutralized prior to injecting.

3.4 INJECTION OF CRACKS – POLYURETHANE GROUT

A. Entry Points:

1. Establish openings for polyurethane entry along crack.

2. Determine space between entry ports equal to thickness of concrete member to allow polyurethane to penetrate to the full thickness of the member.

3. Drill injection holes at 45-degree angle to the surface and on alternate sides of a crack, where possible, to intercept cracks. Space holes as close as required. Maximum spacing is 300 millimeters on center.

4. Provide a means to prevent concrete dusts and fines from contaminating the crack or ports when drilling.

5. Install injectors into drilled holes.

6. Apply surface sealer along crack surface as required.

7. Flush cracks with clean water.

B. Polyurethane Injection:

1. Inject polyurethane grout into cracks in accordance with Manufacturer's written instructions.

2. Start injection into each crack at lowest injector on a vertical face and at one end on a horizontal surface.

3. Continue injection until pure uncontaminated material flows out from adjacent injectors.

4. Cap injectors and proceed to adjacent injectors until all injectors have been filled.

C. Finishing:

1. Upon completion, remove injectors, surface seal material and injection polyurethane runs and spills from concrete surfaces.

2. Thoroughly clean the concrete surfaces of excess grout material.

3. Prepare concrete for application of gas proofing, waterproofing, or traffic topping, where required. Finish surface to match surrounding concrete.

4. Remove/cut injection ports (at least 40 mm below concrete surface) upon satisfactory completion of crack injection and patch with non-shrink mortar.

3.5 EPOXY CRACK REPAIRS

A. Cracks on Horizontal Surfaces: When permitted by the Consultant, repair existing structural cracks by gravity feeding an epoxy crack repair binder into the prepared crack.

1. Rout concrete surface at the crack to form a minimum 6 mm wide by 6 mm deep V-notch and clean to remove all loose and foreign particles. Fill crack with clean, dry sand and pour epoxy crack repair binder into V-notch, completely filling crack.

2. As binder penetrates into crack, apply additional binder to the V-notch.

B. Cracks on Vertical or Horizontal Surfaces: Repair existing structural cracks by pressure injecting an epoxy crack repair binder into the prepared crack. Seal cracked surfaces and install injection ports per Manufacturer's recommendations.

1. Do not cut reinforcement steel when drilling holes injection ports. If rebar is encountered during drilling, abandon the hole, and relocate. Patch the abandoned hole immediately with epoxy mortar flush with the surface of the existing concrete.

2. Once the surface sealing material has cured, inject crack with epoxy crack repair binder as directed by the Manufacturer.

3. Remove/cut injection ports (at least 40 mm below concrete surface) upon satisfactory completion of crack injection and patch with non-shrink mortar.

3.6 EQUIPMENT FOR CRCAK INJECTION

A. Use portable, positive displacement type pumps with in-line metering to meter and mix material components and inject mixture into crack as per product Manufacturer’s instructions.

B. Coordinate with product Manufacturer’s instructions for the required injection pumps, discharge pressure of material, pressure shutoff control system, and mixing ratio of repair material components.

3.7 PATCHING/REPAIR OF AREAS OF UNSOUND CONCRETE

A. Complete visual examination and delamination survey on site in the presence of the Consultant to evaluate the existing conditions. The exact location and extent of concrete repairs will be determined and designated by the Consultant.

B. Where concrete repair area is more than 10 mm thick, saw cut edges around the repair area to form square edges from the surface to the depth of the removed concrete or 10mm shorter than any rebar whichever is shorter. Do not damage any existing rebar.

C. Where concrete surface imperfections are extended till reinforcement rebar, clean exposed rebar with sand blasting to remove any rust or lose concrete. Apply zinc-rich coating to exposed rebar prior to any mortar applications.

D. Fill repair areas with approved repair grout and trowel to smooth finish.

E. Maintain the environmental conditions specified by the product Manufacturer during the application and curing of the repair grout.

F. Application of concrete repair mortar shall conform to the Manufacturer's recommendation.

G. Protect repair areas from snow or rain during execution of the work. Repair work shall not be undertaken during rain, snow, or freezing conditions.

H. Dispose any waste materials as a result of cleaning or coating removal outside construction site.

I. Cure patches in accordance with Manufacturer's printed instructions.

J. Finish patches to match surrounding adjacent concrete surface.

3.8 JOINT REPAIR

A. Remove sealant, bond breaker and joint filler.

B. Remove unsound concrete on the joint faces and repair with non-shrink grout.

C. Remove laitance and provide a clean dry surface.

D. Prepare an epoxy mortar by combining epoxy crack repair binder with aggregate following the Manufacturer's instructions.

E. Restore surface to original dimensions by troweling epoxy mortar onto the existing substrate in a manner to ensure bonding following the Manufacturer's instructions.

F. Cure repair in accordance with the Manufacturer's instructions.

G. Install new joint filler, bond breaker and sealant where required for expansion joints.

PART 4. FIELD QUALITY CONTROL

4.1 GENERAL

A. Take samples of repair material at regular interval of material on plywood boards. Record time and date for each sample.

B. Engage repair material Manufacturer's representative for inspection service:

1. Before application, to examine suitability of the substrate.

2. During and after application, to ensure that specified products are properly applied and cured. Provide signoff from Manufacturer's representative.

C. Carry out sample testing of the repair materials at the beginning and at regular intervals to verify correct mixing proportion, consistency and setting time.

D. Crack injection will only be accepted if the injected material achieves a minimum of 90 percent penetration of the crack depth. Notwithstanding the foregoing, injected cracks or joints found to exhibit leakage shall be deemed as deficient work irrespective of the depth of penetration. Carry out reinjection of deficient work as required to meet the performance requirements at no extra cost to the Contract.

E. Prepare compressive strength specimens from concrete repair material for testing at 7, 14 and 28 days. Submit test results for the Consultant's review and record.

END OF SECTION

DIVISION 11

EQUIPMENT

PART 1. GENERAL

1.1 SUMMARY

A. Conform to Section – 11530 Filter Underdrain, and Section 11535 – Filter Media.

B. Install pre-purchased Underdrain System as supplied by Orthos Liquid Systems through ACG-Environcan Inc. (Contact: Dale Jackson – (905) 856-1414, ext. 222, dale@acg-environcan.ca), as provided by the City to the Contractor. Refer to Division 11, Appendix A.

C. Co-ordinate with Orthos Liquid Systems (Orthos) and ACG-Environcan, the City, and the Engineer regarding all necessary labour and equipment to complete Filter Underdrain System Performance Test, Operator Training, and Post Start-up Support Services.

1.2 WORK OF THIS SECTION

A. The Work of this Section includes the supply, installation, testing, and start-up of the Underdrain System and all appurtenant work as shown on the Drawings and as described in ACG-Environcan-Orthos Purchase Order #236670-5644 (Orthos P.O.). The Contractor shall coordinate all Work shown on the Drawings, Specifications, and in Orthos P.O. and Contract Documents.

B. The City has executed a contract with Orthos Liquid Systems through ACG-Environcan Inc. for procurement of goods and special services for the supply of Filter Underdrain Equipment. The materials and equipment provided for in the procurement contract are to be furnished and delivered by ACG-Environcan to the site of the Wanapitei WTP for installation by Contractor. Following execution of the General Contract and issuance of the City's written order to commence work to the General Contractor, the General Contractor will notify the ACG-Environcan.

1.3 DEFINITIONS FOR THIS SECTION

A. Contractor refers to the General Contractor, who is responsible for constructing the filter underdrain system, including installation of the pre-purchased Filter Underdrain System.

B. Consultant refers to AECOM, and its representatives, in providing Professional Engineering Services to the City of Greater Sudbury.

C. ACG-Environcan refers to the party under separate contract with the City for furnishing the material or equipment procured by the City for assignment to the Contractor. The party furnishing City-procured products is Orthos Liquid Systems.

D. Transfer: The time when ACG-Environcan's instructions for off-loading, handling, storage, and protection have been received; products have been delivered to the jobsite and jointly inspected by the Contractor, Consultant, and the City; any damage or loss has been reported in writing to the Consultant and ACG-Environcan; and the Contractor, Consultant have accepted such products as ready for off-loading, storage, and protection by the Contractor. At this time, the Contractor assumes responsibility for off-loading, storage, coordination, installation, testing, start-up, and training for the Filter Underdrain System.

E. Filter Underdrain System: The Filter Underdrain System is shown on the Drawings and ACG-Environcan's scope of work is further defined in Orthos P.O. for the Filter Underdrain System, Appendix A. The installation of the Filter Underdrain System shall be as specified herein and as specified in the applicable Contract Documents.

1.4 ATTACHMENT AND DRAWING INFORMATION

A. The following documents are provided for information and are related to the pre-purchased Filter Underdrain System:

1. Appendix A: ACG-Environcan-Orthos Purchase Order #236670-5644.

1.5 BIDDING REQUIREMENTS

A. The Contractor shall include in the Base Bid all costs to install, test, and start-up the Filter Underdrain System, as described in the Orthos P.O. and as shown on the Drawings.

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1.7 SUBMITTALS

A. General: Administrative, Shop Drawings, samples, quality control, and contract closeout submittals shall conform to the requirements of Section 01330 – Submittal Procedures and as described in the procurement Contract Documents.

B. ACG-Environcan shall provide to the Contractor for submission to the Consultant and the technical information as required in the Filter Underdrain System Procurement Contract Documents.

C. Specific Project Submittals: ACG-Environcan shall provide the following to the City for submission to the Consultant and the Contractor:

1. Special shipping, off-loading, storage and protection, and handling instructions.

2. Procedures for removal of existing underdrain system and cleaning of filter concrete box (to be performed by Contractor). Identify process piping and connections to be isolated and blinded, indicate desired equipment that is required to conduct removals.

D. Shop Drawings: Contractor shall submit the following additional information.

1. Layout, location, and identification of materials, including pipe, fittings, valves, specialties, hangers, pipe supports, equipment, instrumentation, anchor bolts and required specialties and miscellaneous hardware, provided by the Contractor in order to complete the Filter Underdrain System installation. The Contractor is advised to review the Orthos P.O. The Contractor is responsible for designing, furnishing and installing all pipe supports and associated hardware as required in Section 11530, that is not detailed in the Orthos P.O from ACG-Environcan.

2. The Contractor shall review the ACG-Environcan Shop Drawings and related off-loading, storage, handling, installation, and field-testing procedures for the Filter Underdrain System. The Contractor shall provide a written statement to the City and Consultant indicating that the Contractor has reviewed the ACG-Environcan Shop Drawings and supplemental information for the Filter Underdrain System, and that the equipment can be incorporated into the Work in accordance with the Contract Documents without modification to the Contract requirements.

1.8 SPECIAL COORINDATION

A. Contractor assumes responsibility for off-loading, storage, coordination, installation, testing, startup, and training for the Filter Underdrain System, to provide a complete and functional system, except for the assistance that ACG-Environcan. Note that ACG-Environcan coordinates the shipment of the equipment with the Contractor. Normally, ACG-Environcan will not ship the equipment if there is expected to be a delay in their installation of greater than the time specified in their Installation Instructions. If the actions of the Contractor result in delays after the equipment has been shipped to the site, the Contractor shall be responsible for storing the equipment in accordance with the instructions received from ACG-Environcan. The storage protocol has specific requirements such as temperature control, control of UV exposure and insurance requirements to name a few. If actions of the Contractor result in delays to the shipping schedule defined in the assigned ACG-Environcan Contract.

B. Contractor assumes complete responsibility for adjusting, maintaining, testing, and start-up of the Filter Underdrain System.

C. ACG-Environcan responsibility for Products:

1. Storage prior to delivery (if necessary).

2. Factory testing and certification of results.

3. Notification seven (7) calendar days prior to shipment of equipment, and 48 hours prior to delivery of equipment.

4. Instruction manual, including off-loading, storage, and installation instructions.
5. Operation and Maintenance data.
6. ACG-Environcan representative will be available on-site to:
7. Furnish installation supervision and assistance and Certificates of Proper Installation.
8. Assist Contractor to conduct functional and performance testing and startup (commissioning assistance).
9. Train City's operations staff.
10. Assist with process startup.
11. Provide other services as outlined in the ACG-Environcan Contract in Appendix A.

1.9 QUALITY ASSURANCE

A. The Contractor will identify an individual on the project whose primary role on the project will be to coordinate submittal, construction, manufacturer support and coordination, consultation with the Consultant, pre-startup, startup, City-training and post-startup troubleshooting assistance activities. This individual will coordinate and review the daily work orders when ACG-Environcan field services personnel are on-site. A resume for the individual proposed, shall be submitted to the Consultant for review and approval. The individual named and approved shall be part of the project team and attend the Pre-Installation Meeting.

B. Pre-Installation Meeting: Arrange and attend a pre-installation meeting scheduled at least 90 days prior to shipment with the ACG-Environcan field staff to review general procedures, installation instructions, and installation sequence.

1. The Contractor shall provide 60 days advance written notice of the proposed date for starting installation.
2. Additional meetings prior to installation may be required, as determined by the Consultant and City, to transmit the ACG-Environcan installation instructions to the Contractor.
3. The Consultant and City may attend the meetings.

1.10 SEQUENCYING AND SCHEDULING

A. Contractor shall request equipment delivery directly from ACG-Environcan and provide timely notification to the City and Consultant of such request.

B. Contractor shall be responsible for overall scheduling of equipment delivery to the Project site. Verify availability of the Filter Underdrain by contacting ACG-Environcan, the City and Consultant before making final arrangements for or committing resources to off-loading, handling, storing and protecting, or installing equipment.

C. The price in the assigned contract for the Filter Underdrain System is based upon a specific shipment packaging from ACG-Environcan to the jobsite. An equipment delivery schedule with different requirements may require negotiation with the ACG-Environcan and the additional costs to be borne by the Contractor. The contracted shipment packaging is as follows:

1. Main equipment (including all filter underdrain Nozzles and components listed on Orthos P.O.

D. Contractor is cautioned that the dimensional data given on the ACG-Environcan Drawing is subject to field verification.

1.11 OPERATING MANUALS

A. ACG-Environcan shall furnish to the City six (6) hard copies and one (1) electronic copy of a complete instruction manual for installation, operation, maintenance, and lubrication requirements for each component of mechanical and electrical equipment. The Consultant will provide one (1) copy of the manual to the Contractor.

B. The manuals shall be furnished at least 30 calendar days prior to the scheduled delivery of equipment. Any deficiencies found by the Consultant to exist in the manuals submitted shall be corrected by ACG-Environcan within 30 calendar days following notification by the Consultant of the deficiencies.

C. The Contractor shall confirm reception of the manual from the Consultant prior to issuing the written notice of installation of any piece of pre-purchased Filter Underdrain System to ACG-Environcan.

1.12 INSURANCE

A. Contractor shall include in the insurance for work under this Contract sufficient coverage to protect the Filter Underdrain System against all losses during off-loading, storage, protection, handling, and installation until final acceptance of the work by the City. The City and Consultant shall be named as additional insured(s) for this work.

1.13 MAINTENANCE

A. Notify Consultant immediately in the event that ACG-Environcan spare parts and maintenance materials are not available when field testing is scheduled to begin.

PART 2. PRODUCTS

2.1 CONTRACTOR-SUPPLIED PRODUCTS

A. Provide all products required to complete the work under this section, except where specifically designated as provided by ACG-Environcan on Orthos P.O. Such products may include, but are not limited to, inserts, connecting piping and valves, hangers and supports, piping accessories, specialties, miscellaneous hardware, coatings and expendable materials, all as necessary to provide a complete and properly functioning system.

B. The additional items required to meet the installation detail shall be provided by the Contractor.

C. Provide incidental products such as gaskets, supports, bolts, and lubricants, as required for proper operation of equipment installed under this section. Products shall conform to applicable sections of these Specifications for the intended service.

D. Furnish anchor bolts, fasteners, washers, etc. and templates needed for installation of the Filter Underdrain System.

E. Verify the number and size of anchor bolts required to install the Filter Underdrain System and all accessories furnished by ACG-Environcan and furnish all necessary anchor bolts.

F. Size and locate anchor bolts in accordance with the ACG-Environcan Shop Drawings and installation instructions.

G. Anchor bolts, fasteners, washers, etc. shall be Type 316 Stainless Steel. Number and size as recommended by ACG-Environcan and Division 3.

PART 3. EXECUTION

3.1 HANDLING OF PRE-PURCHASED FILTER UNDERDRAIN SYSTEM

A. The Contractor is responsible for taking all reasonable precautions to prevent damage during installation and to prevent debris and foreign objects from falling in the filter tank after the nozzles and underdrain elements are installed. Inspection Prior To Off-Loading.

B. Prior to transfer of the Filter Underdrain System to the Contractor, the Contractor, City, and Consultant shall jointly inspect all shipments on arrival at site for damages and check against shipping information to ensure all parts, boxes, crates, bundles or items have been received.

C. Record in writing the products transferred to Contractor's care. Provide listing of the materials and/or equipment received and provide written statement to Consultant and ACG-Environcan that materials and/or equipment were received in good condition.

1. Report damage to or loss of materials and/or equipment immediately to Consultant and ACG-Environcan.
2. Do not off-load products to be returned to ACG-Environcan for repair or replacement, unless necessary to expedite return shipping.
3. Contractor is responsible for unpacking, repacking and handling of equipment as required.
4. Provide trucking company with signed shipping manifest, signed by the Contractor, prior to allowing the trucking company to leave the site.

3.2 OFF-LOADING OF EQUIPMENT

A. After any damage or loss is reported, off-load the Filter Underdrain System only with approval by the Consultant in accordance with ACG-Environcan's instructions and under ACG-Environcan and the Consultant's supervision.

B. Damage incurred during equipment off-loading, shall be reported to Consultant and ACG-Environcan immediately.

3.3 HANDLING OF PRE-PURCHASED FILTER UNDERDRAIN SYSTEM

A. After any damage or loss is reported, off-load the Filter Underdrain System only with approval by the Consultant in accordance with ACG-Environcan's instructions and under ACG-Environcan's and the Consultant's supervision.

3.4 STORAGE AND PROTECTION OF PRE-PURCHASED FILTER UNDERDRAIN SYSTEM

A. Following the transfer of Filter Underdrain System, and until final acceptance of the completed work, protect and maintain products to prevent damage or loss in accordance with ACG-Environcan instructions. Contractor shall replace all materials and/or equipment that are lost or damaged while in the custody of the Contractor. Replacement materials and/or equipment shall be acceptable to the Consultant, City and ACG-Environcan.

B. Maintain current, complete inventory and record of all Filter Underdrain System materials and equipment following transfer.

C. Repair or replace all damages or shortages that may occur during the period of storage at the Contractor's expense.

3.5 PLACING OF ANCHOR BOLTS

A. In accordance with ACG-Environcan instructions.

B. Anchor Bolts: Accurately place using templates furnished by ACG-Environcan and as specified in Section 03300.

C. Refer to Contract Drawings and consult with ACG-Environcan for the locations in which anchor bolts can be installed during angle ledge placement.

D. Contractor shall be responsible for all aspects of Underdrain installation. Critical installation work shall be supervised jointly by ACG-Environcan and Orthos. ACG-Environcan Service Representative shall be available to, but not limited to, the following:

1. Provide general installation assistance for equipment, as required.
2. Provide supervision of the installation of the Underdrain segment by the Contractor.
3. Perform a complete check of the installation by the Contractor, following Contractor completion of checklists and prior to wet testing of installed equipment
4. Complete Certificates of Proper Installation for equipment.

E. Contractor shall complete ACG-Environcan's "Equipment Inspection, Start-Up and Process Training" and "Underdrain Equipment Checkout" Checklists" prior to equipment testing.

F. Contractor is responsible for installing the spool pipe connection and couplings between the filter air scour air header and the existing air supply pipe as shown on Drawings.

G. Disposal of crates and other miscellaneous Filter Underdrain system equipment packing materials is the responsibility of the Contractor.

3.6 SUMMARY OF SUPERVISORY AND ON-SITE SERVICES PROVIDED BY ACG-ENVIRONCAN

A. Refer to ACG-Environcan-Orthos P.O. and Section 11530.

B. ACG-Environcan shall provide written notice of demonstration to the Consultant and City two (2) weeks prior to the demonstration.

3.7 FIELD TESTING AND REPORTING

A. Refer to ACG-Environcan-Orthos P.O. and Section 11530.

B. Commissioning shall be as described in the Filter Underdrain System Section 11530.

C. ACG-Environcan's Services: Any time or materials required, in excess of what is specifically stipulated in the ACG- Environcan's Orthos P.O., shall be considered included in the bid price for the Work.

3.8 EQUIPMENT TESTING AND FACILITY START-UP OF THE PRE-PURCHASED FILTER UNDERDRAIN EQUIPMENT

A. Refer to ACG-Environcan-Orthos P.O.

B. Conduct Performance Testing and start-up of the pre-purchased Filter Underdrain system in accordance with the requirements of Section 11530.

C. Provide all consumables required for testing and start-up. Process chemicals for the disinfection and cleanings.

D. Provide all temporary facilities, equipment and appurtenances required for the Performance Test and initial start-up of the pre-purchased Filter Underdrain equipment.

E. After the pre-purchased Filter Underdrain equipment is installed, tested and adjusted to the satisfaction of ACG-Environcan and the Consultant, submit the pre-purchased Filter Underdrain Supplier's installation report as per Section 01330 – Submittal Procedures.

F. Filter Underdrain System Performance Test.

1. Contractor shall be responsible to perform the test in accordance with the requirements of Section 11530.

3.9 FACILITY START-UP AND PERFORMANCE EVALUATION

A. Support the City and the City's Operator throughout upgraded filter Facility Startup and the Performance Evaluation in accordance with Section 11530.

END OF SECTION

PART 1. GENERAL

1.1 INTENT OF SECTION

A. This Section covers the removal and demolition of the existing filter underdrain system, piping and associated appurtenances located in Filter No. 3 (only), and installation, startup, testing, commissioning, and training of the new filter underdrain system, piping and associated appurtenances as requirement of the Contractor, as shown on the Contract Drawings.

B. The filter underdrain system(s) are pre-purchased by the City from ACG-Envirocan Inc. (Orthos Liquid System Inc.) "Supplier". Contact: ACG-Envirocan; Dale Jackson at (905) 856-1414 ext.222; dale@acg-envirocan.ca. Refer to the Supplier submittal appended to the end of this Specification.

C. This Section also covers the design basis and performance requirements for the filtration underdrain system.

D. The City has executed a contract with Supplier for procurement of goods and services for filter underdrain equipment. The materials and equipment provided for in the procurement contract are to be furnished and delivered by the Supplier to site for installation by the Contractor. Following execution of the General Contract and issuance of the Consultant's written order to commence work, the Contactor will notify the Supplier to coordinate delivery of the equipment to site.

E. The Contractor is responsible for the receipt and safe onsite storage of the equipment, complete installation, startup, testing, commissioning and training.

F. Contractor shall install the new filter monolithic concrete underdrain system including but not limited to nozzle systems, forming panels, wall angle supports, panel support columns, and air distribution manifold, as specified herein and as indicated on the Drawings, and pre-purchased documents appended herein.

G. Installation of the filter underdrain system and air distribution manifold shall include all items and materials within the filter cell to collect filtered water, uniformly distribute backwash water and scour air, retain the filter media, and to retain, support, and seal the filter underdrain systems to make complete and operable.

H. The Contractor is responsible for removal and disposal of the existing underdrain systems, and removal and disposal of the existing filter media consisting of a 305 mm sand layer and a 460 mm Anthracite, refer to Specification Section 11535 Filter Media.

I. The Contractor shall install a new air distribution header to replace the existing air scouring distribution manifold/header underneath of filter underdrain false floor.

J. The filter underdrain system comes complete with all accessories and appurtenances (including, but not necessarily limited to underdrain false floor forms, PVC support column forms, leveling shims, stainless steel air scour distribution header pipe, deflector plate, clamps, bolts, nuts, anchors, as supplied by Orthos Liquid System Inc. The Supplier shall provide all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features and functions without altering or modifying the Underdrain Supplier's responsibilities under the Contract Documents. The Contractor is responsible for installing the equipment systems as specified herein.

K. The Contractor is advised that the Drawings show the general arrangement and details for the filter underdrain system based on the monolithic underdrain system as supplied by Orthos Liquid System Inc. The Contractor is also advised that such details shall be reviewed against the Supplier's design details and inform the City and/or Engineer of any discrepancy.

L. The Supplier shall provide the installing Contractor written interface requirements, installation details, and recommendations as are necessary to properly interface these systems with all surrounding structures and to provide a complete, functional, and operable filter.

M. The Contractor shall supply and install new sand and anthracite media upon completion of installation of the filter underdrain system. The Contractor shall be responsible for the installation and commissioning of the sand and anthracite media. Refer to Specification Section 11535 Filter Media.

N. The Contractor is responsible for the overall coordination and installation of the filter underdrain system, air distribution piping, piping connections of distribution and media.

O. The adjacent Filters (1, 2 and 4) are required to provide continuous and uninterrupted operation for the complete duration of the project. The Contactor shall be responsible to take every precaution necessary to protect the adjacent filters from being impacted by the work.

P. The existing stainless steel wash water troughs in Filter No.3 will remain in place during upgrades and construction. The Contractor shall ensure the existing throughs are protected at all times and will be responsible for rectifying any damage to the existing troughs.

1.2 RELATED DIVISIONS/SPECIFICATIONS

A. Division 1.

B. Section 11750 – Piping and Valves.

C. Section 11535 – Filter Media.

D. Division 3.

E. Section 11750 – Piping, Valves and Fittings.

1.3 CODES AND STANDARDS

A. Unless specified herein, all the following reference standards shall be adhered to:

1. ACI 318 Building Code for Requirements for Reinforced Concrete and Commentary.
2. ANSI/AWWA C653-03, Standard for Disinfection of Water Treatment Plants.
3. ANSI/NSF 61 – Drinking Water System Components – Health Effects.
4. ASME/ANSI B16 – Standards of Pipes and Fittings.
5. ASTM/A790-Standard Specification for seamless and welded Ferritic/Austenitic Stainless-Steel Pipe.
6. ASTM A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
7. AWWA B100 – Water Treatment Filtering Material, including addenda.

1.4 MEASUREMENT AND PAYMENT

A. Work outlined in this Section shall be included in the Lump Sum Tender Price.

1.5 OPERATING CONDITIONS

A. The following site operating, and water quality conditions shall be assumed for all design conditions:

1. 40^{o}C maximum/5^{o}C minimum ambient air temperature.
2. 25^{o}C maximum/1^{o}C minimum water temperature.
3. 95% maximum relative humidity (non-condensing).
4. 7.5 – 8.5 water pH.
5. Elevation 255± meters above sea level.
6. Fully enclosed facility.
7. Refer to the Contract Drawings for further details.

1.6 SYSTEM DESCRIPTION

A. Physical Requirements:

1. Each filter basin (1 of 4) has a nominal internal dimension of 30.00 ft (9.14 m) long by 24.00 ft (7.32 m) wide. The proposed plenum height shall be 1.772 ft (0.540 m) formed by a 6-inch (150 mm) filter floor tied into the filter walls using the existing or new concrete ledges.

2. Each filter shall be equipped with an air distribution manifold located in the lower gullet. The Supplier shall design and supply the air distribution manifold from the connection point as shown on the Drawings. The air distribution manifold shall be structurally and seismically supported per the project Specifications.

