**A. GENERAL**

The Work will be performed in coordination with and under the oversight of the Engineer-in-Charge (EIC) designated by the Owner and approved by the Maryland Department of the Environment Water and Science Administration Dam Safety Division (MDE). Any deviation from the approved plans for any reason must be approved by the EIC and MDE before proceeding with those deviations from the approved plans.

The Contractor shall perform the Work in accordance with all required permits.

**The Work is not considered complete until the EIC, Owner and MDE have completed final inspection of the project and the as-built plans have been approved by MDE.**

The Contractor shall ensure the quality of work by employing qualified, experienced personnel, trained in dam construction. The Contractor will provide all necessary management, supervision, personnel, labor, tools, materials, and equipment necessary for all aspects of construction.

The EIC shall supervise and inspect construction to ensure it is completed in accordance with the Contract Documents. The EIC may designate other individuals to supervise and inspect construction as appropriate for the type of construction being completed. The EIC is responsible for the accuracy and quality of the work performed by other appointed individuals on the project. For the purposes of these specifications, those individuals may include the following:

* Geotechnical Engineer – the geotechnical engineer must be a Maryland-licensed professional engineer experienced in geotechnical engineering, dam engineering, and dam construction. The geotechnical engineer may appoint inspectors acting under responsible charge of that engineer to complete inspection and testing of construction.
* Inspector – the inspector is an engineering technician appointed by and acting under responsible charge of the geotechnical engineer or EIC to complete inspection and testing of construction as required by the Contract Documents.

For the purposes of these specifications, references to the EIC under the *Supervision and Inspection* section of each specification may refer to either the EIC, Geotechnical Engineer, or Inspector.

**B. REFERENCED STANDARDS AND SPECIFICATIONS**

The following specifications and standards, including addenda, amendments and errata, form a part of this specification to the extent required by the references thereto. The Contractor must adhere to any newer versions of the referenced standards and specifications. The list below is the most frequently used standards that are referenced but other references may be referenced in the standard specifications.

American Association of State Highway and Transportation Officials (AASHTO). Washington D.C. <http://www.transportation.org/>. Referenced as “AASHTO”.

American Concrete Institute (ACI), Farmington Hills, Michigan. <http://www.concrete.org/general/home.asp>. Referenced as “ACI”.

* ACI-318-11 – “Building Code Requirements for Reinforced Concrete”.
* ACI-350-06 – “Code Requirements for Environmental Engineering Concrete Structures and Commentary”.
* ACI SP-66-04 – “ACI Detailing Manual”. This standard replaced ACI 315-92.

American National Standards Institute (ANSI), “Tree Care Operations: Standard Practices for Tree, Shrub and Other Woody Plant Maintenance”, Washington, D.C. 2008. Referenced as Standard A300.

American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), “Standard Methods for the Examination of Water and Wastewater”. Washington D.C. 2012, 22nd Edition. < http://www.standardmethods.org/>. Referenced as “Standard Methods for the Examination of Water and Wastewater”.

American Society of Testing and Materials International, Standards Worldwide. West Conshohocken, PA. <http://www.astm.org/Standard/index.shtml>, Referenced as “ASTM”.

Concrete Reinforcing Steel Institute (CRSI). Schaumburg, Illinois. <http://www.crsi.org/>. Referenced as “CRSI”

* CRSI “Manual of Standard Practice 2009”, 28th edition.
* CRSI “Placing Reinforcing Bars 2011”, 9th edition,

International Code Council (ICC), International Building Code (IBC). Washington D.C. <http://www.iccsafe.org/>. Referenced as “International Building Code”

Maryland Department of the Environment (MDE), Water Management Administration in association with Soil Conservation Service and State Soil Conservation Committee, “2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control”. Baltimore, Maryland. 2011. Referenced as “MDE Specifications for Soil Erosion and Sediment Control”.

Maryland Department of Environment, Water Resources Administration, “Maryland’s Guidelines to Waterway Construction”, Baltimore, Maryland. November 2000 revision. Referenced as “MDE Construction Guidelines”.

Maryland Department of Transportation (MDOT), State Highway Administration (MSHA), Hanover, Maryland. <http://www.roads.maryland.gov/home.aspx/>. As revised on MSHA website. Referenced as “MSHA”.

* “Book of Standards for Highway and Incidental Structures”. Referenced as “MSHA Standard Details”.
* “Standard Specifications for Construction and Materials”, latest edition. Referenced as “MSHA Standard Specifications” or “MSHA”.

United States Occupational Safety and Health Administration (OSHA), “Confined Spaces Standard, 2004”. Washington D.C. <http://www.osha.gov>.

**C. SPECIFICATIONS/SCOPE OF WORK:**

Where applicable, items are cross-referenced to, and incorporate, information and requirements provided in the Part III – Technical Requirements of the Maryland State Highway Administration (MSHA) Standard Specifications for Construction and Materials, latest edition and the MSHA Book of Standards, latest revision.

The link to the Specifications document is:

https://policymanual.mdot.maryland.gov/mediawiki/index.php?title=2017\_Standard\_Specifications\_For\_Construction\_And\_Materials

Notes:

1. Part I (General Provisions) and Part II (Terms and Conditions) of the MSHA Standard Specifications for Construction and Materials **DO NOT APPLY** to, and are not incorporated into these specifications.
2. Any references in MSHA Part III – Technical Requirements to the “Administration” or “MSHA” shall be interpreted as referring to the Owner.
3. Any references in MSHA Part III – Technical Requirements to the “Engineer” shall be interpreted as referring to the EIC.
4. Any reference to “Contract Documents” in the Specifications shall be interpreted as referring to approved plans.
5. The referenced MSHA Sections and Subsections apply unless noted otherwise elsewhere in the Contract Documents. In case of conflict between MSHA specifications and other Contract Documents, the requirements of the other Contract Documents shall apply.

**CLEARING AND GRUBBING**

DESCRIPTION:

Comply with Subsection 101.01 of MSHA of these specifications unless noted otherwise on Contract Documents. This work consists of clearing and grubbing within the limits specified in the Contract Documents. Clearing includes removing and disposing of all trees, brush, shrubs, vegetation, rotten wood, rubbish, fences and structures in construction area for removal and disposal, and trimming and disposal of tree limbs that interfere with performance of the Work. Grubbing covers removal and disposal of all stumps, roots, stubs, brush and debris within Limits of Disturbances specified in the Contract Documents. Woody vegetation within 15-feet of the dam’s embankment and appurtenant works must be removed if present.

Provide protection for trees designated to be protected per the Contract Documents.

MATERIALS:

Not Applicable

SUBMITTALS:

Not Applicable

CONSTRUCTION:

Comply with Subsection 101.03 of MSHA unless noted otherwise on Contract Documents.

1. Vegetation: The Contractor must mark (do not use paint) the clearing limits including any trees, shrubbery, and plants that are to be removed, as well as those that are to remain and be protected, prior to work. The Owner and other appropriate regulatory agencies must review and approve the clearing limits. The Contractor must protect the marked items from any damage. Branches and exposed roots of trees overhanging and interfering with the Work must not be cut without the Owner’s prior approval. All trimming must be done under the field supervision of a licensed arborist or tree expert licensed by the State of Maryland and furnished by the Contractor, including trimming of trees by the Contractor for any other reason. Trimming, and/or repair of cuts and scars must be properly bandaged (Referenced Standards: American National Standard Institute (ANSI), “American National Standard for Pruning.”)
2. Grubbing:
	* 1. All embedded stumps and roots must be removed to a depth of not less than 3 feet below the subgrade or slope surfaces. Depressions made below the subgrade or slope surfaces by removal of stumps must be refilled with soil or as specified on Contract Documents.
		2. In the area of a dam embankment, all embedded stumps and roots must be completely removed on the embankment or beneath the embankment subgrade. Depressions made below the subgrade or embankment surfaces by removal of stumps must be refilled with materials suitable for dam embankment construction, and compacted per requirements in these specifications. The embankment material must be overlaid with 6” of top soil, seeded, and mulched. The final grade must match the adjacent grades.
		3. Disposal: Unless designated for reuse on the Contract Documents, material and debris collected because of the clearing and grubbing operation is the property of the Contractor and must be disposed of in accordance with the local and state regulations. No burning will be permitted within the Work Site or on County properties.
3. Fallen and storm-damaged trees: Removal of all fallen and/or storm-damaged trees, regardless of size, shall be cleared and removed per this Clearing and Grubbing Section.

SUPERVISION AND INSPECTION:

The EIC will inspect the limits of clearing within 15 feet of the dam’s embankment or appurtenant structures. The limits of clearing within 15 feet of the dam’s embankment or appurtenant structures must be surveyed and included on the as-built plans.

**REMOVAL AND DISPOSAL OF EXISTING STRUCTURES**

DESCRIPTION:

Comply with Subsection 102.01 of MSHA unless noted otherwise on Contract Documents.

MATERIALS:

Not Applicable

SUBMITTALS:

Not Applicable

CONSTRUCTION:

Comply with Subsection 102.03 of MSHA unless noted otherwise on Contract Documents.

SUPERVISION AND INSPECTION:

The EIC must inspect the limits of removal of existing structures following removal to ensure that they comply with the Contract Documents.

**CONSTRUCTION STAKEOUT**

DESCRIPTION:

Comply with Subsection 107.01 of MSHA unless noted otherwise on Contract Documents. This work consists of providing a construction layout (stakeout) performed by personnel acting under responsible charge of a professional land surveyor currently registered in the State of Maryland.

Note: The Contractor must use competent personnel and appropriate equipment for all work required to set and maintain the elevations and dimensions as specified in the Contract Documents. If any discrepancies between plan and field conditions are found, the Contractor must resolve any needed field adjustments with the EIC and Owner before starting construction.

MATERIALS:

Comply with Subsection 107.02 of MSHA unless noted otherwise on Contract Documents. The surveyor must use marker materials that can be maintained by the Contractor during construction. Demarcation of wetlands using SHA Wetland Tape as described in Section 107.03.09 is not required unless specifically called for on Contract Documents.

SUBMITTALS:

Prior to construction of structures, conduit, earthwork, or other installations, the Contractor shall submit stakeout cut/fill sheets to the EIC for review and approval. Stakeout sheets for limits of disturbance, erosion and sediment control device, and landscape stakeout are not required to be submitted. The stakeout cut/fill sheets shall include a plan showing the location and identification of all stakes/hubs and a table showing:

1. Stake/hub identification
2. Surveyed elevation
3. Proposed elevation
4. Resultant cut or fill depth
5. Offsets or other pertinent notes concerning the stake/hub point.

CONSTRUCTION:

Comply with Subsection 107.03 of MSHA unless noted otherwise on Contract Documents.

