SPECIFICATIONS

STORM SEWER AND DRAINAGE MAINTENANCE SERVICES

IFB # 2000002574
Attachment A
# TECHNICAL SPECIFICATIONS

COUNTY OF FAIRFAX, VIRGINIA

Storm Sewer and Drainage Maintenance Services Technical Specifications

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SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Submittal Procedures
2. Shop Drawings
3. Samples
4. Product Data

1.2 SUBMITTAL PROCEDURES

A. Approval Requests: As the Work progresses and in the sequence indicated by the accepted Progress Schedule, the Contractor shall submit to the Engineer a specific request in writing for each item of information or approval required of him by the Contract. These requests shall be submitted sufficiently in advance of the date upon which the information or approval is actually required by the Contractor to allow for the time the Engineer will take to act upon such submissions or resubmissions. The Contractor shall not have any right to an extension of time due to delays caused by his failure to submit his requests for the required information or the required approval on time.

B. Transmittal: The Contractor shall submit to the Engineer, at the address given in the Agreement, 3 complete copies and one digital copy of each submittal unless otherwise noted. Submittals shall be accompanied by a letter of transmittal containing the following information:

1. Submittal number: Number submittals sequentially.
2. Identification of the Contractor, subcontractor or supplier.
3. Project title, project number and division, and contract number.
4. Specification Section number, Section submittal number and suffix.
5. Drawing sheet, and detail number as appropriate.
6. Contractor's stamp or certification the products have been reviewed and are in accordance with the requirements of the Work and the Contract Documents.
7. Listing of variations from Contract Documents and any limitations which may be detrimental to the Work.
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C. Review by Engineer: Drawings or descriptive data will be marked "Approved," "Approved as Noted," "Revise and Resubmit," or "Rejected" and Contractor's copies together with a letter of transmittal will be returned to the Contractor.

D. No Additional Copies Required: When the drawings and data are returned marked "Approved," no additional copies need be furnished.

E. Corrected Copies: When submittals are marked "Approved As Noted", 2 corrected copies with changes highlighted shall be submitted. If additional, new changes are proposed, they shall be submitted in accordance with Paragraph B of this Article.

F. Resubmittals: When the drawings and data are returned and marked "Rejected," the corrections shall be made as noted thereon and as instructed by the Engineer, and corrected copies shall be resubmitted in accordance with Paragraph B of this Article. When corrected copies are resubmitted, the Contractor shall in writing direct specific attention to all revisions and shall list separately any revisions other than those called for by the Engineer on previous submittals. A marked copy of the original submittal shall also accompany the resubmittal.

1. Resubmittals shall be given an alphabetic suffix to the Section submittal number of the original submittal to indicate which resubmittal it is (i.e.; #a indicates first resubmittal, #b indicates second and so forth).

2. Letter of Resubmittal: Contractor's letter of resubmittal shall list the date of his original submittal letter, the date of the Engineer's letter returning the submittal, and the dates of submission and return of any previous resubmittals.

1.3 PROGRESS SCHEDULES

A. Upon request of the Engineer the Contractor shall submit a schedule to include the following:

1. Prepare schedules as a horizontal bar chart with separate bar for each major operation or portion of Work identifying first workday of each week.

2. Provide space to show proposed and actual progress, notations and revisions

3. Show complete sequence and direction of construction by activity with beginning and ending dates and stations of each element of construction.

4. Activities shall include receipt and unloading of pipe, installation of pipe, VDOT crossings, railroad crossings, anticipated shutdown of mains, hydrostatic testing and closures at minimum. Coordinate content with the proposal breakdown (required by Article 10, 10.2 of the General Conditions).

5. Provide sub-schedules to amplify critical activities.
TECHNICAL SPECIFICATIONS

6. Show accumulated percentage of completion of each item and total percentage of Work completed as of the 25th day of each month

1.4 SHOP DRAWINGS

A. Shop Drawings: The Contractor shall promptly prepare and submit layout, detail, and shop drawings for such parts of the Work as specified.

B. Schedule: A schedule of shop drawing submittals shall be submitted for the Engineer's review within 20 days after the Notice to Proceed for each Project assigned under this Contract.

C. Project Information: Each shop drawing shall be dated and shall contain the following: (1) Project Name, (2) Contract Number, (3) Submittal Number, (4) Project Identification, (5) Drawing Title, (6) Reference to Contract Drawing Number and specification section and paragraph, (7) Contractor's certification statement, (8) names of equipment or materials, and (9) the locations at which the equipment or materials are to be installed in the Work. The Engineer may decline to consider any shop drawing that does not contain complete data on the Work and full information on related matters.

D. Requirements: Shop drawings shall present, where applicable, engineering data and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

1. Numbering and Additional Considerations: Shop drawings shall be numbered consecutively and shall accurately and distinctly present the following:

a. All working and erection dimensions
b. Arrangement and sectional views
c. Necessary details, including complete information for making connections between Work under this Contract and work under other contracts
d. Types of materials and finishes
e. A list and description of parts

E. Review by Contractor:

1. The Contractor shall check and approve all shop drawings before transmitting them to the Engineer to determine that they comply with the requirements of the Contract Documents. Drawings which are not complete or not in compliance with the Contract Documents shall not be submitted. All shop drawing submittals, regardless of origin, shall be stamped with the approval of the Contractor and identified with the Contractor's name and references to applicable specification paragraphs and Contract Drawings. Each shop drawing submittal shall indicate the
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intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified. Non-applicable data shall be stricken from the submittal. The current revision, issue number, and date shall be indicated on all shop drawings and other descriptive data. The Contractor's stamp of approval shall constitute a representation to the Owner and the Engineer that the Contractor accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data; that he has reviewed or coordinated each submittal with the requirements of the Work and the Contract Documents; and that the submittal fully meets the requirements of the Contract Documents or is specifically marked otherwise.