3. The Contractor shall ensure that the filter underdrain and air distribution manifold are constructed to avoid blocking the waterways and flow from the backwash supply, the filtered effluent, and filter to drain operations.

B. Design Requirements:

1. General:

a. The Supplier shall design the filter underdrain systems to ensure long-term stability in its operating characteristics.

b. The Supplier shall design the filters to be resistant to changes in head loss, flow uniformity, corrosion, and any other effects which would in time cause loss of efficiency or effectiveness of its operation.

c. The Supplier shall design the filter underdrain systems to meet all requirements specified for delivery, storage, handling, installation, testing and operation.

2. Flow Design Requirements:

a. The Supplier shall design the filter underdrain systems to produce uniform air and water flows throughout the filter cells over the full range of normal backwash flow rates.

b. Flow uniformity per square foot of filter area shall be as required to permit efficient and effective filtration and backwashing.

c. The installed filter underdrain systems shall satisfy both of the following criteria for acceptable flow uniformity:

i. Maldistribution of air and water flow during backwash, for specified flow conditions, shall not exceed:

a. Plus or minus 5% of average gallons per minute per square foot (cubic meter per hour per square meter) of filter area.

b. Plus or minus 10% of the average standard cubic feet or air per minute per square foot (Normal cubic meter per hour per square meter) of filter area.

c. Visual test shall reveal no evidence of maldistribution or disturbance of filter media.

d. In addition to the uniformity requirements specified above, the headloss through the nozzle systems for the backwash water shall be 24 to 30 inches (0.060 to 0.075 Bar) of water when backwashing at 20.0 GPM/ft^2 (48.87 $m^3/hr/m^2$) of filter area, no exceptions.

3. Structural Design Requirements:

a. The filter underdrain system is as shown in the Contract Drawings. The filter underdrain support system will consist of Orthos' designed false reinforced concrete floor supported by the wall sections and columns which transfer the load to the filter structural floor. The false filter floor will consist of cast-in-place reinforced concrete placed over prefabricated Glass Reinforced Cement (GRC) formwork panels. The false floor shall be tied to the filter box walls, as shown in the Drawings.

b. The filter underdrain systems, including the concrete false floors and related appurtenances, anchorage, and supports, shall be designed in accordance with ACI 318 Code and/or CSA A23.1/2 Standard to safely withstand the specified loadings.

c. The underdrain concrete slab shall be designed for:

i. An uplift of 1400 pounds per square foot (psf) (6,800 kg/m^2) not accounting for the weight of the media.

ii. A downward force of 1600 psf (7,800 kg/m^2) plus the dead load of the underdrain concrete slab.

d. There shall be no leakage from the seals, joints, or gaskets at the design pressure at maximum backwash rates.

e. The filter underdrain systems shall be designed to withstand:

i. A net downward loading of not less than 1,600 pounds per square foot (7,800 kg/m^2) to account for the weight of the media, and the in-service hydraulic loading, plus its own dead weight, without the presence of media above.

f. A minimum safety factor of 1.5 to be considered in the design to account for dynamic loading (such as during the initiation and termination of backwash), shall be included in the design to account for any dynamic loading above and beyond that described above.

g. Adequate safety factors to account for dynamic loading (such as during the initiation and termination of backwash), shall be included in the design to account for any dynamic loading above and beyond that described above.

h. The design shall adequately provide for all loads incurred during shipment, handling, and installation.

4. Performance Requirements:

a. The Supplier shall furnish such installation details and recommendations to the Contractor as are necessary to acceptably interface the filter underdrain systems with all surrounding structures, including requirements for leveling, grouting keys and pockets, dowels, support angle iron, piers, and anchorage.

1.7 MANUFACTURER'S DATA AND SUBMITTALS

A. Shop Drawings:

1. Submit Shop Drawings for review in accordance with Section 01330 – Submittals.

2. The Contractor shall coordinate all pre and post installation submittals with the Supplier. The Supplier shall provide the Contractor all technical information as requirement of the pre-purchased filter underdrain system. Refer to the Supplier submittal appended to the end of this Specification.

3. The Shop Drawing submission shall include, but not limited to the following:

a. General dimensioned layout and materials list.

b. Installation details and leveling requirements.

c. Certificate of Compatibility of the underdrain system with the filter media specified in Section 11535.

d. Mathematical proof or test data to demonstrate the maximum percentage of flow maldistribution within a filter cell and the maximum percentage of flow maldistribution across the underdrain system.

e. Submit full and complete hydraulic test results and design calculations showing conformity with all flow design requirements to the Engineer for review and acceptance. Separate tests and design calculations shall be based on the filter cell design. Include the full range of flow conditions specified, and indicate pertinent physical relationships between the metering orifices, cross-sectional flow areas for water transport to the flow metering elements, relative magnitudes of entrance, transport, metering, and discharge losses: and such other data as may be required by the Engineer. All test setups, procedures and instrumentation shall be capable of providing data accuracy of plus or minus 2%.

f. All testing as identified in the Supplier submittal appended herein.

g. Recommend detailed concrete Specifications for the concrete false floor slab by the Supplier.

h. One sample of each component of the complete underdrain systems intended for the project.

i. Statement of Guarantee of maximum headloss through the underdrain system, and combined underdrain system at maximum design conditions.

j. Statement of Guarantee that the underdrain system is suitable for direct installation of anthracite and sand media layers and guarantee that the underdrain system will prevent any media particles from passing through the underdrain system.

k. Headloss data for air, water and combined air/water backwash, structural design calculations, and flow distribution calculations.

l. Proper documentation showing NSF-61 certification of all underdrain components including nozzles, sealing compound, caulks, and other materials.

m. The Supplier shall indicate a list of spare parts, which would be recommended for purchase and individual prices for each item.

n. All ancillary equipment to be provided by the Contractor shall be listed.

o. Details for installing reinforcing and other items embedded in concrete.

p. Detailed start-up, hydraulic and air scour test procedures as well as the Manufacturer's proposed method of testing the installed underdrains' flow distribution.

q. All other data which in the judgment of the Engineer is necessary to demonstrate conformance with all Specification requirements

4. The Contactor shall submit the following additional information.

   a. Layout, location, and identification of materials, including pipe, fittings, valves, specialties, hangers, pipe supports, equipment, instrumentation, anchor bolts and required specialties and miscellaneous hardware, provided by the Contractor in order to complete the filter underdrain system installation. The Contractor is advised to review the Supplier submittal appended to the end of this Specification. The Contractor shall be responsible for designing, furnishing and installing all pipe supports and associated hardware as required in Section 11750, that is not detailed in the Supplier submittal.

B. Field Test Reports:

1. Contractor to coordinate required submittals with the Supplier for providing (3) copies of full and complete test reports for all tests, describing the units tested; the type of test; test set-ups, procedures, and instrumentation; and test flow rates, pressures, levels and all other data and results as required to demonstrate that all items tested meet specified requirements. Refer to section below 3.5 Testing and Certification.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Contractor shall coordinate delivery of the equipment with the Supplier. The time when the Supplier's instructions for off-loading, handling, storage, and protection have been received; products have been delivered to site and jointly inspected by the Contractor, Consultant, and the City; any damage or loss has been reported in writing to the Consultant and Supplier; and the Contractor, Consultant have accepted such products as ready for off-loading, storage, and protection by the Contractor. At this time, the Contractor assumes responsibility for off-loading, storage, coordination, installation, testing, start-up, and training for the filter underdrain system.

B. Storage: Contractor is responsible for the safe storage of the filter underdrain equipment onsite. Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements. Store underdrains and specialties off the ground, under ultraviolet-resistant tarps from the time of delivery on-site until final installation in the filters.

The Contractor shall review the Supplier submittal related off-loading, storage, handling, installation. The Contractor shall provide a written statement to the City and Consultant indicating that the Contractor has reviewed the Supplier submittal and supplemental information for the filter underdrain system, and that the equipment can be incorporated into the Work in accordance with the Contract Documents without modification to the Contract requirements.

C. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. The Contractor shall ensure the equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times.

D. Replace underdrains and specialties damaged during storage and delivery.

1.9 QUALITY ASSURANCE

A. The Contractor shall provide a Manufacturer certificate of proper installation that states the underdrain systems have been installed in accordance with the Manufacturer's requirements have been supervised by an authorized representative of the Manufacturer, and that all of the specified testing has been conducted to ensure proper performance.

B. The Underdrain Installation Quality Assurance Plan is to be drafted by the Underdrain Manufacturer and submitted at the same time as the initial Shop Drawing submission. A final version incorporating all of the Engineer's comments on the Draft Plan is to be provided a minimum of eight (8) weeks prior to the actual installation. The intent of the Plan is to provide the City and the Engineer with a well-documented and transparent installation procedure confirming that the Contractor has installed the underdrain equipment in accordance with the Manufacturer's written instructions and installation Drawings. The Plan is to provide a means by which the Engineer and the City can participate in the quality assurance of witnessing the checks and signoffs between the Contractor and the Underdrain Manufacturer. The Plan is to include a recommendation of such quality and inspection milestones, the integration of testing results (e.g., pull tests on anchors), photographic documentation in a detailed photo log for each filter underdrain (minimum daily and at critical stages around the entire perimeter of each underdrain as a minimum), and how oral or written directions provided by the Manufacturer's representative who is supervising and observing the work during the installation is documented and disclosed to the Engineer and the City. The Underdrain Installation Quality Assurance Plan must also include a plan to accurately monitor and record the backwash pressure so that the maximum differential pressure stated by the Underdrain Manufacturer is never exceeded.

C. Nozzle Underdrain System: Polyvinyl chloride support column forms, glass reinforced cement false floor forms, nozzle sleeves, nozzles, and any specialties required for installation such as special anchorage, leveling shims, temporary sealing caps, shall be the products of Orthos Liquid System Inc.

1.10 SPARE PARTS

A. Provide a minimum quantity of 80 spare nozzle sets from the Supplier as noted in the Supplier submittal appended herein.

PART 2. PRODUCTS

2.1 GENERAL

A. The underdrain system is pre-purchased by City and manufactured by Orthos Liquid System Inc. and supplied through ACG-Envirocan Inc. (Contact: Dale Jackson – (905) 856-1414, ext. 222, dale@acg-environcan.ca). Refer to the Supplier submittal attached herein.

B. Filter No. 3 shall be equipped with a monolithic concrete underdrain with plastic nozzles designed to withstand the maximum operating and uplift loads encountered during normal operation. The filter underdrain shall consist of a false bottom in each filter cell supported above the true bottom of the filter. The underdrain system shall be constructed on-site using only the Supplier's corrosion-resistant non-metallic structural foam underdrain forms, plastic underdrain nozzles, cylindrical PVC column forms and cast-in-place reinforced concrete. All materials, including the underdrain pan forms, which come in contact with water must be NSF 61 approved.

C. The Existing four (4) filters (Tag No. F-1710 to F-1740) have the same dimensions. Filter dimensions and media information are provided in the table below. Refer to the Contract Drawings for filter details and the location of underdrain equipment.

Item	Value
Number of Filters	4
Length of Filter Box (m)	9.14
Width of Filter Box (m)	7.32
Filter Area (m^2)	66.89
Depth of Filter (m)	4.9
Flume Design	___
Thickness of Sand Media Layer (m)	0.3
Thickness of Anthracite Media Layer (m)	0.46
Note 1: Refer to Section 11535 for filter media details.	

D. The underdrain system shall meet the following filter design conditions.

Item	Value	
Filter Downflow Rate (based on 18 ML/d, each)	Average: Maximum:	11.2 m/h 16.8 m/h
Backwash Rate	Low Rate: High Rate:	16.0 m/h ≤ 50.0 m/h
Air Scour Rate	69 m/h (3.75 scfm/ft)	
Concurrent Air/Water Backwash Rates	Air – 69 m/h (3.75 scfm/ft^2) Water – 12.7 m/h (5 gpm/ft^2)	
Filter Bed Expansion during Backwash	30%	

Item	Value
Maximum (allowable) Maldistribution (MD) of Water Flow during Backwash	± 3% of the average filter downflow rate for a backwash rate of 50 m/h (20 gpm/ft^2).
System Air Maldistribution (MD)	Visually, airflow distribution shall show a uniform pattern.

E. The filter underdrain system, as installed, shall provide acceptable flow uniformity. Additional maldistribution, due to specific nozzle arrangement, nozzle tailpipes, entry conditions into nozzles and underdrain system and flow velocities, must be considered.

F. It is intended that the filter media be retained by the underdrain system without the use of support gravel. Nozzles shall be constructed of high strength erosion resistant NSF approved and suitable plastic for the application.

G. The nozzles slot size and slot volume shall be sufficient to prevent the media from obstructing or passing through the underdrain.

H. The underdrain system shall be designed and installed to ensure long-term stability in its operating characteristics. It shall be resistant to changes in headloss, flow uniformity, and any of the effects which would in time cause loss of efficiency or effectiveness in operation.

I. The underdrain system shall allow for the uniform collection of contacted water and uniform distribution of backwash water and air over the total area of the filter floor.

J. The system shall be designed to avoid localized areas of excessive flow (maldistribution) which may cause mounding, lateral displacement, or other deleterious disturbances in the filter support media.

K. The Supplier is responsible for the design of the air distribution header system for the underdrain to result in uniform distribution of air over the entire area of the filter floor and for ensuring that the design of the distribution header for the underdrain is set with the existing filter configuration to result in uniform distribution of backwash water and air and uniform collection of contacted water over the entire area of the filter floor.

L. Separate water backwash and air scouring as well as co-current use of air and water shall be allowed. The design of the underdrain system shall allow for effective water-based only backwashing and co-current water-air backwashing (air scouring). During backwash with air, the underdrain system shall be suitable to withstand a maximum air temperature of 65°C.

2.2 MATERIAL

A. All materials used in contact with the water and backwash air shall meet National Sanitation Foundation (NSF) Standard 61 Drinking Water System Components – Health Effects.

B. Materials used in the filter underdrain system shall conform to specified requirements unless more stringent requirements are specified by the Supplier.

C. Grout:

1. Non-shrink epoxy grout conforming to the applicable requirements of Section 03300.

2. All grout associated with the installation of the underdrains shall be non-shrink epoxy grout.

3. Underdrain Manufacturer shall certify compatibility between the underdrain material and the epoxy non-shrink grout.

4. Structural Concrete:

   a. As specified in Section 03300 – Cast-in-Place Concrete, except that coarse aggregate shall not be larger than ½-inch (13 mm) maximum diameter in slabs greater than 3 inches (75 mm) in depth and shall have a minimum strength of 5000 psi (34.5 MPa) at 28 days.

5. Concrete Reinforcement:

   a. As specified in Section 03300 – Cast-in-Place Concrete.

6. Metals:

   a. All exposed (not embedded in concrete) or partially exposed metals, including but not limited to anchor bolts and anchorage, fasteners, washers, etc., shall be Type 316 Stainless Steel.

7. Grout Stops, Cover Plates, and Concrete Retaining Strips:

   a. Shall be high-impact plastic, or PVC (polyvinyl chloride), properly keyed or mechanically restrained to prevent the strips from working loose with time.

   b. Shall also be completely sealed with caulking to prevent water, air, or grout from leaking around them.

   c. Plastics shall be high-strength, completely inert, resistant to erosion, corrosion, and degradation from chlorine up to 150 mg/l, and suitable for use with backwash temperatures from 40 to 140 degrees Fahrenheit (4.4 to 60 degrees Celsius).

2.3 NOZZLE UNDERDRAIN SYSTEM

A. The underdrain system(s) are pre-purchased by City from Orthos Liquid System Inc. "Supplier". Refer to the Supplier submittal appended to the end of this Specification. The underdrain system as supplied shall meet the following criteria.

B. Structural Design Requirements:

1. The filter underdrain full system, including concrete slab, anchorage to concrete, pedestal supports shall be designed to safely withstand loadings for the specified conditions.

2. The filter underdrain system, when installed, shall be designed for a net force from the backwash of 200% of the maximum backwash pressure.

3. Safety Factor: A minimum safety factor of 1.5 shall be included in the design to account for dynamic loadings which may occur during the initiation and termination of backwash.

4. The design of subdrain system shall adequately consider all loads incurred during shipment, handling, and installation as required.

C. Support System:

1. The false floor shall be made up of forming panels as specified. The false floor and support columns shall be designed according to the criteria specified under Structural Design Requirements.

D. Forming Panels:

1. The forming panels shall be constructed of Glass Reinforced Concrete (GRC) supplied by Orthos; no other forming panels are unacceptable.

2. The forms will become a permanent part of the finished false floor.

3. Forms shall be designed to carry stresses due to the placement of concrete with a maximum deflection of 1/8-inch (3 mm).

4. Contractor shall trim or cut forms per Orthos' instruction, as required, to close the area along the perimeter walls where a full form cannot fit.

E. Flow Nozzles and Sleeves:

1. Nozzle Sleeves:

a. The false floor shall contain an array of plastic nozzle sleeves cast in the concrete, uniformly spaced at 6-inch (150 mm) centers both ways and designed to accept a nozzle sleeve which shall lock into place at each nozzle location.

b. The nozzle sleeve shall contain a disposable seal which shall prevent concrete from passing through or fouling the threaded portion.

2. Nozzles**:**

a. Each media retaining underdrain nozzle shall be molded of NSF-certified durable, impervious high-strength Polypropylene.

b. Nozzles shall screw into the nozzle sleeves and shall have narrow, vertical slot openings in a screen section.

c. The nozzles shall be of the slotted type wherein the slots lie in a horizontal plane so that the backwash water is uniformly discharged horizontally into the filter media.

d. Nozzle slots shall be suitably sized for compatibility with the filter media and no larger than 0.30 mm.

e. Without exception, the nozzle screen shall be supported by a minimum of one reinforcing rib perpendicular to slot length to minimize deflection in either flow direction.

f. Nozzle slots shall be designed to prevent clogging from small particles.

g. Nozzles shall be designed to collect filtered water during the filtration cycle, and uniformly distribute scour air and wash water during the backwash cycle without permitting media to enter the plenum.

h. Nozzles shall be easily installed (screwed into) and removed from the top side of the underdrain.

i. Nozzles shall not require epoxy or metal fasteners for installation.

j. Nozzles shall be uniformly spaced at not more than 6-inch (150 mm) centers both ways, without exception.

k. Nozzles shall be designed to allow the direct placement of filter media (as specified) on top of the nozzle.

l. Each nozzle shall be designed to withstand the same loadings as the monolithic pour.

3. Nozzle Tail Pipe:

a. Each nozzle shall have a tailpipe of proper design to provide for the uniform distribution of scour air and backwash water.

b. The Supplier shall provide the correct length of the tailpipe as an integral part of the distributor nozzle.

c. Each tail pipe shall include one circular air metering orifice for proper distribution of scour air at the rates specified herein. Multiple air metering orifices or the use of non-circular air metering slots are unacceptable due to inconsistent air rates.

d. Each nozzle shall have a hole in the tailpipe so placed to bleed off trapped air in the plenum.

e. The Supplier shall supply torque and other installation instructions and requirements to account for the variation in temperature from installation to service and other effects that may cause the nozzles to loosen in service.

2.4 AIR DISTRIBUTION MANIFOLD

A. In each filter underdrain plenum, an air distribution manifold shall be provided and installed with the main header and riser pipes sized by the Supplier to deliver an evenly distributed air flow to the respective underdrain plenum.

B. The main header shall be 316 Stainless Steel, minimum Schedule 10, in accordance with the requirements of ASTM A312.

C. The Supplier shall design the air distribution manifold to provide a uniform distribution of airflow through each underdrain system to meet the airflow design requirements specified.

D. The Supplier shall design the air distribution manifold to clear the manifold of water at the beginning of the air scour operation to result in an evenly distributed air flow to the respective underdrain plenum at the air rates specified herein.

E. Air metering tubes shall extend vertically upward between nozzle tailpipes, terminating above the nozzle tailpipes, terminating above the nozzle air metering hole without creating an air knife (less than 67 feet per second (20 m/sec)) to the plenum ceiling. Air velocity in the metering tubes shall not exceed 130 feet per second (40 m/sec).

F. The Supplier shall design the air distribution manifold from the connection point, indicated on the Drawings.

G. The air distribution manifold shall meet the current distribution header set-up to minimize the impact on the current air supply blower system and to ensure no upgrades or changes to the scour air supply system beyond filter boxed will be required.

H. 316 Stainless Steel pipe supports, anchors and hardware.

2.5 MANUFACTURER

A. Where a Manufacturer's standard equipment name and/or model number is listed, the equipment system shall be provided as modified to conform to the performance, functions, features, and materials of construction as specified herein.

PART 3. EXECUTION

3.1 REMOVALS

A. Refer to the Contract Drawings for the extent of removals.

B. Coordinate the upgrade work with the Engineer and City to meet the acceptable existing Filter No. 3 shutdown sequence prior to proceeding with any work. Refer to Section 01040 – Summary of Work and Coordination.

C. Remove and dispose of the existing filter media (sand and anthracite) at site(s) approved by the City. The City must be advised and agree to the final disposal details of the existing media.

D. Remove and dispose of the existing underdrain system at an acceptable site(s) approved by the City.

E. Demolish and remove the existing underdrain system including the existing monolithic concrete false floor complete with nozzles, tailpipes, concrete-filled PVC columns, etc.

F. Remove the air distribution manifold and all supports and related components with all attachments to the underdrain and filter floor.

G. Remove access blind flanges and air distribution connection flanged spool pipe embedded in concrete as shown on Drawings.

H. All further removals as specified here, shown or Drawings and/or required to replace the existing underdrain system and air distribution manifold inside the filter box.

3.2 FILTER FLOOR PREPARATION

A. Clean the filter cell of all debris as required to allow installation of the new underdrain system. All loose debris and dirt within the filter cell and flume shall be removed by pressure washing, sweeping and vacuuming. Backwash water piping shall be thoroughly flushed clean.

B. Take all necessary precautions recommended by the underdrain Manufacturer's published instructions and as specified to ensure the underdrain system and piping are completely clean and free of any debris, dirt, or other foreign materials which could clog the underdrain system or interfere with the flow.

C. Obtain the Engineer's approval prior to proceeding with installation.

D. The Contractor shall exercise care in preparing the filter cell floor slab and in setting the anchors to ensure proper alignment and elevation in accordance with Contract documents. The floor slab shall be screeded into a flat level plane and be free of protrusions and depression.

3.3 INSTALLATION AND INSPECTION

A. Contractor shall take full responsibility for installing and putting into specified working operation, pre-purchased equipment to be installed under this Contract.

B. Contractor to confirm to his own satisfaction the respective scope of supply of the pre-purchased equipment and the installation requirements of this Contract.

C. Coordinate the underdrain installation work with the filter media Contractor. The filter media shall be installed within 24 hours following the successful completion and testing of the underdrain system.

D. Installation of the underdrain system shall be in accordance with the Supplier's recommendations, as indicated on the Contract Drawings, and as approved by the Engineer. Ascertain from the Supplier the extent of field work required for the installation of the equipment. Obtain from the equipment supplier all dimensions, details and other information required to successfully complete the work outlined in the is Contract.

E. Work with the installing Contractor's qualified trades to install the underdrains in accordance with the Supplier's instructions.

F. Provide the services of a factory-trained representative to inspect, operate, test, adjust, and troubleshoot the installation.

G. Coordinate with the Supplier and provide signed reports describing in detail the inspection, tests, and adjustments made, quantitative results and recommendations for precautions to be taken to ensure proper maintenance. The report must verify that the underdrain system conforms to all Specifications.

H. Complete concrete repairs to the filter walls and filter boxes as per the Contract Special Provisions.

I. Install new concrete pipe, flanges, valves (if required), manways as well as air distribution manifold and related components, supports etc.

J. Install differential pressure tubing and probe connections.

K. Ensure that the false floor made up of forming panels is installed as per the Supplier's instructions. The forms will remain in place as the underside of the floor slab and will provide preformed holes for locating and supporting the cast-in-place flow element sleeves. The false floor forms shall be installed onto 6" (150 mm)-diameter PVC support columns inside the filter cell, and onto support ledges along the perimeter walls of the

filter cell. Existing perimeter and/or new concrete ledges shall be used for support ledges.

L. The newly installed stainless-steel angle ledges and columns shall be carefully levelled to within plus or minus 1/8 inch (3 mm) before installing the false floor forms.

M. The level tolerance of the ledges and columns shall be checked by a laser to ensure compliance with the Specifications.

N. Leveling shims shall be provided by the Supplier, no exception.

O. The support system shall adequately provide for both longitudinal and transverse flow under the false floor to ensure uniformity of flow distribution.

P. Install rebar for reinforcement of the columns and the monolithic slab with spacing and connections as shown on the Contract Drawings. Reinforcing steel shall be placed to accurately fit in place without bending the reinforcing bars in the field.

Q. Install underdrain nozzles in accordance with the Supplier's tolerances. Add end cap protectors to placed nozzle sleeves prior to pouring concrete per the Supplier's instructions.

R. Place concrete on the false floor in accordance with the Supplier's requirements and tolerances.

S. Grout, care shall be taken during installation to prevent grout from extruding into any of the flow passages or ports or into the underdrain system itself. Any evidence of grout intrusion witnessed during installation shall require that the affected section be removed and replaced.

T. The reinforced concrete false floor underdrain system shall be a monolithic, cast-in-place, concrete structural slab that shall be finished to a true level plane within the lesser of plus or minus 1/8 inch (3 mm) or the tolerance specified by the Supplier of the filter underdrain. Flood the underdrain with water to ascertain that the level of tolerance is met.

U. Failure of the filter underdrain system to meet the level tolerance shall require the removal of the failed sections and replacement with new underdrain sections to within level tolerances.

V. Once all concrete work is complete, the concrete shall be allowed to cure for at least 28 full days before any functional testing.

W. Remove end protector caps from nozzle sleeves in concrete and install nozzles in accordance with the Supplier's requirements.

X. Should any underdrain materials, including the false floor forms, nozzle sleeves, and nozzles become chipped, plugged, bent, or damaged in any way, they shall be removed and replaced before the false floor is poured.

Y. Before installation of the media, the contractor shall vacuum clean the underdrain area, all cell effluent and backwash supply piping, and all surfaces that come into contact with the backwash supply water. The Engineer and Supplier must approve this cleaning before the contractor can begin the placement of the filter media.

Z. Before placing the filter media, have the filter underdrain installation inspected, tested, and passed by the Filter Underdrain Supplier. Correct any deficiencies after the initial inspection. Have the Supplier re-inspect the installation again until the installation passes with no deficiencies. Do not place media until the installation passes by the Supplier. Operate and work with the Owner to test and adjust equipment to prove that it is satisfactorily installed to operate under the intended conditions as specified.

AA. Arrange with the Engineer a mutually agreeable date when the representative should be on site.

3.4 CLEANING AND PROTECTION DURING INSTALLATION, TESTING AND START-UP

A. The Contractor shall take all precautions recommended by the Supplier to ensure that the underdrain system and any piping communicating therewith is completely clean and free of any debris, dirt, or other foreign materials which could clog the underdrain system or interfere with the flow. Backwash air and water piping shall be thoroughly flushed clean. All loose debris and dirt within the filter and flume shall be removed by brooming down and vacuuming. Care shall be taken to keep the grout from being deposited anywhere where it could interfere with flow. Any concrete and grout so deposited shall be removed.

