PART 1 - GENERAL

1.01 SCOPE

A. Work described in this section includes furnishing all labor, equipment, materials, tools and incidentals required for a complete and operable installation of the Downstream Defender® stormwater treatment system (treatment system, system, Advanced Hydrodynamic Vortex Separator, or AHVS) as shown on the drawings and specified herein.

B. The manufacturer shall design and supply the equipment listed herein and the Contractor shall install the equipment in accordance with the manufacturer's Handling, Storage, and Installation Instructions.

1.02 GENERAL REQUIREMENTS

A. The treatment system shall use an induced vortex to separate pollutants from stormwater runoff. The system shall be self-activating with no mechanical parts or external power requirements.

B. The treatment system shall be supplied by a manufacturer regularly engaged in such work who has furnished similar installations that have been in successful and continuous operation for a minimum period of fifteen years.

C. Upon request, independently certified performance data and references shall be made available to the Engineer of Record for use in determining that the treatment system meets the design criteria and performance requirements stated herein.

1.03 SUBMITTALS

A. Submittals shall be provided and shall include the following:

1. General arrangement and dimensional drawings of the treatment system.

2. Plan and elevation drawings of the treatment system as it shall be incorporated into the stormwater drainage system. The elevation drawing shall indicate the top of water level both upstream and downstream of the treatment system at the flow conditions specified herein.

3. Handling, Storage and Installation Instructions.

4. Operation and Maintenance Instructions and a Maintenance video.

1.04 QUALITY ASSURANCE

A. The stormwater treatment system shall be manufactured under the direction of an ISO 9001 Certified Company.
B. Inspection

The stormwater treatment system shall be subject to inspection by the Engineer of Record or the owner’s representative at either the place of manufacture or the project site. Any and all observed defects shall be repaired to the satisfaction of the owner or owner’s representative or replacement shall be made available.

C. Warranty

The manufacturer shall guarantee the treatment system from defects in materials and workmanship for a period of two years following installation. If during the warranty period defects in materials or workmanship are noted, then the manufacturer shall be promptly notified. The decision to repair or replace affected units shall be made at the discretion of the manufacturer.

D. Patent Indemnity

Upon request, the manufacturer shall warrant that the treatment system does not infringe upon or violate any patent, copyright, trade secret or any other proprietary right of any third party and shall indemnify the Owner against any loss, cost, expense or liability arising out of such claim whether or not such claim is successful.

E. Certificate of Compliance

Upon request, the manufacturer shall provide a “Letter of Certification” to certify that the stormwater treatment system adheres to the specifications required herein and complies with the project’s stormwater management permit.

1.05 MANUFACTURER

A. The stormwater treatment system shall be the Downstream Defender® as designed by Hydro International located at 94 Hutchins Drive, Portland, Maine 04102. Telephone (207) 756-6200. Fax (207) 756-6212.

B. Alternate stormwater treatment systems must demonstrate compliance with the specifications herein and be approved by the Engineer of Record. Request for alternative systems shall include:
   i. Revised site plan showing location and orientation of proposed alternative, pipe sizes, connections and excavation limits.
   ii. Product installation drawings showing plan and elevation views with water elevations for the flow conditions specified herein.
   iii. Performance data as required in Part 2.
   iv. Maintenance manual including inspection and clean out costs, maintenance video and three references for verifying successful completion of the procedures and associated costs.

C. Costs for reviewing submittals for alternative treatment system shall be the Contractor’s or Manufacturer’s responsibility.
PART 2 – STORMWATER TREATMENT SYSTEM

2.01 General

A. The stormwater treatment system shall be an Advanced Hydrodynamic Vortex Separator (AHVS) with flow-modifying internal components that minimize turbulence and prevent any flow from internally bypassing the separation region within the vortex chamber.

B. A tangential inlet pipe shall be used to establish rotational flow within a cylindrical vortex chamber. All polluted flow entering the vortex chamber through the inlet pipe shall follow a controlled three-dimensional flow path. Internal baffles will prevent flow entering the vortex chamber from discharging directly to the outlet pipe.

C. The tangential inlet pipe shall be positioned to convey flow into the vortex chamber beneath the internal water elevation. The AHVS shall not exceed the pressure drop (headloss) for the design flow rates specified herein as determined by ASTM C1745 / C1745M – 11.

D. The AHVS shall fit within the limits of excavation (area and depth) as shown in the project plans and will not exceed the dimensions for the design flow rates specified herein.

E. The AHVS shall provide separate and protected storage regions for captured pollutants that float and for those that settle and shall prevent re-suspension and washout of stored pollutants for the specified flow rates. The AHVS shall not release captured floating pollutants during surcharge conditions.

F. The storage capacities for pollutants that settle (sediment) and float (oil) shall not be less than the volumes listed in Table 1. The AHVS shall operate as intended and perform as specified herein as pollutants accumulate. The storage capacity for pollutants that settle shall not reduce the volume required in the vortex chamber for separation and for preventing re-suspension and washout, or reduce the floatables storage volume capacity.

G. Minimum 24-inch openings shall provide access to the sediment storage volumes from the surface for inspection and maintenance. Two access openings shall be provided for systems larger than 4 feet in diameter. Removal of pollutants from the treatment system shall be possible without requiring confined space entry.

2.02 Performance

A. Performance of the AHVS shall be based on independent full-scale laboratory and/or field testing and shall adhere to the Performance Specifications listed in Table 1. The laboratory testing used as the basis of product performance shall be undertaken in accordance with testing protocols approved or endorsed by the Stormwater Equipment Manufacturers Association (SWEMA) or acceptable State agency, such as a State Department of Environmental Protection (DEP) or recognized verification agency (e.g. ETV, NJCAT, NETE).