2. Deviations From Contract Requirements: If the shop drawings show deviations from the Contract requirements, the Contractor shall make specific mention thereof as previously specified in this Section. Review of such submittals shall not constitute approval of the deviation. Review of the shop drawings shall constitute review of the subject matter thereof only and not of any structure, arterial, equipment, or apparatus shown or indicated. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by the Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams, all in accordance with Section 01630 Product Options and Substitutions.

3. Completeness of Shop Drawings: The Contractor shall accept full responsibility for the completeness of each submittal, and, in the case of a resubmittal, shall verify that all exceptions previously noted by the Engineer have been taken into account.

F. Review of Shop Drawings by Engineer: The review of shop drawings will be general and shall not relieve the Contractor of responsibility for the accuracy of such drawings, or for the proper fitting and construction of the Work, or for the furnishing of materials or Work required by the Contract and not indicated on the shop drawings. No Work called for by shop drawings shall be done until the said drawings have been reviewed and approved by the Engineer.

G. Resubmittals:

1. Resubmittals Within 30 Days: Resubmittals shall be made within 30 days of the date of the letter returning the material to be modified or corrected, unless within 14 days the Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be complete within that time.

2. Additional resubmittals: Any need for more than one resubmittal or any other delay in obtaining the Engineer's review of submittals will not entitle the Contractor to an extension of time unless a delay of the Work is directly caused by an authorized change in the Work or by the Engineer's failure to return any submittal.
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1.5 SAMPLES

A. General: When required, the Contractor shall submit to the Engineer for review typical samples of materials and appliances. The samples shall be properly identified by tags and shall be submitted sufficiently in advance of the time when they are to be incorporated into the Work so that rejections thereof will not cause delay. A letter of transmittal, in triplicate, from the Contractor requesting review must accompany all such samples.

1.6 PRODUCT DATA

A. General: Submit Manufacturer’s standard product data when special fabrication is not required.

1. Products proposed for use in the Work shall be clearly designated in order for submittal to be considered for approval.

2. Manufacturer’s product data shall provide sufficient information for thorough review. Attach supplemental information to detail how the product will be installed in the Work.

3. Line through extraneous information.

END OF SECTION 01300
TECHNICAL SPECIFICATIONS

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. General Requirements
   2. Manufacturers
   3. Transportation and Handling

1.2 SUBMITTALS

A. Manufacturers, Materialmen, Suppliers and Dealers: The names of proposed manufacturers, materialmen, suppliers, and dealers who are to furnish materials, fixtures, equipment, appliances, or other fittings shall be submitted to the Engineer for acceptance, in accordance with Section 01300, as early as possible, to afford proper investigation and checking. Such acceptance must be obtained before shop drawings will be reviewed. No manufacturer will be accepted for any materials to be furnished under this Contract unless, in the Engineer's opinion, the manufacturer is of good reputation and has a plant of ample capacity. Upon the Engineer’s request, the manufacturer shall submit evidence that a product like the one specified has been previously manufactured and used for a like purpose and for a sufficient period of time to demonstrate satisfactory performance.

B. Samples: Submit samples for approval in accordance with the individual specification sections.

1.3 GENERAL REQUIREMENTS

A. Conformance with Laws, Ordinances, Codes, and Specifications: All materials and appliances used in construction shall be in accordance with the Contract Documents and shall be a grade sufficient to conform to the requirements of applicable laws, ordinances, and codes.

B. Quality Requirements:

   1. Materials and Equipment: All materials and equipment incorporated into the Work shall be new, unused, and correctly designed. Materials and equipment shall be of a standard, high-grade quality, produced by expert workmen, and intended for the use for which they are offered. Materials or equipment which in the Engineer's opinion are inferior or of a lower grade than indicated, specified, or required will not be accepted.

   2. Workmanship: The quality of workmanship and materials entering into the Work under this Contract shall conform to the requirements of the Contract Documents.
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C. Standards:

1. Equipment and Appurtenances: Equipment and appurtenances shall be designed in conformity with ANSI, ASME, IEEE, NEMA, AWWA, and any other applicable standards and shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, and all conditions of operation. All bearings and moving parts shall be adequately protected against wear by bushings or other approved means and shall be fully lubricated by readily accessible devices. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, and the like shall be finished the same in appearance. All exposed welds shall be ground smooth, and the corners of structural shapes shall be ground smooth, and miter the corners of structural shapes.

2. Electrical Requirements: Electrical devices, motors, equipment, control panels, electrical equipment enclosures, and other electrical equipment appurtenances shall be UL labeled. Shop drawings for electrical equipment shall denote that the represented material has the UL label. Nonlisted materials and special equipment devices not normally UL listed and labeled shall equal or exceed the latest UL standards for such types of equipment. The contractor shall be responsible for providing the services of an electrical inspection firm to certify compliance of all nonlisted materials to the UL standards and for providing materials with an inspection label in accordance with local code requirements.

D. Dimensions:

1. Equipment: Equipment shall be of the approximate dimensions shown or specified, shall fit the spaces shown with adequate clearances, and shall be capable of being handled through openings provided in the structure for this purpose. Equipment shall be designed to permit piping and electrical connections, ductwork, and auxiliary equipment to be assembled and installed without causing major revisions to the location or arrangement of any of the facilities. The Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from those anticipated in the Drawings or Specifications.