B. As installation progresses, partially completed portions of the work shall be protected with heavy Visqueen or other suitable material to maintain the cleanliness of the underdrain system. Such protection shall be maintained until the media is installed.

C. Any time the underdrain system is to be used as a work surface, the underdrain system and nozzles shall be protected to prevent damage to the underdrain as per the Supplier's instructions.

D. Disinfect, the filter structure and underdrain system prior to installing anthracite filter media per Section 01750.

3.5 TESTING AND CERTIFICATION

A. After start-up and prior to final acceptance, the Contractor shall conduct Engineer witnessed performance tests on the underdrain system. All costs for such testing shall be borne by the Contractor, as well as the costs for all work and materials to correct deficiencies revealed during testing and retesting.

B. For each filter, the Supplier's field service representative shall work with the Contractor, and City's Engineer that will cause the underdrain system to perform all functions that it is designed to perform and will perform flow distribution tests described below. Tests will be scheduled with the Engineer at least two (2) weeks prior to the planned test dates.

C. Under the direction of the Supplier's field service representative, the Contractor shall take adequate precautions to prevent over-pressuring the underdrain system during field testing. These precautions shall be in accordance with project-specific written instructions from the Supplier.

D. Data Accuracy: Unless specifically allowed by the Engineer, all test setups, procedures, and instrumentation shall be capable of providing data accuracy of plus or minus 2%.

E. Preliminary Structural Integrity Test:

1. Perform this test after a sufficient curing time of 28 days, as defined by the Supplier, has elapsed to permit the installation to develop adequate strength for dynamic testing and before the placement of any media.

2. Flood the filter cell with approximately one foot of clean water above the underdrain.

3. Backwash each underdrain installation increasing the backwash rate in stages as follows:

   a. 5 GPM/ft^2 (12.7 $m^3/hr/m^2$).

   b. 13 GPM/ft^2 (31.00 $m^3/hr/m^2$).

   c. 20 GPM/ft^2 (50 $m^3/hr/m^2$) (maximum backwash rate).

   d. Hold rate at each stage for a sufficient observation period.

4. During this test, flow from each nozzle as well as any sign of dead spots or boils shall be visually observed. Any evidence of flow maldistribution such as a water "mound" or "boil" in any area of the filter will constitute a failed test.

5. After this initial test, the filter shall be drained, and the underdrain system shall be inspected for any damage or leaks.

6. Follow the Supplier's specific instructions necessary to correct any damage or deficiencies revealed by these tests.

7. Repeat test after damages are repaired and until deficiencies are corrected at no additional cost to the Owner.

F. Underdrain Flow Distribution Test:

1. This test shall be performed after the Preliminary Structural Integrity Test and before the media is placed.

2. The series of tests shall be conducted in accordance with the Supplier's instructions and the following table:

Test Condition (up-flow)	Initial Water Surface Elevation	Flow Rate (referenced to filter area)	Min. Duration (minutes	Min. No. of Repetitions (pre-filter)
Air Only	15 cm above top of the nozzles	69 $Nm^3/h/m^2$ (3.75 $scfm/ft^2$)	3	1
Air with Backwash Water	15 cm above top of the nozzles	69 $Nm^3/h/m^2$ (3.75 $scfm/ft^2$) with 12.7m/h (5gpm/ft^2)	3	2
Water Only	15 cm above top of the nozzles	50m/h (20gpm/ft^2)	3	3

3. During each test, the water surface shall present a uniformly turbulent appearance without dead spots or boils.

4. Extend or repeat the test when additional time is needed to make observations, as directed by the Engineer.

5. Follow the Supplier's specific instructions necessary to correct any deficiencies revealed by these tests. Any evidence of flow maldistribution will constitute a failed test.

6. Correct and retest underdrain systems that fail to meet the test criteria.

7. Follow the Supplier's specific instructions for repairing any damage to the underdrain system caused by the test procedure.

8. Repeat tests after damages are repaired and until deficiencies are corrected at no additional cost to the Owner.

9. During each test, the underdrain system nozzles shall be visually inspected for uniform distribution of air and water and for any signs of quiescent zones and excessive surface turbulence. All remedial measures shall be in accordance with instructions from the Supplier and supervised by the Supplier's technical representative.

G. Equal Distribution Test of Backwash Water (Manometer Test):

1. The demonstration must be completed before the installation of media.

2. Since pressure is directly related to flow in a flooded filter, this test measures the pressure in the plenum during a backwash. To measure the pressure, the Contractor shall install seven (7) Supplier-provided piezometric adapters in the false floor as indicated on the plans. Four (4) adapters shall be placed near each corner of the filter and three across the centerline of the filter from the backwash entrance(s).

3. From the piezometric adapters on the nozzle sleeves, the Contractor shall route Supplier-provided transparent vinyl tubing of equal length from the installed piezometric adapters to a Supplier-provided piezometer panel that contains a scale for each sample tube. Contractor is to adjust the panel and the scales with the water level during backwashing and assist with measurements as directed by the Supplier.

4. The panel shall be installed in a place far from the troughs. Figure 3.24 of "Filter Troubleshooting and Design Handbook" by R.P. Beverly of the AWWA shall serve as a reference for performing this test.

5. Pressure readings representing the pressure drop of the underdrain are measured as the height of the water in each tube above the wash water level during a backwash. Using the highest and lowest values, the maldistribution can be calculated as follows:

$$Maldistribution\ (\%) = \left[1 - \sqrt{\frac{(P\ Highest)}{(P\ Lowest)}}\right] \times 100$$

6. Testing shall be performed at 20 GPM/ft2 (48.87 $m^3/hr/m^2$) of backwash water.

7. The test shall demonstrate equal distribution of the backwash water.
   A maldistribution variation of up to ± 5% between different measurement points is acceptable. If the variation is found to be greater than ± 5%, the Contractor must make all corrections required to meet the maximum prescribed variation. No work will be allowed in any subsequent filters until the problem is corrected.

8. After testing, the Contractor shall remove the piezometric taps and replace them with approved nozzles. The Contractor shall also remove the vinyl tubing and manometer board and assist the Supplier with clean-up and storing of the piezometric equipment. The piezometric equipment provided by the Supplier for the testing shall remain the property of the Supplier.

9. The test protocol shall be prepared by the Supplier and be submitted to the Engineer for approval.

10. The measurements shall be recorded by the Supplier, and a report shall be submitted to the Engineer for review.

H. Sand Flow Distribution Tests:

1. After the underdrain systems have been installed and have passed the Equal Distribution Test of Backwash Water, the filter sand media may be placed.

2. The Sand Flow Distribution Test for each filter may occur in conjunction with the sand washing and skimming procedure as described in the Filter Media Section 11535 but before placement of Anthracite filter media.

3. Sand Flow Distribution Tests shall consist of at least three (3) backwash cycles and shall be as follows:

   a. Prior to testing, to measure the levelness of the sand surface, the Supplier shall identify seven (7) locations throughout the filter at which to measure the distance from an elevation above the media down to the sand surface.

   b. Flood filter cell approximately 6 inches (150 mm) above the sand media with clean water.

   c. Air backwash at 3 scfm/ft^2 (54.87 $Nm^3/hr/m^2$) for 4 minutes.

   d. Simultaneous air and water backwash at 3 scfm/ft^2 (54.87 $Nm^3/hr/m^2$) and 5 GPM/ft^2 (12.22 $m^3/hr/m^2$), respectively, for 4 minutes.

   e. Water backwash at 20 GPM/ft^2 (48.87 $m^3/hr/m^2$) for 4 minutes.

   f. Drain down to the initial level and repeat.

   g. At the conclusion of the three (3) backwash cycles, inspect the sand surface.

4. Results:

   a. Variation more than plus or minus 1/2 inch (13 mm) from the average level plane indicates failure.

   b. Media boiling shall constitute a failed test.

   c. Media movement from one area of the filter to the other shall constitute a failed test.

   d. Follow the Supplier's specific instructions necessary to correct any deficiencies revealed by these tests and for repairing damage to the underdrain system caused by tests.

   e. Repeat tests until deficiencies are corrected at no additional cost to the Owner.

I. Anthracite Flow Distribution Tests:

1. After the Sand Flow Distribution Test, the Anthracite media may be placed.

2. The Anthracite Flow Distribution Test for each filter may occur in conjunction with the Anthracite washing and skimming procedure as described in the Filter Media Section 11535.

3. Anthracite Flow Distribution Tests shall consist of at least 3 backwash cycles and shall be as follows:

    a. Prior to testing, to measure the levelness of the sand surface, the Supplier shall identify seven (7) locations throughout the filter at which to measure the distance from an elevation above the media down to the Anthracite surface.

    b. Flood filter cell approximately 6 inches (150 mm) above the Anthracite media with clean water.

    c. Air backwash at 3 scfm/ft^2 (54.87 $Nm^3/hr/m^2$) for 4 minutes.

    d. Simultaneous air and water backwash at 3 scfm/ft^2 (54.87 $Nm^3/hr/m^2$) and 5 GPM/ft2 (12.22 $m^3/hr/m^2$), respectively, for 4 minutes.

    e. Water backwash at 20 GPM/ft^2 (48.87 $m^3/hr/m^2$) for 4 minutes.

    f. Drain down to the initial level and repeat.

    g. At the conclusion of the three (3) backwash cycles, inspect the Anthracite surface.

4. Results:

    a. Variation more than plus or minus 1/2 inch (13 mm) from the average level plane indicates failure.

    b. Media boiling shall constitute a failed test.

    c. Media movement from one area of the filter to the other shall constitute a failed test.

    d. Follow the Supplier's specific instructions necessary to correct any deficiencies revealed by these tests and for repairing damage to the underdrain system caused by tests.

    e. Repeat tests until deficiencies are corrected at no additional cost to the Owner.

J. Final Underdrain Inspection:

1. After the Flow Distribution Test(s), the filter shall be completely drained, and the underdrain system shall be inspected for indication of media passage through the underdrain system or media deposition inside/below the underdrain. Such indication of media shall constitute a failed inspection. Underdrain hatches beneath media shall not be removed; instead, other inspection methods shall be utilized, as practicable.

2. Follow the Supplier's specific instructions necessary to correct any deficiencies revealed by this test.

3. Repeat tests until deficiencies are corrected at no additional cost to the Owner.

4. For each filter, the field service representative shall submit to the Engineer a written report stating that the underdrain system has been checked and is suitable for operation.

5. The test filter shall then be placed into backwash and rise rate measurements shall be taken in 150 mm rise increments until the water crests the backwash trough weirs. The variation in measured rise rate shall not be greater than 4% plus or minus from the average across all points tested in the Contactor. If the variation is greater than that specified, the Supplier shall make whatever adjustment is necessary to the underdrain installations to correct the maldistribution at no cost to the Owner.

6. Piezometer measurements or visual flow distribution analysis alone shall not be used to verify backwash flow distribution.

7. Prior to placing the media, the Contractor shall take such remedial measures as are necessary to correct any deficiencies revealed by these tests and shall repeat the specified tests until it is demonstrated that such deficiencies have been satisfactorily corrected.

3.6 SUPERVISION OF INSTALLATION AND COMMISSIONING

A. The Contractor shall coordinate with the Supplier for providing a factory-trained representative to supervise installation, start-up, commissioning, instruct operating personnel, and direct acceptance tests.

B. Provide additional supervision of installation by the Equipment Supplier as required.

C. Modify or replace equipment or materials failing required tests.

D. Perform additional testing required due to changes of materials and/or failure of materials or construction to meet Specifications at no extra cost to the Owner.

3.7 SUPPLIERS FIELD SERVICES

A. Provide services of Supplier's field representative of four (4) trips of two (2) days eight (8) hours each to ensure proper installation, consultation, testing, and start-up of the filter underdrain system. The cost of all on-site supervision and field services required from the pre-purchased equipment Supplier is not to be included as part of this Contract. These costs are already included as part of the existing pre-purchased equipment Contact.

B. The Supplier's representative shall be present at the job site for whatever period is necessary to ensure proper installation.

3.8 PROTECTION OF WORK IN PROGRESS

A. Adequately protect work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Engineer, at no increase in the Contract Price or extension of the Contract completion date(s).

3.9 DAMAGE TO STRUCTURE

A. Care must be taken to avoid damage to the structure. Cover and protect the backwash throughs and walkways around the filters and such other parts of the work with which workers come in contact.

B. Should any portion of the structure be damaged during the progress of the work, the Contractor shall repair completely the damaged portion(s), at the Contractor's expense, in a manner satisfactory to the Agency.

3.10 STORAGE

A. The equipment and accessories shall be stored indoors in a dry area, in accordance with the Supplier's recommendations.

3.11 INSURANCE

A. The Contractor shall include in the insurance for work under this Contract sufficient coverage to protect the Supplier's equipment against all losses during off-loading, storage, protection, handling, and installation until final acceptance of the work by the City. The City and Consultant shall be named as additional insured(s) for this work.

3.12 MAINTENANCE

A. Provide maintenance on the Supplier's equipment and materials as required by the Supplier from the date of delivery to the initial start-up. Notify the Consultant immediately in the event that the Supplier's spare parts and maintenance materials are not available when field testing is scheduled to begin.

END OF SECTION

PART 1. GENERAL

1.1 INTENT OF SECTION

A. This Section covers the removal of the existing sand and anthracite media in Filter No. 3 only and the supply, delivery, storage, supervision of installation, commissioning and testing (by Vendor) of new filter media (sand and anthracite) in Filter No. 3.

B. Contractor shall be responsible for installation, commissioning and testing of new filter media.

C. Refer to Section 01040 – Summary of Work for additional details, staging and permitted outages regarding work within the filters and elsewhere.

1.2 CODES AND STANDARDS

A. Unless otherwise specified herein, all materials and equipment shall conform to the appropriate and latest Standard Specifications of the American Society of Testing and Materials, referred to as the ASTM Standards. Unless specified herein, all the following reference standards shall be adhered to:

1. ASNI/AWWA B100-16, Standard for Granular Filter Material.
2. ANSI/AWWA C653-13, Standard for Disinfection of Water Treatment Plants.
3. ANSI/ NSF 61-2009, Drinking Water System Components – Health Effects.
4. ASTM E11, Specification for Wire-Cloth Sieves for Testing Purposes.

1.3 MEASUREMENT AND PAYMENT

A. Work outlined in this Section shall be included in the Lump Sum Tender Price.

1.4 PLANT DESIGN CONDITIONS

A. The Wanapitei Water Treatment Plant has a rated capacity of 54 MLD and consists of the following treatment upstream of the filters:

1. Flash mixing with chemical injections using lime, polymer and aluminum-based coagulant.
2. Hydraulic flocculation.

3. Gravity sedimentation with two (2) reactivator clarifiers with central slow mix zone and outer settling zone and automated desludging system.

4. Gravity Filtration: As part of this Contract, the Contractor is to refurbish Filter No. 3 and install new underdrains and new filter media along with a new air manifold and appurtenances.

B. Refer to Section 11530 – Filter Underdrains for design information of the filters, including filter backwashing and air scouring.

C. Media shall be suitable for operating 24 hours per day, 365 days a year, continuous or intermittent, under the following expected clarifier effluent quality conditions.

Parameter	Water Quality
Alkalinity (mg/L as $CaCO_3$)	10-20
Hardness (mg/L as $CaCO_3$)	30-47
pH	6.0-9.0
Turbidity (NTU)	< 5.0 NTU
Temperature (degrees Celsius)	0.5-25
Colour (CTU)	0-10

1.5 MAINTENANCE DATA

A. Section 01770 – Closeout Procedures.

B. Section 01780 – Closeout Submittals.

1.6 SHOP DRAWINGS

A. Affidavit of Compliance stating that all filter media furnished comply with this Specification, AWWA B100-16, AWWA C653-13 and are NSF-61 compliant and shall be NSF listed.

B. List of projects where media of similar type and size were provided in Canada or areas of equivalent climatic conditions.

C. Material specifications.

D. Certified test results (Certificate of Analysis) from an independent testing laboratory (submit qualifications of laboratory for approval).

E. Samples of the representative filter media (not less than 2 litres of each media) and certified test reports shall be submitted to the Engineer not less than 14 days prior to shipment of the media from the point of manufacture. Separate sets of samples shall be taken from actual lots of material to be supplied to the Owner. A minimum of three samples are required.

F. A backwash rise-rate curve of up to 40% expansion is to be provided for the following range of water temperatures for both media: 1, 5, 10, 15, 20, 25 and 30 degrees Celsius. In addition, provide a backwash rise-rate curve to identify the minimum fluidization velocity for the same water temperatures.

G. A list of special accessories or tools required to handle the media. These shall be furnished as part of the supply.

H. Media shipping, storage and installation instructions/procedures from the Media Supplier including the following items as a minimum:

1. Comprehensive step-by-step outline of each step, including confirmation that the media will be delivered to the site by bulk bags (also known as Super Sacs).

2. Measures to be taken to avoid disruption to filter underdrains.

3. Measures to be taken to avoid damage and contamination of media being installed.

4. Measures to be taken to ensure filters are properly disinfected prior to being placed back into service – Refer to Section 01750 – Disinfection of Water Retaining Structure.

5. Description, if applicable, of the discharges of any liquid/fluid used to transport the media including flow rates, volumes, durations, monitoring procedures, sampling procedures, etc.

6. Measures taken to ensure that any fluid which is discharged either to the plant wastewater/drainage system or local storm/sanitary sewers meets all applicable by-laws and regulations.

7. Recommendations for preparation of filters for service.

1.7 QUALITY ASSURANCE

A. Verify that Designers and Manufacturers of filter media have a minimum of five (5) years of experience in the supply of similar materials satisfying AWWA B100. Submit a list of similar types of projects with a list of contact persons as a Shop Drawing as per Section 01330 – Submittals.

B. Verify that installers of filter media have a minimum of five (5) years of experience. Submit a list of similar types of projects with a list of contact persons as a Shop Drawing as per Section 01330 – Submittals.

C. Employ a Manufacturer's representative with a minimum of five (5) years of experience in supervising the installation of the filter media. Submit the resume of the Manufacturer's representative to the Engineer for approval at least two (2) weeks prior to commencing installation of filter media.

PART 2. PRODUCTS

2.1 GENERAL

A. Supply engineered sand and anthracite media for each filter meeting the characteristics specified below.

Media	Effective Size (ES or d_{10}) (mm)[4]	Uniformity Coefficient (UC)[4]	Specific Gravity (S.G.)[4]	Depth (L) (mm)	Approximate Volume (m^3)[1,2]	L/d^3
Anthracite	0.85 +/-0.05	1.40 (max) 1.30 (max)	1.65+/-0.05	450	30/filter	530
Sand	0.50 +/-0.05	1.40 (max) 1.30 (max)	2.65 +/-0.05	300	20/filter	600
Total	**-**	**-**	**-**	**-**	**-**	**1,130**

Notes:

1. Volume assumes 9.1 m L x 7.3 m W x media depth shown. Contractor is to provide additional volume to make up for the loss of media during testing, backwashing, skimming, commissioning, etc.
2. Sand volume based on volume measured from the highest location of underdrain.
3. $L/d = L/d_{10}$.
4. The Media Vendor to confirm that the final specifications of the sand and anthracite are such that the media are hydraulically compatible for backwashing, i.e., they fluidize at the same velocity. The following relationship shall be maintained between the two layers of media (the tolerance shall be within +0.05 when comparing the left and right sides of the equation).

$$\frac{d_S \times UC_S}{d_A \times UC_A} = \left[\frac{\rho_A - \rho_W}{\rho_S - \rho_W}\right]^{2/3}$$

where: d_s = Sand Effective Size (mm)
d_A = Anthracite Effective Size (mm)
UC_s = Sand Uniformity Coefficient
UC_A = Anthracite Uniformity Coefficient
ρ_s = Density of Sand (gm/cm^3) (wetted)
ρ_A = Density of Anthracite (gm/cm^3) (wetted)
ρ_w = Density of Water = 1 gm/cm^3

5. Provide a sufficient volume of media in super sacs to allow for an additional 5% spare media capacity of each type of media for future topping up of the media by the Owner.

B. Sand Media:

1. Uniformity: The media shall be equal in all respects to the approved sample and a similar sample for test purposes shall be furnished if required by the Engineer during the preparation and placing of the filter materials.

2. Material Quality: Filter sand shall be composed of hard, durable, uncoated grains, and shall contain not more than 5% of flat particles and not more than a total of 1% of clay, loam, dust, and other foreign matter, and shall comply with Section 4 of ANSI/AWWA B100-16. The filter media shall be free from soluble iron compounds.

3. Acid solubility shall not exceed 5% in accordance with Section 4 of ANSI/AWWA B100-16.

4. Gradation Standard: The sand shall have the effective size and uniformity coefficient specified herein. Effective size is defined as the theoretical size of the sieve (in millimetres) that will pass 10% of the sample by weight. The uniformity coefficient is defined as the theoretical size of the sieve (in millimetres) that will pass 60% of the sample by weight divided by the effective size. The size of the filter sand shall be determined by screening through standard sieves that have been calibrated in accordance with ASTM E 11. No more than 5% by weight shall be finer than the lower designated size limit, and not more than 3% by weight shall be coarser than the upper designated size limit.

5. The filter sand furnished for use shall be equal in all respects to the approved samples, and similar samples for test purposes shall be furnished as required by the Engineer during the preparation and placing of the filter materials.

C. Anthracite Media:

1. Uniformity: The media provided shall be equal in all respects to the approved samples, and a similar sample for test purposes shall be furnished if required by the Engineer during the preparation and placing of the filter materials.

2. Material Quality: The anthracite shall be composed of hard and durable grains and shall be processed from anthracite coal. Average apparent specific gravity shall be determined by the procedure outlined in ASTM C 128 – Test Method for Specific Gravity and Absorption of Fine Aggregate, which requires soaking the sample in water for 24 hours.

3. The anthracite shall be free from any significant amounts of iron sulfides, clay, shale, dust or other foreign matter.

4. The anthracite solubility in a 1:1 mixture of concentrated hydrochloric acid (approximately 37%) shall be less than 2.5%. It shall have a hardness of not less than 2.7 on the MOH scale. All test procedures shall be in accordance with the applicable portion of Section 3 of ANSI/AWWA B100 – Filtering Material.

5. Extruded or pelletized carbon shall not be accepted.

6. Particle Size and Gradation: Anthracite shall have the uniformity coefficient and size as specified. The particle size shall be determined by screening through standard sieves calibrated in accordance with ASTM E 11 – Specification for Wire-Cloth Sieves for Testing Purposes. Effective size is defined as the theoretical size of the sieve (in millimetres) that will pass 10% of the sample by weight. The uniformity coefficient is defined as the theoretical size of the sieve (in millimetres) that will pass 60% of the sample by weight divided by the effective size.

7. Provide Hardgroves Grindability Index (HGE).

8. Provide test results for percent volatiles (dry ash free).

9. Provide test results for ash percent (dry).

10. Provide test results for carbon percent.

11. Determine washability characteristics (percent material with a specific gravity of 1.4 and percent material with a specific gravity above 1.95).

2.2 ACCEPTABLE MANUFACTURER

A. Continental Carbon Group.

B. Anthrafilter Media & Coal Ltd.

C. Approved equal.

PART 3. EXECUTION

3.1 REMOVALS

A. Refer to the Contract Drawings for the extent of removals. Refer to Section 01040 – Summary of Work for additional details, staging and permitted outages regarding work within the filters.

B. Coordinate all work with the Engineer and Owner.

3.2 TESTING AND SAMPLES

A. Conduct all specified testing and furnish all material, instrumentation, and personnel for conducting tests as specified herein. Factory and field testing of the filter media shall be performed by an approved independent testing laboratory.

B. All costs of factory testing shall be borne by the Contractor. The costs of all works and materials to correct deficiencies revealed during testing, and the costs of retesting, shall be borne by the Contractor. Contractor shall give the Engineer two (2) weeks advance notice of the testing to enable the Engineer to witness the tests.

C. Submit Certified Test Reports for each type of filter media from an independent laboratory for approval at least 14 days before each shipment of the media from the point of manufacture. Samples shall meet the requirements of AWWA B100, including all addenda. Test every 25 m^3 of media at the factory prior to shipment. All testing and independent certified test reports shall be paid for by the Media Vendor.

D. Certified test reports shall show the analysis of all specified physical characteristics, gradation and size including acid solubility, shape, specific gravity, and sieve analysis tests.

E. Field samples and testing shall be performed in accordance with the requirements of AWWA B100. The Media Vendor shall assist the Owner with taking field samples. All testing and independent certified test reports from field samples shall be paid by the Owner.

F. The Filter Media Vendor shall provide for review and approval of media installation instructions. The provider of the filter media shall supervise the media installation in all filters.

G. Acid solubility tests, specific gravity tests, and sieve analysis tests shall be made in accordance with applicable Test Procedures as described in AWWA B100.

H. The particle size distribution shall be determined by screening through standard sieves, Tyler square root of 2 series or equivalent U.S. series. The percent size shall be determined from a plot, on semi-log or probability paper, of the percentage of material passing each sieve against the rated opening of the sieve or the equivalent diameter of the grains. Sieve dimensions shall conform to ASTM E11 and Table B.1 of Appendix B to AWWA B100-16. Media with a particle size distribution not meeting the specified size and quality values will be subject to rejection.

I. Conduct all tests necessary to obtain the information outlined in Clause 2.1 in conformance with AWWA Standards B100.

J. All material not meeting AWWA B100 and as specified will be rejected.

K. Retest additional samples if any results are unsatisfactory.

L. Supply material equal with all aspects of the approved samples.

M. Conduct chlorine residual test for all filter media prior to shipment to ensure disinfection per Section 01750 – Disinfection of Water Retaining Structure can be achieved. Provide testing results to the Engineer.

3.3 PREPARATION

A. No filter media shall be placed in the filters until the filter structure and underdrain system have been thoroughly cleaned and examined by the Engineer and underdrains have been tested and approved in accordance with Section 11530 – Filter Underdrain.

B. Do not place any filter media in any filter basin before the Engineer has reviewed the media's test results and completed a visual inspection of the media. Any media placed in the filter without the Engineer's written acceptance shall be subject to rejection and removal off-site.

3.4 HANDLING AND STORAGE

A. Contractor is responsible for handling and storage and insurance of the media once delivered to the site, including for all necessary equipment for the proper handling of materials during off-loading, storing and installation.

3.5 SERVICES OF MEDIA VENDOR

A. The factory-trained Field Service Representative (FSR) shall visit the site as required ensuring that the installation work is being performed in a proper and workmanlike manner and in accordance with this Specification and the Vendor’s recommendations. Provide supervision to the installation and commissioning of the media.

B. Inspection Prior to Receipt: Upon arrival of the filter media at the job site, the Vendor will assist the Owner in obtaining suitable samples of media all in accordance with Section 5.2 of AWWA Standard B100. The number of samples upon receipt shall be at the Owner's discretion. Media received that is not in accordance with the Specifications will be dealt with in accordance with Section 5.3.5 Rejection, of AWWA Standard B100.

C. Inspection in Place: when media has been placed in each filter and skimmed as specified herein, the Owner will take core samples from each filter. These will be tested as to conformity with the Specifications.

3.6 FILTER MEDIA INSTALLATION

A. Contractor shall not commence the filter media installation until the filter underdrain representative has certified the underdrain installation and until approval is given by the Engineer in accordance with Section 11530 – Filter Underdrain.