B. Performance of the AHVS shall be based on treating the Water Quality Flow rate (WQF) without internally bypassing and without re-suspension and washout of
captured pollutants (scour). The Maximum Treatment Flow Rate(s) (MTFR-50 and/or MTFR-100) shall be greater than or equal to the WQF. The AHVS shall remove greater than or equal to 80% of TSS based on the Target Particle Size (TPS) of 50 microns and/or 100 microns at MTFR-50 and MTFR-100, respectively.

C. The AHVS shall treat all flows without internally bypassing up to the Peak Treatment Flow Rate (PTFR). Full-scale independent laboratory scour testing shall demonstrate effluent control of less than or equal to 20 mg/L for all flows up to 150% of MTFR-100 without internal or external bypass.

D. The AHVS shall be capable of capturing and retaining fine silt and sand size particles. Analysis of captured sediment from full-scale field installations shall demonstrate particle sizes predominately in the 20-micron range.

E. The AHVS shall capture and retain 100% of all floating trash and debris and remove greater than 80% of hydrocarbons up to its rated storage capacities under conditions of a catastrophic spill such as might be experienced in an automobile or truck accident spill like conditions.

Table 1.

<table>
<thead>
<tr>
<th>Model</th>
<th>Depth</th>
<th>MTFR-50</th>
<th>MTFR-100</th>
<th>Scour Flow Rate</th>
<th>PTFR</th>
<th>Headloss</th>
<th>Oil Storage Capacity</th>
<th>Sediment Storage Capacity</th>
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<td>(cfs)</td>
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<td>(cfs)</td>
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Notes:
1. Depth measurement is from the outlet invert to top of the bottom slab.
2. MTFR-50 and MTFR-100 are the Maximum Treatment Flow Rates for removing target particle sizes of 50 microns and 100 microns, respectively.
3. Scour Flow Rates are based on testing that demonstrates retention of captured sediment having a D50 of 100. Effluent concentrations shall not exceed 20 mg/L.
4. PTFR or Peak Treatment Flow Rate is based on the treatment system maintaining positive removal efficiencies and headlosses no greater than those listed above for each model.
5. Headlosses are the difference in water elevations upstream and downstream of the AHVS as determined by ASTM C1745 / C1745M – 11. The headlosses listed above for any particular model are for that treatment system operating at the Peak Treatment Flow Rate.
6. Refer to 2.01 E.
PART 3 – EQUIPMENT

A. The Downstream Defender shall consist of a hollow, cylindrical vessel with internal components.

   (i) The internal components to be supplied by Hydro International shall include the center shaft and cone, dip plate, benching skirt, floatables lid and component support frame.

   Materials of construction for the above components excluding the support frame shall be cross-linked polyethylene (XLPE). The component support frame members and all metal parts shall be Type 304 stainless steel or carbon steel powder coated in accordance with ASTM 775/ ASTM A775M with a resulting thickness of 8-12 mils. All components shall be designed to withstand all normal loadings associated with fabrication, shipping, site installation, and normal operation of the equipment. The component support frame shall withstand a live load of 500 pounds.

   (ii) The hollow cylindrical vessel shall be a precast concrete structure manufactured with concrete that has attained a compressive strength of 4,000 psi after 28 days. The structure shall be reinforced to withstand an HS20-44 loading. Shiplap joints shall be sealed with butyl rubber mastic sealant conforming to ASTM C990. Slab tops shall be suitably reinforced and provided with manhole openings and covers as required. The cast iron manhole frames and covers shall be sized as per the manufacturer’s drawings and shall be in accordance with ASTM A48, CL.35B and AASHTO M105. The masonry fixing bolts shall be Type 304 stainless steel.

   (iii) All piping connections and ancillary items not listed herein shall be provided by the Contractor.

PART 4 - EQUIPMENT DELIVERY

A. The Downstream Defender components shall be delivered within six weeks of date of approved technical submittal.

B. The Downstream Defender components shall be delivered to the site fully fabricated or shall be ready for the final assembly of the support frames within the host manhole structure.

C. Off-loading, storage, and installation shall be by the Contractor.

D. The Contractor shall inspect and provide signed acceptance of equipment prior to unloading, or notify Hydro International of any damage to equipment to effect proper remedial action. Failure to notify Hydro International of damage to equipment prior to unloading will void all warranties pertaining to subject equipment.
PART 5 - EQUIPMENT INSTALLATION

A. The system shall be installed in strict accordance with the site plans, and the manufacturer’s general arrangement drawings and Handling, Storage and Installation Instructions. The Contractor shall be responsible for installing the equipment and all necessary site connections.

B. The Manufacturer shall be notified immediately of any equipment which is damaged during unloading, storage, or installation. The damaged equipment shall be repaired or replaced at the discretion of Hydro International and entirely at the Contractor’s expense.

C. The precast concrete structure shall be set on a granular or compacted sand sub-base in accordance with local requirements for standard manhole installation. In no instances shall the compacted sub-base material have a thickness of less than 12 inches.

D. The precast concrete structure shall be set level and plumb to within 0.5%.

E. Non-shrink grout or hydraulic cement conforming to ASTM C 595 shall be used to provide a water tight seal in the lift holes, any drain holes and around the concrete knock-outs for the inlet and outlet pipes.

F. The Contractor shall, at the discretion of the owner or owner’s representative, test the concrete structure for water tightness before backfilling.