2. Machinery Parts: Machinery parts shall conform exactly to the dimensions on the shop drawings. There shall be no more fitting or adjusting in setting up a machine than is necessary in assembling a high grade apparatus of standard design. The equivalent parts of identical machines shall be made interchangeable. All grease lubricating fittings on equipment shall be of a uniform type. All machinery and equipment shall be safeguarded in accordance with the safety codes of the ANSI and the State Industrial Code.
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1.4 MANUFACTURERS

A. General:

1. Unless named in the specifications, a manufacturer shall have furnished equipment of the type and size specified in the Contract Documents which has been in successful operation for not less than the five years.

2. All transactions with the manufacturers or subcontractors shall be through the Contractor when materials or products are being furnished by the Contractor.

3. Any two or more pieces of material or equipment of the same kind, type, or classification used for identical types of service, shall be made by the same manufacturer.

1.5 TRANSPORTATION AND HANDLING

A. Delivery: Deliver Contractor materials in quantities sufficient to insure the uninterrupted progress of the Work and its completion within the allotted time. Coordinate Contractor deliveries in order to avoid delay in, or impediment of, the progress of the Work of any related contractor.

B. Care and Protection: The Contractor shall be solely responsible for properly storing and protecting all materials, equipment, and Work furnished under this Contract from the time such materials and equipment are delivered at the site of the Work until final acceptance thereon. The Contractor shall at all times take necessary precautions to prevent injury or damage to such materials, equipment, and Work by whatever cause, including, without limitation, water, freezing, dust and atmospheric contaminants, or inclemencies of the weather. All injury or damage to materials, equipment, or work resulting from any cause whatsoever shall be made good by the Contractor.

END OF SECTION 01600
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. This Section outlines the policies and procedures for obtaining consideration and acceptance of products other than those specified.

1.2 DESIGN REQUIREMENTS

A. Intention of Contract Documents: It is the intention of these Contract Documents that the Work be constructed with the specified products. The Contractor shall base the bid price on the products specified. The County has the right to reject proposed substitutions for any reason.

B. Equivalent Materials and Equipment

1. Whenever a material, article or method is specified or described by using the name of a proprietary product or the name of a particular manufacturer(s) or vendor(s), followed by the phrase "or approved equal", the specific item mentioned shall be understood as establishing the type, function, dimension, appearance, and quality desired and is to be the basis upon which bids are to be prepared. Other manufacturer's materials, articles and methods not named will be considered as substitutions provided required information is submitted in the manner set forth herein and provided substitution will not require substantial revisions of the Contract Documents. This applies to specific construction methods when such are required by the Contract Documents.

2. Whenever a material, article, or method is specified or described without the phrase "or approved equal", no substitutions will be allowed.

1.3 SUBMITTALS

A. Submittal of Proposed Substitutions: Bids shall be based on materials, articles and methods named and specified in the Contract Documents. If the bidder proposes to use substitutions for named and specified materials, articles and methods followed by the phrase "or approved equal" within the Contract Documents during the construction process, he shall submit a list of proposed substitutions For Specific Items with his bid. The Contractor shall submit a separate request for each product, supported with complete data, drawings, and samples as appropriate. Three copies of the following data, including but not limited to the following information shall be submitted in order for substitutions to be considered.
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B. Contractor to Submit Requests for Substitutions: Requests for review of a substitution or equivalent will not be accepted from anyone except the contractor. Moreover, such requests will not be reviewed until after the contract award. Complete data for substitutions must be submitted not later than twenty (20) days after date of Notice to Proceed for any given task.

1. Comparisons of the proposed substitution with the product specified.

2. Changes required in other elements of the work because of the substitutions.

3. Effects on the Construction Schedule.

4. Cost data comparing the proposed substitution with the product specified and the amount of credit that the Contractor proposes to issue to the County if the proposed substitution is accepted.

5. Any required license fees or royalties.

6. Availability of maintenance service and source of replace parts and materials.

C. Rejection of Proposed Substitution

Substitutions will not be considered at any time if:

1. They are indicated or implied on Contractor's drawings or project data submittals without formal request submitted in accordance with this Section.

2. Acceptance will require substantial revision of Contract Documents.

3. Acceptance will create problems in stocking of repair parts and in future maintenance by the Owner.

D. Approval of Substitution

The Engineer's decision regarding evaluation of substitutions shall be final and binding. Request for time extensions and additional costs based on submission acceptance or rejection of substitutions will not be allowed. All approved substitutions will be incorporated into the Contract by Change Order.

1.4 QUALITY ASSURANCE

A. Contractor Certification: By the submittal of a substitution request, the Contractor shall represent that:

1. An investigation of the proposed substitute product has determined that it is equal to or superior in all respects to the product specified;
TECHNICAL SPECIFICATIONS

2. The same warranties or bonds will be provided for the substitutions as for the specified products;

3. Coordination will be provided for the installation of an accepted substitution into the Work and other changes as required to make the Work complete in all respects;

4. All claims for additional costs due to the substitution which may subsequently become apparent shall be waived.

B. Contractor Responsible for Performance: Neither the acceptance by the Engineer of alternate material or equipment as being equivalent to that specified nor the furnishing of the material or equipment specified shall in any way relieve the Contractor of responsibility for failure of the material or equipment due to faulty design, material, or workmanship, to perform the functions required by the Contract Documents.

END OF SECTION 01630
TECHNICAL SPECIFICATIONS
SECTION 02020

EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The work in this section shall include, but is not limited to, construction and maintenance of berms and dikes, temporary diversion barriers, sediment traps, siltation ponds, temporary vegetation covers, and other measures to prevent and control erosion and sedimentation.

1.2 REFERENCES

A. All work shown on the drawings and specified herein shall be performed in accordance with all applicable Federal, state, County, local ordinances, and the following references:


2. Erosion and Sediment Control Law, Title 21, Chapter 1, Article 6.1 of the Code of Virginia (1590 as amended).

3. Fairfax County Public Facilities Manual

1.3 EROSION CONTROL

A. It shall be the Contractor's responsibility to schedule his operations and perform the work in such a manner as to minimize soil erosion, from whatever cause, due to his operations.