B. Remove all debris from filter cells. Thoroughly wash down all parts of the filter units with clean water. Remove and dispose of media made dirty in any way and replace it with clean material.

C. Prepare each filter prior to the placement of media in accordance with AWWA Standard B100. In addition, the backwash piping and pumps shall be tested and flushed to remove any debris, dirt, dust, and any other foreign material prior to placement of the filter media. All material deposited in the plenum, flumes and channel, under the underdrain shall be removed and the space vacuumed clean.

D. Maintain the cleanliness of the filters throughout the media placement operation.

E. Placing Materials:

1. The Contractor shall place all materials in layers and in accordance with Section 4.4 of AWWA Specification B-100-16.

2. If frozen, the media shall be left to thaw prior to placing in the filter(s).

3. Placement methods shall not damage any equipment or piping in the filter units.

4. Workers shall not stand or walk directly on the filter materials. The workers shall walk on plywood mats that will sustain their weight without displacing the material (minimum dimensions 0.6 m by 0.6 m by 12 mm thickness).

5. The filter may be flooded with water to use as leveling gauge for each layer of material.

6. Each layer of media shall be thoroughly washed and have passed the specified in-place media tests before the next layer is placed. The media is considered to have passed these tests upon the Engineer's acceptance of the test results.

7. Place each layer evenly throughout the filter. Do not place it in one area and then spread it to the rest of the filter.

8. Filter Media Washing: Owner, Underdrain Manufacturer and Engineer shall be present during the washing of media. The Owner shall operate all filter backwash controls when washing the filter media installed in the filter basins.

9. The Contractor is responsible for scheduling filter media washing through the Engineer with plant operations. Plant operations shall govern the scheduling of the use of the backwash system. In no case will new filter backwashing operations be permitted to impact the plant's ability to meet water demands. The Contractor is responsible for this coordination to avoid delays to the project schedule.

10. Filter media washing will be allowed as determined by the Engineer so as not to interrupt the operation of the plant. Filter media washing shall be terminated before reaching a liquid level that would affect plant operations regardless of the status of the media washing operation.

3.7 PLACING MULTI-LAYER MEDIA

A. Use methods of storage, handling and placing of filter media such that segregation within designated sizes is avoided.

B. Transport and place the filter media carefully to prevent contamination of any sort, and replace material made dirty before or after placement with clean media. Transportation by any pneumatic method is prohibited.

C. Place sand media first (bottom layer) followed by anthracite as the top layer. Carefully place each layer so as not to disturb previous layers.

D. Anthracite media shall not be placed until the bottom layer has been skimmed and the final test results accepted by the Engineer.

1. Before placing the anthracite, remove all plywood panels used by the workmen to walk on the filter media. Anthracite shall be placed in a manner so as not to disturb the top layer of filter sand.

2. Obtain the correct thickness of each layer of filter media, backwash and scrape as follows:

   a. Place the bottom layer through water so as to finish off smooth and level.

   b. Place the initial depth of the bottom layer prior to backwashing and skimming of fines, as recommended by the Manufacturer.

   c. After placement, backwash bottom layer at a rate recommended by the Manufacturer and as indicated in Table 2, AWWA B100-16 Section 4.

d. After backwashing, skim the bottom layer to the recommended final depth.

e. Placement and skimming of subsequent layers in a manner similar to the method specified for the bottom layer.

f. After backwashing at least three times for at least 5 minutes and skimming off fines, measure the top elevations of each layer as follows:

i. Before media is placed, mark top of each layer on the side of filter.

ii. Level top of each media layer against the water surface brought to appropriate mark.

iii. Depth of each layer of media is acceptable with water level at reference mark and media level at the water level.

iv. Replace all fine material that was removed with additional material to bring the top of each layer to the proper elevation.

v. Measure the depth of each layer of media after the media has been backwashed at least three times and skimmed as recommended in AWWA B100-01.

vi. When stopping backwashing, allow filter media to compact by closing the backwash valve slowly to flow which will give 10% expansion. Hold flow at that rate for 30 seconds before starting the final slow closure of the valve.

g. Provide detailed supervision and written instructions for placement of filter media by the Manufacturer of the filter bed and services of a qualified representative of the Manufacturer for a period of time (not less than 16 hours per filter to completely install all filter beds.

E. Preparing Filter for Service:

1. After installation of the filter media is completed, do filter washing, and sampling as per AWWA B100-16 Section 4.5.

2. After installation and testing, and if construction in the filters still is ongoing, cover the media with a 4 mil plastic sheet to prevent dirt and any construction debris from contaminating the media.

3.8 FINAL DISINFECTION

A. The Contractor shall provide disinfection of all portions of the filters downstream from the filter influent in accordance with ANSI/AWWA C653-03 Disinfection of Water Treatment Plants.

B. The Contractor will store and handle the media to keep it clean. The Contractor shall avoid any filter media contamination.

C. Any equipment used by the Contractor in placing the filter media in the filter cell(s) will be cleaned and disinfected by the Contractor in accordance with ANSI/AEEA C653-03.

D. Rubber boots and gloves that have been previously disinfected with a 200 mg/L chlorine solution should be worn.

E. Also refer to Section 02652 – Disinfection & Hydrostatic Testing Water Retaining Structure.

3.9 ACCEPTANCE TESTS

A. After the filters have been serviced and been in operation for a minimum of seven (7) consecutive days, demonstrate to the Engineer, in the presence of the Manufacturer's representative (for filter media, filter underdrain and filter valves and instruments), that each filter is capable of performing its specified functions in both the filtering and back-washing modes meeting the requirements of the Specifications. Provide a written statement presenting the data collected during the acceptance tests. Furnish this written statement with the statement certifying proper installation.

B. Data and observations noted during the testing to include but not be limited to the following:

1. Filtered water flow rate, quality measured as turbidity and temperature.
2. Pressure drops across filter bed.
3. Rise of filter bed during backwashing in relation to water flow and temperature as per Shop Drawing submittals.

C. Make adjustments to place equipment in satisfactory working order at the time of test.

D. Correct or replace promptly defects or defective equipment revealed by or noted during tests at the expense of the Contractor. If necessary, repeat tests until satisfactory results are obtained and at no additional cost to the Owner.

3.10 TRAINING

A. Provide Demonstration and Training in accordance with Section 01800 – Cleanup, Startup, Commissioning and Training.

END OF SECTION

PART 1. GENERAL

1.1 INTENT OF SECTION

A. This Section covers the supply, delivery, supervision of installation and commissioning of process piping and valves and fittings.

B. The term “Process Piping” includes pipes and valves within structures.

C. The following piping systems are included in this Section:

1. Air Scour header and spool connection to the existing pipe.

2. Other Process Piping.

D. The plans and specifications are intended to set the acceptable minimum and shall not be construed to relieve this Contractor of the responsibility of:

1. Installing a complete, trouble-free system.

2. Good workmanship.

1.2 REFERENCES

A. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.

B. ANSI B16.5, Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys.

C. ANSI B16.20, Ring-Joint Gaskets and Grooves for Steel Pipe Flanges.

D. ANSI B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.

E. ANSI B18.2.1, Square and Hex Bolts and Screws.

F. ASTM A47M, Specification for Ferritic Malleable Iron Castings.

G. CSA B242, Groove and Shoulder type Mechanical Pipe Couplings.

H. CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.

I. MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

J. MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.3 RELATED SECTIONS

A. Division 1 – General Requirements.

B. Division 3 – Concrete.

C. Section 11530 – Filter Underdrain.

1.4 SUBMITTALS

A. Submit the Shop Drawings and samples for review in accordance with Section 01330 – Submittals.

B. The Shop Drawing submission applies to all valves, couplings, and custom piping.

1.5 MAINTENANCE DATA

A. Refer to Section 01800 – Clean-Up, Start-Up, Commissioning and Training.

1.6 MEASUREMENT AND PAYMENT

A. Work outlined in this Section is included in the Lump Sum Tender Price.

PART 2. PRODUCTS

2.1 PIPE

A. General – Supply all pipes, valves and fittings of the materials, size, classes and types as shown on the Contract Drawings and as specified herein.

B. All pressurized process piping systems shall be designed for:

1. Working pressure of 690 kPa (100 psi).

2. Field test at 1034 kPa (150 psi).

2.2 STAINLESS STEEL PIPING AND FITTINGS

A. All piping systems specified here shall be fabricated from Stainless Steel 316L. Pipe wall thicknesses, schedules or USS gauges are shown on the Drawings and/or noted herein.

1. Process piping as noted on the Contract Drawings.

2. Sensors/transmitters and gauges.

B. Stainless steel piping systems shall be fabricated using the table below as a guideline.

TABLE 2.1
SUITABILITY OF STAINLESS STEEL IN WATER

Chloride Levels	Stainless Grades
<200 ppm	304L, 316L
200 – 1,000 ppm	316L, Duplex Alloy 2205
1,000 – 3,500 ppm	Duplex Alloy 2205 6% Mo Superaustentic, Superduplex
>3,500 ppm	6% Mo Superaustentic, Superduplex
15,000 – 25,000 ppm (Sea Water)	6% Mo Superaustentic, Superduplex

C. From Nickel Institute fabricating stainless steel water industry.

D. Material thickness shall be based on the following Table 2.2.

TABLE 2.2 1,035 kPa AND LESS THAN 150°C			
Material Size	**Thickness**	**Pipe**	**Fittings**
75 mm to 600 mm ID	Schedule 10S	A778	A774
75 mm ID	4.8 mm	A778	A774
900 mm to 1,200 mm ID	5.08 mm	A778	A774
1,500 mm to 1,650 mm ID	6.35 mm	A778	A774
1,800 mm to 2,100 mm ID	9.53	A778	A774

E. The stainless steel piping system, including tees, elbows, lateral fittings, flanges, specials and couplings, etc., shall be designed and reinforced for 1,035 kPa (150 psi) cold water working pressure unless otherwise indicated.

F. The stainless steel piping and fittings shall be manufactured from Type proper Grade L or 316L Stainless Steel produced from parent metal conforming to ASTM A240 and AWWA Manual M11 and reinforced.

G. The Manufacturer shall provide the Engineer with a chemical analysis confirming material grade with each batch of stainless steel piping.

H. NPS 50 mm and smaller piping systems may be installed with the Vic Press grade to match the stainless steel piping system. The pipe shall be wall thickness stainless steel conforming to ASTM A403/A774. Fittings shall be precision, cold drawn, stainless steel with elastomer O-ring seals (grade to suit intended service). The Vic Press properly graded stainless steel system shall be rated to 2,068 kPa (300 psi).

I. The wall thickness shall be designed to withstand full vacuum, working pressure and surge pressure. The pipe shall be carefully die formed or rolled true to dimension and round within a tolerance of ±1.5 mm. The ends of the pipe and fittings shall be perpendicular to the longitudinal axis.

J. Prior to welding, submit copies of the Procedure Qualification Report for each type and size of weld required.

K. All stainless steel fabrication shall be conducted in a specific area that is separate from the fabrication of all other materials such as carbon manganese steel to prevent cross-contamination.

L. Carry out welding of stainless steel as specified under Subsection 3.4. Shop assembles pipe and fittings and weld in an accredited welding shop by certified welders for the specified type of medium. Field welds are allowed only where pipe assembles are too large or awkward to install. Obtain approval of the Engineer for all field welds.
All welds, including fittings and spool piece assembles, will be full penetration welded butt joints, except for flanges and collar rings.

M. For pipe wall thickness up to 4.76 mm (3/16") and the root pass on thicker materials use a Tungsten Inert Gas (TIG) arc welding process, with 100% argon purge backing gas. The weld penetration surface shall be gold/silver in appearance when completed. A blue appearance is not acceptable and must be redone. Subsequent passes shall be by the Metal Inert Gas (MIG) arc process.

N. Visual of all welds to ASME B31.3 Table 341.3.2 normal and Category M fluid service shall be acceptable.

O. The pipes shall be pickled by immersion in an acid bath or pickle paste when immersion is not possible for the removal of weld discolouration and iron pickup. After pickling, the pipe and fittings shall be thoroughly washed with fresh clean water and air-dried. The exterior finish of the pipe work shall be in accordance with the Manufacturer's recommendations unless otherwise noted herein.

P. Joints shall be welded or grooved end unless otherwise noted on the Drawings.

Q. Pipe couplings shall be YNC, Straub, Victaulic Depend-O-Loc or Victaulic grooved style and shall be provided as noted on the Drawings or as deemed necessary for expansion and/or maintenance purposes.

R. Schedule 10S pipe ends used for Victaulic grooved piping systems shall be grooved using Victaulic "RX" roll sets specifically designed for grooving stainless steel pipe.

S. After the piping system has been installed and tested, the Contractor shall pickle wash the stainless steel piping system to remove weld discolouration and iron pickup. After pickling, the pipe and fittings shall be thoroughly washed with fresh clean water and air-dried before inspection by the Engineer. If deemed necessary by the Engineer, the Contractor may be required to repeat the entire pickle wash procedure.

TABLE 2.3
SCHEDULE OF STAINLESS STEEL PIPE WORK AND FITTINGS

Item	Size Range (mm)	Gauge USS	Description
Flanges	38 to 300 350 or Greater	Schedule 10	Rolled Van Stones or Stub End Type or Victaulic Ridgelock.
Backing Flanges	38 to 1500 200 to 250 300 to 350 400 to 450 500 to 550 600 750 900		Galvanized Carbon Steel Drilled to ANSI B16.1 Class 125. Backing flanges in chambers and submerge conditions shall be constructed to type proper grade stainless steel.
Gaskets	All Sizes		3 mm full-face neoprene suitable for potable water.
	50 to 300		Couplings shall be Constructed of Galvanized Steel. Couplings in Chambers and Submerged Conditions shall be Constructed of Type 316 Stainless Steel.
	50 to 300		Roll-Grooved Style Couplings for Design Pressures up to 2,068.4 kPa (300 psi) shall be Victaulic Style 89 or 489 (Stainless Steel) for Rigid. Couplings shall be Type 316 Stainless Steel.
	350 to 600		Roll-Grooved Style Couplings for Design Pressures up to 1,725 kPa (250 psi) shall be Victaulic Style W89 for Rigid. Couplings shall be Type 316 Stainless Steel.
	50 to 450		Roll-Grooved Style Couplings for Design Pressures up to 2,068.4 kPa (300 psi) shall be Victaulic Style 77 (DI) or 77S (Stainless Steel) for Flexible Joints. Victaulic Roll-Grooved Style Couplings shall be Type 316 Stainless Steel.
	All Sizes	Couplings	Grooved style couplings for design pressures up to 1,206.5 kPa (175 psi) shall be Victaulic Style 31 and 44. Closure style shall be Supplier complete with stainless steel type DVIC rings. Victaulic grooved style couplings shall be galvanized. Compression couplings shall be a type of proper-grade stainless steel as supplied by Straub or YNC. Split sleeve couplings for design pressures up to 2,068.4 kPa (300 psi) shall be fusion bonded epoxy coated or stainless steel Victaulic Depend-O-Lock FXF or FXE or EXE.

TABLE 2.3
SCHEDULE OF STAINLESS STEEL PIPE WORK AND FITTINGS

Item	Size Range (mm)	Gauge USS	Description
Studs, Nuts, Bolts and Washers	All Sizes		Studs, Nuts, Bolts and Washers shall be Best Quality Type 316 Stainless Steel Heavy Hex bolts complete with Hex Nuts. Use Anti-seize Lubricant on Stainless Steel Bolts.
Flanges	40 to 350	Equal wall to pipe wall of same size	Pressed neck type – butt welded.
	400 or Greater	Equal wall to pipe wall of same size	Rolled angle type.
Elbows	40 to 900	Equal wall to pipe wall of same size	Smooth flow or fabricated mitred type – butt welded.
Tees, Crosses, Reducers	40 to 900	Equal wall to pipe wall of same size	Fabricated type – butt welded or Victaulic.

2.3 SMALL PROCESS PIPING

A. Small Piping generally 50 mm in diameter and smaller.

B. PVC Piping and Fittings:

1. Schedule 80 ASTM D-1784 Type 1, Grade 1, suitable for a minimum working pressure rating of 1,500 kPa at 23 degrees C.

2. Certified to CSA B137.3.

3. Pipe and fittings purpose-made for solvent weld joints.

4. Provide flanged connections as required, 150 LB ANSI, ASTM D-2467. Fittings - ANSI B16.5, ASTM D-2467.

5. Provide fittings and flanges for discharge piping from the pump suitable for 1,700 kPa.

6. Solvent weld primer and solvent to be suitable for the type and class of pipe and supplied by the Pipe Manufacturer.

C. Type L hard drawn copper tubing, soldered joints, wrought copper or bronze fittings - potable water lines 50 mm dia. and smaller, air valve blow-off lines, equipment drain lines.

D. Stainless steel tubing 20 gauge (0.9 mm) wall thickness, tube fittings and stainless steel isolating valves – rigid instrument lines.

E. Instrument grade natural polyethylene tubing, minimum 1,700 kPa working pressure, polypropylene compression fittings – flexible chemical solution lines.

F. Dielectric unions must separate all interconnections between galvanized and black or stainless steel, ferrous and copper.

G. Gasketted PVC electrical type junction pull boxes for chemical solution lines, suitable for surface mounting or cast-in, to the sizes shown on the Drawings.

2.4 FASTENERS

A. Studs, nuts and washers shall be Stainless Steel 316.

2.5 PIPE SUPPORTS

A. Generally as shown on the Drawings, or as directed by the Consultant equal to:

1. ITT Grinnell adjustable clevis type hanger Figure 260.
2. ITT Grinnell adjustable saddle type support Figure 264.
3. ITT Grinnell medium duty angle brackets Figure 195.
4. Unistrut pipe clamps for small diameter lines.
5. Concrete pipe supports – as per Drawing.

2.6 PRESSURE GAUGES

A. Supply and install pressure gauges as shown on the Contract Drawings and specified herein.

B. Pressure gauges shall be 114 mm dial size with fibreglass reinforced polypropylene case, threaded ring, solid front, blow out back, molded acrylic window.

C. Movement shall be stainless steel.

D. Bourdon tube shall be bronze.

E. Dial face shall be white with black figures, pointer shall be micrometre adjustable type.

F. Dual scale and operating range shall be -140 kPa to 140 kPa (-20 psi to +20p si) for pressure gauges installed on the pump suction piping, and 0.0 kPa to 1105 kPa (0.0 psi to 160 psi) for all other pressure gauges.

G. Pressure gauges shall be liquid-filled.

H. All other pressure gauges shall be supplied with a diaphragm. Surfaces exposed to media to be stainless steel (lower housing). The seal shall be of the continuous duty safety type complete with a locking device.

I. Pressure gauge shall be supplied with a stainless steel nipple and quick disconnect connection fitting.

J. Acceptable Suppliers:

1. Trerice Type 450 LFB.

2. Ashcroft Durogauges, Type 1279 ASL.

3. Ametek US Gauge.

2.7 GATE VALVES

A. Supply and install gate valves at the sizes and locations shown in the Contract Drawings and specified herein.

B. Resilient Wedge Gate Valves:

1. Unless indicated otherwise on the Drawings, gate valves where shown shall be of the resilient wedge type conforming to the latest revision of AWWA Standard C-509. The valves shall be non-rising stem type. Unless shown otherwise on the Drawings the valves shall be handwheel operated. Provide chain wheel operation, motorized actuators, extension stems, floor standing operators, and operators complete with crank handles or actuators as shown on the Drawing.

2. The valves shall have a body from cast iron conforming to ASTM A126 Class B and shall be flanged to ANSI B16.5 Class 150. The wedge shall be of cast iron to ASTM 126 Class B and shall be fully encapsulated with urethane rubber. Stem shall be low zinc cast bronze with integral collars in full compliance with AWWA Standards. NRS stem stuffing box shall be ‘O' ring seal type with two (2) ‘O' rings which shall be replaceable with the valve fully open and under pressure.

3. The body and bonnets shall be coated internally and externally with a suitable corrosion-resistant finish formulated from materials suitable for use on sewage.

C. Bronze Wedge Gate Valves:

1. The Contractor shall supply and install bronze wedge gate valves for the following applications:

   a. Steel piping systems where indicated.

   b. General isolating service on pipelines 40 mm and smaller.

2. Bronze wedge gate valves 40 mm in diameter and smaller except as otherwise noted, shall have NPT threaded ends in accordance with ANSI B2.1. Bronze gate valves 40 mm and larger shall have end connections flanged to ANSI B16.1 Class 150. Valves shall be Class 150 and shall have a non-rising stem, solid wedge disc with stuffing boxes precision machined and filled with high-grade, non-asbestos packing to ensure a tight step seal.

3. Bronze wedge gate valves with screwed end connections shall have unions fitted on either side of them to facilitate easy removal from the pipeline.

4. The bronze wedge gate valves shall be Valves shall be Jenkins Fig 2310, Crane #437 or reviewed equivalent.

5. Acceptable Suppliers:

   a. Clow, Mueller, AVK or reviewed equivalent Stafsjo Model MVE (for Valves 300 mm or smaller).

   b. Seguro as supplied by Neo Valves or reviewed equivalent (for Valves 350 mm and larger).

PART 3. EXECUTION

3.1 INSTALLATION AND INSPECTION

A. The piping, valves, fittings and accessories shall be installed as indicated on the Contract Drawings, in accordance with the Manufacturer's recommendations and as approved by the Engineer.

B. Refer to Section 01800 – Clean-Up, Start-Up, Commissioning and Training.

C. Provide the services of a factory-trained representative(s) to inspect, operate, test, adjust, and troubleshoot the installation.

D. Inspection to include checking for:

1. Cracks and other damaged or defective parts. The equipment must be undamaged, without cracks and free of defective parts.
2. Completeness of installation as specified and as recommended by the Manufacturer.
3. Correctness of setting, alignment and relative arrangement of various parts of the system.

3.2 HANDLING

A. Provide all necessary equipment for properly handling materials during off-loading, storing and installation. Rectify any damage to materials in a manner acceptable to the Consultant and Supplier such that guarantees are not invalidated.

B. Provide adequate protection against weather, damage and theft for equipment not required for immediate use.

C. Provide proper equipment and tools for safe and convenient handling and installation of pipes, fittings, valves and other accessories.

D. Exercise particular care to prevent abrasion of pipe coating.

3.3 SIZING

A. Supply and install pipes, valves and other fittings according to the sizes indicated on Drawings. Where sizes are not clearly indicated, obtain sizes from the Engineer before proceeding with the work.

3.4 MECHANICAL TESTING AND CERTIFICATION

A. After start-up and prior to final acceptance, the Contractor shall conduct Engineer-witnessed performance tests on the equipment.

B. The field service representative will cause the piping, valves and fittings to perform all mechanical functions that they have been designed to perform. Tests will be scheduled with the Engineer at least two (2) weeks prior to the planned test date.

C. The field service representative shall submit to the Engineer a written report stating that the equipment has been checked and is suitable for operation.

3.5 LEAKAGE TESTING

A. All valves larger than 900 mm in diameter are to be shop leak tested to the AWWA pressure rating for 10 minutes on each side of the disc, with no leakage allowed, prior to delivery to the site.

3.6 SUPERVISION OF INSTALLATION AND COMMISSIONING

A. Test and commission the equipment in accordance with Section 01800 – Clean-Up, Start-Up, Commissioning and Training.

B. At the completion of satisfactory installation, each valve, gate, and/or section will be tested by the General Contractor under the supervision of the Supplier and the Engineer. All controls and alarms shall be checked and tested to ensure proper control and equipment protection.

C. Equipment installation shall only be accepted after receipt of a satisfactory report submitted by the Manufacturer's representatives.

D. Modify or replace equipment or materials failing required tests.

E. Perform additional testing required due to changes of materials and/or failure of materials or construction to meet specifications at no extra cost to the Region.

3.7 STORAGE

A. Prior to the installation the piping, valves, fittings and accessories shall be protected and stored indoors in a dry area, in accordance with the Manufacturer's recommendations.

3.8 MAINTENANCE

A. Provide maintenance on the Supplier's equipment as required by the Supplier from the date of delivery to the initial start-up.

END OF SECTION

APPENDIX A

ACG-Environcan-Orthos

FILTER UNDERDRAIN REPLACEMENT

WANAPITEI WATER TREATMENT PLANT

Coniston, Canada

PURCHASE ORDER #236670-5644

Centurion™ MONOLITHIC FILTER FLOOR UNDERDRAIN SYSTEM

ANY QUESTIONS REGARDING THIS SUBMITTAL, PLEASE CONTACT DALE JACKSON OF ACG ENVIROCAN, INC.
Tel: (905) 856-1414 Ext. 222
Cell: (647) 746-1569
E-mail: dale@acg-envirocan.ca

CONTRACTOR: ACG ENVIROCAN INC.
131 Whitmore Road, Unit 7
Woodbridge, ON L4L 6E3

SUPPLIER: ORTHOS LIQUID SYSTEMS, INC.
596 BROWNS COVE ROAD
RIDGELAND, SC 29936
[redacted]
[redacted]

POSEIDON FILTRATION SYSTEM®

SUBMITTED MARCH 2024

TABLE OF CONTENTS

SECTIONS REMOVED FOR TENDER DOCUMENTS

WANAPITEI WATER TREATMENT PLANT

Sudbury, Ontario

PURCHASE ORDER #236670-5644 **CONTRACT SCOPE**

1.0 INTRODUCTION

ORTHOS Liquid Systems, Inc. (ORTHOS) is pleased to provide the following scope for Centurion™ Monolithic Filter Underdrain Systems with air scour manifolds. Four (4) 9.14 m x 7.32 m (30'-0" x 24'-0") filters, each with a surface area of 66.9 m^2 (720.0 ft^2), will be retrofitted.

2.0 MONOLITHIC UNDERDRAIN

788 – Glass Reinforced Concrete (GRC) Flat 609.6 mm x 609.6 mm (2'-0" x 2'-0") Panels with (16) panel insert nuts on 6" centers. Includes (8) spares

Note: Contractor is responsible for field-trimming supplied 609.6 mm x 609.6 mm (2'-0" x 2'-0") GRC panels as necessary to fit

432 – Linear feet of 316 SS angle, 1.5" x 1.5" x 0.25" with 0.5" diameter inch holes at 22" O.C. of one leg for securing to concrete walls with wedge anchors

CO 1

250 – 316 SS all thread anchors, 3/8" X 3-3/4" for securing 316 SS angle support to concrete wall

11,600 – Concrete sleeve inserts B32/150 to thread into the panel insert nuts. Material polypropylene. NSF 61 approved. Includes (80) spares

11,600 – Filter nozzles model Type D-36x0.30-1¼ WW-30-350-Ø16-4xØ6.0-PP-NSF61. Includes (80) spares

Note: Nozzles will be provided with a 16 mm Ø ID closed stem tailpipe with four (4) 6 mm Ø ID holes to provide the recommended pressure drop.

11,600 – Caps EG50 to protect the concrete sleeve inserts during the concrete pour. Material polypropylene. Includes (80) spares

672 – PVC support columns (NSF 61), 150 mm (6")-diameter, approximately 686 ~~540~~ mm (2.25' ~~1.772~~') long.