The Contractor must have the licensed surveyor provide the following:

1. Project Layout: The Contractor’s surveyor shall accurately locate the Work horizontally and vertically – to ensure that the Work is performed in accordance with the Contract Documents.
2. Baseline Stakeout
3. The surveyor must stakeout all construction baselines with the **maximum** spacing of stations (stakes, nails, crosses, etc.) of 100 feet unless closer stakeouts are specified in the Contract Documents.
4. Site Stakeout
5. The Contractor must perform a surveyed stake out of any alignment centerlines (e.g., embankments) and structure locations.
6. The Contractor shall maintain alignment centerline stake out survey markers such that the EIC can record the station and elevation of each compaction test within +/- 1-foot horizontal accuracy and +/-0.25-foot vertical accuracy.
7. As-built survey
8. An as-built survey of the completed **subsurface** Work shall be performed and shall include but not limited to: horizontal dimensions, grading limits, elevations, slopes, types/length/height of features not able to be surveyed after project completion. Documentation of this survey including red-line plans, notes, dimensions, etc. must be provided to the EIC upon completion of the project.
9. Control Markers: The Contractor must preserve the center line and bench marks set by the surveyor. When the center line and bench marks are disturbed or destroyed, they must be replaced by the Contractor.
10. Control Stakes: For construction baselines, the surveyor must furnish and set stakes at each station as shown on the Contract Documents or offset along one side of the project as site conditions require and per the EIC’s approval. As applicable, each of these stakes must be marked with its offset distance from the center line along with key reference elevation(s) needed for proper construction. Maintenance of surveyor stakes and additional stakes needed for the horizontal and vertical controls necessary for the correct layout of the work must be provided by the Contractor.
11. Utilities: When applicable, the Contractor must furnish to the utility companies or agencies working within the limits of the project, reference information related to control points, alignment and grade data. These must be furnished promptly upon request, so that the utility companies may properly locate and coordinate their work related to the project.

SUPERVISION AND INSPECTION:

Not Applicable

**EARTHWORK - GENERAL**

**General Description:** Work consists of all labor, materials, equipment, dewatering, sheeting and shoring, and services necessary for and incidental to the execution and completion of Grading (Earthwork), as indicated on the Contract Documents and specified herein. The extent of excavation, filling, and grading is shown in the Contract Documents. Preparation of subgrade for conduits, structures, and fills is part of this Work. Backfilling required to establish proposed grade around installations such as structures is included as part of this Work.

All borrow sites and off-site disposal sites utilized by the Contractor to perform work under this Contract must have all necessary State and local permits. The Contactor must identify these sites and provide a copy of appropriate permit(s) to the Owner upon request prior to starting work.

**Existing Utilities:**

1. Notify “Miss Utility” a minimum of 48 hours prior to performing earthwork by calling 1-800-257-7777. Locate existing underground utilities in the areas of work. If utilities are to remain in place, provide adequate means of protection during earthwork operations. The Contractor must repair any Contractor damage to utilities shown on the Contract Documents or identified in the field. All utility work must be done in accordance with specific utility requirements including the use of utility-approved contractors and/or inspectors as appropriate
2. Should pipe conduits or other utilities (not shown on the Contract Documents) be encountered during excavation, stop work in that area and consult the EIC immediately for direction. Cooperate with the Owner and utility companies in keeping respective services and facilities in operation. Repair any Contractor-damaged utilities to satisfaction of utility company.
3. Do not interrupt existing utilities serving occupied facilities, except when permitted in writing by the Owner, and only after acceptable temporary utility services have been provided.

**General Execution Requirements:**

1. Use of Explosives: The use of explosives is prohibited unless authorized in writing by the Owner and approved by MDE.
2. Protection:
3. Safety: Provide protective measures necessary for the safety of the workers, public, the existing dam embankment, and adjacent property. Prevent cave-ins, collapse of walls, structures and slopes, both on and adjacent to the site.
4. Standards: Comply with regulations of local authorities having jurisdiction, including all applicable OSHA and MOSH requirements.
5. Repair: Remove damaged materials and replace with new materials (as required by the Contract Documents) where such materials are affected by settlement or other damage caused by improper earthwork.

**EARTH EXCAVATION**

DESCRIPTION:

Comply with Subsection 201.01 of MSHA unless noted otherwise on Contract Documents.

**Although the MSHA title and specification Section refers only to roadway excavation, this Section applies to all excavation not identified elsewhere in these Specifications.**

This Section covers excavation and handling of any soil material. Earth excavated for reuse as fill on site must be kept in separate stockpiles for top soil and general soil regrading as required by the Contract Documents, Owner, or applicable permit inspectors.

MATERIALS:

Comply with Subsection 201.02 of MSHA unless noted otherwise on Contract Documents.

Material Storage:

1. Stockpile excavated material suitable for backfill or fill where permitted by the Contract Documents, until required. Place, grade and shape stockpiles for proper drainage.
2. Locate and retain soil materials away from edge of excavations.
3. Dispose of excess and or unsatisfactory materials as specified herein.
4. Temporarily stabilize or cover the stockpile as required.

SUBMITTALS:

Not Applicable

CONSTRUCTION:

Comply with Subsection 201.03 of MSHA unless noted otherwise on Contract Documents.

1. Excavation consists of cutting, removing, stockpiling and grading of material encountered when establishing required grade elevations in accordance with the Contract Documents that are not classified rock excavation, pond dredging or unauthorized excavation.
2. Unauthorized excavation consists of site grading that extends beyond the specified bottom elevations or horizontal limits without the direction of the Owner. All remedial work, to correct unauthorized excavation, including backfilling and compacting with earth or gravel, lean concrete fill or any other material to bring elevations to grade as specified and to the satisfaction of the Owner.
3. The EIC must be contacted, and work in that area must be stopped, if unsuitable bearing materials, as determined by the Geotechnical Engineer, are encountered at required elevations. Any additional work must be authorized by the EIC and the Owner **before work continues** including deeper excavation and placement of suitable replacement material. Excavating unsuitable material solely to facilitate performance of other work shall be considered Contractor “means and methods”.
4. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace the excavation where sloping is not possible because of space restrictions or stability of materials excavated. Sheeting, shoring, and bracing is not permitted for excavations in dam embankments. The embankment must be excavated to safe, stable slopes (2-horizontal-to-1-vertical minimum). No vertical trenching is allowed. All conduits penetrating through the dam’s embankment must be installed during construction/re-construction of the embankment. Conduits may not be installed in vertical trenches after the embankment has been constructed.
5. Site Information: Data on indicated subsurface conditions is not intended to be a representation or warrant of continuity of such conditions between soil borings. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn there from by the Contractor. Data is made available for the convenience of the Contractor.
6. Excavation for Structures:
	1. Excavation for structures must conform to elevations and dimensions shown on the Contract Documents within a tolerance of plus or minus 0.1 foot. Excavation should extend 36 inches minimum from footings and foundations to permit placing and removal of concrete formwork and compacting backfill in addition to placing other conduits or adjacent structures. Excavation must not be backfilled without the EIC’s approval.
	2. In excavating for structure footings and foundations, conduits, cradles, drains, etc. do not disturb bottom of excavation. Excavate by hand to final grade just before concrete or other backfill material is placed. The horizontal limits of excavation must be within 36 inches of the surface of installed structures unless specified otherwise on the Contract Documents or covered separately for deep excavation.
	3. Abandoned structures, which may exist where structure footings and foundations, conduits, cradles, drains, etc., are to be placed, are to be removed in their entirety.
7. Fine Grading
	1. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finish surface within specified tolerances, with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
	2. Ditches: Finish ditches to ensure proper flow and drainage. Manage excavation equipment and travel paths as to minimize soil compaction. Stabilize the soil surface with temporary or final stabilization in accordance with sediment control guidelines.
	3. Grass Areas: Finish areas to receive topsoil must conform to within a tolerance of 0.1 foot above or below the required sub-grade elevations.
8. Maintenance
	1. Protection of Graded Areas: Protect newly graded areas from traffic and erosion in accordance with local and State Sediment Control Standards and keep free of trash and debris. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
	2. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.
	3. Disposal of excess and waste materials: Remove waste materials, including unacceptable excavated material, trash, and debris from the construction site. All excess and waste materials must be disposed of in accordance with local requirements.
9. Rock Excavation
	1. Refer to MSHA 201.03.04.
	2. Clean all rock and other hard foundation material of loose material and cut to a firm surface, either level or stepped, as directed. Clean out and grout all seams and crevices using a water jet and/or compressed air and excavate the crack to three (3) times the crack width. Remove all loose and disintegrated rock and thin strata.
	3. Rock excavation consists of removal and disposal of materials encountered that cannot be excavated without the use of explosives or pneumatic equipment. Typical materials classified as rock are, solid rock, rock in ledges, and rock hard aggregate deposits. Intermittent drilling performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.
	4. The determination of rock excavation will be determined and measured in the field by the EIC. Rock is defined as that material which cannot be removed by use of a bulldozer blade with a single-tooth ripper or use of pneumatic equipment and may require blasting. The removal of disintegrated rock is classified as Earth Excavation.
	5. Minimum Effort: If rock is not removed during the process of normal digging and ripping, contact the EIC and Owner for prior approval, then extend the excavation to expose the rock surface within the limit of original excavation. The Contractor must perform any and all rock excavation required to complete the Work.

SUPERVISION AND INSPECTION:

All excavations shall be supervised and inspected by the EIC. All rock excavations, rock surface cleaning, and rock surface preparation shall be supervised by an engineering geologist appointed by the EIC. The EIC shall issue reports for each excavation indicating:

1. Date of inspection
2. Excavation intent (e.g. for structure, for conduit, etc.)
3. Approximate location (base line station, offset, and bottom elevation) of the excavation
4. Area of the excavation
5. Visual observations of the excavation including ground surface condition, any cleaning, deleterious material removal, and/or surface preparation completed,
6. Photos of the excavation
7. Sketches of the excavation geometry (horizontal and vertical) noting dimensions, side slopes, and depth

**PLACEMENT OF EARTH FILL MATERIALS AT DAMS**

DESCRIPTION:

The work consists of the provision and placement of earth fill material at dams. Fill is material, described below, placed above an existing or interim grade required by the Contract Documents.

MATERIALS:

The Contractor must provide the proper care of excavated material to be used as dam embankment and/or impervious material including protection against contamination, moisture and other undesirable effects.

1. Coarse-grained materials used for the embankment shell must be classified in accordance with Unified Soil Classification System (USCS) Soil Types GC, GM, SC, or SM, and the maximum dry density must be not less than 110 PCF as determined by ASTM D698 or AASHTO T-99.
2. Fine-grained materials used for the embankment shell must be classified in accordance with USCS Soil Types CL, or ML and the maximum dry density must be not less than 105 PCF as determined by ASTM D698 or AASHTO T-99.
3. Materials used for the impervious core, cutoff trench or liner must be classified in accordance with USCS Soil Types GC, SC, or CL and must have a minimum of 30% passing the #200 sieve. The material must have a maximum dry density not less than 105 PCF as determined by ASTM D698 or AASHTO T-99.
4. All satisfactory soil materials must be free of rock or gravel larger than two (2) inches in any dimension, debris, waste/rubbish, frozen materials, organic, and other objectionable materials.
5. Material required for filters and drains is not specified in this section but is specified elsewhere in these specifications.