B. The installation and removal of the Silt Fence and Super Silt Fence is the responsibility of the contractor.

C. All construction work shall be conducted with a minimum of disturbance of the land area affected.

D. Erosion control measures shall be placed prior to or as the first step in grading.

E. All temporary earth berms, diversions, and silt dams shall be machine compacted and seeded and mulched for temporary vegetative cover immediately after being constructed.
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F. All underground pipe or utility lines shall be seeded and mulched for temporary or permanent vegetative cover within 7 days after backfilling. No more than 500 feet of trench are to be open at any one time.

G. No disturbed area will be denuded for more than 60 calendar days.

H. Soil stockpiles that are to remain for more than 15 days shall be seeded and mulched or protected by other temporary cover.

I. All cut and fill slopes shall be seeded and mulched within 7 days of completion of grading.

1.3 SEDIMENT CONTROL

A. It shall be the Contractor's responsibility to perform the work in such a manner as to prevent the washing of any soil, silt or debris into any adjacent water course or onto adjacent properties.

1.4 MAINTENANCE AND STABILIZATION

A. The Contractor shall be responsible for the maintenance of the siltation and erosion control measures until the tributary areas have been stabilized. No additional payment will be made for maintenance of siltation and erosion control measures.

B. Following completion of any work performed under the contract, and after the site has been stabilized, the Contractor shall remove all temporary siltation control devices.

1.5 WETLAND SEED MIX

A. Item 16 of the Pricing Schedule should be any of the following 3 types of Ernst Wetland Mix or Equal:
   - VA Northern Piedmont Riparian Mix – ERNMX-852
   - Riparian Buffer Mix- ERNMX-178
   - Riparian Forest Seeding
     - Please see next few pages regarding the composition of the products.
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### VA Northern Piedmont Riparian Mix - ERNMX-852

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<th>Botanical Name</th>
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<tr>
<td>21.00% Panicum anceps, Eastern Shore MD Ecotype</td>
<td>Beaked Panicgrass, Eastern Shore MD Ecotype</td>
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<tr>
<td>18.00% Panicum clandestum, ‘Tioga’</td>
<td>Deertongue, ‘Tioga’</td>
</tr>
<tr>
<td>15.00% Elymus virginicus, PA Ecotype</td>
<td>Virginia Wildrye, PA Ecotype</td>
</tr>
<tr>
<td>15.00% Sorghastrum nutans, PA Ecotype</td>
<td>Indiangrass, PA Ecotype</td>
</tr>
<tr>
<td>7.50% Andropogon gerardii, ‘Niagara’</td>
<td>Big Bluestem, ‘Niagara’</td>
</tr>
<tr>
<td>5.00% Panicum virgatum, ‘Shelter’</td>
<td>Switchgrass, ‘Shelter’</td>
</tr>
<tr>
<td>4.00% Carex vulpinaoidae, PA Ecotype</td>
<td>Fox Sedge, PA Ecotype</td>
</tr>
<tr>
<td>4.00% Panicum rigidulum, PA Ecotype</td>
<td>Redtop Panicgrass, PA Ecotype</td>
</tr>
<tr>
<td>2.00% Agrostis perennans, Albany Pine Rush-NY Ecotype</td>
<td>Autumn Bentgrass, Albany Pine Rush-NY Ecotype</td>
</tr>
<tr>
<td>2.00% Helenium flexuosum, VA Ecotype</td>
<td>Purplehead Sneezeweed, VA Ecotype</td>
</tr>
<tr>
<td>2.00% Senecio hebecarpa, VA &amp; WV Ecotype</td>
<td>Wild Senna, VA &amp; WV Ecotype</td>
</tr>
<tr>
<td>1.00% Asclepias incarnata, PA Ecotype</td>
<td>Swamp Milkweed, PA Ecotype</td>
</tr>
<tr>
<td>1.00% Eupatorium perfoliatum, PA Ecotype</td>
<td>Boneset, PA Ecotype</td>
</tr>
<tr>
<td>1.00% Hibiscus moscheutos, Coastal Plain NC Ecotype</td>
<td>Crimsoneyed Rosemallow, Coastal Plain NC Ecotype</td>
</tr>
<tr>
<td>1.00% Vernonia novaeboracensis, PA Ecotype</td>
<td>New York Ironweed, PA Ecotype</td>
</tr>
<tr>
<td>0.50% Eupatorium fistulosum, PA Ecotype</td>
<td>Joe Pye Weed, PA Ecotype</td>
</tr>
</tbody>
</table>