CO 1

1 – Lot of shims for leveling

260 – 20 oz. sealant adhesive tubes with 2 application guns (1 manual and 1 rechargeable)

4 – 316 Stainless Steel Diverter Plates to divert backwash water and reduce velocity into the plenum

1 – Structural design of suspended floor per ACI 318

1 – Shop drawings and submittals

1 – Freight to site

3.0 AIR SCOUR MANIFOLDS – 316 SS

4 – Schedule 10 316 SS linear manifolds, as further described:

- 254 mm (10-inch) diameter 316 SS Schedule 10 Pipe header, 7.62 m (25.0') total length, per ASTM A312
- 102 mm (4-inch) diameter 316 SS Schedule 10 Pipe risers, 194 ~~111~~ mm (7.625 ~~4.37~~") tall, per ASTM A312 (4 per header)
- 254 mm (10-inch) diameter 316 SS Cap
- 254 ~~203~~ mm (10 ~~8~~-inch) diameter 316 SS ANSI 150 Flange, per ASME B16.5
- ~~203 mm x 254 mm (8" x 10") concentric reducer~~
- 15 mm (1/2")-diameter 316 SS J-tube for evacuation of water in air header
- Based upon 69.0 $Nm^3/hr/m^2$ (3.75 $scfm/ft^2$) maximum

CO 1

1 – Lot of 316 SS bolts, nuts, and washers for header connection

1 – Freight to site

4.0 ENGINEERING

The following engineering services shall be provided by ORTHOS:

- Submittals and maintenance manuals (§11000 ¶1.16 and §11530 ¶1.7)
- Structural design of the filter underdrain system to meet the project's structural design requirements (§11530 ¶1.6B.1)
- Oversight of plenum performance testing (§11000 ¶1.17 and §11530 ¶3.3 & ¶3.4)

5.0 SERVICE

The services of a qualified representative are included for four (4) startup visits totaling no more than eight (8) days on site for pre-installation meetings, installation consultation, performance test witnessing, and operational training.

Additional ORTHOS field service is available at a cost of US$3,500 per trip plus US$1,000 per day (or fraction thereof) onsite.

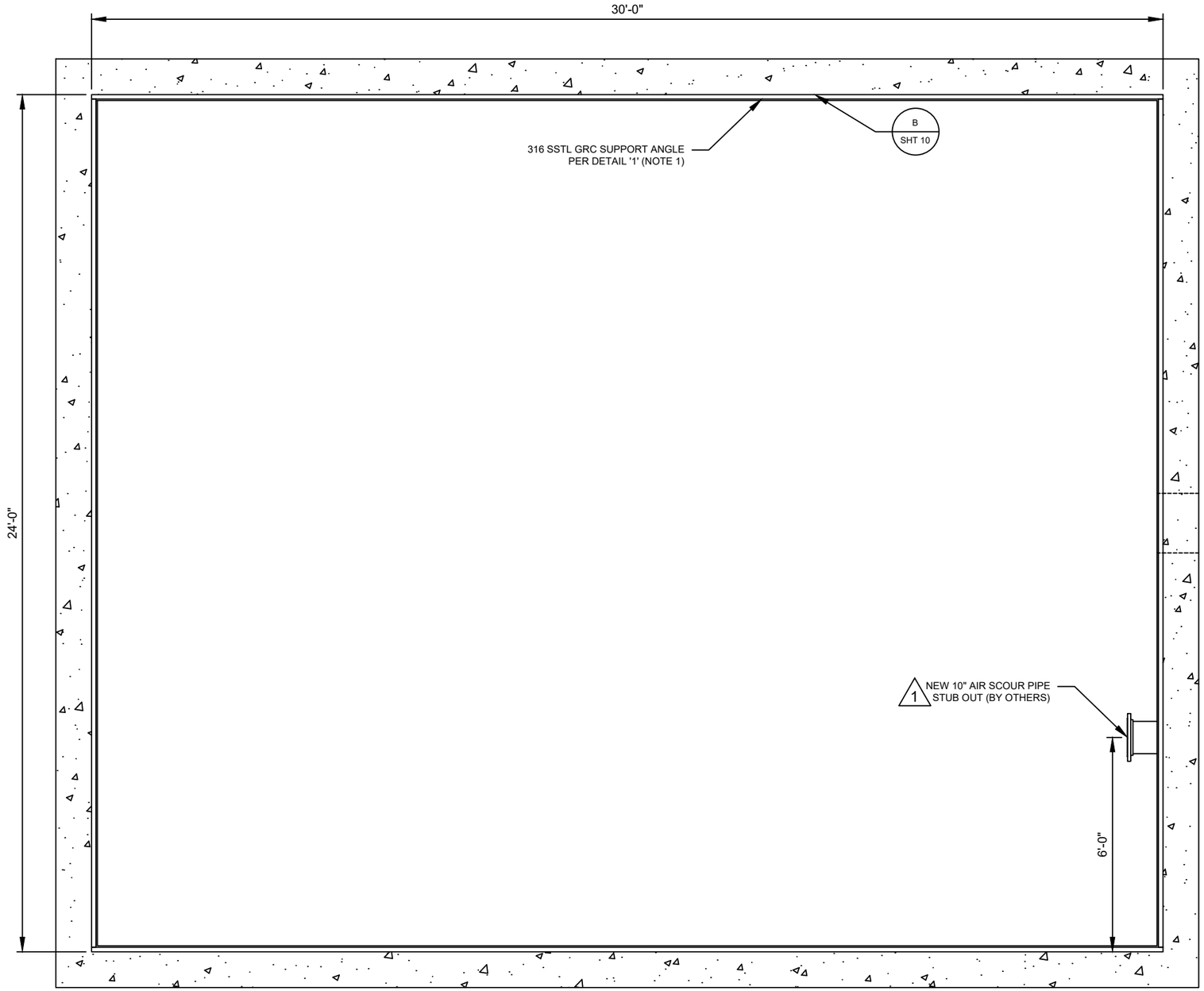
6.0 EXCEPTIONS

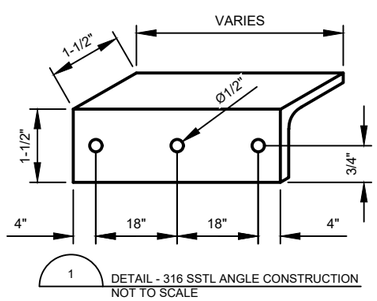
The following items are not included in the scope of supply in the quotation:

- Receiving, unloading, storing and installation of the equipment and materials
- All concrete, shuttering and pouring
- Concrete testing
- Openings, doors, or access hatches (unless as identified above)
- Rebar, chairs, resin, or resin anchors
- Pipe hangers
- Concrete pipe supports, anchorage, and appurtenances per *Concrete Pipe Support* detail on Contract drawing C-7095-5
- HILTI epoxy anchorage system
- PVC pipe cuts
- Gaskets and bolts, other than identified above
- Valves
- Pumps
- Instrumentation
- Spare parts other than identified above
- Media
- Media testing, other than identified above
- Electrical control/power wiring
- Motor Control Centers (MCCs)
- Permitting
- No third-party payment service fees
- Anything else not specifically identified above

SECTION 2:

PROJECT DRAWINGS AND DETAILS





1 DETAIL - 316 SSTL ANGLE CONSTRUCTION
NOT TO SCALE

NOTES:

1. 316 SSTL ANGLE TO BE INSTALLED ABOVE THE EXISTING 2" LEDGE TO SUPPORT GRC PANELS ALONG THE EDGE OF THE FILTER.
2. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS.

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P.O. BOX 1970
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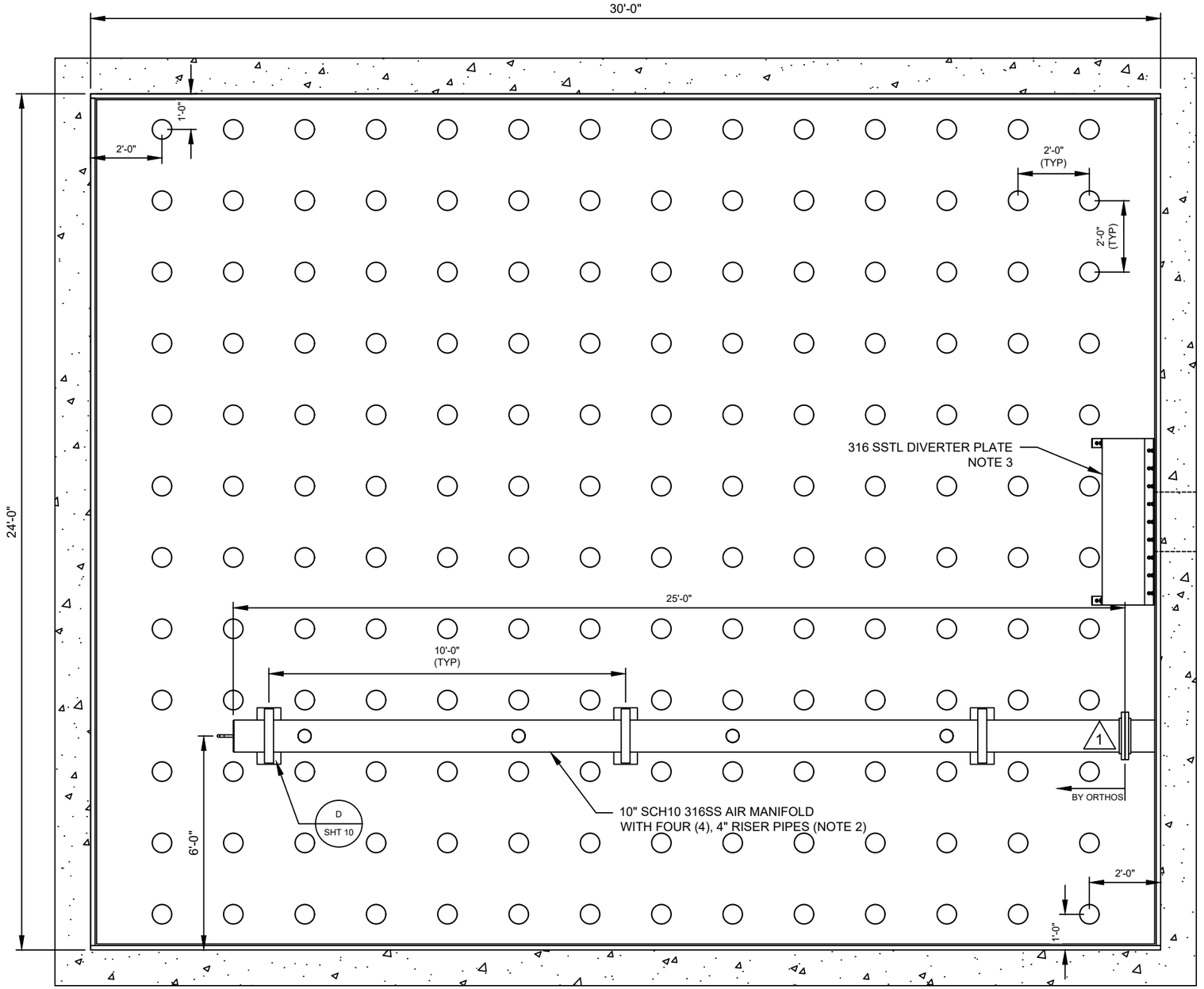
POSEIDON FILTRATION SYSTEM™

ANGLE LAYOUT

SUDBURY, ON WANAPITEI WTP

DATE:	03/14/24
REVISED:	04/30/24
DESIGNER:	WPC
CAD:	WPC
REVIEWER:	SFH

SHEET
1
OF 10



NOTES:

1. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS.
2. AIR MANIFOLD SUPPORTS ARE INSTALLED BY OTHERS. SEE SHEETS 8 AND 9 FOR AIR MANIFOLD DETAILS.
3. SEE SHEET 7, DIVERTER PLATE CONSTRUCTION DETAILS, FOR FURTHER INFORMATION.
4. EPOXY: HILTI RE500 VE, INSTALLED PER MANUFACTURER REQUIREMENTS.
5. ALL ANCHOR BOLTS, STD BOLTS, AND ALL-THREAD BOLTS: SS 18-8 OR SS A-2.

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PEDESTAL LAYOUT

SUDBURY, ON
WANAPITEI WTP

DATE:	03/14/24
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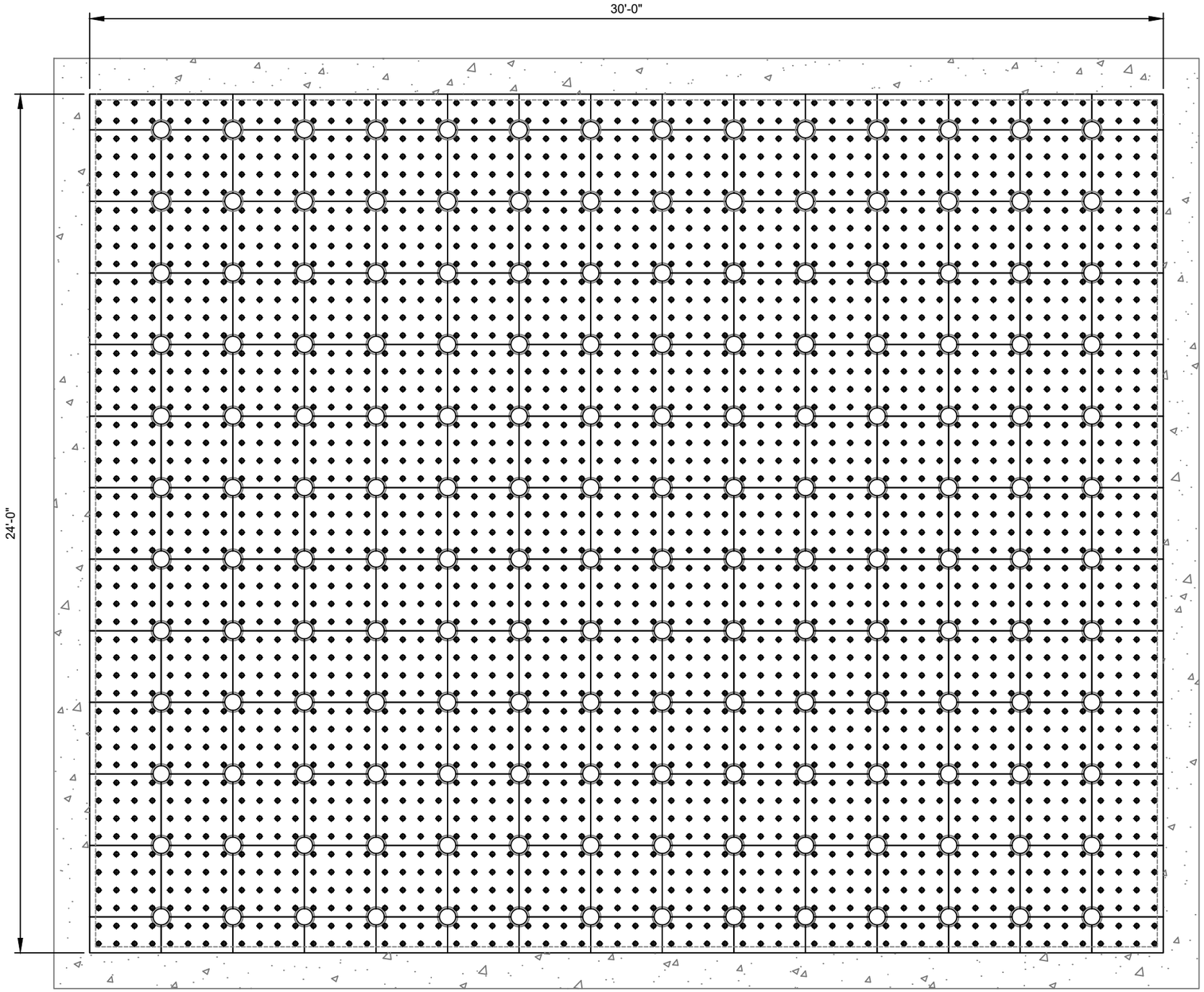
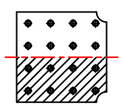
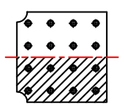
DESIGNER:	WPC
CAD:	WPC
REVIEWER:	SFH

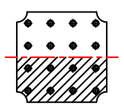




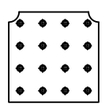
PANEL TYPE 1
CORNER 2' X 1'
(2 PER FILTER)



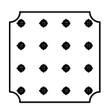
PANEL TYPE 2
CORNER 2' X 1'
(2 PER FILTER)



PANEL TYPE 3
EDGE 2' X 1'
(26 PER FILTER)



PANEL TYPE 4
EDGE 2' X 2'
(22 PER FILTER)



PANEL TYPE 5
CENTER 2' X 2'
(143 PER FILTER)

NOTES:

1. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS.
2. PANELS TO BE CUT IN THE FIELD TO FIT BY THE CONTRACTOR. 2' X 2' GRC PANELS WILL BE PROVIDED TO THE PROJECT SITE.
3. GRC FORM PANELS HAVE TESTS RESULTS THAT CONCLUDE THE FOLLOWING STRENGTHS:
   - MIN 28 DAY (F'c) = 8,000 PSI
   - MIN 28 DAY RUPTURE STRENGTH (Fr) = 1,390 PSI.

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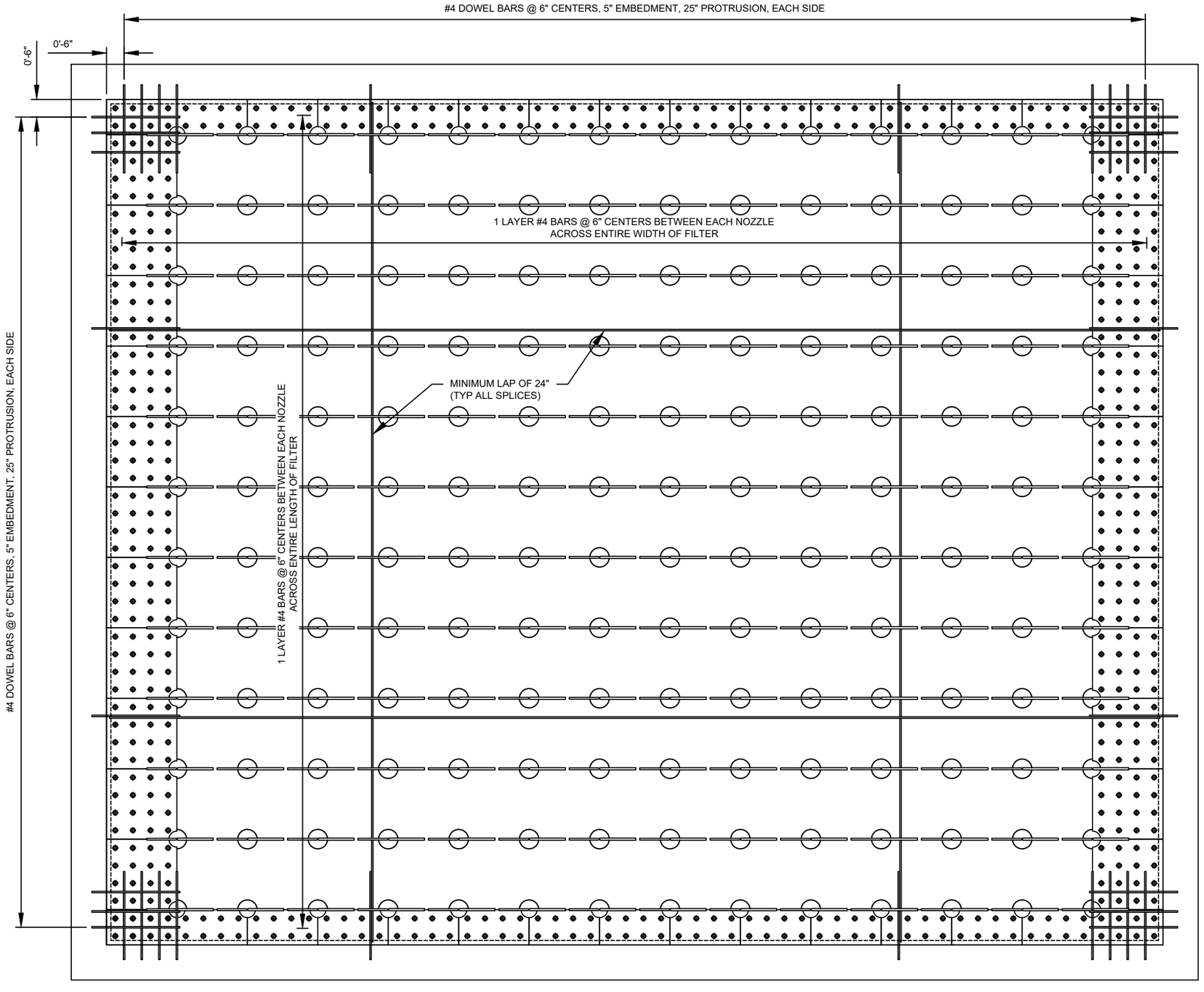
POSEIDON FILTRATION SYSTEM™

PANEL LAYOUT

SUDBURY, ON WANAPITEI WTP

DATE:	03/14/24
REVISED:	--/--/--
DESIGNER:	WPC
CAD:	WPC
REVIEWER:	SFH



REBAR, ASTM A615, GR 60
CONCRETE, F'c = 5,000 PSI

NOTES:

1. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS AND CONNECTIONS.
2. REFER TO SHEET 5, STEEL CROSS SECTION FOR FURTHER INSTALLATION DETAILS.
3. NOT ALL STEEL AND GRC PANELS ARE SHOWN FOR CLARITY.
4. SPECIAL CONSTRUCTION PROCEDURES (DURING PLACEMENT OF THE 6" UNDERDRAIN SLAB OVER THE GRC FORM PANELS) ARE TO BE IMPLEMENTED AS FOLLOWS:
   - CONSTRUCTION LIVE LOAD IS TO BE LIMITED TO 35 PSF.
   - CONCENTRATED WORKER LOADS ARE TO BE LOCATED ONLY DIRECTLY ABOVE THE PVC PIPE PEDESTALS.
5. FILTER TANK STRUCTURE CONCRETE STRENGTH ASSUMED TO BE A MINIMUM OF F'c=3,500 PSI. ALERT ORTHOS LIQUID SYSTEMS IF FOUND TO BE OTHERWISE.

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POSEIDON FILTRATION SYSTEM™

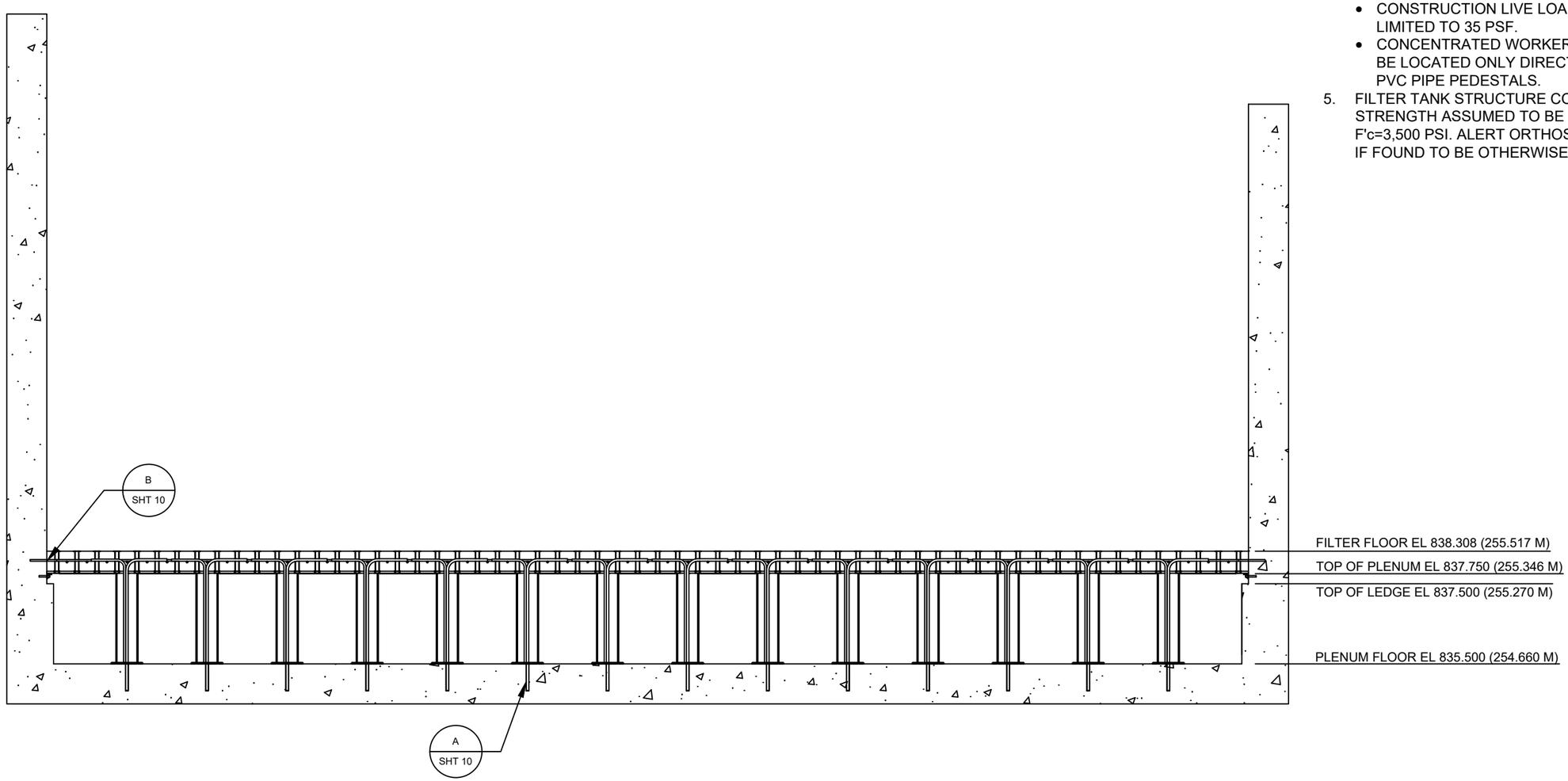
STEEL LAYOUT

SUDBURY, ON
WANAPITEI WTP

DATE:	03/14/24
REVISED:	--/--/--
DESIGNER:	WPC
CAD:	WPC
REVIEWER:	SFH

NOTES:

1. DIVERTER PLATE, BACKWASH TROUGHS, AND MEDIA NOT SHOWN FOR CLARITY.
2. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS AND CONNECTIONS.
3. REFER TO SHEET 5, STEEL CROSS SECTION FOR FURTHER INSTALLATION DETAILS.
4. NOT ALL STEEL AND GRC PANELS ARE SHOWN FOR CLARITY.
5. SPECIAL CONSTRUCTION PROCEDURES (DURING PLACEMENT OF THE 6" UNDERDRAIN SLAB OVER THE GRC FORM PANELS) ARE TO BE IMPLEMENTED AS FOLLOWS:
   - CONSTRUCTION LIVE LOAD IS TO BE LIMITED TO 35 PSF.
   - CONCENTRATED WORKER LOADS ARE TO BE LOCATED ONLY DIRECTLY ABOVE THE PVC PIPE PEDESTALS.
5. FILTER TANK STRUCTURE CONCRETE STRENGTH ASSUMED TO BE A MINIMUM OF F'c=3,500 PSI. ALERT ORTHOS LIQUID SYSTEMS IF FOUND TO BE OTHERWISE.