SUBMITTALS:

Prior to installation, the Contractor shall submit to the EIC and receive approval of test results not older than 60 days from an accredited laboratory confirming the acceptability of each earth fill material for use in construction. For the impervious core, cutoff trench, and/or liner, the submittal must include:

1. Sample Location ID (note: if multiple submittals are provided from the same site, each submittal must have a unique location ID and this ID must be provided on the delivery ticket so the appropriate Proctor analysis can be used during compaction testing)
2. Particle Size Distribution Report including hydrometer analysis demonstrating that the earth fill material contains 30% passing the #200 sieve per ASTM D421/D422
3. Atterberg Limits analysis including values for Liquid Limit, Plastic Limit, Plasticity Index per ASTM D4318 and USCS Classification per ASTM D2487
4. Proctor Analysis per ASTM D698 or AASHTO T-99 noting:
	1. Maximum Dry Density
	2. Optimum Moisture Content
	3. Natural Moisture Content

For embankment shell material, the submittal must include:

1. Sample Location ID (note: if multiple submittals are provided from the same site, each submittal must have a unique location ID and this ID must be provided on the delivery ticket so the appropriate Proctor analysis can be used during compaction testing)
2. Particle Size Distribution Report demonstrating that the earth fill material contains no material larger than two (2) inches per ASTM D421/D422
3. Atterberg Limits analysis including values for Liquid Limit, Plastic Limit, Plasticity Index per ASTM D4318 and USCS Classification per ASTM D2487
4. Proctor Analysis per ASTM D698 or AASHTO T-99 noting:
	1. Maximum Dry Density
	2. Optimum Moisture Content
	3. Natural Moisture Content

The Contractor shall also submit to the EIC for approval specification sheets for each type of compaction equipment to be used for compacting embankment fill. The specification sheet should include the following information:

1. Make and Model of the equipment
2. Operating weight
3. Dimension of the equipment’s compaction device (e.g. drum length and diameter, plate area, etc.) including tine dimensions (length, width, depth)
4. Vibration frequency of the equipment’s compaction device
5. Centrifugal force

CONSTRUCTION:

Construction must be in accordance with MSHA Section 204, unless noted otherwise. Sections 204.02.01, 204,03,01(b), and 204.03.02(a) do not apply to this specification. Rock is not to be used in embankment fill unless specifically called for in the Contract Documents and approved by the EIC and MDE. Areas on which fill is to be placed must be stripped of all topsoil, roots, and other deleterious materials and then scarified prior to placement of fill. All fill material must be inspected by the EIC prior to placement for consistency with the approved submittal. Fill materials must be placed in maximum pre-compaction horizontal lifts of four (4) inches around pipes or structures and eight (8) inches for embankment and other fills unless specified otherwise in the Contract Documents. Lifts shall be continuous and horizontal over the entire length of fill. Each layer of embankment fill must be compacted by a power sheepsfoot or pad-foot roller approved by the EIC. Compaction of fill materials must be to 95% of the laboratory maximum dry density as determined by ASTM D-698 or AASHTO method T-99 (Standard Proctor) with moisture content between -2% and +4% of laboratory optimum unless specified otherwise in the Contract Documents.

Backfill adjacent to pipes and structures associated with dam embankments must be of the type and quality conforming to that for adjoining fill. The fill must be placed in horizontal layers not to exceed four (4) inches in thickness and compacted by hand tampers. The fill material must fill completely all voids under and adjacent to pipes and structures. Equipment must not be driven over any part of concrete structure or pipe unless there is compacted fill of 24 inches or more over the structure or pipe.

Impervious cores must be constructed to the elevation and dimensions noted in the Contract Documents. The impervious backfill material must be placed in layers not exceeding eight (8) inches for the entire length of the embankment fill unless specified otherwise in the Contract Documents. Place the impervious core material concurrently with the outer shell of the embankment

SUPERVISION AND INSPECTION

The EIC shall perform compaction tests in accordance with ASTM D6938 or AASTO T-310 (Nuclear method) or ASTM D1556 or AASHTO T191 (Sand Cone method). Test frequency shall be a minimum of one per 5,000 SF but not less than one per lift of material. Cutoff trench compaction shall be tested a minimum of one per 50 LF of trench but not less than one per lift of material. The EIC reserves the right to test at more frequent intervals.

The EIC will prepare and make available written reports documenting the following:

1. Verification of each footing subgrade including bearing tests as applicable
2. Compaction Test Results:
	1. Test Date
	2. Gauge Serial Number
	3. Station/Offset Location
	4. Elevation
	5. Depth of Test (through lift)
	6. Wet Density
	7. Moisture Count
	8. Moisture Content
	9. Dry Density
	10. Maximum Dry Density (from approved submittal)
	11. Optimum Moisture Content (from approved submittal)
	12. % Compaction Required (from Contract Documents)
	13. % Compaction Obtained
	14. Any relevant remarks (“failure”, “re-test”, etc.)

**SUBGRADE PREPARATION**

DESCRIPTION:

Comply with Subsection 208.01 of MSHA unless noted otherwise on Contract Documents.

MATERIALS:

Comply with Subsection 208.02 of MSHA unless noted otherwise on Contract Documents.

SUBMITTALS:

Not Applicable

CONSTRUCTION:

Comply with Subsection 208.03 of MSHA unless noted otherwise on Contract Documents.

SUPERVISION AND INSPECTION:

Subgrade for conduit and structures must be inspected and approved by the EIC. For structure foundations, the EIC shall assess the bearing capacity of the subgrade using a dynamic cone penetration (DCP) test per ASTM D6951 or other method as approved to ensure it equals or exceeds the design bearing capacity assumption.

The EIC shall issue written reports concerning subgrade preparation noting the following:

1. Date of inspection
2. Subgrade preparation intent (e.g. for structure, for conduit, etc.)
3. Approximate location (base line station, offset, and bottom elevation) of the subgrade preparation
4. Area of the subgrade preparation
5. Visual observations of the subgrade including ground surface condition, any cleaning, deleterious material removal, and/or surface preparation completed, measured bearing capacity, etc.
6. Modifications to the subgrade made by the Contractor as a result of findings (e.g. “recompact”, “pour mudmat” (with details of thickness and material used), etc.)
7. Photos of the subgrade

**TREATMENT OF ROCK SURFACES**

DESCRIPTION:

This work consists of preparing and cleaning rock surfaces and the furnishing and placing of either dental or slush grout. Dental concrete is used to fill irregularities in the foundation surface due to joints, bedding, sheared zones, overhangs, or excavated surfaces. Slush Grout is a neat cement grout or a sand-cement slurry that is applied to cracks in the foundation. Slush grout should be used to fill only narrow surface cracks.

MATERIALS:

1. Portland cement shall conform to the requirements of ASTM C150 for the type specified in this specification.
2. Pozzolans conforming to the ASTM C 618, Class C or F, may be used in amounts not to exceed 25 percent, based on absolute volume, to substitute for an equal amount of Portland cement in the concrete grout mixture, unless otherwise specified in the Contract Documents.
3. Aggregates shall conform to the requirements of ASTM C33, except that the grading for coarse aggregate shall be as specified in this specification. For slush grout, the maximum aggregate size shall be no greater than one-third of the minimum crack width.
4. Water shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.
5. Admixtures, when specified, shall be of the type and quality specified in this specification.
6. Curing compound shall conform to the requirements of ASTM C309. If Type I is used, a fugitive dye shall be used.
7. Dental concrete shall have a minimum 28-day strength of 3,000 PSI.
8. Slush grout may consist of Portland cement and water or sand, Portland cement, and water.



1. Slush grout aggregate shall have a maximum particle size no larger than one-third of the smallest crack width.

SUBMITTALS:

Prior to completing rock excavation and surface preparation activities, the Contractor shall submit to the EIC and obtain approval of mix designs for all dental concrete and slurry grout. The mix design submittal must include:

1. Date of Mix Design Analysis
2. Design proportions of component materials by weight per unit of material
3. Design unit weights of component materials
4. Specific gravity of component materials
5. Absolute volume of component materials
6. Theoretical unit weight of material
7. Design strength of material
8. Slump of material
9. Water to Cement Ratio of Material
10. Air Content of Material
11. Sources/Suppliers of each of the component materials
12. Specification sheets for all component materials
13. Certification of the mix design by an accredited laboratory

CONSTRUCTION:

PREPARATION AND CLEANING -After excavation of the overburden has been

completed, the rock surfaces shall be thoroughly cleaned and dewatered. All loose rock,

ledges, and overhangs exposed during preparation of the rock surfaces shall be

removed. Surfaces exceeding the slope limitations specified in section 10 of this

specification shall be eliminated by excavation or by filling with concrete as described in

this specification.

Dental excavation shall consist of the removal of all soil and soft or loose rock from cracks, fissures, holes, and solution channels exposed during excavation activities. The extent of the dental excavation shall be as shown in the Contract Documents with onsite adjustments as determined by the EIC.

Rock surfaces shall be cleaned by air-water cutting, water jetting, wire brush scrubbing, or other suitable methods determined necessary to obtain an acceptable surface. No surface treatment material shall be applied until rock surfaces have been inspected and approved by the EIC. Rock surfaces shall be free of standing or running water during the placement of surface treatment material.

CONVEYING AND PLACING DENTAL CONCRETE OR SLUSH GROUT - Surface treatment material shall not be placed until the rock surfaces have been inspected and approved by the EIC.

Surface treatment material shall be delivered to the site and placed within 1.5 hours after the introduction of the cement to the aggregates. Hot weather and cold weather concreting accommodations shall be made in accordance with ACI 305 and ACI 306 respectively. In any case concrete shall be conveyed from the mixer to the final placement as rapidly as practical by methods that prevent segregation of the aggregates, loss of mortar, or both. Concrete shall not be allowed to free fall more than four feet unless suitable equipment is used to prevent segregation.

All cracks, fissures, solution channels, and other surfaces within the designated area shall be treated as shown in the Construction Documents. Cracks shall be cleaned out and wetted prior to placement of slush grout. Surfaces to be treated shall be kept moist for at least two (2) hours before treatment.

Dental concrete shall be placed a minimum of six (6) inches in thickness. Feathering at the ends of slabs is not permitted – a beveled edge with minimum thickness of six (6) inches shall be provided at the top of the fillet when placing dental concrete against vertical or near-vertical surfaces. Edges of slabs shall be sloped no flatter than 45 degrees. When formed, dental concrete shall not be placed at slopes greater than 0.5 horizontal to 1 vertical.

Concrete shall be filled against any specified remaining rock surfaces that exceed the slope limitations and shall be shaped so that no part of the finished surface exceeds these limitations. The upper surface of overhangs shall be cleaned thoroughly and shaped to allow air to escape during concrete placement to ensure a strong bond between the rock and the concrete.

Slush grout shall be mixed with a mechanical or centrifugal mixer and applied within 30 minutes of mixing.

Slush grout may be applied by brooming over the surfaces containing closely-spaced cracks or by troweling, pouring, rodding, or funneling into individual cracks.

Material placed in cracks, fissures, and solution channels shall be consolidated by vibration, spading, or tamping as necessary to assure complete filling of the void.

Dental concrete slabs shall have a roughened, broomed (but not corrugated) finish to provide a satisfactory bonding surface for embankment material.

CURING AND PROTECTION - The surface of treatment material shall be

prevented from drying for a minimum curing period of seven (7) days after placement. Exposed surfaces shall be maintained in a moist condition continuously for the 7-day curing period or until curing compound has been applied as specified in this section. Moisture shall be maintained by sprinkling, flooding, or fog spraying or by covering with

continuously moistened canvas, cloth mats, straw, sand, or other acceptable material.

Water or moist covering shall be used to protect the concrete treatment during the curing

process without causing damage to the treatment surface by erosion or other

mechanisms that may cause physical damage.

