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PART 1 - GENERAL

1.1 DESCRIPTION

Work Included:

Work under this SECTION includes the installation of manholes, inlets, drainpipe, seepage collars, porous backfill, stilling basins, filter fabric, riprap and grout, all as required for earthen dam or other drainage structures shown on the Plans. The work shall include, but is not necessarily limited to, completion of the following work:

- A. Field engineering.
- B. Drainage Blanket.
- C. Chimney Drain.
- D. Toe Drain.
- E. Pipe Outlets.
- F. Auxiliary Spillway.
- G. All excavation, backfill and compaction necessary to complete these drainage structures.

1.2 REFERENCE SPECIFICATIONS

- A. The following specifications or applicable standards are incorporated by reference into this SECTION:
 - 1. SECTION 02220 – EARTHWORK, DAMS
 - 2. SECTION 02300 – DRAINAGE SYSTEMS, GENERAL
 - 3. Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction (IDOT)
 - 4. NRCS Conservation Practice Standard, Pond (387).
 - 5. AASHTO/ASTM STANDARDS
 - 6. Statewide Urban Design and Specifications (SUDAS)
- B. Above-mentioned references, which do not appear printed with the Contract Documents, can be provided to Contractor upon request.

1.3 QUALITY ASSURANCE

- A. Contractor shall use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this SECTION.
- B. Contractor shall use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

- C. In addition to complying with requirements of governmental agencies having jurisdiction, Contractor shall comply with the directives of Engineer and Division.

1.4 SUBMITTALS

- A. Contractor shall submit material certification, including material type and gradation for all granular fill and for engineering fabric.
- B. Contractor shall submit supplier's material data for all pipes shown on the Plans to be used at the site.
- C. Contractor shall submit weight tickets and/or shipping tickets for all materials delivered to the Project site for the work of this SECTION.
- D. If the trash rack is not prefabricated, Contractor shall submit shop drawings to Engineer for approval prior to fabrication.

PART 2 - PRODUCTS

2.1 BACKFILL MATERIALS

- A. General Backfill: Unless specified in the Plans, ditch subgrades and backfill for pipes and risers shall be constructed of on-site materials from required excavation. Backfill material shall be sorted to remove all rocks or hard material with any dimension larger than one one-half (1 1/2) inches from the backfill area within six (6) inches of the pipes and risers. Thereafter, no dimension of the material within the backfill shall exceed four (4) inches. Backfill material shall be considered impervious fill, and any sand material found from the required excavation shall be sorted out and not used as backfill.
- B. Porous Backfill: Backfill material around toe drains and for the drainage blanket and chimney drain, where shown on the plans, shall consist of non-calcareous sand (not limestone product) meeting the requirements of IDOT Section 4112, Fine Aggregate for Mortar, Gradation No. 2. Refer to SECTION 02220 – EARTHWORK, DAMS.

2.2 DRAINAGE CONDUITS

- A. Various material types and sizes are specified for drainage conduits as noted on the Plans or in the Supplemental Specifications. The conduit material used shall meet the minimum requirements as specified below. All drainage conduit used at the site shall be non-perforated unless specified otherwise.
- B. "Tiling" shall be understood to mean single wall, corrugated plastic drainage conduit that is shipped to the project site in continuous rolls or coils. Rolls or coils of tiling are usually installed by a tiling machine that mechanically places the conduit in a relatively narrow trench immediately following a trenching wheel, chain, or plow.
- C. "Pipe" shall be understood to mean drainage conduit that is shipped to the site in straight lengths from the manufacturer to be installed in a trench created by an excavator bucket.
- D. Single Wall Corrugated Polyethylene Tubing (SWPE)