REBAR, ASTM A615, GR 60
CONCRETE, F'c = 5,000 PSI

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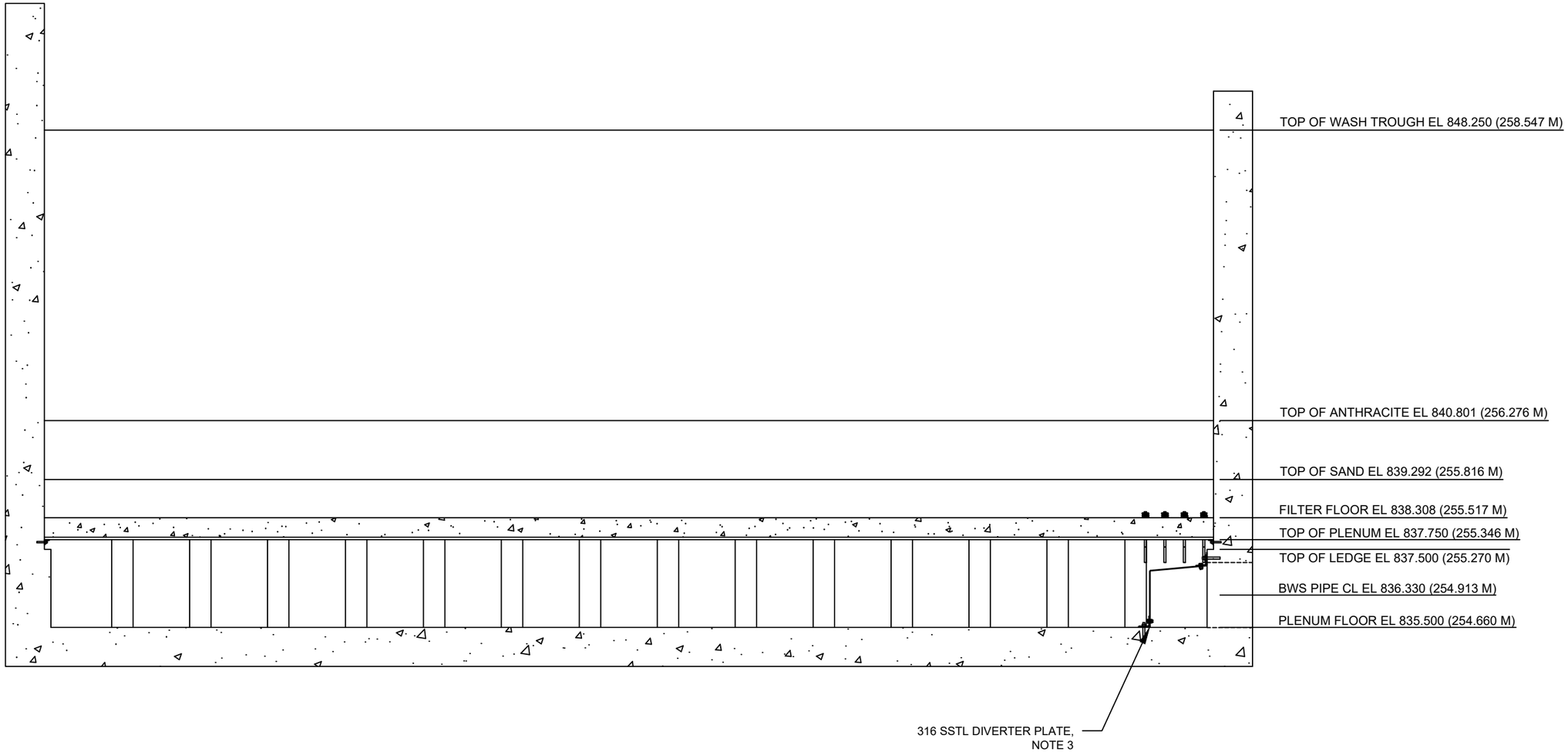
POSEIDON FILTRATION SYSTEM™

STEEL CROSS SECTION

SUDBURY, ON
WANAPITEI WTP

DATE:	03/14/24
REVISED:	--/--/--
DESIGNER:	WPC
CAD:	WPC
REVIEWER:	SFH



NOTES:

1. CONTRACTOR TO CONFIRM DIMENSIONS AND CONNECTIONS.
2. SOME NOZZLES, AIR MANIFOLD, MEDIA, AND BACKWASH TROUGHS NOT SHOWN FOR CLARITY.
3. SEE SHEET 7, FOR DIVERTER PLATE CONSTRUCTIONS DETAILS.

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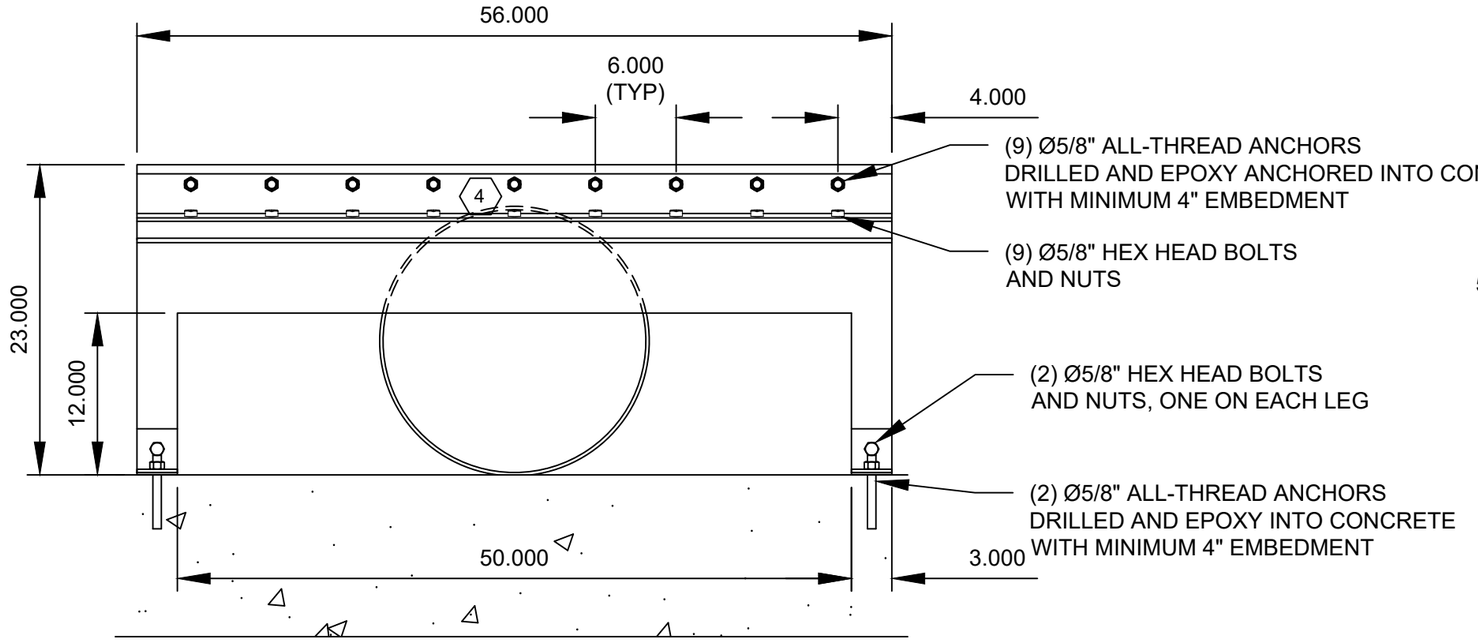
POSEIDON FILTRATION SYSTEM™

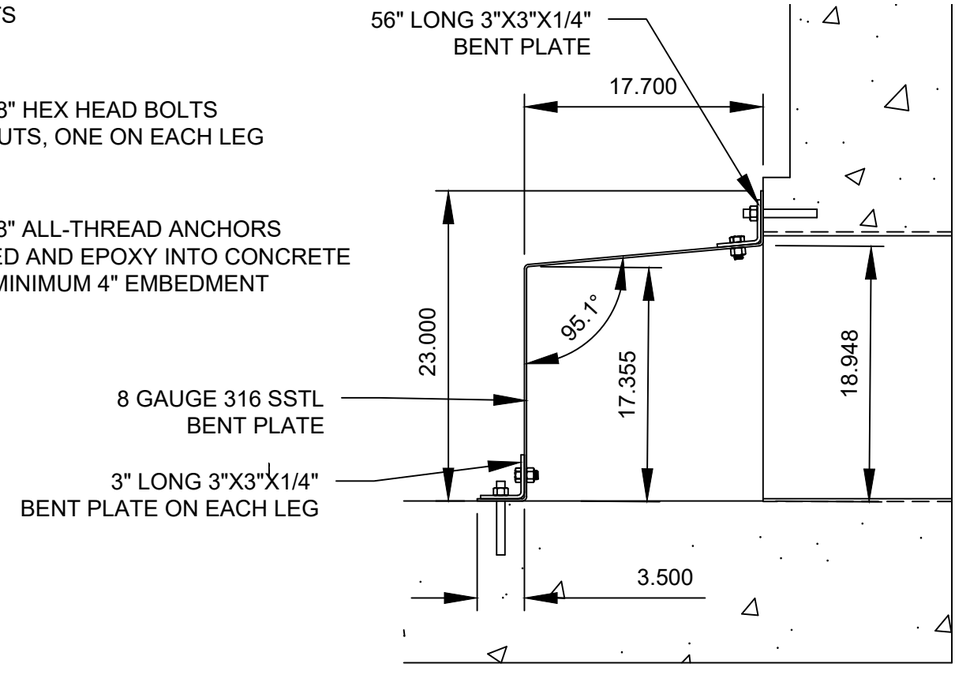
FILTER CROSS SECTION

SUDBURY, ON
WANAPITEI WTP

DATE:	03/14/24
REVISED:	--/--/--
DESIGNER:	WPC
CAD:	WPC
REVIEWER:	SFH



SECTION VIEW 1



SECTION VIEW 2

NOTES:

1. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS AND CONNECTIONS.
2. ALL DIMENSIONS ARE IN INCHES, UNLESS OTHERWISE NOTED.
3. DIVERTER PLATE IS NEEDED TO SLOW THE VELOCITY OF THE BACKWASH WATER AS IT ENTERS THE FILTER PLENUM.
4. ANCHOR BOLTS WILL NEED TO MISS THE EXISTING 20"Ø BACKWASH PIPE.
5. DIVERTER PLATE MATERIAL TO BE 8 GAUGE 316 SSTL BENT PLATE, UNLESS OTHERWISE STATED.

ORTHOS

ORTHOS LIQUID SYSTEMS
P.O. BOX 1970
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843.987.7203 (F)
INFO@ORTHOSFILTERS.COM

POSEIDON FILTRATION SYSTEM™

DIVERTER PLATE CONSTRUCTION DETAILS

SUDBURY, ON
WANAPITEI WTP

DATE:	03/14/24
REVISED:	--/--/--
DESIGNER:	WPC
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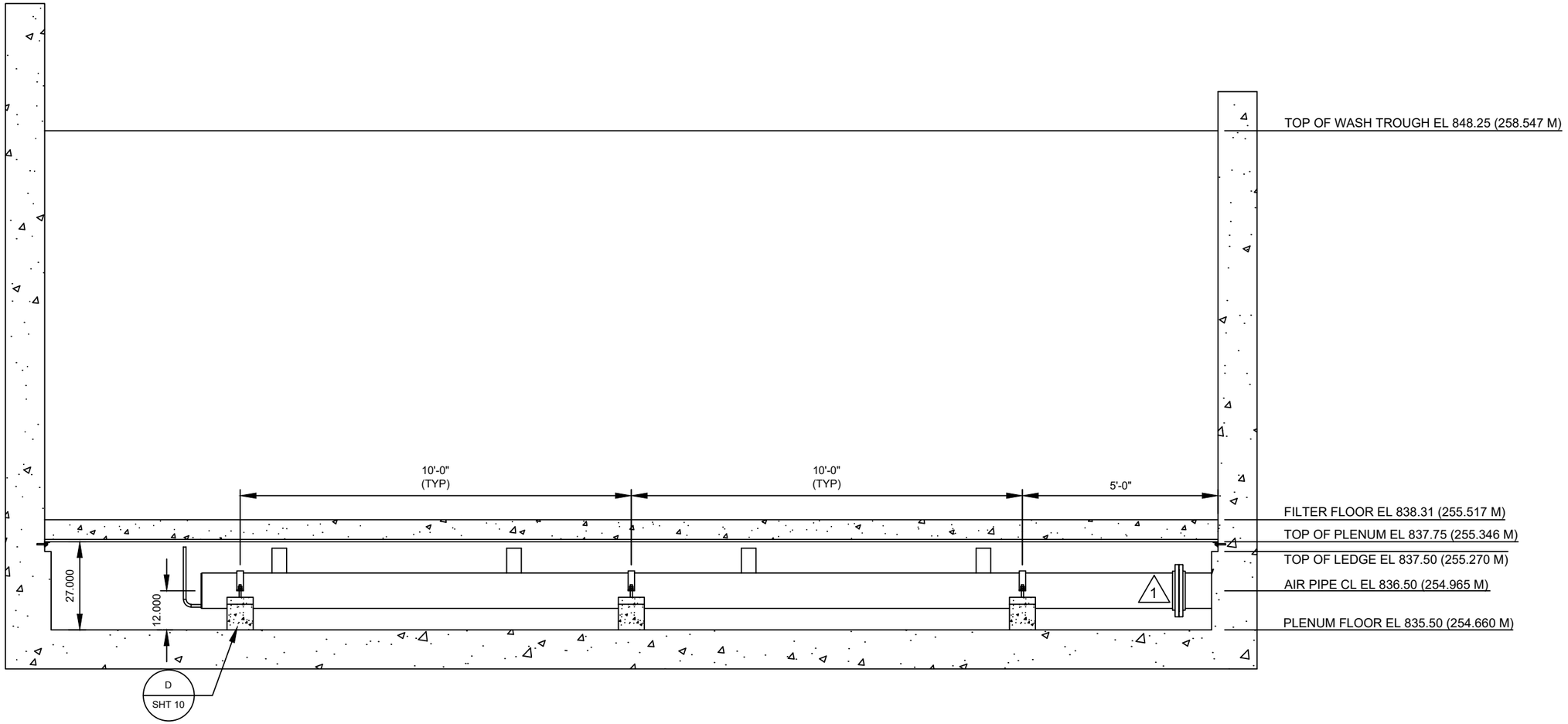
REVIEWER:	SFH



NOTES:

1. 6" PVC PEDESTALS NOT SHOWN FOR CLARITY
2. REFER TO AIR HEADER MANIFOLD CONSTRUCTION DETAILS SHEET FOR FURTHER DETAILS
3. MANIFOLD SUPPORTS TO BE CONSTRUCTED BY OTHERS

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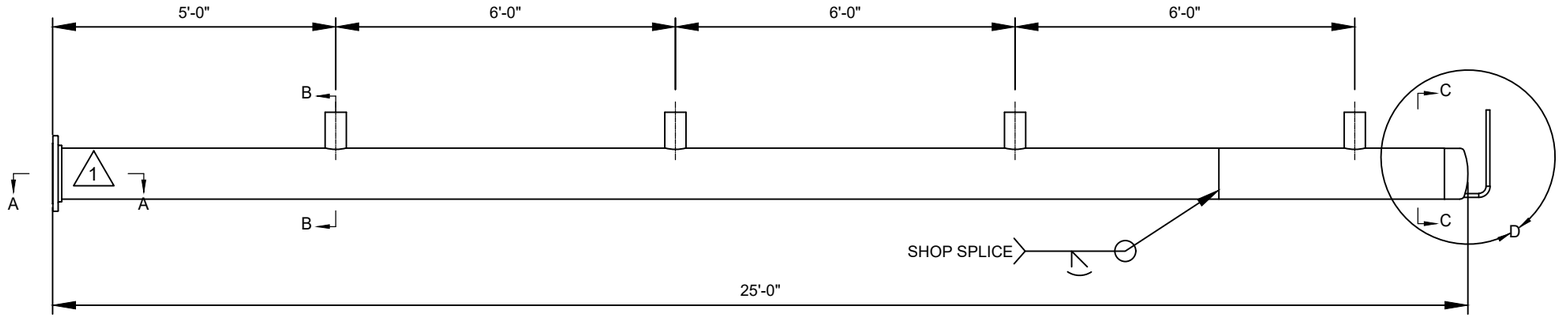
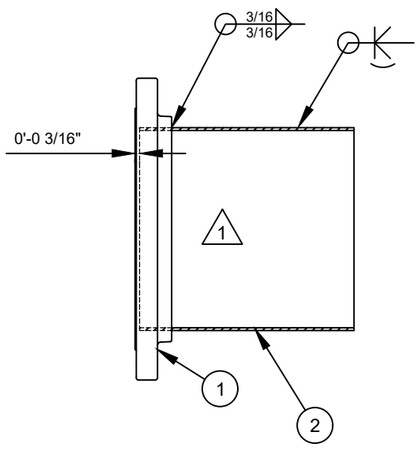
AIR MANIFOLD CROSS SECTION

SUDBURY, ON
WANAPITEI WTP

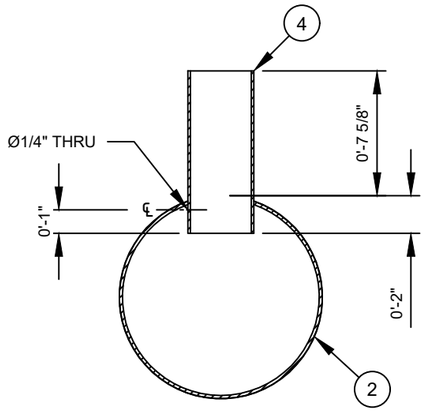
DATE:	03/14/24
REVISED:	04/30/24
DESIGNER:	WPC
CAD:	WPC
REVIEWER:	SFH

ITEM NO.	QTY.	DESCRIPTION	MATERIAL
1	1	RFSO FLANGE 150LB, 10"	SA-182 316/316L
2	1	PIPE 10" SCH 10	SA-312 316/316L
3	1	PIPE 10" SCH 10	SA-312 316/316L
4	4	PIPE 4" SCH 10	SA-312 316/316L
5	1	PIPE CAP 10" SCH 10	SA-403W 316/316L
6	1	PIPE 1/2" SCH 10	SA-312 316/316L

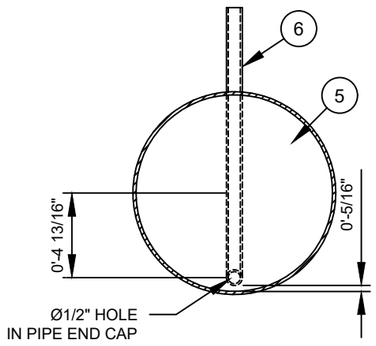




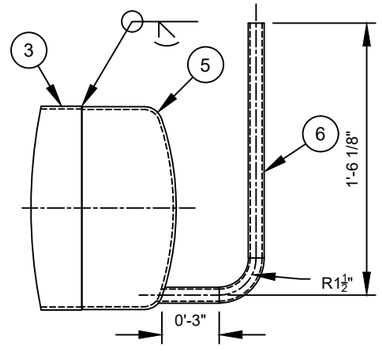
SECTION A-A



SECTION B-B



SECTION C-C



DETAIL D

NOTES:
1. ALL DIMENSIONS ARE IN INCHES, UNLESS OTHERWISE NOTED
2. PICKLE AND PASSIVATE WELDS
3. ALL FLANGE BOLTS TO STRADDLE NATURAL CENTERLINES
4. ALL FLANGE FACES TO BE FLAT AFTER WELDING
5. ALL WELDS:
   - SHALL BE CONTINUOUS, CRACK & CREVICE FREE
   - WELD SEAMS SHALL AVOID ALL NOZZLES, ACCESS OPENINGS AND REINFORCING PADS, WHERE POSSIBLE
6. ALL SHARP EDGES WILL BE REMOVED AND DEBURRED

ORTHOS

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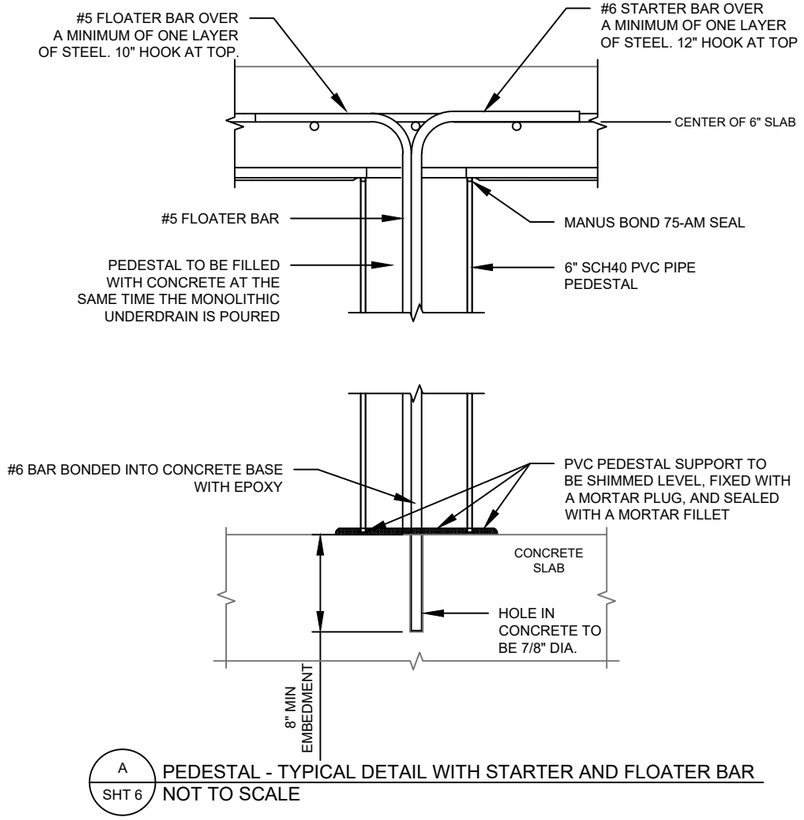
POSEIDON FILTRATION SYSTEM™

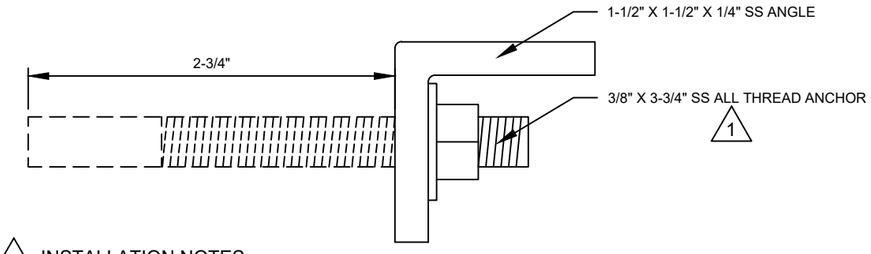
AIR MANIFOLD CONSTRUCTION DETAILS

SUDBURY, ON
WANAPITEI WTP

DATE:	03/14/24
REVISED:	04/30/24
DESIGNER:	WPC
CAD:	WPC
REVIEWER:	SFH



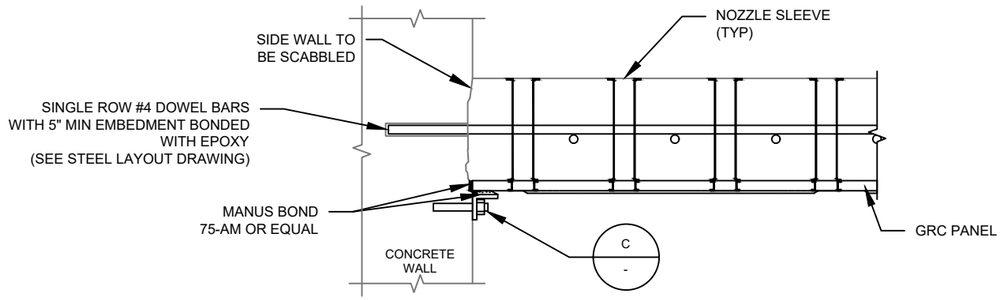
A / SHT 6 PEDESTAL - TYPICAL DETAIL WITH STARTER AND FLOATER BAR
NOT TO SCALE



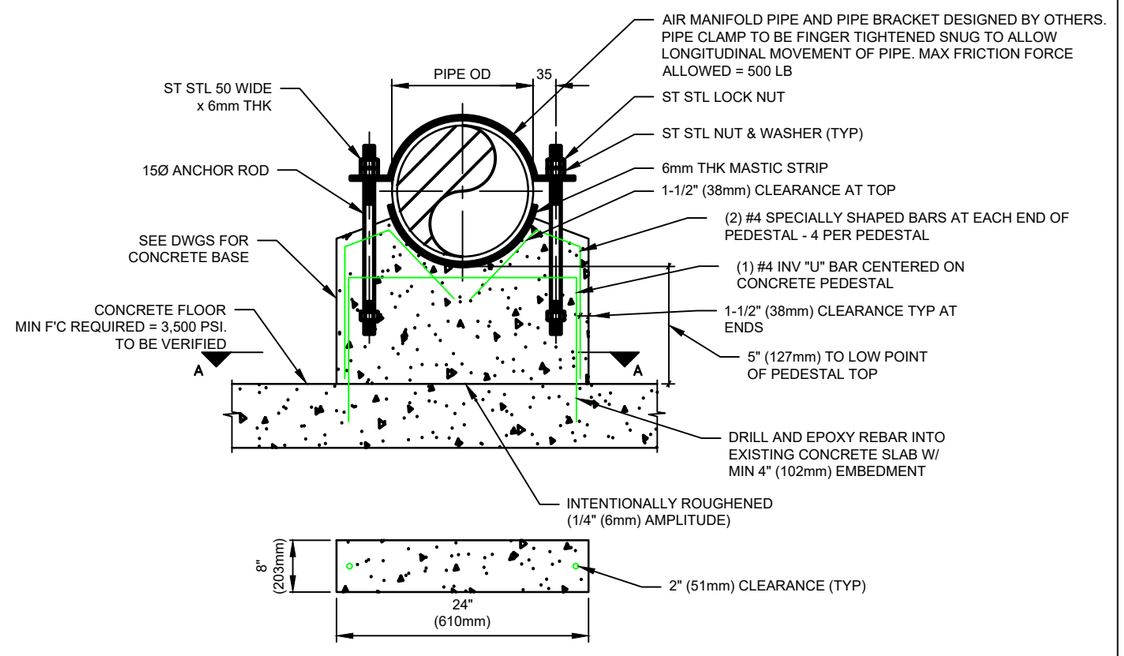
1 INSTALLATION NOTES:

1. ANGLE TO BE INSTALLED WITHIN ±1/16" OF PROPER ELEVATION.
2. DRILL 3/8" HOLE FOR ALL-THREAD ANCHOR EMBEDMENT OF 2-3/4" MINIMUM.
3. TIGHTEN ANCHOR BOLTS TO 30 FT*LBS TORQUE. DO NOT USE IMPACT WRENCH.
4. INSTALL ANCHORS WITH EPOXY PER MANUFACTURER'S INSTALLATION INSTRUCTIONS.
5. ANCHORS ARE TO BE SPACED A MAXIMUM OF 18" O.C.