The concrete treatment material may be coated with an approved curing compound as an alternative method to maintaining a continuous moisture condition during the curing period. The compound shall be sprayed on the moist treatment surfaces as soon as free water has disappeared and all surface finishing has been completed. The compound shall be applied at a minimum uniform rate of 1 gallon per 175 square feet of surface and shall form a continuous adherent membrane over the entire treated surface. Curing compound shall not be applied to surfaces requiring bond to subsequently placed grout or concrete. If the membrane is damaged during the curing period, the damaged area shall be resprayed at the rate application specified for the original treatment.

Backfilling operations shall not commence for a minimum period of 72 hours following the placement of concrete treatment unless otherwise specified. No backfill material shall be placed until the treated surfaces have been inspected and approved by the engineer.

Surface treatment material shall not be placed when the daily minimum temperature is less than 40 degrees Fahrenheit unless facilities are provided to ensure that the temperature of the material is maintained at a minimum temperature of 50 degrees Fahrenheit and not greater than 90 degrees Fahrenheit during placement and the curing period. Concrete treatment material shall not be placed on a frozen surface. When freezing conditions prevail, rock surfaces to be treated must be covered and heated to within a range of 50 to 90 degrees Fahrenheit for a minimum period of 24 hours before placing concrete treatment material.

SUPERVISION AND INSPECTION:

All rock surface treatment shall be supervised by an engineering geologist appointed by the EIC. The EIC must prepare written reports for each day surface treatments are applied. The written report shall include:

1. Date of Inspection
2. Weather
3. Surface Treatments Applied
	1. Type of treatment
	2. Station, Offset, and Elevation of treatment
	3. Approximate area of treatment
4. Photos of treatment

In addition, dental concrete placement shall be supervised and inspected. The Owner and EIC must be notified at least 48 hours in advance of concrete placement. Concrete must be poured only in the presence of the EIC during construction and the concrete shall be tested in accordance with MSHA Standard Specifications Section 902.10.08. The EIC must also make test cylinders for all concrete pours for cradles. Seven-day (lab cured) and 28-day (lab cured and field cured) tests must be conducted. For each day that concrete is poured on a project site, a minimum of eight test cylinders must be made for each mix design to be tested at an accredited laboratory for every 50 cubic yards of concrete placed or fraction thereof. Six (6) test cylinders must be cured under the laboratory conditions (two (2) for seven (7) days, two (2) for 28 days, two (2) for 56 days) and two (2) cylinders must be cured under field conditions (for 28 days). The Owner or EIC may require an equal number of test cylinders cured under the job conditions. The test results must be made available within seven days of each completed test. If the concrete fails to meet the contractual requirements, the Owner has the right to require additional testing or reject the concrete.

The EIC will be required to produce written reports summarizing concrete placement and including:

1. Date/Time of Placement
2. Weather Conditions
3. Location of Placement
4. Concrete Supplier
5. Estimated Quantity of Concrete Placed
6. Concrete Slump
7. Concrete Air Percentage
8. Concrete Temperature
9. Number of Cylinders Made
10. Special Measures taken by Contractor to protect concrete (e.g. hot weather or cold weather measures)
11. Concrete Delivery Tickets
12. Photos of Concrete Placement

**PIPE CONDUITS**

DESCRIPTION:

Comply with Subsection 303.01 of MSHA unless noted otherwise on Contract Documents.

This Section includes the requirements to install and/or reconstruct temporary and permanent piping systems to the limits indicated in accordance with the Contract Documents.

This Work includes trench excavation for installation of pipe, including when the trench excavation requires shoring.

MATERIALS:

Comply with Subsection 303.02 of MSHA unless noted otherwise on Contract Documents. Bedding Section shall be revised as follows:

Bedding: All concrete pipe conduits shall be firmly and uniformly bedded in concrete cradles meeting dimensions shown on the Contract Documents. Concrete cradle material shall meet Subsection 902.10 of MSHA Mix No. 3. Reinforcement of the cradle shall be provided as specified by the Contract Documents. All other conduits shall be firmly and uniformly bedded in earth fill materials meeting the material requirements of the Placement of Earth fill Materials at Dams section of these specifications.

All pipe conduits shall have a manufacturer’s stamp indicating the size and class of the pipe on each length of pipe conduit installed. Stamps on reinforced concrete pipes shall be located on the inside wall of the pipe.

Reinforced concrete pipe associated with dam embankments and spillways must be watertight and meet ASTM C361 standards unless noted otherwise on Contract Documents. These pipes must have bell and spigot joints with O-ring rubber gaskets.

Heavy duty corrugated black polyethylene pipe (HDPE), slotted or solid must meet the requirements of AASHTO M252 Type S for diameters of three inches through 10 inches and AASHTO M294 Type S for diameters of 12 inches through 60 inches. All pipe must have a smooth walled interior.

DIP Ductile Iron Pipe (DIP) must meet AWWA C150 and C151 and follow special thickness class minimum Class 51 for four (4)-inch through 54-inch diameters. DIP must include restraining joints if located within a dam embankment. DIP fittings shall be either ductile iron bell, mechanical, or push-on joint unless noted otherwise on the Contract Documents. Fittings shall meet AWWA C110 or AWWA C153 and AWWA C111. Flanged fittings where noted on the Contract Documents shall meet AWWA C110. Bolts, nuts, and studs for flanges shall be 304 stainless steel.

Polyvinyl Chloride (PVC) plastic pipe must meet the requirements of ASTM D1785 for the schedule noted on the Contract Documents. PVC fittings must meet the requirements of ASTM D2466 (Schedule 40) or D2467 (Schedule 80) for the schedule noted on the Contract Documents.

SUBMITTALS:

Prior to installation of pipe conduits, the Contractor shall submit to the EIC and obtain approval of the following:

1. Manufacturer’s certification that pipe meets the appropriate material specification (e.g. AWWA C301, ASTM C361, etc.). This shall include the size, material, and specification for each type of pipe used in the project.
2. Mix Design of cementitious bedding materials (e.g. concrete for cradle)
3. Supplier’s steel drawing of reinforcement for cradle (if required by Contract Documents) indicating all reinforcement to be used including:
	1. Bar Size and lengths
	2. Bend Types and Dimensions
	3. Quantities of all reinforcement materials

CONSTRUCTION:

Comply with Subsection 303.03 of MSHA unless noted otherwise on Contract Documents. Vertical trenching is not allowed. All excavations for pipe conduits shall comply with Construction Section 4 of the Earth Excavation section of these specifications.

Reinforced concrete pipe installation in dam embankments must meet the manufacturer’s recommendation and must be laid in a concrete cradle only after the entire conduit is installed and all joints sealed. Bell and spigot joints shall be installed with the bell end upstream. Pipe conduit shall be installed from downstream to upstream. Mechanical pipe pullers or come-along devices must be utilized to bring the pipe joins into the “home” position. All backfill near pipe conduits and in other critical areas identified on the Contract Documents will be compacted to 95% of the laboratory maximum dry density as determined by ASTM D698 or AASHTO T-99. Reinforced concrete pipe installed in a dam embankment and associated with a concrete structure must be installed prior to construction of the structure with the structure then cast around the pipe. The first downstream joint of the pipe shall be no less than two (2) feet but no more than four (4) feet from the outside face of the structure wall.

Ductile Iron Pipe construction shall be in accordance with MSHA 303.03 (although not specified in MSHA 303). Ductile iron pipe installed in a dam embankment and associated with a concrete structure must be installed prior to construction of the structure with the structure then cast around the pipe. This installation requires bentonite water stop to be installed around the pipe to work as a gasket to ensure watertight connection.

HDPE and PVC pipe must conform with MSHA 303.

All temporary pipes must be removed at the end of the project.

SUPERVISION AND INSPECTION:

1. All pipe conduits must be installed under supervision of the EIC. The EIC will must inspect the pipe conduit installation prior to backfill to ensure the conduit installation meets the intended line and grade specified on the Contract Documents, that all joints are properly seated, and that there is no damage to the installed pipe.
2. Concrete cradles must be installed under supervision of the EIC. Reinforcement for cradles must be inspected by the EIC prior to closing formwork. During construction, the concrete shall be tested in accordance with MSHA Standard Specifications Section 902.10.08. The EIC must also make test cylinders for all concrete pours for cradles. Seven-day (lab cured) and 28-day (lab cured and field cured) tests must be conducted. For each day that concrete is poured on a project site, a minimum of eight test cylinders must be made for each mix design to be tested at an accredited laboratory for every 50 cubic yards of concrete placed or fraction thereof. Six (6) test cylinders must be cured under the laboratory conditions (two (2) for seven (7) days, two (2) for 28 days, two (2) for 56 days) and two (2) cylinders must be cured under field conditions (for 28 days). The Owner or EIC may require an equal number of test cylinders cured under the job conditions. The test results must be made available within seven days of each completed test. If the concrete fails to meet the contractual requirements, the Owner has the right to require additional testing or reject the concrete.
3. The EIC will be required to produce written reports summarizing concrete placement and including:
	1. Date/Time of Placement
	2. Weather Conditions
	3. Location of Placement
	4. Concrete Supplier
	5. Estimated Quantity of Concrete Placed
	6. Concrete Slump
	7. Concrete Air Percentage
	8. Concrete Temperature
	9. Number of Cylinders Made
	10. Special Measures taken by Contractor to protect concrete (e.g. hot weather or cold weather measures)
	11. Concrete Delivery Tickets
	12. Photos of Concrete Placement

**MISCELLANEOUS STRUCTURES**

DESCRIPTION:

Comply with Subsection 305.01 of MSHA unless noted otherwise on Contract Documents.

This Work includes excavation for installation of underground structures, including when the excavation requires shoring.

MATERIALS:

Comply with Subsection 305.02 of MSHA unless noted otherwise on Contract Documents.

Reinforced concrete pipe and end sections associated with storm drains must meet the applicable MSHA Standard Specifications provided in Section 905. End sections must conform with MSHA 305 and the Contract Documents.

Corrugated Metal Pipe end sections must meet the requirements of MSHA Standard Specifications Section 905.

Manhole frames, covers, and steps must be provided in accordance with Construction Documents. Where materials are traffic bearing, they must be designed to withstand H-20 loading. Manholes Steps must be Polypropylene Encapsulated manufactured and in accordance with the Contract Documents.

SUBMITTALS:

Prior to fabrication, the Contractor must submit to the EIC and obtain approval of shop drawings for each structure to be fabricated prior to installation. The shop drawing must include:

1. Identification of the structure (matching notation for the structure shown the Contract Documents)
2. Detailed drawings showing all dimensions, thicknesses, projection distances, appurtenances, reinforcement (bar size, spacing, and bends) for the structure.
3. Detailed calculations supporting the design of the structure including stability analysis (buoyancy, overturning, and sliding) and reinforcement sizing
4. The shop drawings shall be signed and sealed by a Maryland-licensed professional engineer

CONSTRUCTION:

Comply with Subsection 305.03 of MSHA unless noted otherwise on Contract Documents.

Sheeting, shoring, and bracing is not permitted for structure installation in dam embankments. The embankment must be excavated to safe, stable slopes (2-horizontal-to-1-vertical minimum) for structure installation.

SUPERVISION AND INSPECTION:

Prior to installation, the EIC must inspect the structure for damage and to ensure that it matches the approved shop drawings. The Contractor shall not proceed with installation of the structure without approval of the EIC. The EIC must also inspect the structure after installation and prior to backfill to ensure proper joint connections to adjacent conduits, and to ensure that eh structure was not damaged during installation. The Contractor may not proceed with backfilling the structure without approval of the EIC.