1. Perforated single wall corrugated polyethylene (PE) tubing and fittings shall conform to IDOT Section 4143.01-B, Pipe for Longitudinal Subdrains with sizes as shown on the Plans.
 2. SWPE shall not be used to convey drainage from concrete structures.
- E. Dual Wall High Density Polyethylene Pipe (DWPE)
1. DWPE pipe shall be high density, high molecular weight, polyethylene pipe meeting the requirements of AASHTO M 294, Type S corrugated exterior and smooth interior. The pipe shall conform to ASTM D3350 with a minimum cell classification value of 345420C and the minimum pipe stiffness at five (5) percent deflection per ASTM D2412.
 2. The fittings supplied shall be made from polyethylene resin which meets this same specification.
 3. Perforated DWPE may be used for Toe Drains or Subdrains subject to Engineer approval.
- F. Polyvinyl Chloride Pipe (PVC)
1. PVC pipe shall be plastic PVC – ASTM D3034-SDR26 Type 1, Grade 1.
 2. Joints shall meet ASTM D3033/D3034 Standards.
- G. Reinforced Concrete Pipe (RCP):
1. All reinforced concrete pipe shown on the Plans shall meet the requirements of IDOT Section 4145. The diameter and length shall match that shown on the Plans. All lift holes and unused tie holes shall be properly plugged.
 2. Joints for RCP: Joints shall be sealed with cold applied bituminous jointing material or rubber gaskets. Where gasketed joints are used, they shall meet the requirements of ASTM C443.
 3. Ties for RCP: Unless otherwise noted on the Plans ties shall be required to secure the first three joints beginning from the daylight end of a run of RCP. The ties shall conform to Type 2 connections for sealed joints.
- H. Polypropylene High-Performance Pipe (PPHP)
1. PPHP shall have a smooth interior and annular exterior corrugations meeting ASTM F2736 for diameters up to thirty (30) inches and meeting ASTM F2881 for diameters of thirty-six (36) through sixty (60) inches. Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2736 – Section 4, ASTM F-2881 – Section 5, and AASHTO M330 – Section 6.1 for the respective diameters. Table 02310-01 specifies the minimum pipe stiffness based on diameter when tested in accordance with ASTM D2412.

Table 02310-01

Nominal Pipe (I.D) (inches)	12	15	18	24	30	36	42	48	60
Min. Pipe Stiffness @ 5% Deflection (#/in/in)	75	60	56	50	46	40	35	35	30

2. PPHP sections shall be joined with gasketed, integral, bell & spigot joints that conform to ASTM F2736 and ASTM F2881 for the respective diameters. The joints can be either spun-on, welded, or an integral bell and spigot. Pipe bells shall be reinforced with a polymer composite band installed by the manufacturer. Each spigot shall have two gaskets meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gaskets are free from debris. These joints shall meet the watertight joint performance requirements of ASTM D3212.

2.3 ANTI-SEEP COLLARS AND FILTER DIAPHRAGMS

A. Anti-seep Collars

1. Manufactured anti-seep collars shall meet the dimensions and consist of the material types shown on the plans.
2. Cast-in-place concrete anti-seep collars shall be constructed as specified with a monolithic pour.

B. Filter Diaphragms

1. Filter diaphragms (also known as sand or drainage diaphragms) shall be designed and installed in accordance with plans and the requirements of NRCS Conservation Practice Standard 387.
2. The filter diaphragm shall be a minimum of two (2) feet thick and extend in all directions a minimum of two times the outside pipe diameter from the surface of the pipe.
3. The filter diaphragm shall consist of sand meeting the requirements of ASTM C-33.
4. Provide an outlet at the base with a minimum six-inch diameter perforated drain tubing.
5. Perforated drain tubing shall be enclosed within porous stone backfill.
6. Connect the perforated tubing to non-perforated tubing which extends to the downstream toe of the berm.
7. Install a PVC outlet for the last twenty (20) lineal feet to daylight and install a rodent guard.

2.4 DROP INLETS AND OPEN SIDED AREA INTAKES

A. Drop Inlets

1. Drop Inlets shall consist of either a cast-in-place or precast reinforced concrete pipe (RCP), Class 3, with a cast-in-place paved invert or fillet. Reinforced concrete pipe shall meet the requirements of ASTM C76, Wall B. Sizes and lengths shall be as shown on plans. Any joints shall be gasketed and sealed per the manufacturer's recommendations. All lift holes shall be plugged with grout.
2. The base for the risers shall be either a cast-in-place or a pre-manufactured base that conforms to the dimensions and includes the required steel reinforcement as indicated on the Plans.

B. Open-Sided Area Intakes

1. Area intakes shall meet the specifications of SUDAS Specification Section 6010 and shall follow details for 'SW-513 Open-Sided Area Intake' and can be either pre-cast or cast-in place.
2. The locations, quantity, and dimensions shall be as indicated on the plan sheets.

2.5 TRASH RACKS AND BAR GUARDS

- A. Trash Rack: The trash racks shall be as shown on the plans, including the type, size, and diameter. If the trash rack is not pre-fabricated, then shop drawings shall be submitted to Engineer for approval prior to fabrication. Anti-vortex protection shall also be included as shown on the plans.
- B. Bar Guard Intakes: Bar Guard Intakes as distributed by AgriDrain Corp. or approved equal. Sizes shall be as shown on the Plans.