C / - ANGLE IRON - WEDGE ANCHOR DETAIL
NOT TO SCALE



B / SHT 6 LEDGE - TYPICAL FILTER FLOOR TO WALL CONNECTION
NOT TO SCALE



SECTION A

D / SHT 8 CONCRETE PIPE SUPPORT - BY OTHERS
NOT TO SCALE

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POSEIDON FILTRATION SYSTEM™

MISCELLANEOUS DETAILS

SUDBURY, ON WANAPITEI WTP

DATE:	03/14/24
REVISED:	04/30/24
DESIGNER:	WPC
CAD:	WPC
REVIEWER:	SFH

SHEET
10
OF 10

SECTION 3:

HYDRAULIC CALCULATIONS

SECTION REMOVED FOR TENDER DOCUMENTS

SECTION 4:

FILTER NOZZLE DETAILS

SECTION REMOVED FOR TENDER DOCUMENTS

SECTION 5:

ORTHOS NSF 61

NSF International

789 N. Dixboro Road, Ann Arbor, MI 48105 USA

RECOGNIZES

Orthos Liquid Systems, Inc.

Facility: Ridgeland, SC

AS COMPLYING WITH NSF/ANSI 61 AND ALL APPLICABLE REQUIREMENTS.
PRODUCTS APPEARING IN THE NSF OFFICIAL LISTING ARE
AUTHORIZED TO BEAR THE NSF MARK.

ANSI Accredited Program
PRODUCT CERTIFICATION
#0216
Certification Program
Accredited by the
American National
Standards Institute

Certification Program
Accredited by the
Standards Council
of Canada

This certificate is the property of NSF International and must be returned upon request. This certificate remains valid as long as this client has products in Listing for the referenced standards. For the most current and complete Listing information, please access NSF's website (www.nsf.org).

Theresa Bellish

January 8, 2016
Certificate# 36251 - 02

Theresa Bellish
General Manager, Water Systems

The Public Health and Safety Organization

NSF Product and Service Listings

These NSF Official Listings are current as of **Thursday, July 28, 2022** at 12:15 a.m. Eastern Time. Please contact NSF to confirm the status of any Listing, report errors, or make suggestions.

Alert: NSF is concerned about fraudulent downloading and manipulation of website text. Always confirm this information by clicking on the below link for the most accurate information:
http://info.nsf.org/Certified/PwsComponents/Listings.asp?Company=36250&Standard=061&

NSF/ANSI/CAN 61
Drinking Water System Components - Health Effects

NOTE: Unless otherwise indicated for Materials, Certification is only for the Water Contact Material shown in the Listing. Click here for a list of Abbreviations used in these Listings. Click here for the definitions of Water Contact Temperatures denoted in these Listings.

Orthos Liquid Systems, Inc.
596 Browns Cove Road
Riverwalk Business Park
Ridgeland, SC 29936
United States
843-987-7200

Facility : Ridgeland, SC

Mechanical Devices

Trade Designation	Size	Water Contact Temp	Water Contact Material
Filter Underdrain			
Centurion™ Monolithic Filter Underdrain	[1]	CLD 23	MLTPL
Centurion™ Monolithic Filter Underdrain with Filtration Nozzles	[1]	CLD 23	MLTPL

[1] Certified for a minimum flow of 0.7 gallons per minute per square foot of filter area.

Miscellaneous Process Devices/Components

MU Nuts	[1]	CLD 23	MLTPL
Series T Nozzle	[1]	CLD 23	MLTPL
Series C Nozzle	[1]	CLD 23	MLTPL
Series D Nozzle	[1]	CLD 23	MLTPL
Series K Nozzle	[1]	CLD 23	MLTPL
Series R Nozzle	[1]	CLD 23	MLTPL
Series S Nozzle	[1]	CLD 23	MLTPL
DP Washers	[1]	CLD 23	MLTPL
DB Expanding Rings	[1]	CLD 23	MLTPL
PS Saddle	[1]	CLD 23	MLTPL

[1] Certified for a minimum flow of 0.7 gallons per minute per square foot of filter area.

Number of matching Manufacturers is 1

Number of matching Products is 12

Processing time was 0 seconds

SECTION 6:

STRUCTURAL DESIGN AND CALCULATIONS

SECTION REMOVED FOR TENDER DOCUMENTS

SECTION 7:

CONCRETE SPECIFICATIONS

ORTHOS
LIQUID SYSTEMS

CONCRETE MIX DESIGN

Concrete design compressive strength is to be 5,000 psi at 28 days.

A maximum aggregate size of 3/8 in (9.5mm) and a concrete slump value of 5 – 6 inches (127mm-152.4mm) is necessary to enable the concrete to flow properly around the reinforcement, nozzle concrete sleeve, and into the support piers. The stated value for concrete slump is a minimum and not subject to tolerance on deliveries.

The aggregate size is smaller for the false floor and support piers than the concrete mix in the project specifications. This is to allow the concrete to flow properly and fill in areas where the sleeves and steel reinforcing are adjacent to each other.

Plasticizer (NSF61 Approved) may be used to achieve the required slump for ease of placement, to easily flow into the pier supports and across the GRC Panels to form the false floor slab for a monolithic pour.

Use of concrete vibrators is required to verify consolidation of the placed concrete, especially inside the pier supports.

ORTHOS
LIQUID SYSTEMS

Finishing of Concrete Monolithic Floor Surface

Unless otherwise shown on the DRAWINGS the concrete filter floor surfaces shall be finished as follows:

1. Screed with straightedge to remove low and high spots bringing the surface to the required finish elevation of slope and float with a steel float at least three (3) feet (914.4mm) in width. When the concrete has reached its initial set, finish with a steel trowel. Leave finish essentially free of trowel marks, uniform in texture and appearance, and plane to the correct tolerance. Dusting the surface with dry cement, sand, or sprinkling with water is prohibited.
2. No wetting of concrete surfaces during slab finishing operations shall be permitted. Further, no concrete finishing operation shall be permitted while there is water on the surface of slabs and other flatwork.
3. Smooth trowel surface within 1/16 inch (1.5mm) of final elevation is required at the completion of pouring and finishing the concrete monolithic filter floor.
4. Wet Curing
    a. Keep surfaces of concrete constantly and visibly wet, day and night, for period of not less than 7 days, preferably 14 days.
    b. After wet curing, the water can be drained off so that the caps can be removed from the nozzle sleeves. Personnel can enter the filter to remove the caps, but no equipment should be set on the curing monolithic filter floors.
    c. The concrete must cure for 28 days prior to completing any testing. The long curing time and 28-day schedule should prevent micro cracking from occurring during the pressure and manometer testing.

SECTION 8:

STORAGE AND HANDLING

ORTHOS
LIQUID SYSTEMS

MATERIAL HANDLING AND STORAGE INSTRUCTIONS

GRC PERMANENT FORMWORK FILTER FLOOR PANELS

1.0 General Handling

1.1 GRC (fiberglass reinforced cement) is a material comprising of cement, sand and alkali resistant glass fibers and is NSF61 approved.

1.2 GRC is inert and harmless, is non-combustible and will not burn.

1.3 GRC can be cut with normal concrete handling precautions such as gloves, dust mask and goggles. The wearing of gloves is advisable when handling the GRC.

2.0 Storage

2.1 Pallets should be stored on firm level ground to prevent them from collapsing and the materials being damaged. Panels that have been dropped should be tested for compliance and rejected if they fail. Pallets should not be double stacked.

2.2 Panels can be stored outside but should be protected from extremes of environment, loosely covered but allowing air to circulate.

2.3 All panels should be visually inspected prior to use to ensure no physical damage has resulted during transit.

2.4 In general, panels are intended for use within six months of manufacture. Panels stored for more than six months should be visually inspected prior to use to ensure no damage or degradation has occurred.

2.5 Panels stored for more than twelve months should undergo random destructive testing to ensure compliance with the original design calculations.

STORAGE OF FILTER NOZZLES AND ACCESSORIES

1.0 On receipt of the filter nozzles and accessories, ensure that no damage has occurred during transportation.

2.0 Store the filter nozzles in a clean area and protect from frost or freezing.

3.0 If the filter nozzles are to be stored outside, protect the boxes with a waterproof covering.

4.0 Prior to installation in cold temperatures, the filter nozzle should be pre- warmed using warm water.

STORAGE OF FORMWORK PANELS

1.0 Ensure all pallets are stored in a dry condition on level ground.

2.0 Do not double stack pallets.

SECTION 9:

UNDERDRAIN INSTALLATION INSTRUCTIONS

ORTHOS
LIQUID SYSTEMS

PRE-INSTALLATION CHECKLIST

The following shall be completed before an ORTHOS representative will arrive onsite to supervise the installation start-up. Upon completion, please submit Certificate of Readiness to Install Form ORTHOS-101, and this completed checklist to Orthos Liquid Systems.

Email to tbaumgartner@orthosfilters.com

- □ Following appropriate concrete cure time, mark the PVC pedestal centers on the filter chamber floor with a chalk line. Submit photos to ORTHOS for approval prior to drilling any starter bar holes, as this will dictate the final placement of panels and nozzles.

- □ Map the GRC panel support ledge (blockout / concrete ledge / angle) on the filter wall using a transit level, starting in one corner and mapping around the filter wall every 2' (609.6 mm) to 2'-6" (762 mm) (as applicable) or where the panels will adjoin. This will determine the high point of the GRC panel support ledge. This elevation will be transferred to the filter basin corner that will be used as the starting point for panel installation.

- □ Ensure that the center of the PVC pedestal and the proposed starter bars are not located within 12-inches (304.8 mm) of a joint, or within 12-inches (304.8 mm) of center of previous PVC pedestal.

- □ Ensure the GRC panel support ledge (blockout / concrete ledge / angle) around the edge of the filters is clean and level to +/- 1/16" (1.57 mm).

- □ Set out holes on the filter chamber walls for the horizontal dowel bars, per ORTHOS steel layout drawings. Submit photos and layout to ORTHOS for approval prior to drilling any holes, as this will dictate the final placement of panels and nozzles.

- □ Following approval from ORTHOS, drill holes for the horizontal dowel bars and vertical starter bars in the filter chamber walls and floor. Take care not to accumulate tolerances. The hole diameter and depth should allow for the adhesive anchorage system to bond between the concrete and steel.

  (Do not install horizontal dowel / starter bars at this time. Starter bars will be installed with the PVC pedestals and the horizontal dowel bars will be installed following the complete installation of the GRC panels.)

- □ Scabble the filter chamber walls where the new filter floor will adjoin.

- □ Clean out and prepare all horizontal dowel and vertical starter bar holes using compressed air and modified air lance to blow out any residue and water.
- □ Ensure the filters are clean and dry.
- □ Use a string line from side to side using the high point (found previously) of the GRC panel support ledge (blockout / concrete ledge / angle) to verify the final PVC pedestal cut lengths.
- □ Contractor acknowledges the review of Orthos Monolithic Floor Handling and Installation procedures.
- □ Contractor Personnel has been identified to provide installation documentation of monolithic floor construction activities.

If you have any questions regarding these steps, please contact Tim Baumgartner at (912) 667-1294 or tbaumgartner@orthosfilters.com.

GRC MONOLITHIC FILTER FLOOR

Method Statement for Handling & Installation of Flat Panel System

General:

Please read the entire document prior to beginning the installation procedure.

A. After Delivery

1) Verify that all components have been delivered per bill of laden and complete the delivery confirmation form(s) ORTHOS-101. Confirm the completed delivery forms are emailed or faxed to Orthos Liquid Systems to tbaumgartner@orthosfilters.com.
2) Store materials in boxes off the ground and covered from the elements, or in an enclosure to protect from inclement weather.
3) Ensure the panel pallets are stacked on level ground and not double stacked.

B. Pre – Installation

1) Establish the most favorable horizontal level for the top of the slab to suit both sides of the filter floor and mark a temporary datum around the chamber walls. The blockout / ledge / angle around the edge of the filters that supports the GRC panels must be clean and level to ± 1.57 mm (1/16 inch).
2) Install the angle, if necessary, using the provided anchors to create a ledge around the perimeter of the filter. The angle must be level to ± 1.57 mm (1/16 inch).
3) Ensure rebates in concrete are clean and level. Make-up to level with polymer modified or epoxy mortar if necessary. Use products as specified in the general specification.
4) Ensure new concrete has cured sufficiently to accept resin adhesive and anchors and that the filters are dry and clean.
5) Set out and drill the filter chamber walls for the horizontal dowel bars
6) Scabble chamber walls where the new filter floor will abut.
7) Clean the filter floor, and pick up any debris, concrete pieces, concrete dust, etc.
8) Mark the PVC pedestal centers on the filter floor and drill holes to receive the vertical dowel bars. Take care not to accumulate tolerances. Diameter and depth of the drilling should allow space for the resin to bond between the concrete and steel.
9) Ensure the center of the PVC pedestal and starter bars are not located within 305 mm (1 ft) of a concrete joint.
10) Clean out and prepare the starter bar holes using a compressor and modified air lance to blow out any residue and water.
11) Clean the concrete basin floor, and pick up any debris, concrete pieces, concrete dust, etc. from drilling vertical holes and cleaning of the dowel holes.
12) PVC pedestals can be pre-cut by the Contractor provided the filters are constructed to reasonable tolerances. If the filter floor is more than 1/2" out of tolerance, ORTHOS recommends cutting the PVC pedestals as the Contractor progresses to avoid using an excess number of shims.

13) Inject epoxy resin adhesive and set the starter bars with the PVC pedestals set loosely around. Ensure correct level of the top of starter bar hook by spacing off the top of the PVC pedestal.

C. Installation

1) Ensure the flange surface and threads of the panel nut inserts are clean.

2) Screw concrete sleeves into the four corners of the GRC panel to be laid. The sleeves will help assist with placing the panels during installation.
   Note: Make sure the concrete sleeves are installed into the bushings on the unfinished side of the panel. The unfinished side of the panel needs to be facing up when placed upon the PVC pedestals for proper installation.

3) Select the corner of the filter that you will use as your starting point for GRC panel installation.

4) Site panels squarely level on the tops of the PVC pedestals. Adjust the pedestals to true level and vertical by packing under the pedestals with the ORTHOS-provided plastic shims at three points. The panels, when positioned, must be level to ±1.57 mm (1/16 in) of the datum. Shims of varying thickness will be provided. Take special care to ensure tolerances are not accumulated.

5) When true level has been established, remove the GRC panel off the PVC pedestal and bed and joint the bottom of the pedestal to the filter floor using the Manus Bond 75 or Sikaflex 11fc sealant / adhesive to prevent mortar/grout loss. Now seal the pedestal base with a neatly pointed 1-inch (25 mm) fillet of polymerized mortar/grout.

6) After PVC pedestal is secured, install GRC panel in place and check levelness.

7) If necessary, GRC panels along the filter perimeter being supported by the blockout / ledge / angle will need to be wedged so they are rigidly held and will not displace under the concrete load.
   Note: All perimeter panels supported by the blockout / ledge / angle should be bedded on mortar or sealant to achieve a sound bearing.

8) Seal all panel joints with the sealant / adhesive.

9) Proceed with installation (Steps 4 – 8) across and down the filter ensuring panels remain level and square. Clean out below the panels as they are laid.

10) Inject epoxy resin adhesive into the pre-drilled holes and set the horizontal dowel bars into the chamber walls.
    Note: Ensure rebar will not conflict with the concrete nozzle sleeves.

11) Prior to installation of steel reinforcement, remove the concrete nozzle sleeves that were installed during panel installation. This will prevent damage to the concrete sleeves or bushings.

12) Fix the bottom layer of steel reinforcement spacing off the GRC panels. Refer to the steel reinforcement detail drawing for spacing details.

13) Fix the top layer of steel, if required, on spacers perpendicular to the bottom layer (refer to Steel Layout drawings), ensuring a minimum top cover of concrete is achieved. Tie reinforcement as required.

14) Fit the protective caps into the concrete sleeves by snapping them into place and screw the concrete nozzle sleeves into the installed GRC panels.

15) Clean off the deck and position walk boards (0.91 m x 0.91 m x 13 mm, 3 ft x 3 ft x 1/2 in plywood) over the nozzle sleeves when ready for concrete placement.

16) Place the concrete using a crane with skip or pump. Avoid surges of concrete directly onto the panels, carefully compact with a 25 mm (1 in) to 38 mm (1-1/2 in) vibrating poker.

17) It is recommended to use a 127 mm (5 in) to 152 mm (6 in) slump mix to ensure proper placement around the steel and nozzles. Properly vibrated 3/8" aggregate base concrete is recommended.
Note: 127 mm (5 in) is the minimum required slump.

18) Trowel off the top of the protective caps with a steel float and prepare for curing.

19) Where a top seal is required at the juncture of the new floor and the filter wall, 13 mm x 13 mm (1/2 in x 1/2 in) wood strips should be pressed into the edges of the poured concrete around the perimeter wall. When removed, a small channel will be left that will then be filled with a sealant as specified in the Contract specifications / drawings.

D. Completion

1) When the concrete has set, remove the protective caps and thread in the filter nozzles to a torque of 5.4 – 6.8 Nm (4 – 5 ft.lbs.). If necessary, adjust the level of the nozzles with plastic washers to a tolerance of ±1.57 mm (1/16 in). If the filter panels have been properly set, few if any adjustments will be required.

2) The completed structural slabs (filter floors) should not be loaded until concrete test results confirm the design strength has been reached. ORTHOS recommends 28 days of curing prior to dynamic testing commencing.
Note: Refer to the pressure test procedure when this test is required. This procedure will be performed prior to installation of the filter nozzles.

E. Supplementary

1) It is advisable when placing concrete to use walk boards placed on top of the concrete sleeves. This assist working and also avoids accidental breakage of the sleeves. Damaged sleeves should be removed and replaced immediately.

2) Panels are designed to be capable of supporting the following loads:
   i. Self-weight of the formwork
   ii. Weight of the wet concrete slab depth
   iii. 1.44 kN/m^2 (30 lbs/ft^2) superimposed loading

3) Concrete should not be allowed to accumulate in heaps or be dropped from heights sufficient to damage the concrete sleeves.

4) It is extremely important to always maintain thorough cleanliness of the plenum chamber to avoid debris from eventually blocking the filter nozzles during operation.

ORTHOS LIQUID SYSTEMS

FILTER NOZZLE ASSEMBLY SEQUENCE AND INSTRUCTIONS

(REFER TO FOLLOWING DRAWING)

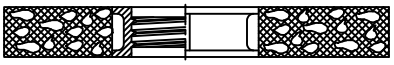
STEP 1: After ensuring the surface of the panel nut is clean, thread the concrete sleeve hand tight and fully into the panel nut.

STEP 2: Press protective caps EG50 or EG70 into the tops of the concrete sleeves to protect the threads during the concrete pour. Ensure the caps are squarely fitted and properly locked into the sleeve.

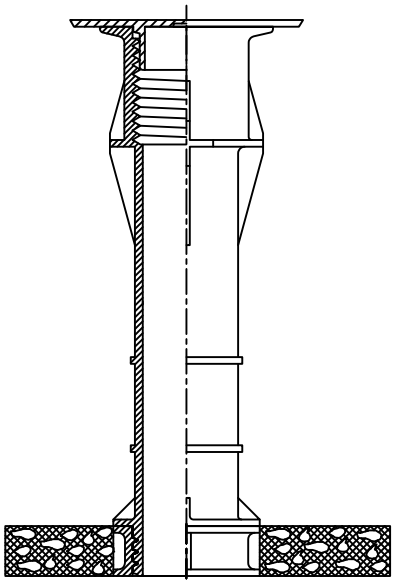
STEP 3: **This is for pressure test only – proceed to step 4 if this is not required.** After the concrete has fully cured, remove the protective caps EG50 or EG70 and thread in the pressure test screws SR50 complete with EPDM gaskets. Again, ensure the surface of the panel nuts are clean. Follow the instructions for the pressure test procedure.

STEP 4: Remove the protective caps or pressure test screws and thread the filter nozzles into the concrete sleeves. If any adjustments of the nozzle height are required to maintain tolerances, washers or gaskets can be added at this time. The filter nozzle should be tightened to 6.0 Nm (4.2 ft.lb. or 53.1 inch lb.) torque rating.

NOTE: **Inspect all filter nozzles as they are installed to ensure they have not received any mechanical damage during transit and handling.**



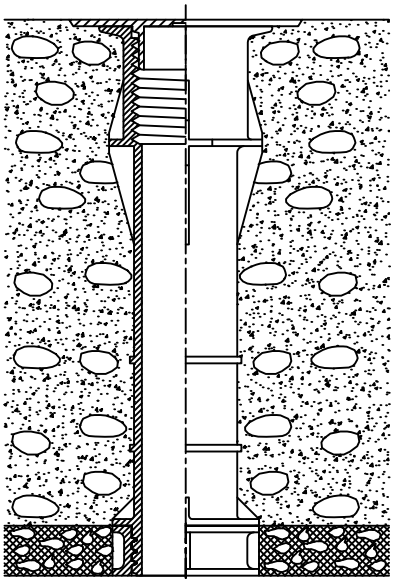
PANEL BUSH

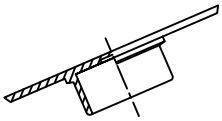


CONCRETE SLEEVE WITH PROTECTIVE CAP

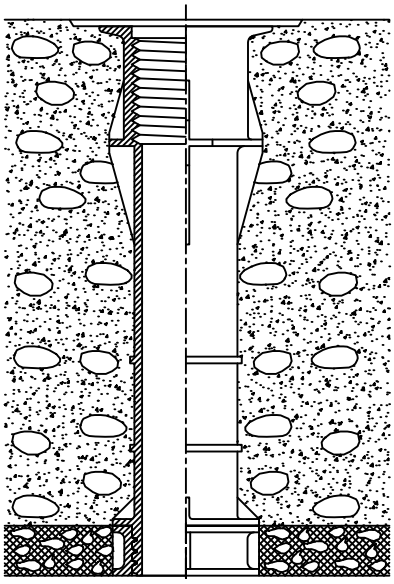
1	2
3	4

CONCRETE POURED





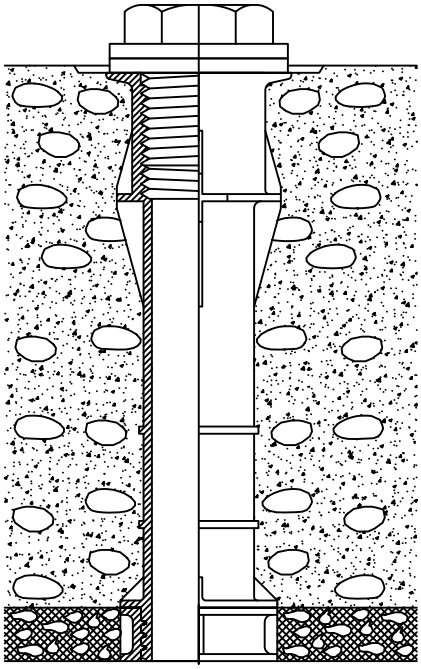
PROTECTIVE CAP REMOVED



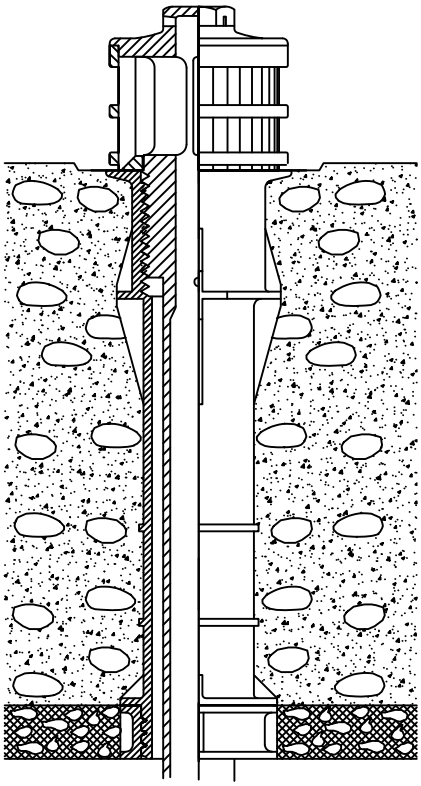
NOT TO SCALE

ORTHOS

DRAWN	WPC	12.07.22	PROJECT NUMBER	SHEET 1/2
C'KED.	TDB	12.07.22	DRAWING NUMBER	MATERIAL
APP'D.	SFH	12.08.22		
REV.	0		NOZZLE INSTALLATION PROCEDURE STEPS 1-4	



PRESSURE TEST SCREW INSTALLED
(IF REQUIRED)



PRESSURE TEST SCREW REMOVED AND
FILTER NOZZLE INSTALLED

5 6

NOT TO SCALE

ORTHOS

DRAWN	WPC	12.07.22	PROJECT NUMBER	SHEET 2/2
C'KED.	TDB	12.07.22	DRAWING NUMBER	MATERIAL
APP'D.	SFH	12.08.22		
REV.	0		NOZZLE INSTALLATION PROCEDURE STEPS 5-6	

SECTION 10:

JOINT SEALER AND ADHESIVE APPLICATOR

MANUS-BOND 75-AM LOT NSF61

Manus-Bond 75-AM exhibits excellent adhesion to many substrates including aluminum, brass, steel, glass, mortar, concrete, wood and many plastics. 75-AM is highly weather resistant and can be painted with most paints. Contains no solvents or isocyanates and is non-yellowing. Meets all of the requirements of ASTM C920, Type S, Grade NS, Class 25, Use NT. Tested and Certified by NSF.

TECHNICAL DATA

TACK FREE TIME	3 hours
EXTRUSION RATE	2 seconds
HARDNESS (SHORE A)	35
TENSILE STRENGTH	280 psi
HEAT AGING WEIGHT LOSS	1.9%
STAIN & COLOR	No stain
SERVICE TEMPERATURE	-75F to 180F
WEATHERING	No cracking

NOTES

COLORS

White, Colonial White, Aluminum Gray, Limestone, Bronze, Tan, Black. Many other colors available.

PACKAGING

10.3 fl. oz. cartridges, 10 & 20 fl. oz. sausage packs, 1 gallon, 3 gallon,, 5 gallon and 55 gallon containers. Other packaging options available on request.

SURFACE PREPARATION

Apply to clean, dry surlaces free of contaminants that can adversely affect adhesion. Remove all old sealant before applying 75-AM.

PAINTING

Cured 75-AM may be painted with most industrial & consumer paints.

STORAGE LIFE

Twelve months in unopened containers at temperatures not exceeding 80 F..

PRECAUTIONS

Use with adequate ventilation. Inhalation of vapor during application and cure may cause slight eye or throat irritation. In case of contact with eyes, lips, or mouth, flush thoroughly with water. If irritation persists, consult a physician. Avoid repeated, prolonged contact with skin. Do not take internally. See MSDS for additional information KEEP OUT OF REACH OF CHILDREN.

TECHNICAL SERVICE

Manus technical representatives are always available to provide assistance. Please contact our Technical Service Department with your questions or requests for specific applications.

LIMITED WARRANTY

Any goods proved defective will be replaced or the purchase price refunded. The limited warranty described herein is in lieu of any other warranty, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. The user shall determine suitability of the product for its intended use. Liability for any incidental or consequential damage or loss is excluded. The user assumes all risks of the product's use, handling or storage.

MANUS PRODUCTS, INC.