**DRAINS**

DESCRIPTION:

Comply with Subsection 306.01 of MSHA unless noted otherwise on Contract Documents.

MATERIALS:

Comply with Subsection 306.02 of MSHA unless noted otherwise on Contract Documents. Polyvinyl Chloride (PVC) plastic pipe must meet the requirements of ASTM D1785 for the schedule noted on the Contract Documents. PVC fittings must meet the requirements of ASTM D2466 (Schedule 40) or D2467 (Schedule 80) for the schedule noted on the Contract Documents. No geotextiles are permitted within dam embankments or drain features unless specifically noted in the Contract Documents.

Except for cleanout fittings and as otherwise noted in the Contract Documents, all bends in drains internal to the dam embankment shall be 22.5 degrees.

Unless noted otherwise, perforated pipes used for drains must have 3/8” inch diameter perforations spaced at 4 inches on center every 90 degrees around the pipe. For slotted pipe used for drains, the slot width must be 1/8-inch, slot length 1.9 inches, 4 slots per row, and 4 slots per linear foot.

Drain cleanout caps must be water tight screw type lid. The pipe must have a plastic collar with ribs to prevent rotation when removing cap. The screw top lid must be a "Panella" type (or Owner-approved equal). Cleanout caps must be installed flush with finished grade.

SUBMITTALS:

Prior to installation of pipe conduits, the Contractor shall submit to the EIC and obtain approval of the following:

1. Manufacturer’s certification that pipe and fittings (bends, Y’s, etc.) meet the appropriate material specification (e.g. 4-inch P.V.C. Schedule 80, etc.) This shall include the size, material, and specification for each type of pipe used in the project.
2. Supplier sample sheet for drain cleanout caps

CONSTRUCTION:

Comply with Subsection 306.03 of MSHA unless noted otherwise on Contract Documents.

SUPERVISION AND INSPECTION:

All drains must be installed under supervision of the EIC. The EIC will must inspect the drain conduit installation prior to backfill to ensure the conduit installation meets the intended line and grade specified on the Contract Documents, that all joints are properly seated, bonded or mechanically attached, and that there is no damage to the installed pipe.

**RIPRAP SLOPE AND CHANNEL PROTECTION**

DESCRIPTION:

Comply with Subsection 312.01 of MSHA unless noted otherwise on Contract Documents.

This section includes the requirements for the provision and installation of rip-rap for channel and slope stabilization in accordance with the Contract Documents.

MATERIALS:

Comply with Subsection 312.02 of MSHA unless noted otherwise on Contract Documents.

The material for rip-rap slope and channel protection must conform to the requirements of MSHA Standard Specifications listed below unless otherwise specified in the Contract Documents:

|  |  |  |
| --- | --- | --- |
| a. | Aggregate Filter Blanket (Graded Aggregate Sub-base) | 901.01 |
| b. | Stone (Rock) | 901.02 |
| c. | Geotextile, Class as specified | 919 |

Locally Harvested Riprap: When the Contractor and the EIC jointly determine that local rock meets the above-specified requirements, the rock may be used to construct project installations per the Contract Documents. Stone must be harvested within the limits of disturbance of the Project Site. The installation of the rock must adhere to all requirements stated in this Section (including filter cloth).

SUBMITTALS:

Prior to installation of riprap slope and channel protection, the Contractor shall submit to the EIC and obtain approval of the following:

1. Riprap stone including:
	1. Gradation
	2. Certification that the riprap meets the class(es) specified in the Contract Documents
2. Aggregate Filter Blanket including:
	1. Gradation
	2. Certification that the aggregate meets the gradation specified in the Contract Documents
3. Geotextile Supplier’s Material Specification Sheet
	1. Material Specification Sheet must include values for all parameters noted in Section 919.01 of MSHA

CONSTRUCTION:

Comply with Subsection 312.03 of MSHA unless noted otherwise on Contract Documents.

Excavation must conform to the lines and grades specified in the Contract Documents. The subgrade must be smooth and firm, free from protruding objects that would damage the geotextile.

Geotextile Filter Cloth: Unless specified otherwise by Contract Documents, the geotextile must be placed on the prepared subgrade with the adjacent edges overlapping a minimum of 2 feet (0.6m). Geotextile torn or damaged must be replaced or repaired.

Aggregate Filter Blanket (Graded Aggregate Sub-base): When aggregate filter blanket is specified in lieu of geotextile, it must conform to the lines and grades specified in the Contract Documents.

Installation of rip-rap aprons must be in accordance with MSHA Section 312. Installation of rip-rap in stacked configurations must be in accordance with Contract Documents. The Maryland Department of the Environment (MDE) Maryland’s Guidelines to Waterway Construction must be followed unless specified otherwise in the Contract Documents.

Backfill: Any excavation voids existing along the edges of the completed slope and channel protection must be completely backfilled.

SUPERVISION AND INSPECTION:

The EIC will must inspect the riprap slope and channel protection installation to ensure the installation meets the intended line and grade specified on the Contract Documents, that rock is placed at uniform depths and meets the minimum required depth, and that there is no damage to the geotextile if installed.

**GABIONS**

DESCRIPTION:

Comply with Subsection 313.01 of MSHA unless noted otherwise on Contract Documents.

This work consists of protecting slopes and channels with stone filled wire baskets as specified in the Contract Documents.

MATERIALS:

Comply with Subsection 313.02 of MSHA unless noted otherwise on Contract Documents.

Gabion wire baskets must be PVC-coated or galvanized and must be in accordance with MSHA Standard Specifications Sections 313 and 906.01. Stone material used to fill gabion baskets must conform to the quality and size specified in MSHA Standard Specifications Section 901.05, and manufacturer’s recommendations. Geotextile shall conform to MSHA Standard Specifications Section 919.

SUBMITTALS:

Prior to installation of gabions, the Contractor shall submit to the EIC and obtain approval of the following:

1. Gabion stone including:
	1. Gradation
	2. Certification that the stone meets the specification in the Contract Documents
2. Wire Basket Supplier’s Material Specification Sheet
	1. Material Specification Sheet shall include confirmation that the wire basket wire, ties, and connecting wire have a minimum tensile strength of 60,000 PSI
	2. Fasteners, if substituted for wire ties are stainless steel interlocking and meet ASTM A313 and maintain closed and locked position when subjected to a force of up to 900 pounds.
	3. Galvanized coating meets ASTM A123 and galvanization rate is 0.8 oz./SF minimum
	4. PVC coating meets MSMT 508 and exhibits no weight loss.
3. Geotextile Supplier’s Material Specification Sheet
	1. Material Specification Sheet must include values for all parameters noted in Section 919.01 of MSHA

CONSTRUCTION:

Comply with Subsection 313.03 of MSHA unless noted otherwise on Contract Documents.

Excavation must conform to the lines and grades specified in the Contract Documents. The subgrade must be smooth and firm, free from protruding objects that would damage the geotextile, and constructed in a manner acceptable to the Owner. The installation of the gabions, filled with stone, must be in accordance with MSHA Standard Specifications Sections 313. The work will require manual adjustment of stone within the baskets.

Gabions shall be carefully filled with rock by machine or hand methods to ensure alignment, avoid bulges, and provide a compact mass that minimizes voids. Machine placement requires supplementing with hand work to ensure the desired results. The cells in any row shall be filled in stages so that the depth of rock placed in any one cell does not exceed the depth of rock in any adjoining cell by more than 12 inches. Along the exposed faces, the outer layer of stone shall be carefully placed and arranged by hand to ensure a neat, compact placement with a uniform appearance. The last layer of rock shall be uniformly leveled to the top edges of the gabions.

SUPERVISION AND INSPECTION:

The EIC must inspect the gabion installation to ensure the installation meets the intended line and grade specified on the Contract Documents, that rock is placed as specified in this section, that the wire baskets are properly closed, tied, and fastened, and that there is no damage to the geotextile, wire baskets, or ties.

**STRUCTURE EXCAVATION**

DESCRIPTION:

Excavate for installation of risers, intake towers, retaining walls (e.g. head walls, end walls, wing walls), weir walls. This excavation includes excavation done solely to facilitate installation of the structure and is above and beyond excavation required to install conduits or make other modifications to the dam covered under the Earth Excavation specification section.

MATERIALS:

Comply with Subsection 402.02 of MSHA unless noted otherwise on Contract Documents. Crusher Run Aggregate CR-6 shall not be used as backfill material around structures.

SUBMITTALS:

Not Applicable

CONSTRUCTION:

Comply with Subsection 402.03 of MSHA unless noted otherwise on Contract Documents.

Where structures are located within dam embankment, sheeting, shoring, and bracing is not permitted. The embankment must be excavated to safe, stable slopes (2-horizontal-to-1-vertical minimum) for conduit installation.

Backfill of the footing foundation shall be done with earth fill meeting the requirements specified in the Placement of Earth Fill Materials at Dams section of these specifications, or sub foundation concrete. Aggregate (including Crusher Run Aggregate CR-6) is not permitted a backfill material. All backfill shall be compacted to a minimum of 95% of the laboratory maximum dry density with a moisture content between -2% and +4% of the laboratory optimum per ASTM D698 or AASHTO T-99.

SUPERVISION AND INSPECTION:

All excavations shall be supervised and inspected by the EIC. All rock excavations, rock surface cleaning, and rock surface preparation shall be supervised by an engineering geologist. EIC shall issue written reports for each excavation indicating:

1. Date of inspection
2. Excavation intent (e.g. for structure, for conduit, etc.)
3. Approximate location (base line station, offset, and bottom elevation) of the excavation
4. Area of the excavation
5. Visual observations of the excavation including ground surface condition, any cleaning, deleterious material removal, and/or surface preparation completed,
6. Photos of the excavation
7. Sketches of the excavation geometry (horizontal and vertical) noting dimensions, side slopes, and depth

For structure excavation backfill, the EIC shall perform compaction tests per ASTM D6938 or AASTO T-310 (Nuclear method) or ASTM D1556 or AASHTO T191 (Sand Cone method). Test frequency shall be a minimum of one per 2,000 SY but not less than one per lift of material. The EIC reserves the right to test at more frequent intervals.

The EIC will prepare and make available written reports documenting the following:

1. Verification of each footing subgrade including bearing tests as applicable
2. Compaction Test Results:
	1. Test Date
	2. Gauge Serial Number
	3. Station/Offset Location
	4. Elevation
	5. Depth of Test (through lift)
	6. Wet Density
	7. Moisture Count
	8. Moisture Content
	9. Dry Density
	10. Maximum Dry Density (from approved submittal)
	11. Optimum Moisture Content (from approved submittal)
	12. % Compaction Required (from Contract Documents)
	13. % Compaction Obtained
	14. Any relevant remarks (“failure”, “re-test”, etc.)

**PORTLAND CEMENT CONCRETE STRUCTURES**

DESCRIPTION:

Comply with Subsection 420.01 of MSHA unless noted otherwise on Contract Documents.