2.6 CONCRETE

- A. All connections for drainage conduit where a change in diameter, size or type occurs and every joint where there is a sudden change in pipe direction, shall be sealed and/or buttressed with concrete. Concrete can be ready-mix, hand-mixed or packaged gravel-mix concrete. Areas where concrete is known to be needed include:
1. Pipe connections to riser and paved invert.
 2. Toe drains connection to subdrain outlet pipe.
- B. Structural concrete placed for the bases of structures and anti-seep collars shall be ready-mix concrete with a minimum twenty-eight (28) day strength equal to three thousand five hundred pounds per square inch (3,500 psi). Concrete shall contain admixture to provide entrained air. Concrete shall be mixed and placed in accordance with IDOT Section 2403. Concrete used for seepage collars shall be placed with a monolithic pour.

2.7 PIPE STRAPS

- A. Pipe straps used to restrain bell and spigot joints of corrugated dual wall HDPE or PPHP pipe shall be AgriDrain Pipe Straps or approved equal.

- B. Pipe straps shall be constructed with flat, woven, high-strength nylon fabric with welded stainless steel "D" rings. The loops at the ends of each strap shall be double sewn. Each sewn loop shall contain two (2) "D" rings.
- C. Pipe straps shall not be used with single wall corrugated tubing.

2.8 OTHER MATERIALS

- A. Refer to SECTION 02300 – DRAINAGE SYSTEMS, GENERAL for details relating to rodent guards, erosion stone, riprap, grout, and filter fabric for the stilling basins, pipe protection, and any other areas where these materials are used.
- B. Provide other materials, not specifically described but required for a complete and proper installation, as selected by Contractor, subject to the approval of Engineer.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Contractor shall examine the areas and conditions under which work of this SECTION will be performed and correct conditions detrimental to timely and proper completion of the work. Contractor shall not proceed until unsatisfactory conditions are corrected.

3.2 PROTECTION

- A. Contractor shall use means necessary to prevent dust from becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- B. Contractor shall always maintain access to adjacent areas as needed.
- C. Contractor shall protect previous construction from damage while constructing drainage systems.
- D. Contractor shall protect drainage systems from damage during subsequent construction in the areas.

3.3 CARE OF WATER

Furnish and operate sufficient pumps and/or provide other means including materials, labor and equipment to prevent interference to any work by water, ice or snow. No structure or pipe shall be laid in water, and no water shall be allowed to run into or over any work or pipe until installation is capable of accepting water without damage or deterioration. Damage of any kind resulting from insufficient pumping facilities or similar lack of proper conduct of the work shall be corrected by Contractor at no cost to Division.

3.4 FLOW LINES AND GRADES

- A. Contractor shall construct drainage systems precisely to lines and grades as shown on the Plans or as required for proper functioning. Any changes in elevations or grades must be approved by Engineer.
- B. Pipe runs shall be installed straight with a uniform slope to meet entrance and exit conditions at both ends of the pipe run. Slopes shall be uniform in so far as practical.

- C. Match flow lines and provide smooth transitions between intersecting riprap ditches and between tile outlets and riprap ditches or grassed swales. Contractor shall complete this work in a manner to prevent falling or ponding of water at these intersections.

3.5 INSTALLATION OF TOE DRAINS

- A. Install perforated SWPE or DWPE for toe drains and subdrains in strict accordance with these Specifications, manufacturer's recommendations and the Plans. In case of discrepancy, the most stringent requirements shall apply. The Plans or Supplemental Specifications shall specify whether single wall or dual wall drainage conduit is required.
- B. Excavate trenches as needed to establish the necessary grades for placement. The trenches shall be excavated with an excavator bucket of sufficient width to allow for compaction of porous backfill along the sides and haunches of the tile.
- C. After excavation, place any required filter fabric and drainage conduit in bottom of trench. Connect tubing to proper outlet placing concrete or pipe straps to restrain all joints.
- D. Hand place and compact backfill material around drainage conduit as shown on the Plans. Place material carefully under the haunches so that the drainage conduit drainage conduit is properly and fully supported. In placing and compacting material around the drainage conduit, exercise care to prevent tubing shifting and/or uplift. Backfill remainder of excavation with compacted lifts using excavated material unless this material is unsuitable. Provide suitable backfill material if necessary. Reshape and/or compact adjacent ground surface as required.
- E. In lieu of B, C & D, above, a wheel or chain type tiling machine capable of installing porous backfill in the trench concurrently with the drainage conduit may be used subject to Engineer approval.
- F. If any drainage conduit collapses due to improper installation or from routing of construction equipment over the trench, or it becomes clogged for whatever reason, the malfunction shall be corrected at no cost to Division. Correction of any malfunction shall also be required during the one year guarantee period and shall be repaired at no cost to Division.