866 INDUSTRIAL BOULEVARD W.
WACONIA, MN 55387

PHONE: 952.442.3323

FAX: 952.442.3327

EMAIL: INFO@MANUS.NET

DCE580D1

20V MAX* 300-600ML SAUSAGE PACK ADHESIVE GUN KIT

FEATURES & SPECS

FEATURES

- Variable Speed Trigger allows for increased control over the flow of your adhesive
- Variable Speed Dial allow for setting maximum and minimum flow rates
- Anti - Drip Feature automatically retracts the plunging rod once trigger is released preventing excess adhesive from dripping out
- Quick Connect Inter-changeable canister trays allows user to quickly change between canister sizes
- LED light assists users with visibility in low light situations
- Hang hook allows for easy storage when not in use
- Made in the USA with global materials

SPECIFICATIONS

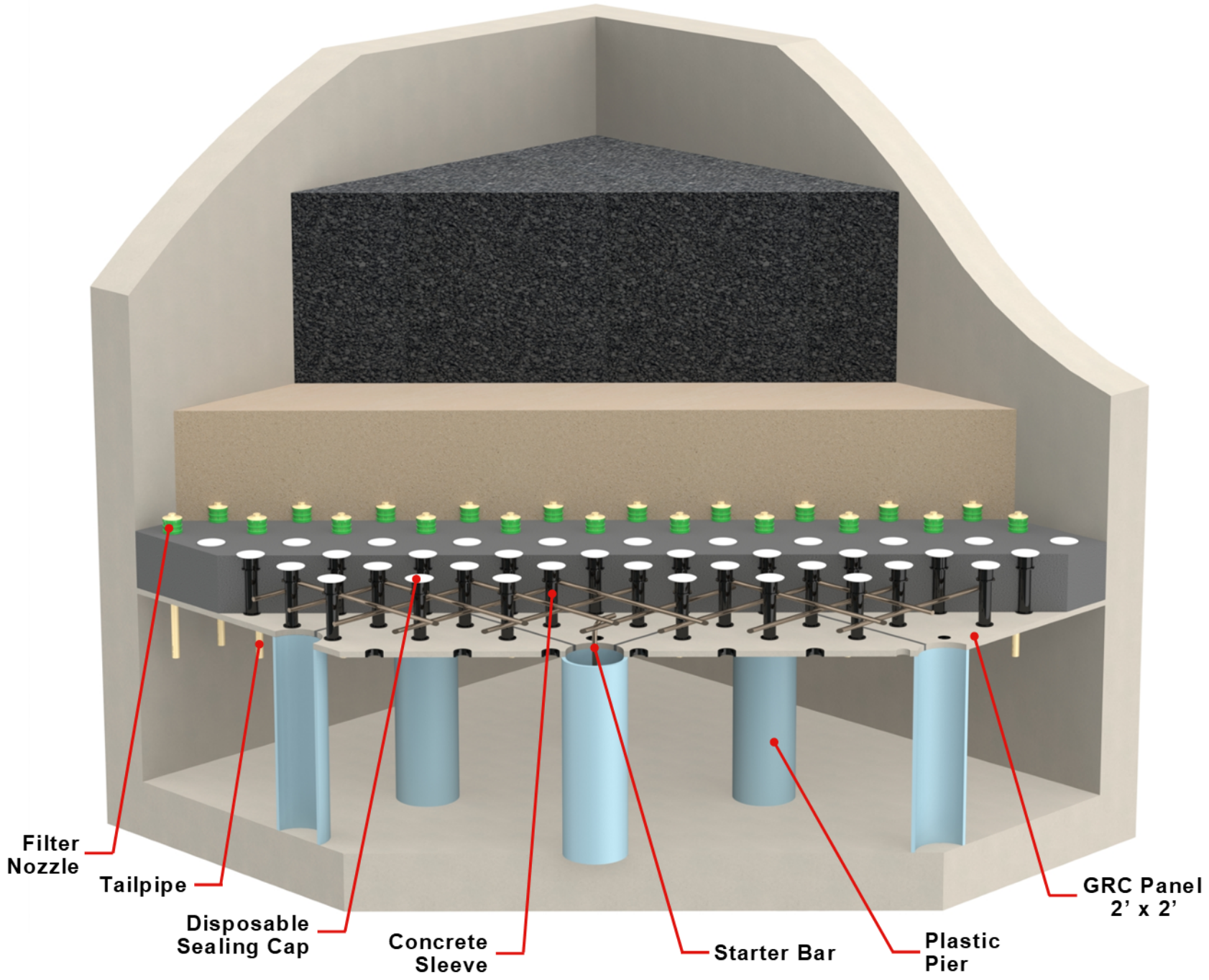
CAPACITY	300-600 ML
MAX SPEED	21 IN/MIN
POWER TOOL TYPE	CORDLESS
SYSTEM	20V MAX*
WEIGHT	4.9 LBS

INCLUDES

- (1) DCE580 Adhesive Gun
- (1) Charger
- (1) 20V MAX* Lithium Ion Battery

SECTION 11:

INSTALLATION PHOTOS AND GRAPHICS


Filter Nozzle
Tailpipe
Disposable Sealing Cap
Concrete Sleeve
Starter Bar
Plastic Pier
GRC Panel 2' x 2'

Grid Layout for Pedestals

Properly Scabbled Wall

ORTHOS
LIQUID SYSTEMS

Installed 316 SS Angle Support

Starter Bar Holes & Dowel Holes

Installation of Starter Bars

Pedestals with Starter Bars

ORTHOS
LIQUID SYSTEMS

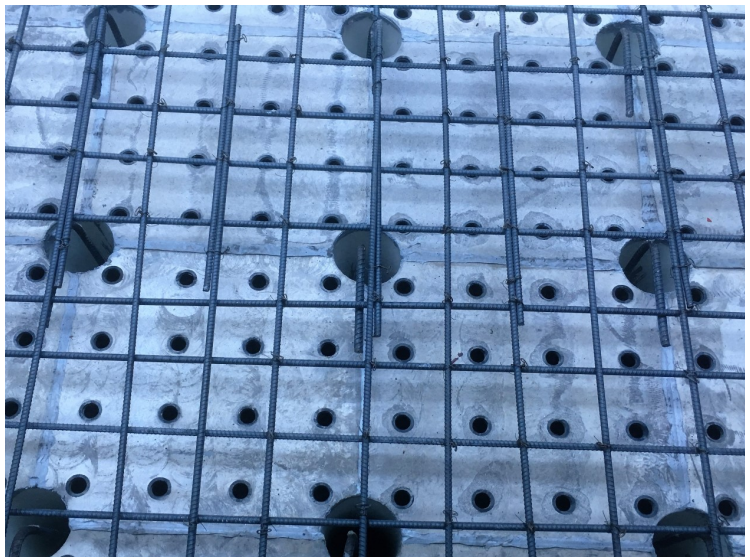
Panels in Place on Pedestals

Verifying Panels are Level

Panels Secured in Place with Mastic

ORTHOS LIQUID SYSTEMS

Completed Reinforcement (Tied into Walls with Adhesive Anchorage)



Completed Reinforcement (6” x 6”/ each way)

Panels and Reinforcement Completed for Filter Basin

(STEEL DESIGN VARIES BASED ON DESIGN SPECIFICATIONS)

Install of Sleeves with Caps

ORTHOS LIQUID SYSTEMS

Install of Sleeves with Caps

Placing of Concrete to Form 6” Slab

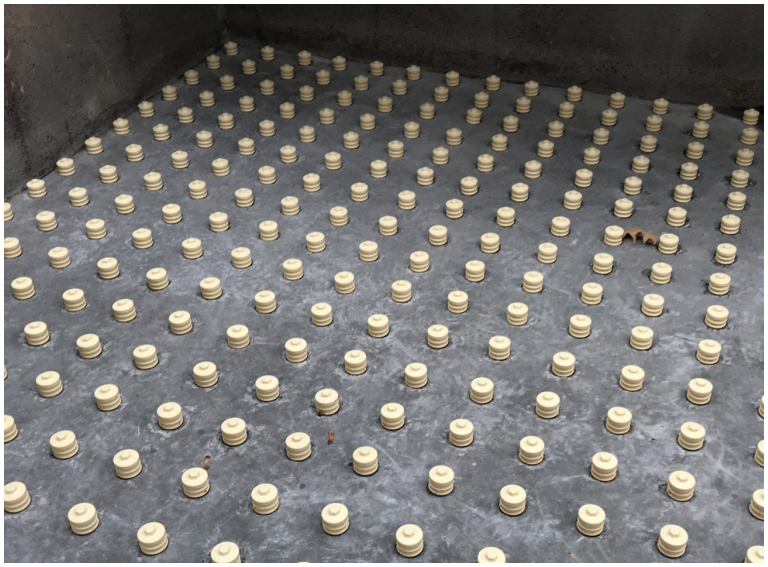
Concrete in Place & Curing

(STEEL DESIGN VARIES BASED ON DESIGN SPECIFICATIONS)

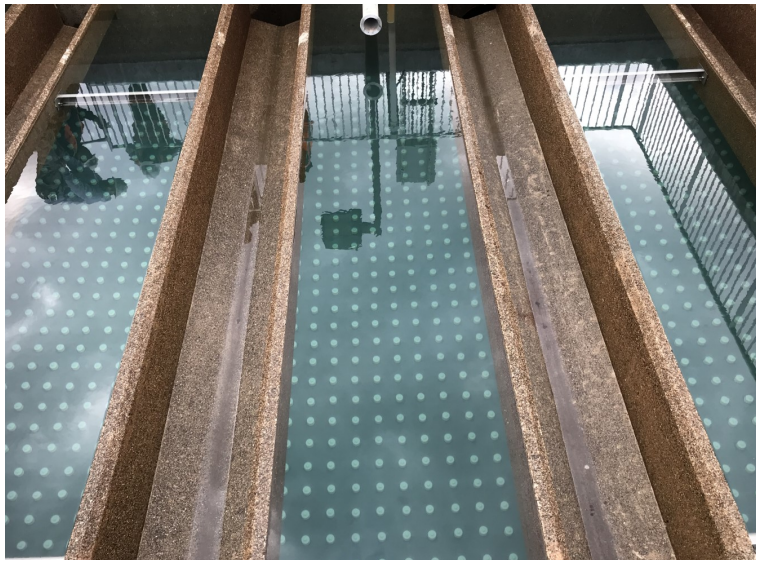
Clean Up of Concrete

Nozzle Placement

ORTHOS
LIQUID SYSTEMS

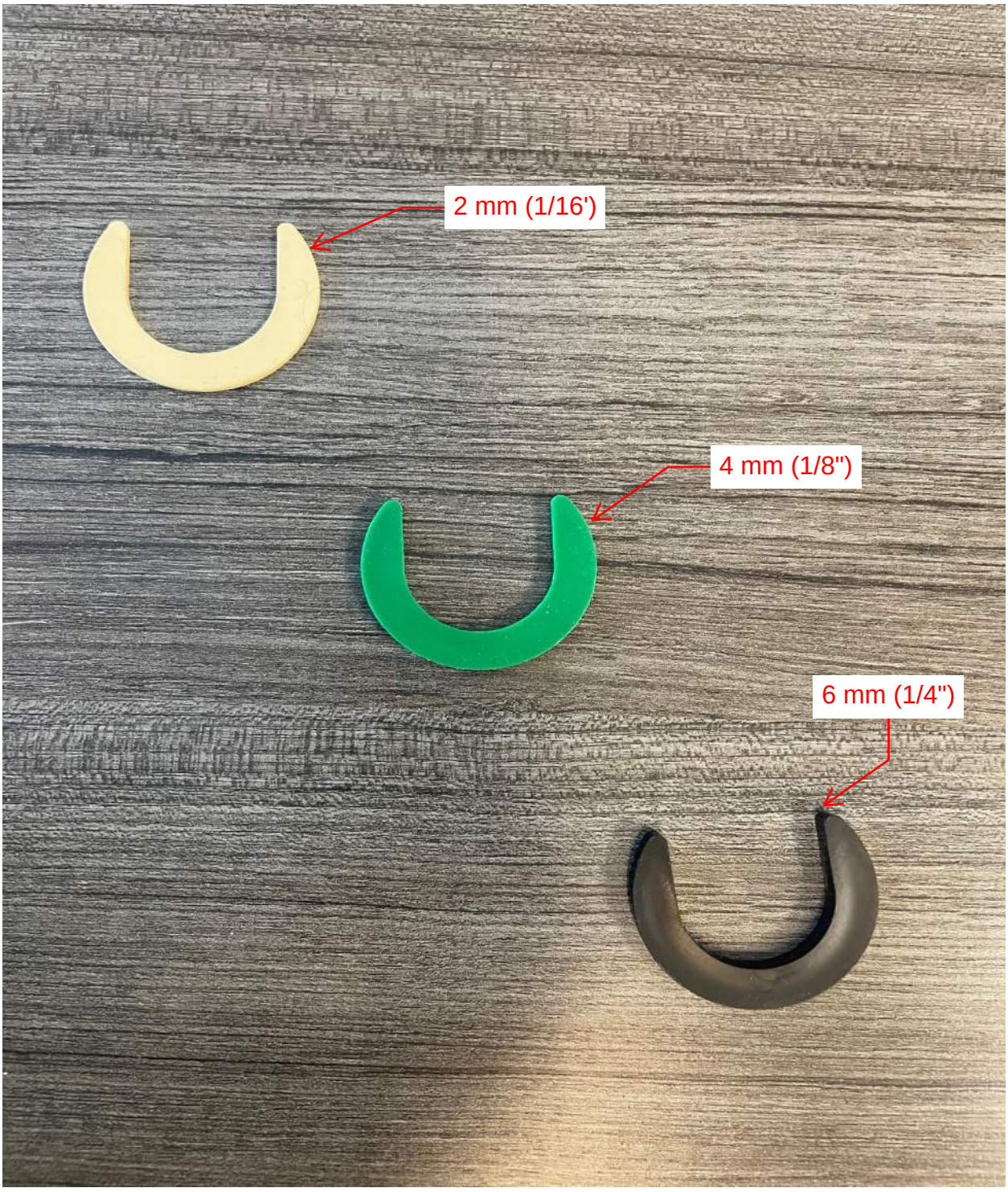


Nozzles in Place



Nozzle Install Pre Media Placement

ORTHOS
LIQUID SYSTEMS



NSF 61 APPROVED
PVC SUPPORT COLUMN SHIMS

SECTION 12:

FILTER TESTING

ORTHOS
LIQUID SYSTEMS

UNDERDRAIN TESTING

A. TEST

1. Conduct all specified testing and provide all material, instrumentation, personnel, etc. for the test specified. The Engineer shall be given sufficient advance notice of the testing to enable the Engineer to witness the tests.

2. **Before any up-flow cycle of either air or water, ensure that the plenum chamber is clean and free from excess concrete dust etc., as this can block the nozzles.**

3. A manufacturer's representative shall inspect and supervise the filter underdrain testing.

4. All test set-ups, procedures and instrumentation shall be designed by the underdrain manufacturer as required to provide data accuracy of plus or minus 5%.

5. Perform each test on every filter unless otherwise noted.

   A) Structural Test (varying flows as shown below)
   This test is normally carried out by visual inspection of varying backwash water flows, and an inspection of the false floor afterward.

   B) Air Scour Only (3.75 scfm/ft^2, 69 $Nm^3/h/m^2$)
   This test is normally carried out by visual inspection of the air scour pattern and observing to ensure that there are no areas of excessive activity which would indicate a leveling problem or a nozzle tube inside of a riser pipe.

   The air scour pattern test is the most sensitive test relative to the levelness of the filter floor.

   C) Air/Water Combined Backwash (3.75 scfm/ft^2 [69 $Nm^3/h/m^2$] and 5 gpm/ft^2 [12.7 $m^3/hr/m^2$])
   This test is normally carried out by visual inspection of the air scour and water backwash pattern. Verifying that the design flows are met and uniform pattern of air and water backwash throughout the filter, especially in the corners.

   D) Water Backwash (5 gpm/ft^2 [12.7 $m^3/hr/m^2$] to 20.5 gpm/ft^2 [50 $m^3/hr/m^2$])
   This test is normally carried out by visual inspection of the water backwash pattern. Verify that the design flow is met, uniform pattern of backwash water is observed throughout the filter, and flow is even over the media retention weir.

E) Maldistribution Test

It is difficult to determine a bad distribution by measuring the actual speed of the wash water in a flooded filter. Therefore, this test aims to measure the pressure in the plenum during a backwash instead because pressure is related to flow. The target is to be within +/- 5% per AWWA recommendations.

B. PRELIMINARY STRUCTURAL INTEGRITY AND FLOW DISTRIBUTION TEST

1. Perform this test prior to the placement of any filter media or support gravel.
2. After sufficient curing time of 28 days, as defined by the underdrain manufacturer, has elapsed to permit the installation to develop adequate strength, test each filter underdrain system to verify underdrain integrity.
3. This test involves water-only backwash testing.
4. Flood filter cell with 6 inches (150 mm) of clean water above the underdrain.
5. Introduce backwash water slowly in the filter, increasing in stages as follows:
   a. 5 gpm/ft^2 (12.7 m^3/hr/m^2) (3,600 gpm/filter)
   b. 13 gpm/ft^2 (31.00 m^3/hr/m^2) (9,360 gpm/filter)
   c. 20.5 gpm/ft^2 (50 m^3/hr/m^2) (maximum backwash rate) (14,760 gpm/filter)
   d. Hold rate at each stage for a sufficient observation period.
6. Hold the rate at each stage for sufficient visual observation.
7. During this test, flow from each nozzle, as well as any sign of dead spots or boils, shall be visually observed. Any evidence of flow maldistribution such as water mound or boil in an area of the filter will constitute a failed test.
8. After this initial test, the filter shall be drained, and the underdrain system shall be inspected for any damage or leaks.
9. Correct and retest underdrain systems that fail to meet the test criteria.
10. After completion of the preliminary structural test, then the air, air/water combined, and flow maldistribution tests can be completed.

C. AIR SCOUR TEST

1. After installation of the filter nozzles, and before placement of the media, fill the filter with clean water to approximately 6” (150 mm) above the nozzle head.

2. Ensure all inlet and outlet valves are fully closed.

3. Introduce air into the plenum at 3.75 scfm/ft^2 (69 $Nm^3/h/m^2$), using the air flow meter to monitor. Inspect the bubble pattern and intensity over the entire filter floor for 3 minutes, taking extra care to inspect the corners.

4. After the air scour test, the air blanket under the filter floor should release through the air bleed holes. If full release is not achieved, the air will be quickly expelled when water pressure is applied.

5. If there are areas of over-vigorous air bubbles, this would usually indicate the highest point of the filter and should be checked and corrected as necessary per the underdrain manufacturer.

6. In some filters, after a period of time, a wave may build up in the water during air scour. If this occurs, switch off the air blowers and restart once the water has settled. *This is not a problem; it will be eliminated when the media is placed in the filter.*

D. AIR/WATER COMBINED BACKWASH

1. After installation of the filter nozzles, and before placement of the media, fill the filter with clean water to approximately 6” (150 mm) above the nozzle head.

2. Start up the air scour (3.75 scfm/ft^2, 69 $Nm^3/h/m^2$), then the backwash (5 gpm/ft^2, 12.7 $m^3/hr/m^2$) and allow to fill up the basin and overflow into the backwash trough.

3. Observe the air scour and water combined backwash for uniform patterns throughout the filter basin, especially the corners.

E. WATER BACKWASH

1. After installation of the filter nozzles, and before placement of the media, fill the filter with clean water to approximately 6” (150 mm) above the nozzle head.

2. Start up the backwash at 20.5 gpm/ft^2 (50 $m^3/hr/m^2$), allow to fill up the basin and overflow into the media retention trough.

3. Observe the flow and verify uniform flow over the backwash troughs.

ORTHOS
LIQUID SYSTEMS

FLOW MALDISTRIBUTION TESTING

F. MALDISTRIBUTION TEST

1. The demonstration must be completed before the installation of media and after completing the structural test.

2. It is difficult to determine a bad distribution by measuring the actual speed of the wash water in a flooded filter. Therefore, this test aims to measure the pressure in the plenum during a backwash instead because pressure is related to flow. To measure the pressure, seven (7) piezometric points are installed in the false floor nozzle sleeves as directed by the underdrain manufacturer's representative.

3. From piezometric taps, route transparent 3/8"-inch (95 mm) vinyl tubes to a piezometer panel containing a scale for each sample tubes. Adjust the panel and the scales with the water level during backwashing. The panel will have to be installed in a place far from the troughs. Figure 3.24 of "Filter Troubleshooting and Design Handbook" by R.P. Beverly of the AWWA may serve as a reference for performing this test.

4. Pressure readings representing the pressure drop of the false floor system are measured as the height of the water in each tube above the water level during a backwash.

   Using the highest and lowest values, between testing locations the maldistribution can be calculated as follows:

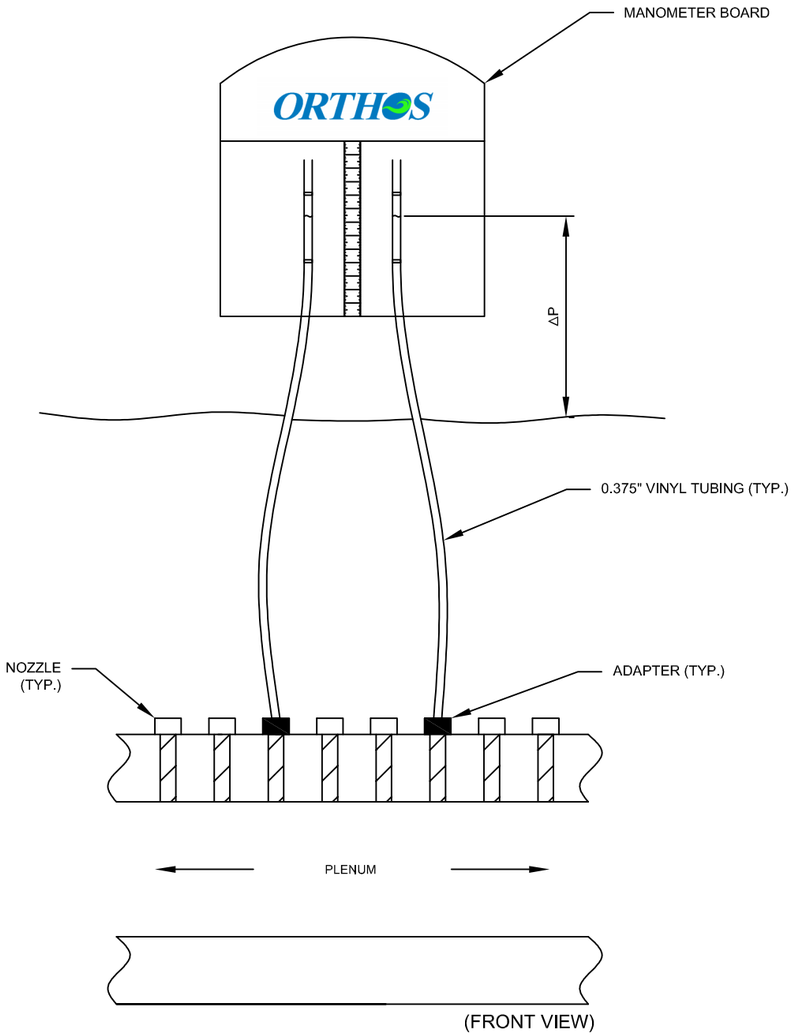
$$Maldistribution\ (\%) = \left[1 - \sqrt{\frac{(P\ Highest)}{(P\ Lowest)}}\right] \times 100$$

6. The test shall demonstrate distribution of backwash water at maximum flow (20.5 gpm/ft^2, 50 m^3/hr/m^2). A deviation of up to ±5% between different measurement points is allowed. If the deviation is found to be greater than ±5%, the Supplier will have to implement everything and make all the corrections required to meet the maximum prescribed deviance. No work will be allowed in any subsequent filters until the problem is corrected.

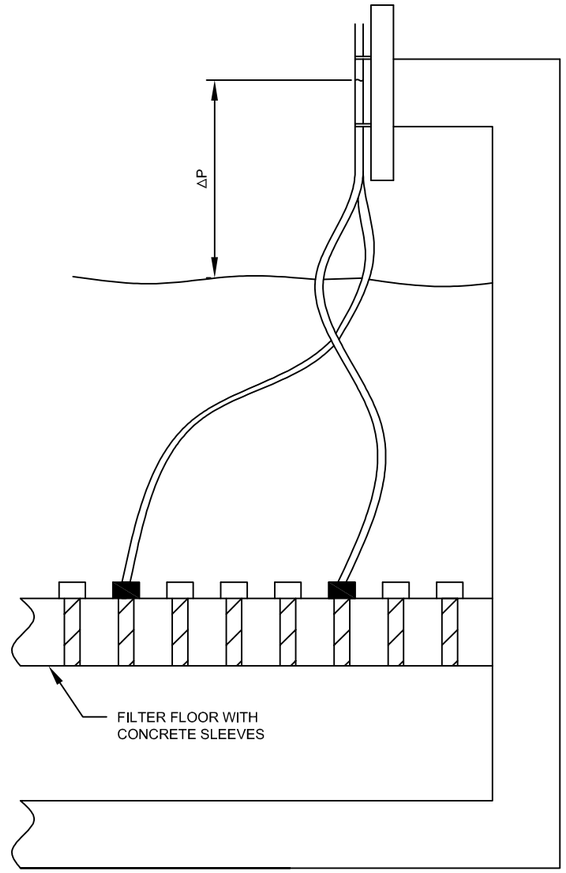
7. The Contractor must remove the seven (7) test caps from the sleeves then reinsert the specified nozzles into the sleeves.

8. The test protocol shall be prepared by the manufacturer of the false bottom (monolithic slab) technology and be submitted to the Engineer for approval.

9. The measurements must be recorded, and the report must be submitted to the Engineer for approval.



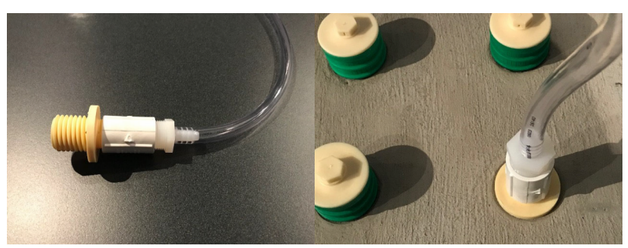
(FRONT VIEW)



(SIDE VIEW)

NOTES:

1. MANOMETER BOARD TO BE PROVIDED BY ORTHOS FOR TESTING.
2. VINYL TUBING TO BE OF EQUAL LENGTHS.
3. ADAPTER INSTALLED IN LIEU OF NOZZLE.
4. DEPENDING ON FILTER SIZE, 4 TO 10 ADAPTERS WITH TUBING TO BE USED. SEE SPECIFICATIONS.
5. USE MAXIMUM BACKWASH RATE PER SPECIFICATIONS.
6. DRAWING NOT TO SCALE



ADAPTERS

ORTHOS

ORTHOS LIQUID SYSTEMS
P.O. BOX 1970
BLUFFTON, SC 29910
843.987.7000 (P)
843.987.7203 (F)
INFO@ORTHOSFILTERS.COM

POSEIDON
FILTRATION SYSTEM™

MANOMETER TESTING

SUDBURY, ON
WANAPITEI WTP

DATE:	03/14/24
REVISED:	--/--/--
DESIGNER:	WPC
CAD:	WPC
REVIEWER:	SFH

SHEET
1
OF 1

SECTION 13:

ORTHOS START-UP DOCUMENTS

SECTION REMOVED FOR TENDER DOCUMENTS

SECTION 14:

WARRANTY