100.00%

**Seeding Rate:** 20 lb per acre

**Riparian Sites**

### Riparian Buffer Mix - ERNMX-178

<table>
<thead>
<tr>
<th>Botanical Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.00% Panicum clandestum, ‘Tioga’</td>
<td>Deertongue, ‘Tioga’</td>
</tr>
<tr>
<td>16.00% Sorghastrum nutans, PA Ecotype</td>
<td>Indiergrass, PA Ecotype</td>
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<tr>
<td>15.00% Elymus virginicus, PA Ecotype</td>
<td>Riverbank Wildrye, PA Ecotype</td>
</tr>
<tr>
<td>10.00% Andropogon gerardii, ‘Niagara’</td>
<td>Big Bluestem, ‘Niagara’</td>
</tr>
<tr>
<td>7.00% Panicum virgatum, ‘Carthage’, NC Ecotype</td>
<td>Switchgrass, ‘Carthage’, NC Ecotype</td>
</tr>
<tr>
<td>3.00% Chamaecrista fasciculata, PA Ecotype</td>
<td>Partridge Pea, PA Ecotype</td>
</tr>
<tr>
<td>3.00% Rudbeckia hirta, Coastal Plain NC Ecotype</td>
<td>Blackeyed Susan, Coastal Plain NC Ecotype</td>
</tr>
<tr>
<td>3.00% Verbena hastata, PA Ecotype</td>
<td>Blue Vervain, PA Ecotype</td>
</tr>
<tr>
<td>2.00% Asclepias incarnata, PA Ecotype</td>
<td>Swamp Milkweed, PA Ecotype</td>
</tr>
<tr>
<td>2.00% Helianthus helenioides, PA Ecotype</td>
<td>Oxeye Sunflower, PA Ecotype</td>
</tr>
<tr>
<td>2.00% Juncus effusus</td>
<td>Soft Rush</td>
</tr>
<tr>
<td>2.00% Juncus tenuis, PA Ecotype</td>
<td>Path Rush, PA Ecotype</td>
</tr>
<tr>
<td>1.50% Aster puniceus, PA Ecotype</td>
<td>Purplestem Aster, PA Ecotype</td>
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<td>1.00% Eupatorium perfoliatum, PA Ecotype</td>
<td>Boneset, PA Ecotype</td>
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<tr>
<td>0.80% Vernonia novaeboracensis, PA Ecotype</td>
<td>New York Ironweed, PA Ecotype</td>
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<tr>
<td>0.50% Aster umbellatus, PA Ecotype</td>
<td>Flat Topped White Aster, PA Ecotype</td>
</tr>
<tr>
<td>0.50% Eupatorium fistulosum, PA Ecotype</td>
<td>Joe Pye Weed, PA Ecotype</td>
</tr>
<tr>
<td>0.50% Monarda fistulosa, Fort Indiantown Gap-PA Ecotype</td>
<td>Wild Bergamot, Fort Indiantown Gap-PA Ecotype</td>
</tr>
<tr>
<td>0.20% Pycnanthemum tenufolium</td>
<td>Narrowleaf Mountainmint</td>
</tr>
</tbody>
</table>

100.00%

**Seeding Rate:** 20 lb per acre with a cover crop at 30 lb per acre (dry sites - grain oats, Jan 1-Aug 1; or, grain rye, Aug 1-Jan 1; moist sites - grain rye year-round)

**Riparian Sites**

A diverse mix of upland and wetland grasses, forbs and shrubs with extensive wildlife and pollinator value. Provides food and cover for many of our songbirds, pheasants, deer and turkey. Mix formulations are subject to change without notice depending on the availability of existing and new products. While the formula may change, the guiding philosophy and function of the mix will not.
## TECHNICAL SPECIFICATIONS

### RIPARIAN FOREST SEEDING

<table>
<thead>
<tr>
<th>SEED PLANTING ZONE</th>
<th>SPECIES(^2)</th>
<th>SEEDING RATE(^3) (LBS/SAC)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L. PERENNNE spp. MULTIFLORUM (ANNUAL RYEGRASS)</td>
<td>45.00</td>
</tr>
<tr>
<td></td>
<td>CHAMACRISTA FASCICULATA (PARTRIDGE PEA)</td>
<td>45.00</td>
</tr>
<tr>
<td></td>
<td>ELYMUS RIPARIUS (RIVERBANK WILD RYE)</td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>ELYMUS VIRGINICUS (VIRGINIA WILD RYE)</td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>DICHTANTHELUM CLANDESTINUM (DEER TONGUE GRASS)</td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>Senna hebecarpa (WILD SENNA)</td>
<td>10.00</td>
</tr>
<tr>
<td></td>
<td>AGRIMONY PARMIFLORA (HARVESTLICE)</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>CAREX SQUALROSA (SQUARROSE SEDGE)</td>
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</tr>
<tr>
<td></td>
<td>PARTHEOCISSUS QUINQUEFOIUM (VIRGINIA CREEPER)</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>JUNCUS TENUS (PATH RUSH)</td>
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</tr>
<tr>
<td></td>
<td>ANEMONE VIRGINIANA (THIMBLEWEED)</td>
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</tr>
<tr>
<td></td>
<td>EUPATORIUM PERFORIATUM (COMMON BONESET)</td>
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</tr>
<tr>
<td></td>
<td>SYMPHYOTRICUM PILOSEUM (WHITE OLDFIELD AMERICA)</td>
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<tr>
<td></td>
<td>RHUS GLABRA (SMOOTH SUMAC)</td>
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</tr>
<tr>
<td></td>
<td>SOLIDAGO CAESIA (BLUESTEM GOLDENROD)</td>
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</tr>
<tr>
<td></td>
<td>VERONICA NOVEBORACENSIS (NEW YORK IRONWEED)</td>
<td>0.10</td>
</tr>
<tr>
<td>RIPARIAN FOREST (VARIABLE, SHADY) SEED MIX</td>
<td>BIDENS FRONDOSA (BEGGAR TICKS)</td>
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<tr>
<td></td>
<td>GELUM CANADENSE (WHITE AVENS)</td>
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</tr>
<tr>
<td></td>
<td>DESMODIUM GABELLUM (DILLENSUS TICK-TREFOIL)</td>
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</tr>
<tr>
<td></td>
<td>PENSTEMON DIGITALIS (PENSTEMON)</td>
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</tr>
<tr>
<td></td>
<td>VERBESINA ALTERNIFOLIA (WING STEM)</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>Hamamelis virginiana (WITCH HAZEL)</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>ILEX VERTICILLATA (WINTERBERRY)</td>
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</tr>
<tr>
<td></td>
<td>LINDERA BENZONI (NORTHERN SPICEBUSH)</td>
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</tr>
<tr>
<td></td>
<td>VIBURNUM DENTATUM (SOUTHERN ARROWWOOD)</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>VIBURNUM PRUNIFOLIUM (BLACK-HAW)</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>ACER RUBRUM (RED MAPLE)(^3)</td>
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</tr>
<tr>
<td></td>
<td>CARPINUS CARoliniana (AMERICAN HORNBEAM)</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>CERCIS CANADENSIS (EASTERN REDBUD)</td>
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</tr>
<tr>
<td></td>
<td>CORNUS FLORIDA (FLOWERING DOGWOOD)</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>NYSSA SYLVATICA (BLACK GUM)</td>
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</tr>
<tr>
<td></td>
<td>PLATANUS OCCIDENTALIS (AMERICAN SYCAMORE)</td>
<td>0.50</td>
</tr>
</tbody>
</table>