The purpose of this specification is to obtain a dense and durable concrete having the specified strength and other characteristics to resist environmental stresses to ensure a watertight construction in accordance with ACI 350. The EIC may inspect and reject any concrete structure that is poor in quality for reasons including but not limited to: exposed reinforcing steel, misaligned features, poor consolidation of concrete (“honeycombing”, “rock pockets”, etc.), unacceptable joints, spalls, cracks, damages or poor workmanship. Concrete delivery and placement shall be scheduled so that each layer is placed while the proceeding one is still plastic to avoid cold joints. Cold joints resulting from untimely concrete placement shall be considered defective work and shall be removed and replaced at no cost to the owner

Work includes constructing concrete structures such as risers, headwalls, weirs, outlet structures, foundations, slabs, underground vaults, manholes, pipe cradles, and any other concrete structures on the Contract Documents. The Work also includes furnishing, forming, transporting, mixing, placing, curing, and finishing of Portland Cement concrete and protecting the work as called for in the Contract Documents. Pre-cast units may not be substituted for cast in-place concrete without prior written authorization of the Owner, the EIC, and approval by MDE, as applicable.

Unreinforced non-structural concrete may be formed or unformed, and is used in construction of pipe cradles in accordance with the Contract Documents.

SUBMITTALS:

Prior to installation, the Contractor shall submit to the EIC and obtain approval of the following submittals:

1. Shop Drawings:
2. See Reinforcement Steel section of these specifications
3. Design Mix Certification:
4. Prior to placing concrete, submit design mixes for each class and type of concrete, certifying that proposed concrete ingredients and proportions will result in concrete mix meeting specified requirements.
5. Include for each class and type of concrete, as many mix designs as there are combinations of different ingredients or type of ingredients anticipated to cover requirements of the work.
6. Establish mix designs through an accredited laboratory. Design concrete mix for protection against alkali-silica reactivity (ASR). ASR must be tested per ASTM C1567 with 14-day mortar bar expansion not exceeding 0.08%. Documentation of ASR mitigation must be included with the concrete mix design submittal including test results.
7. Cast in Place Installation Documentation: Proposed methods for controlling concrete temperature and plans for placing concrete considering sun, heat, wind, ambient air temperature or other limitations of facilities that will prevent proper finishing or curing. Follow ACI 305R for “Hot Weather Concreting” and/or ACI 306R for “Cold Weather Concreting” as applicable.
8. Poured Concrete Certifications
9. Submit with mix design, laboratory test reports and mill or manufacturer’s certificates verifying that ingredients conform to specified requirements. Use ingredients in design mix which are representative samples of materials to be used in the work.
10. Submit test results whenever the aggregates, cement or other additives to be used in the concrete come from a different lot, source, other area of quarry, different quarry or from other than the representative stockpile or batch from which the original material was tested and approved.
11. If the source, brand or characteristic properties of ingredients need to be revised during the term of the Contract, submit revised laboratory-mix report in accordance with procedures specified for original mix design.
12. Concrete Batch tickets: Before unloading at the site, submit certification or delivery ticket from concrete supplier with each batch delivered to the site bearing the following information:
13. Name of supplier
14. Name of batching plant and location
15. Series number of ticket
16. Date
17. Truck number
18. Specific job designation: contract number and location
19. Volume of concrete in cubic yards
20. Class and type of concrete
21. Time loaded
22. Type and brand of cement
23. Weight of cement and fly ash or ground-iron blast-furnace slag.
24. Maximum size of aggregates
25. Weights of coarse and fine aggregates
26. Maximum amount of water to be added and amount of water added at the site
27. Kind and quantity of admixtures – Admixtures containing Calcium Chloride must not be allowed
28. Precast Concrete Certification:
	1. Manufacturer’s certificates.
	2. Mill tests on each heat showing chemical and physical analyses performed in accordance with ASTM A615, as modified by ACI 318.

MATERIALS:

Comply with Subsection 420.02 of MSHA unless noted otherwise on Contract Documents.

Concrete Codes, Regulations, Referenced Standards and Specifications:

1. International Building Code, latest version
2. American Concrete Institute, “Building Code Requirements for Reinforced Concrete”, ACI 318-02
3. American Concrete Institute, "Environmental Engineering Concrete Structures”, ACI 350/350R-01
4. Detail and Detailing of Concrete Reinforcement ACI 325-92
5. MSHA “Standard Specifications for Construction and Materials”, latest edition, Sections 420, 902, 908, 909, 911, 913, 915, 917, and 921.
6. American Society for Testing Materials (ASTM)

Concrete Structure Material Specifications:

1. Building Code Requirements for Reinforced Concrete, ACR 318, Manual of Standard Practice for Detailing Reinforced Concrete, ACI 315.
2. Maryland Department of Transportation, State Highway Administration “Standard Specification for Construction and Materials”, latest edition, Section 421, 902, and 908.
3. CRSI: Manual of Standard Practice and Recommended Practice for Placing Reinforcing Bars.
4. AASHTO: Standard Specification for Highway Bridges.
5. ASTM: A82, A185, A615

Concrete Materials:

1. As a minimum, the materials for structural cast in place concrete must be provided in accordance with MSHA Standard Specifications Section 420.02. Concrete material for spillways and control structures must also meet ACI 350. Structural concrete must be as designated on the Contract Documents. All exposed corners of concrete structures must have ¾” x ¾” chamfered edges or as otherwise noted on the Contract Documents. Note: The slump measured at the point of placement as determined in accordance with ASTM C143 will be: three (3)-inch maximum for footings and substructure walls, and four (4)-inch maximum for beams, reinforced walls and columns.
2. In addition to meeting the requirements of MSHA Standard Specifications Section 420 and related sections, unless noted otherwise, the compressive strength of precast structures must be 5,000 psi at 28 days. Field coring of new precast structures is not allowed. The Owner reserves the right to reject any structure delivered to the jobsite which is poor in its quality, with regard to exposed reinforcing steel, misaligned features, poor consolidation of concrete, unacceptable joints, spalls or workmanship. Rejected poor quality structures must be replaced.

Unless noted otherwise, non-structural concrete must meet all requirements for MSHA Mix #1 (minimum compressive strength of 2500 psi at 28 days) as specified in MSHA Section 420.

CONSTRUCTION:

Comply with Subsection 420.03 of MSHA unless noted otherwise on Contract Documents.

Concrete Installation:

1. The base on which concrete is to be poured must be free of water, mud, debris, loose materials, oil, frost, and ice. Gravel must not be used as concrete sub-base in dam embankments.
2. Proper forms (MSHA Section 420.03.02) must be laid providing the required depth for the concrete as shown on the plans. Forms must be heavy and secure in place so as not to move during the construction process.
3. Concrete must be placed from a truck which should be no more than 15 feet from the area being poured. Tremies, tubes or chutes, if used, must have metal lining, and must have ends lowered as close as possible to the newly poured concrete. Concrete must not be dropped from more than two (2) feet above the forms. Concrete must be placed in such a manner that there is no segregation of material or displacement of reinforcement.
4. Curing of concrete must be in accordance with MSHA Sections 420 and 902. Any options shown in MSHA Section 420.03.09 will be acceptable. Spraying with liquid membrane is encouraged. Product specifications with application rates must be submitted to the EIC for approval. Failure to cure concrete per specifications may result in rejection and Owner-directed removal of the poured concrete.
5. Concrete must be poured within a temperature range of 50 and 90 degrees Fahrenheit. Special provisions must be developed and approved by the EIC when pouring outside of this range.
6. Concrete must be thoroughly consolidated during and immediately after depositing by mechanical vibration, internal or external as approved by the EIC.
7. A broom finish will be used when specified on drawings or details, and it must be provided before the initial set. Ordinary surface finish must be used on all other structures. See MSHA 420.03.07(a). All concrete structures must have chamfered edges.
8. If any concrete is found to be defective, the Contractor must, at the direction of the Owner, remove defective concrete. Concrete must be deemed defective if: the surface is not finished properly to the satisfaction of the Owner, it does not meet the strength requirements, it is not cured properly, it shows excessive cracking, or it fails to meet other contract requirements. Any concrete not accepted to the satisfaction of the Owner must be removed and replaced by the Contractor.

Concrete Joints: Where required, concrete joints must be installed to include water stops to ensure a watertight structure. Commonly used water stops include rubber, PVC, and bentonite. Type and size of the water stops and accommodations for nearby reinforcement must be per Contract Documents. PVC water stops must be at least six (6) inches wide, meet MSHA Standard Specification’s Section 911.08, and must be supported and centered on the joint. PVC water stop can be field spliced by using the electric splicing iron or by using fittings to assure continuity. Swell type bentonite water stops must be placed to ensure a minimum of two (2) inches of concrete cover. Swell type bentonite water stops shall only be used in the following cases:

* + - 1. Around a conduit penetration through a concrete structure where the conduit material is not concrete (e.g. ductile iron pipe, PVC pipe, etc.)
			2. At a joint between existing pre-construction concrete and freshly placed concrete. This application typically occurs during repairs or modifications to an existing concrete structure.
			3. Otherwise noted in the Contract Documents.

SUPERVISION AND INSPECTION

Installation shall be completed under supervision of the EIC. The EIC must be present and complete observation and testing for the following:

1. Prior to any installation of a concrete structure or conveyance piping, the sub-grade must be tested and approved by the EIC. Refer to the Subgrade Preparation section of these specifications for more information.
2. The Owner and EIC must be notified at least 48 hours in advance of concrete placement. Form work must be approved for lines and grades by EIC prior to placing concrete. Concrete must be poured only in the presence of the EIC during construction and the concrete shall be tested in accordance with MSHA Standard Specifications Section 902.10.08. The EIC must also make test cylinders in accordance with ASTM C31 or AASHTO T23 for all concrete pours for cradles. Seven-day (lab cured) and 28-day (lab cured and field cured) tests must be conducted in accordance with ASTM C39 or AASHTO T22. For each day that concrete is poured on a project site, a minimum of eight test cylinders must be made for each mix design to be tested at an accredited laboratory for every 50 cubic yards of concrete placed or fraction thereof. Six (6) test cylinders must be cured under the laboratory conditions (two (2) for seven (7) days, two (2) for 28 days, two (2) for 56 days) and two (2) cylinders must be cured under field conditions (for 28 days). The Owner or EIC may require an equal number of test cylinders cured under the job conditions. The test results must be made available within seven days of each completed test. If the concrete fails to meet the contractual requirements, the Owner has the right to require additional testing or reject the concrete.
3. The EIC will be required to produce written reports summarizing concrete placement and including:
	1. Date/Time of Placement
	2. Weather Conditions
	3. Location of Placement
	4. Concrete Supplier
	5. Estimated Quantity of Concrete Placed
	6. Concrete Slump (ASTM C172/C143 or AASHTO R60/T119)
	7. Concrete Air Content (ASTM C172/C173 or C231 or AASHTO R60/T152 or T196)
	8. Concrete Temperature (ASTM C172/C1064 or AASHTO R60/T309)
	9. Number of Cylinders Made (ASTM C39/ASTM C31 or AASHTO T23/T22)
	10. Special Measures taken by Contractor to protect concrete (e.g. hot weather or cold weather measures)
	11. Concrete Delivery Tickets
	12. Photos of Concrete Placement

**REINFORCEMENT STEEL**

DESCRIPTION:

Comply with Subsection 421.01 of MSHA unless noted otherwise on Contract Documents.

SUBMITTALS:

1. Detail reinforcing in accordance with ACI Detailing Manual.
2. Bar lists showing the individual weight of each bar, total weight of each bar size and total weight of bars on list. Base calculated weights on theoretical unit weights show in ASTM A615, Table 1.
3. Reproduction of the reinforcement plan drawings is not acceptable.