3.6 INSTALLATION OF CHIMNEY DRAIN

- A. All tiling, pipe and/or drainage medium shall be placed to provide a hydraulic connection to the chimney drain. Plastic sheeting or other acceptable barriers shall be used to protect the hydraulic connection while cohesive embankment material is being placed.
- B. The embankment shall be constructed as provided in SECTION 02220 – EARTHWORK, DAMS to a height of no greater than four (4) feet. At this height, a trench shall be excavated to the specified width that extends to the protected drainage connection.
- C. All loose cohesive material and the protective barrier shall be removed. Porous backfill shall then be placed in lifts not to exceed eight (8) inches in height and compacted using hand operated equipment such as a vibratory plate compactor or jumping jack.
- D. Plastic sheeting or other acceptable barriers shall be to protect the porous medium after the porous backfill has been placed to the top of the constructed embankment.

- E. Placement of fill material for construction of the embankment can continue until a height of four (4) feet past the top of the last lift of chimney drain material has been achieved. The steps listed above shall be repeated until the design height of the chimney drain has been reached. Any backfill material that becomes contaminated with cohesive material shall be removed and replaced at no cost to Division.

3.7. INSTALLATION OF DRAINAGE BLANKET

- A. Carefully excavate area for the drainage blanket as indicated on plans to design grade and remove all loose material and clods greater than two (2) inches in diameter. Carefully place the porous granular material for the blanket without allowing it to become contamination with cohesive materials.
- B. The material for the drainage blanket should be placed in lifts no greater than six (6) inches and compacted in place using a walk behind vibratory steel plate or other method as approved by Engineer.
- C. After the drainage blanket material is placed in accordance with the specified location and depth, carefully place cohesive fill material over this porous medium so that it is not excessively disturbed and contaminated. No general earthmoving equipment should be operating directly over the porous medium until at least one (1) foot of cohesive material has been placed.
- D. Any porous material that becomes excessively contaminated or disturbed as determined by Engineer shall be removed and replaced with suitable material at Contractor's own expense.

3.8 PIPE

- A. Excavate the trench to grades necessary to place the pipe as indicated on the Plans. The sides of the trench shall be sloped as needed for stability and to satisfy OSHA requirements. The lower portion of the trench shall have vertical side walls to reduce the amount of stress on the pipe. The bottom width shall provide approximately twelve (12) inches between the haunch of the pipe and the side walls of the trench to permit hand compaction of the backfill on either side of the pipe. Place any granular bedding material around the pipe as shown on the Plans.
- B. Lay the pipe in the center of the trench with female joints facing upstream. Place joint sealant as required as each piece is placed. All gaskets shall be protected during installation. Backfill with suitable material in lifts not exceeding eight (8) inches and compacted by hand operated mechanical tampers to a height at least twelve (12) inches above the pipe. Exercise care not to cause the pipe to shift and/or to uplift while placing and compacting material up to the top of the pipe. Backfill should be placed evenly on both sides of the pipe. Continue backfilling with compacted lifts to the surface.
- C. Mass dumping of the backfill shall not be allowed. Settled areas shall be corrected by Contractor at no cost to Division.
- D. Anti-seep collars or filter diaphragms shall be placed around the pipe as shown on the Plans. The size of the excavation for anti-seep collars shall be at least that indicated on the plans. Cast-in-place anti-seepage collars shall be constructed with a monolithic pour using the sides of the excavation as forms where possible. The excavation shall be cleared of all loose material prior to placement of concrete. After the concrete has sufficiently cured, remove any forms and proceed with backfilling. Cohesive backfill shall be placed against the portion of seepage collars made with forms. The fill shall be placed in lifts not exceeding eight (8) inches in loose thickness and

compacted by hand operated mechanical tampers. The fill shall be placed on both sides evenly on both sides of the anti-seepage collars.