**TOTAL** 136.4

END OF SECTION 02020
TECHNICAL SPECIFICATIONS
SECTION 02100

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes general requirements related to the Contractor's responsibility to provide all labor, material and equipment to perform all clearing and grubbing as called for on the approved plans and as specified herein.

1.2 APPLICABLE SPECIFICATIONS, STANDARDS AND REFERENCES

Virginia Erosion and Sediment Control Handbook
American Association of Nurserymen (A.A.N.)
International Society of Arboriculture (I.S.A.)
National Arborist Association (N.A.N.)

1.3 PROTECTION

A. Protect property pipes, stones and monuments from damage. The Contractor shall be responsible for replacing disturbed markers by a registered surveyor at no expense to the County.

B. Protect existing trees, shrubs and bushes outside the limits of clearing and grubbing by fencing, or barricading as required, by the County or plans. Protect existing trees designated to be saved inside the limits of clearing and grubbing by methods approved by the County or approved plans.

C. Trees damaged by construction operations which were indicated to be preserved on the plans shall be evaluated by an I.S.A. Certified Arborist and replaced or pruned and treated as needed under the supervision of an I.S.A. Certified Arborist at the Contractor’s expense and as directed by the County Arborist.

D. Replace trees damaged beyond repair by the construction process with nursery grown stock meeting American Association of Nurserymen (A.A.N.) Standards.

E. Protect streets, roads, historical objects, adjacent property, vegetation and other works to remain throughout the contract.

PART 2 – PRODUCTS

2.1 Materials shall be at the Contractor’s option with the approval of the Engineer.
TECHNICAL SPECIFICATIONS

PART 3 – EXECUTION

3.1 CLEARING

A. The area of clearing shall be maintained within the limits shown on the plans. Leave individual trees, groups of trees and other vegetation, which are to remain within the areas to be cleared, standing and not injured. Tree protection boundaries, established to protect root systems as well as above ground parts shall not be violated.

3.2 GRUBBING

A. The area of grubbing shall be maintained within the clearing limits shown on the plans. Remove stumps and matted roots to a depth of 24 inches below existing ground surface. Refill excavations made by removal of stumps or roots with materials specified for structural backfill in Section 02200.

3.3 TRIMMING OF TREES

A. Trees may be trimmed to remove branches or roots which interfere with construction when so approved by the Engineer and County Arborist. All trimming and pruning shall conform to the specifications and standards of practice of the National Arborist Association and the International Society of Arboriculture.

B. Do not unnecessarily cut tree roots extending into grading limits. When roots are exposed, cut them back clearly to the soil with hand pruning shears, lopping shears or hand saws. Backfill immediately. Backfill around tree roots immediately after completion of construction in vicinity of the trees.

3.4 SALVAGE

A. Unless otherwise indicated on the plans, remove only those trees which directly interfere with the construction of the project. Trees designated by the Engineer to be salvaged shall be either mechanically dug with a tree spade or hand dug, balled and burlapped with root ball sizes as specified by the American Association of Nurserymen.

B. Material which is to be salvaged, as a result of clearing operations, shall include live plants suitable for replanting. Shrubbery is to be transplanted as trees using A.A.N. Standards. If required, temporarily replant the shrub and at the completion of construction replace according to A.A.N. Standards.

C. Place any desirable topsoil in well-drained stockpiles, not to exceed 7 feet in height, and protect in a manner stipulated in the Virginia Erosion and Sediment Control Handbook.
D. Remove and dispose of any salvageable material not desired by the County.

3.5 DISPOSAL

A. Dispose of trees and shrubs in accordance with Fairfax County Ordinances.

B. Do not burn materials on the site.

C. Remove material from the site as it accumulates. Do not allow waste material to accumulate for more than 48 hours.

D. Prior to depositing surplus material at any off-site location, obtain a written agreement with the owner of the property on which the disposal is proposed unless the surplus material is deposited at a commercial drop facility or landfill. The agreement shall state that the owner of the property gives permission for the Contractor to enter and deposit the material at no expense to the County. Furnish a copy of the agreement to the Engineer.

PART 4 – MEASUREMENT & PAYMENT

Tree and stump removal, specified by class, will be measured by completion of each removal in accordance with this specification and observed by the Engineer, or his agent. Each will be paid for at the contract unit price per each designated class. Removal of any vegetation smaller than 6” diameter at breast height shall be considered incidental to the Work. Unit price shall include removal of both tree and stump.

Root pruning will be measured by completion of each linear foot in accordance with this specification and observed by the Engineer, or his agent. Each will be paid for at the contract unit price per each linear foot.

END OF SECTION 02100
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating Trenches for Storm Drainage Systems and Appurtenant Facilities
2. Excavating Access Pits
3. Rock Excavation
4. Backfilling and Compacting

1.2 REFERENCES

A. Land Use Permit Manual. Virginia Department of Transportation.

B. Road and Bridge Specifications. Virginia Department of Transportation.


E. Occupational Safety and Health Standards-Excavation; Final Rule 29CFR, Part 1926. OSHA.


1.3 definitions

A. Utility: Buried pipe, conduit, or cable, surface features such as swales and ditches, and overhead wires or cables including their supports.