MATERIALS:

Comply with Subsection 421.02 of MSHA unless noted otherwise on Contract Documents.

CONSTRUCTION:

Comply with Subsection 421.03 of MSHA unless noted otherwise on Contract Documents.

Reinforcement Product Delivery, Storage, and Handling:

1. Ship reinforcing steel in bundles limited to one size and length.
2. Tag each bundle at mill with waterproof tag showing name of mill, heat number, grade and size of bars and identifying number.
3. Protect reinforcing steel and wire fabric from damage; foreign matter such as dirt, oil and grease; and rust causing conditions.

Reinforcement Materials Installation:

1. All reinforcement steel must be new billet steel to conform to ASTM A615 Grade 60, and MSHA Standard Specifications Section 421.02 to 421.03 except as modified herein.
2. Concrete Protection for Reinforcement: Reinforcement must be protected by the thickness of the concrete indicated in the Contract Documents. Where not otherwise shown, the thickness of concrete over the reinforcement must be as follows:
3. Where concrete is deposited against the ground without the use of forms, the Contractor must provide not less than three (3) inches of concrete cover.
4. Where concrete is exposed to weather or ground but placed in forms, the Contractor must provide two (2) inches of concrete cover over all reinforcing steel.
5. Steel Reinforcing: All steel reinforcing must be new billet steel to confirm to ASTM A 615 Grade 60 unless otherwise noted on the Contract Documents.
6. Concrete Joints: Where required, concrete joints, including water stops, must be installed to ensure watertight structure. Submittals indicating specific type and size of the water stops and accommodations for nearby reinforcement must be approved by the EIC prior to installation.

Allowable Tolerances: Cut and bend reinforcing steel to conform to dimensions shown within the following tolerances:

1. Sheared length: Plus or minus one inch
2. All other bends: Plus or minus one inch

SUPERVISION AND INSPECTION:

Reinforcing must be inspected in the forms and approved by the EIC before any concrete is placed. Water stops are to be installed as specified, and inspected prior to concrete placement. The EIC shall inspect the bar type, bar sizes, bar spacing, clearance to forms, water stop location, type, and dimensions. The EIC shall complete a written report noting the following:

1. Date of Inspection
2. Structure/Portion of Structure Inspected (e.g. “EW-1 Footing”)
3. Inspected items (reinforcement, water stop)
4. Findings
5. Repair/revision recommendations made to the contractor
6. Pertinent Photos of the inspection

**METAL STRUCTURES**

DESCRIPTION:

Comply with Subsection 430.01 of MSHA unless noted otherwise on Contract Documents.

Work includes fabricating, furnishing, galvanizing and installing ladders, access hatches and trash-racks in riser structures, orifice plates, and other miscellaneous metal items, and all accessories as shown in the Contract Documents.

MATERIALS:

Comply with Subsection 430.02 of MSHA unless noted otherwise on Contract Documents.

Unless stated otherwise; all steel must meet the requirements of ASTM A-36, and be galvanized in accordance with ASTM A-153 and fabricated as shown in the Contract Documents. All components of each installation must be fully welded as one-piece and galvanized after fabrication.

SUBMITTALS

Prior to fabrication of metal structures, the Contractor shall submit to the EIC and obtain approval of shop drawings or manufacturer’s detail sheets. For items that must be custom fabricated such as ladders, catwalks, trash racks, etc., the shop drawing shall include the following:

1. Specifications for all materials to be used in the fabrication
2. All dimensions required for fabrication
3. Finishes for the fabrication (e.g. hot dip galvanizer)
4. In-field construction item specifications such as bolts, screws, ties, caulk, etc.
5. Highlight any deviations from the Contract Documents

For items that do not have to be fabricated such as manhole covers, vault doors, etc., the manufacturer’s detail sheet must include:

1. Name, model, and manufacturer’s identification number of the item
2. All dimensions of the item
3. Specification for the materials used in the item
4. Specifications for finishes used in the item

Reproduction of details provided or referenced in the Contract Documents is not acceptable and will be rejected.

CONSTRUCTION:

Comply with Subsection 430.03 of MSHA unless noted otherwise on Contract Documents.

Codes, Regulations, Reference Standards and Specifications:

* OSHA Regulations (ladders for riser structures and railings)
* MSHA Standard Specifications Sections 430 and 461

Bolts and Expansion Bolt Materials: Expansion anchor bolts used for anchoring the ladders, hatches, security bars and plates to existing concrete structure must be “Kwik-Bolt” as manufactured by Hilti, Inc., or equivalent as approved by the EIC. All bolts or expansion bolts must be A304 stainless steel.

Bar type trash rack must include trash racks made from smooth steel bars welded to a steel frame and must be fabricated as noted on the Construction Documents.

Expanded Steel Grate Low Flow Trash Rack must be fabricated as noted on the Construction Documents.

Ladders and Hand Rails for Riser Structures must be fabricated as noted on the Construction Documents and must be erected plumb. Ladder rungs must be spaced at 12” maximum on center, unless noted otherwise.

Orifice plates must be ¼” thick. Apply a bead of silicon around perimeter of plate and around all bolt holes.

Hood type corrugated metal trash racks and anti-vortex devices must be fabricated as noted on the Construction Documents.

SUPERVISION AND INSPECTION:

The EIC will must inspect all metal structure installations to ensure the installation meets the intention of the Contract Documents, that the installation connections to structures are not loose and are properly sealed, and that all mechanical installations such as vault doors, lids, etc. function properly.

**METAL RAILING**

DESCRIPTION:

Comply with Subsection 461.01 of MSHA unless noted otherwise on Contract Documents.

MATERIALS:

Comply with Subsection 461.02 of MSHA unless noted otherwise on Contract Documents.

SUBMITTALS

Prior to fabrication of metal railings, the Contractor shall submit to the EIC and obtain approval of shop drawings. The shop drawing shall include the following:

1. Specifications for all materials to be used in the fabrication
2. All dimensions required for fabrication
3. Finishes for the fabrication (e.g. powder coating)
4. In-field construction item specifications such as bolts, screws, ties, caulk, etc.
5. Highlight any deviations from the Contract Documents

Reproduction of details provided or referenced in the Contract Documents is not acceptable and will be rejected.

CONSTRUCTION:

Comply with Subsection 461.03 of MSHA unless noted otherwise on Contract Documents.

SUPERVISION AND INSPECTION:

The EIC will must inspect all metal railing installations to ensure the installation meets the intention of the Contract Documents and that the installation connections to structures are not loose and are properly sealed.

**WORKING DRAWINGS**

DESCRIPTION:

Comply with Subsection 499.01 of MSHA unless noted otherwise on Contract Documents.

MATERIALS:

Comply with Subsection 499.02 of MSHA unless noted otherwise on Contract Documents.

SUBMITTALS:

Not Applicable

CONSTRUCTION:

Comply with Subsection 499.03 of MSHA, unless noted otherwise on Contract Documents, except in Subsections 499.03.03 and 499.03.04, replace “Director – Office of Structures” with “Owner” and remove “District Engineer”.

SUPERVISION AND INSPECTION:

Not Applicable. See the following sections for submittal requirements:

1. Reinforcement Steel
2. Metal Structures
3. Metal Railing

**AGGREGATES**

In addition to conformance with MSHA Section 901 (Tables 901 A and B), aggregate must conform to the following ASTM/AASHTO gradation table (M 43). Washed aggregate must also conform to ASTM C-33.

| AGGREGATE, (AASHTO M 43) (inches) |
| --- |
| Size number | Nominal size square openings(1) | Amounts finer than each laboratory sieve (square openings), percentage by weight |
|  |  | 4 | 3-½ | 3 | 2-½ | 2 | 1-½ | 1 | ¾ | ½ | 3/8 | No. 4 | No. 8 | No. 18 | No. 50 | No. 100 |
| 1 | 3-½ to 1-½. | 100 | 90 to 100 |  | 25 to 60 |  | 0 to 15 |  | 0 to 5 |  |  |  |  |  |  |  |
| 2 | 2-½ to 1-½. |  |  | 100 | 90 to 100 | 35 to 70 | 0 to 15 |  | 0 to 5 |  |  |  |  |  |  |  |
| 24 | 3-½ to ¾. |  |  | 100 | 90 to 100 |  | 25 to 60 |  | 0 to 10 | 0 to 5 |  |  |  |  |  |  |
| 3 | 2 to 1. |  |  |  | 100 | 90 to 100 | 35 to 70 | 0 to 15 |  | 0 to 5 |  |  |  |  |  |  |
| 357 | 2 to No. 4. |  |  |  | 100 | 95 to 100 |  | 35 to 70 |  | 10 to 30 |  | 0 to 5 |  |  |  |  |
| 4 | 1-½ to ¾. |  |  |  |  | 100 | 90 to 100 | 20 to 55 | 0 to 15 |  | 0 to 5 |  |  |  |  |  |
| 467 | 1-½ to No. 4. |  |  |  |  | 100 | 95 to 100 |  | 35 to 70 |  | 10 to 30 | 0 to 5 |  |  |  |  |
| 5 | 1 to ½. |  |  |  |  |  | 100 | 90 to 100 | 20 to 55 | 0 to 10 | 0 to 5 |  |  |  |  |  |
| 56 | 1 to 3/8 |  |  |  |  |  | 100 | 90 to 100 | 40 to 75 | 15 to 35 | 0 to 15 | 0 to 5 |  |  |  |  |
| 57 | 1 to No. 4. |  |  |  |  |  | 100 | 95 to 100 |  | 25 to 60 |  | 0 to 10 | 0 to 5 |  |  |  |
| 6 | ¾ to 3/8. |  |  |  |  |  |  | 100 | 90 to 100 | 20 to 55 | 0 to 15 | 0 to 5 |  |  |  |  |
| 67 | ¾ to No. 4. |  |  |  |  |  |  | 100 | 90 to 100 |  | 20 to 55 | 0 to 10 | 0 to 5 |  |  |  |
| 68 | ¾ to No. 8. |  |  |  |  |  |  | 100 | 90 to 100 |  | 30 to 65 | 5 to 25 | 0 to 10 | 0 to 5 |  |  |
| 7 | ½ to No. 4. |  |  |  |  |  |  |  | 100 | 90 to 100 | 40 to 70 | 0 to 15 | 0 to 5 |  |  |  |
| 78 | ½ to No. 8. |  |  |  |  |  |  |  | 100 | 90 to 100 | 40 to 75 | 5 to 25 | 0 to 10 | 0 to 5 |  |  |
| 8 | 3/8 to No. 8. |  |  |  |  |  |  |  |  | 100 | 85 to 100 | 10 to 30 | 0 to 10 | 0 to 5 |  |  |
| 89 | 3/8 to No. 16. |  |  |  |  |  |  |  |  | 100 | 90 to 100 | 20 to 55 | 5 to 30 | 0 to 10 | 0 to 5 |  |
| 9 | No. 4 to No. 16. |  |  |  |  |  |  |  |  |  | 100 | 85 to 100 | 10 to 40 | 0 to 10 | 0 to 5 |  |
| 10 | No. 4 to 0 (2). |  |  |  |  |  |  |  |  |  | 100 | 85 to 100 |  |  |  | 10 to 30 |
| (1) In inches, except where otherwise indicated. Numbered sieves are those of the United States Standard Sieve Series.(2) Screenings. Where standard sizes of coarse aggregate designated by two or three digit numbers are specified, the specified gradation may be obtained by combining the appropriate single digit standard size aggregates by a suitable proportioning device which has a separate compartment for each coarse aggregate combined. Blending must be done as directed by the Laboratory. |

**GEOTEXTILES**

Geotextile Filter Fabric (Non-Woven): In addition to conformance with MSHA Subsection 919, Non-Woven geotextile filter fabric must conform to Class C per Table H-24-1 in the MDE “2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control.” The fabric must have minimum grab strength of 200 pounds and minimum puncture strength of 80 pounds. Note: This item will not be paid when fabric is incidental to other work (e.g., riprap). All geotextiles shall be stored under cover per manufacturer’s specifications until installation. Geotextile shall be completely covered with backfill, aggregate, riprap, or other material after installation.