3.9 STRUCTURES: DROP INLETS AND OPEN SIDED INTAKES

A. Drop Inlets

1. Install Drop Inlets in strict accordance with these Specifications, manufacturer's recommendation, and the Plans. In case of discrepancy, the most stringent requirements shall apply.
2. Install concrete base for the drop inlet as shown on the Plans. Install vertical RCP sections and neatly core drill or saw a hole in the vertical pipe for the outgoing pipe and any incoming pipes. The hole shall be no greater in size than required to permit the outgoing pipe to be inserted into the riser. Insert pipe into the structure a distance no greater than required to properly make the connection; do not unduly restrict the flow area. Wrap the opening with tile tape, strips of filter fabric or other approved material to seal the annular space and encase the entire connection with concrete. Provide fillet concrete in base of riser to direct flows into outflowing pipe. Furnish and install appropriately sized trash rack or riser guard where shown on the Plans.
3. Backfill excavation with compacted lifts using excavated material unless this material is unsuitable. Provide suitable backfill material if necessary. Reshape and/or compact adjacent ground surface as required.

B. Open Sided Intakes

1. Open sided intakes shall be placed to the specific elevations and dimensions indicated on the plans.
2. Pipe connecting to the intakes shall be placed as shown on the Plans and in accordance with SUDAS 6010.
3. Backfill material shall be placed after adequate strength is acquired for the structure. Backfill shall consist of excavated material with rocks larger than four (4) inches in diameter sorted out. The backfill shall be placed in lifts of no more than six (6) inches and compacted using hand equipment.
4. If precast open-sided intakes are used, provide a granular leveling course of one (1) inch clean, angular limestone four (4) to six (6) inches thick at the bottom of the structure and around the pipe connection adjacent to the structure.

PART 4 - MEASUREMENT AND PAYMENT

4.1 UNIT PRICES

- A. Construction cost of all work included in this Section of the Construction Specifications shall be included in Contractor's unit prices set forth in the Proposal and Schedule of Prices (*Document C*) for the work items described below. Unit price for each of these items shall include its pro rata share of overhead so that the sum of the products obtained by multiplying the unit prices so set forth by the amount of the work constructed and measured as described herein, shall constitute full payment to Contractor for performance of the work included in this SECTION.

- B. Measurement and payment for each work item in this SECTION shall be in accordance with the following:
1. *Toe Drain*: The unit prices shall include all materials and work required for installation of the drainage conduit in conformance with details and dimensions shown on the Plans. The unit prices shall include furnishing and installing the tubing, fittings, trenching, removal and disposal of excess trench material, backfill, compaction, and all other work items incidental thereto, including rodent guards, tile tape and concrete for sealing below-grade connections. Measurement for payment shall be based on the length of a specified diameter installed as determined from field measurements and rounded to the nearest one (1) lineal foot.
 2. *Porous Backfill*: Unit prices for porous backfill shall include all work, materials, labor, and equipment needed to place the material as shown on the plans. The costs for excavation and protection barriers are incidental and shall be included with the unit price for these items. The volume of material placed will be determined by Engineer by measuring the height and width of the excavation prior to backfilling. Additional quantities required due to over-excavation or wider trenches not directed by the Engineer will not be approved for payment.
 3. *Pipe*: These unit prices shall include all materials and work required for installation of the pipe in conformance with details and dimension shown on the Plans and these Specifications. The unit prices shall include furnishing and installing the pipe, fittings, trenching, removal and disposal of excess trench material, anti-seepage collars, backfill, compaction and all other work items incidental thereto, including rodent guards. Measurement for payment shall be based on length of pipe for a specified diameter actually installed as determined from field measurements and rounded to the nearest foot.
 4. *Structure*: Unit price shall include all materials and work required for installation of drop inlets or open-sided area intakes in conformance with details and dimensions shown on the Plans and these Specifications. Unit prices shall include furnishing and installing the structure and trash rack or bar guard, concrete base, connecting the pipe, concrete, excavation, backfill, and all other incidental construction including removal of any accumulated sediment, maintenance and repairs. Measurement and payment of structures shall be based on the number of each size and type of structure properly installed and maintained.

4.2 SUMMARY – UNITS OF MEASUREMENT:

Units of measurement for bid items applicable to work covered by this SECTION are as follows:

<u>Description</u>	<u>Unit</u>
Toe Drain - (size)	Lineal Foot
Porous Backfill - Toe Drain	Cubic Yard
Porous Backfill – Chimney Drain	Cubic Yard
Porous Backfill – Drainage Blanket	Cubic Yard
Pipe - (size)	Lineal Foot
Structure - (type & size)	Each

END OF SECTION 02310