B. Earth: The softer materials of the outer surface of the earth. The basic constituents are the products of rock disintegration, glaciation, and erosion, consisting of boulders, cobbles, pebbles, sand, silt, and clay.

C. Rock: The hard, firm and stable parts of the earth's crust which shall include all materials which cannot be removed by excavation equipment of appropriate size and power for the diameter pipe being installed and requires blasting or manual or mechanical barring, wedging or hammering for removal from their original beds. Specifically included are ledge, bedrock, boulders, cement, grout, masonry or concrete larger than 1 cubic yard (meter) in volume.
**TECHNICAL SPECIFICATIONS**

D. Heavy Clearing: Clearing areas where the average diameter of the trees measured at the trunk is greater than 4 inches and the average spacing of the trees is less than 8 feet on center.

1.4 **SUBMITTALS**

A. Blasting Plan: Prepare and submit a plan outlining the methods and procedures to be applied where blasting is necessary.

1.5 **FIELD MEASUREMENTS**

A. Bench Marks: Verify that survey bench marks and intended elevations for the Work are as shown on the Drawings.

1.6 **TREE CUTTING REQUIREMENTS**

A. Establish Clearing Limits: Prior to tree removal or beginning clearing operations, the Contractor shall identify the clearing limits for the Project using continuous yellow ribbon to designate the boundaries.

   1. Specific trees to be saved within the clearing limits shall be flagged.
   2. Clearing limits and trees to be saved will be reviewed at the site by the Engineer.

B. Authorization for Tree Removal: No tree shall be removed until Contractor has written approval from the Engineer.

C. Consequences for Unauthorized Tree Removal: At the discretion of the County, one of the following measures will be imposed as a remedy for each tree removed without prior approval.

   1. The Contractor shall plant minimum 10 foot tall replacement trees in quantities which equal the number of trees removed. The species of replacement trees will be the same as the trees which were removed, or as directed by the Engineer.

   2. The Contractor shall be required to pay the County a penalty fee for each tree removed. The penalty fee will be computed using the International Arborists Society formula as applied by the County Arborist.

1.7 **WORK REQUIREMENTS IN STATE OR COUNTY RIGHTS-OF-WAY**

A. Permits: All permits shall be obtained by the Contractor.

   1. The Contractor shall assume all responsibility for fulfilling any and all requirements specified in right-of-way permits.

   2. All applicable provisions are set up in the "Land Use Permit Manual", Maintenance Division, Virginia Department of Transportation, Richmond,
**TECHNICAL SPECIFICATIONS**

Virginia, as can apply to the type of Work covered by this permit, shall apply, including provisions for revocation of permit.

a. The Contractor shall assist the County in obtaining release from the permit in accordance with the requirements of this Section.

3. Contractor shall employ VDOT certified personnel for clearing and tree trimming operations within the VDOT Right of Way.

B. Protection of Trees and Shrubs: Plant materials shall not be removed from the VDOT Right-of-Way without a permit therefor.

C. Protection of Trees and Shrubs to Remain: No tree roots over 3 inches in diameter shall be cut without special permission of VDOT Landscape Engineer. All roots under 3 inches in diameter shall be clean cut with an ax or saw. Particular attention shall be given not to splinter the roots nearest the trunk. Whenever possible, tunneling through or under roots shall prevail instead of cutting anchor roots.

1.8 **WARRANTY**

A. The Contractor shall be responsible for correcting any damage resulting from trench settlement in the work performed by his or her work, for a period of three years after completion of the Work.

PART 2 **PRODUCTS**

2.1 **BACKFILL AND BEDDING MATERIAL**

A. Select Backfill and Bedding Material: Select backfill shall meet the following requirements:

1. Type A - Material: Shall consist of clean earth, inspected and approved by the Engineer, which has been obtained by the Contractor from sources outside the Work and not meeting the criteria for Type B indicated below.

2. Type B - Crushed Stone: Shall consist of 21-A crushed stone conforming to VDOT specifications or an approved substitute.

   a. The conversion factor for Select Fill supplied by weight instead of volume will be 3000 pounds (1,780 kilograms) per cubic yard (meter).

B. Suitable Backfill: Suitable backfill material shall conform to the following requirements.

1. Type I: Type I material shall consist of clean earth excavated from the trench containing no stone larger than ¾ inch across.
2. Type II: Type II suitable backfill material shall consist of suitable material containing good earth and stone excavated from the trench.

   a. Stone material contained in Type II suitable backfill shall not exceed 6 inches across and shall be uniformly distributed.
   
   b. Type II suitable material shall not consist of more than 50 percent stone by volume.
   
   c. Backfilling and pipe bedding material within VDOT right-of-way and other public road right-of-way.

      (i) All backfill and pipe bedding shall be dense grade aggregate, Size 21A in accordance with the Virginia Department of Transportation Road and Bridge specifications, latest edition.