**VALVE INSTALLATION**

Description, Material and CONSTRUCTION:

Install valve and associated fittings as shown on the Contract Documents.

MATERIALS

Gate valves and valve extensions must meet the requirements of AWWA C509 or AWWA C515. Valves must be manufactured by DeZuric, Mueller, or Kennedy or equal approved by the EIC. All valves must be non-rising stem, and have a resilient seated design for installation in horizontal or near-horizontal pipe conduits.

Valves will have a AWWA two (2)-inch square operating nut or wheel turned counter-clockwise to open as noted on the Contract Documents.

Valve stem extensions must have a minimum yield strength of 40 ksi. Following ASTM B763, UNS alloy C99500 or ASTM B138, UNS alloy C67600 in H04 temper. Externally accessible bolts, nuts, and washers shall be minimum 304 stainless steel.

SUBMITTALS:

Prior to installation of valves and associated fittings, the Contractor shall submit to the EIC and obtain approval of the manufacturer’s detail sheets for the valves and associated fittings such as wheels, stem extensions and guides, actuators, etc. The submittal must include:

1. Name, model, and manufacturer’s identification number of the item
2. All dimensions of the item
3. Specification for the materials used in the item
4. Specifications for finishes used in the item

Reproduction of details provided or referenced in the Contract Documents is not acceptable and will be rejected.

CONSTRUCTION

Install valves using flanged connections in-line and on-grade with adjacent pipe conduit.

Install valve stem extensions plum, supported and installed in such a way as to allow for proper valve operation.

Exercise valve assembly after complete installation to ensure system operability.

Perform leak testing of valve in accordance with AWWA C509 or AWWA C515.

SUPERVISION AND INSPECTION:

The EIC will must inspect all valve installations to ensure the installation meets the intention of the Contract Documents, that the installation connections to structures and conduits are not loose and are properly sealed, and that all installations function properly.

**SEEPAGE CONTROL FILTER**

Description:

Seepage Control Filters (e.g. filter diaphragms, chimney filters, blanket drains, toe drains) are used to control seepage in the dam embankments. A filter is a critical feature within the dam, and must be constructed according to specifications. Filters are generally located inside of the dam’s embankment downstream of the dam axis.

Materials: The size and extent of the seepage control measures and any piping necessary must be in accordance with the Contract Documents.

Fine Aggregate Media: Fine aggregate media must meet the sieve requirements of the fine aggregate media reference noted in the Contract Documents. Fine aggregate must be clean washed fine aggregate. Limestone based products, manufactured sand and stone dust are not acceptable.

Coarse Aggregate Media: Coarse aggregate material must meet the gradation reference noted in the Contract Documents. Coarse aggregate must be clean washed coarse aggregate. Limestone based products are not acceptable.

Pipe conduit and fittings: Per *Drains* Section.

SUBMITTALS:

Prior to installation, the Contractor shall submit to the EIC and obtain approval of manufacturer’s certifications that the fine and coarse aggregate media meet the specifications and gradations required in the Contract Documents.

CONSTRUCTION:

Installation must be in accordance with the requirements stated in the Contract Documents and as follows:

1. Place aggregate uniform eight (8)-inch loose lifts (measured before compaction).
2. Wet each lift thoroughly with potable water prior to compaction.
3. Compact with a minimum of two (2) passes of a vibratory plate compactor weighing at least 160 pounds. The compactor shall have a minimum centrifugal force of 2,450 pounds at a vibrating frequency of no less than 5,000 cycles per minute or by a minimum of two passes of a vibratory smooth wheeled roller weight no less than 325 pounds with a centrifugal force of 2,250 pounds at a vibrating frequency of no less than 4,500 cycles per minute.
4. Place aggregate to avoid segregation of particle sizes and to ensure continuity and integrity of all zones.
5. Take proper measures to prevent contamination of the filter media by adjacent soil lifts, construction debris, or other material. Contaminated areas must be removed and replaced.
6. Any damage to the foundation surface or the trench sides or bottom during placement shall be repaired before placement of the sand media continues.
7. The upper surface of the filter zone constructed concurrently with adjacent fill zones shall be maintained at a minimum elevation of one (1) foot above the upper surface of adjacent fill.
8. The filter diaphragm toe drain(s) shall outlet at the principal spillway outlet and extend a minimum of two (2) inches beyond the end of any support wall.

SUPERVISION AND INSPECTION

1. Installation shall be completed under supervision by the EIC.
2. The EIC shall confirm the validity of the material delivered to the site both by visual-manual classification of the material and by collecting and reviewing the material ticket for each load of material delivered and confirms that it meets the specification in the Contract Documents. One sieve analysis in accordance with ASTM C136 or AASHTO T27 shall be performed for every 500 CY of material installed with one test required per installation per material.
3. The EIC shall confirm that all steps of the process detailed in the Construction section are followed for each lift.
4. The EIC shall manually inspect the wetted fine aggregate by sampling the installed fine aggregate a minimum of once per lift of material installed.

**PIPE RESTORATION BY SLIPLINING**

DESCRIPTION:

This section includes the requirements to repair the existing pipe conduits by inserting a HDPE pipe liner and grouting of the annular space between two pipes with cement based grout (grouting for sliplining is covered under separate specification).

SUBMITTALS

The Contractor must furnish a Supplier’s Certification for the pipe material, and pipe dimensions. Liner and fittings shall be manufactured from PE resin compounds, which conform to the requirements of cell class 345464C as defined and described in ASTM D 3350-12. The liner must have smooth, non-corrugated interior and must be resistant to UV radiation. The liner must be capable of being jointed into continuous length with mechanical connectors, male and female. Liner joints shall comply with ASTM D3212 Standard Specification for Joints. The Contractor must follow the manufacturer’s recommendations for proper installation of the product. Slip liner pipe must be centered on the host pipe and by use of wood spacers in accordance with manufacturer’s recommendations.

MATERIALS:

Prior to installation of the slipliner the Contractor must submit to the EIC and obtain approval of:

1. Manufacturer’s specification sheet for the slip liner. Liner must be Snap-Tite Solid HDPE Liner by ISCO or EIC-approved equal.
2. Installer’s qualifications and experience. The installation must be performed by an experienced installer who has completed pipe lining installations similar in material, design, and whose work has resulted in construction with the record of successful performance. Installer qualifications including list of three (minimum) completed projects involving pipe sliplining, identified by name, linear feet of sliplining installed, location, the reference name and the phone numbers must be included in this submittal.

CONSTRUCTION:

1. Prior to installation, the EIC must complete am inspection of the host pipe. This inspection may be done visually if the pipe size is sufficient to allow safe access or via CCTV methods if the pipe is too small to access. The EIC must provide a written report documenting the following:
	1. Date of Inspection
	2. Pipe Size and Material Inspected and Location in Dam
	3. Inspection Method (visual or CCTV)
	4. Inspection findings including station location along the pipe and orientation of finding around the circumference of the pipe (e.g. 9:00)
	5. Repair recommendations to the Contractor prior to slipliner installation
	6. Photos/Video Captures of the inspection
2. Cleaning and Repairs - the host pipe must be cleaned to remove any obstructions and any recommended repairs made by the EIC completed prior to slip lining.
3. The liner pipe must be centered on the host pipe.
4. The annular space must be fully grouted in a continuous operation (see Cement Based Grout for Sliplining section of these specifications). In case the existing pipe shows signs of significant infiltration, the potential cavity outside the pipe may have to be treated by pumping of a chemical grout prior to slip lining operation as directed by the EIC.

SUPERVISION AND INSPECTION

The pipe segments shall be inspected by the EIC prior to installation to ensure they meet the required material specifications and size specified in the Contract Documents and that they are free of defects or damage.

The pipe shall be inspected by the EIC after installation and prior to grouting to ensure that the line and grade meet that specified in the contract documents, the pipe was not damaged during installation, and all joints are properly seated. The Contractor shall not grout the annular space outside of the slipliner until this inspection is complete.

**CEMENT BASED GROUT FOR SLIPLINING**

DESCRIPTION:

This section includes the requirements for the grouting with cement based grout of the annular space between the slip liner pipe and the host pipe in the sliplining process.

SUBMITTALS

Prior to installation, the Contractor shall submit to the EIC and obtain approval the grout mix design.

MATERIALS:

Grout must be composed of Portland cement, fine sand, admixtures, and potable water proportioned as to create a concrete that can be pumped yet remains dense, to completely fill void between the host pipe and the pipe liner. Grout must be mixed on site, unless approved otherwise by the EIC. The grout mix must be cement and water proportioned in the ratio of one (1) cubic foot of cement to one (1) cubic foot (7.5 gallons) of water. The mix ratio may be modified by grout pump operator to ensure filling of all voids. Grout must meet ASTM C1107. Grout must remain fluid for at least two (2) hours after it was pumped, and must develop minimum compressive strength of 1000 psi within 7 days. Grout must be tested in accordance with ASTM C939. Grout must be non-shrink.

CONSTRUCTION:

The annular void must be completely grouted by injecting grout from one end of the pipe run and allowing it to flow toward the other end. Grouting of the annular space between the slip-lined and the host pipes shall start from the downstream side of the barrel so that the entire annular space between the two pipes is filled with grout.

Venting of the annular void must be performed to ensure uniform filling of the void space during the grouting process. Care must be taken so that the grout does not float or damage the liner. The Contractor must follow the HDPE liner manufacturer’s recommendations for allowable grouting pressures based on the pipe size.

SUPERVISION AND INSPECTION

Installation shall be completed under supervision of the EIC.

During construction, the grout shall be tested in accordance with ASTM C939. For each day that grout is installed on a project site, grout cubes shall be made for every 50 cubic yards of grout placed or fraction thereof. The test results must be made available within seven days of each completed test.

The EIC will be required to produce written reports summarizing concrete placement and including:

1. Date/Time of Placement
2. Weather Conditions
3. Location of Placement
4. Grout Supplier
5. Estimated Quantity of Grout Placed
6. Grout Pumping pressure range
7. Grout Temperature
8. Number of Cubes Made
9. Grout Delivery Tickets
10. Photos of Grout Placement

In addition to supervising the installation of and testing the grout, the final sliplined pipe must be inspected by the EIC after the grout has reached its design strength to ensure no defects (cracks, bulges, leaks, etc.) have developed during the grouting operation.

Requirements in this article coordinate with AIA Document A201. Revise to suit Project. For individual allowance items that include installation labor or other costs, provide detailed description of covered costs in "Schedule of Allowances" Article.

Retain "Unused Materials" Paragraph below if allowances are not used for low-cost or single-unit items only.