C. Reinforced Bed Mix Material: reinforced bed mix shall conform to the following requirements:

```
*REINFORCED BED* MIXTURE SPECIFICATIONS

The reinforced bed mixture specified below must be approved by the project engineer prior to being placed in the stream channel.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>SIZE (D₃₀)</th>
<th>PORTION</th>
<th>PERCENT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROCK</td>
<td>6.7 ln (277 mm)</td>
<td>2 BUCKETS</td>
<td>35 - 40%</td>
</tr>
<tr>
<td>BANK RUN GRavel</td>
<td>0.08 - 2.5 ln (2 - 64 mm)</td>
<td>2 BUCKETS</td>
<td>35 - 40%</td>
</tr>
<tr>
<td>COARSE SAND</td>
<td>0.04 - 0.08 ln (1 - 2 mm)</td>
<td>0.75 BUCKET</td>
<td>12 - 17%</td>
</tr>
<tr>
<td>TOPSOIL</td>
<td>LOAM OR SILT LOAM WITH 3-5% ORGANIC CONTENT</td>
<td>0.5 BUCKET</td>
<td>7 - 12%</td>
</tr>
</tbody>
</table>

1. The reinforced bed shall be a minimum of 1.0 ft in depth. Portions of the stream with slopes greater than 2.0% shall have a minimum reinforced bed material thickness of 1.5x the rock fraction D₃₀. See longitudinal profile for locations and thickness.

2. The rock portion of the mixture shall consist of river cobble (min. allowable D₃₀ = 8 inches) of color white, tan, yellow, or brown. The voids will be filled with a mixture of sand, gravel, and topsoil. This composition will result in a very resistant, armored substrate that will be capable of withstanding much greater shear stress than the computation of the required D₃₀ would suggest. Class A1 RPRAP shall be an acceptable alternate, subject to county approval, as long as it meets the specified size requirements.

3. Bank run gravel may include up to 5% clay, silt, and/or sand, and up to 25% cobble (D₃₀ = 3" to 8"). Gravel must have natural color (white, tan, yellow, or brown).

4. The sand portion of the mixture shall consist of a well mixed sand predominantly 1.0 millimeters to 2.0 millimeters in size. Subject to engineer approval (i.e., washed concrete sand is not required). Sand must be white, tan, yellow, or brown in color.

5. The topsoil portion of the mixture shall consist of 50% sifted, unwashed coarse sand (with fines allowed), 25% composted leaf/bark mulch, 25% mineral silt or finer material (stone dust from rock crushing operations or any silt/clay).
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TECHNICAL SPECIFICATIONS

"BOULDER RIFFLE" MIXTURE SPECIFICATIONS

THE BOULDER RIFFLE MIXTURE SPECIFIED BELOW MUST BE APPROVED BY FAIRFAX COUNTY PRIOR TO BEING PLACED IN THE STREAM CHANNEL

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>SIZE ($D_{50}$)</th>
<th>PORTION</th>
<th>PERCENT (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLASS II RP/RPRAP</td>
<td>19.2 in (490 mm)</td>
<td>2 BUCKETS</td>
<td>35 - 40%</td>
</tr>
<tr>
<td>CLASS A1 RP/RPRAP</td>
<td>6.7 in (170 mm)</td>
<td>1 BUCKET</td>
<td>18 - 20%</td>
</tr>
<tr>
<td>BANK RUN GRAVEL</td>
<td>0.08 - 2.5 in (2 - 64 mm)</td>
<td>1 BUCKET</td>
<td>18 - 20%</td>
</tr>
<tr>
<td>COARSE SAND</td>
<td>0.04 - 0.08 in (1 - 2 mm)</td>
<td>0.75 BUCKET</td>
<td>12 - 17%</td>
</tr>
<tr>
<td>TOPSOIL</td>
<td>LOAM OR SILT LOAM WITH 3-5% ORGANIC CONTENT</td>
<td>0.5 BUCKET</td>
<td>7 - 12%</td>
</tr>
</tbody>
</table>

1 THE BOULDER RIFFLE MIXTURE SHALL BE A MINIMUM OF 24” IN DEPTH. SEE LONGITUDINAL PROFILE FOR LOCATIONS AND THICKNESS.
3 CLASS A1 RP/RPRAP MAY BE SUBSTITUTED WITH RIVER WASHED COBBLE (TAN, YELLOW, OR BROWN) WITH THE SPECIFIED $D_{50}$.
4 BANK RUN GRAVEL MAY INCLUDE UP TO 5% CLAY, SILT, AND/OR SAND, AND UP TO 25% COBBLE ($D_{50} = 3” TO 8”$). GRAVEL MUST HAVE NATURAL COLOR (WHITE, TAN, YELLOW, OR BROWN).
5 THE SAND PORTION OF THE MIXTURE SHALL CONSIST OF A WELL MIXED SAND PREDOMINANTLY 1.0 MILLIMETERS TO 2.0 MILLIMETERS IN SIZE, SUBJECT TO ENGINEER APPROVAL (i.e. WASHED CONCRETE SAND IS NOT REQUIRED). SAND MUST BE TAN, YELLOW, OR BROWN IN COLOR.
6 THE TOPSOIL PORTION OF THE MIXTURE SHALL CONSIST OF 50% SIFTED, UNWASHED COARSE SAND (WITH FINES ALLOWED), 25% COMPOSTED LEAF/BARK MULCH, 25% MINERAL SILT OR FINER MATERIAL (STONE DUST FROM ROCK CRUSHING OPERATIONS OR ANY SILT/CLAY).

PART 3 EXECUTION

3.1 PREPARATION

A. Identify: Required lines, levels, contours, and datum.

B. Protect Existing Vegetation: Protect plant life, lawns, and other features remaining as a portion of final landscaping. Remove only those trees which are directly in the construction work. Trees having a diameter greater than six inches and which are on or near the “Limits of Construction” as indicated on the drawings must be protected as directed by the County.

C. Protect Existing Features: Protect bench marks, existing structures, fences, sidewalks, paving, mailboxes, gas line markers, curbs, and other similar features from excavation equipment and vehicular traffic.

D. Clearing: The site of all open cuts and excavation shall be first cleared of trees, stumps, shrubs, underground and other obstructions prior to excavation. The work to be cleared shall be the minimum reasonable required for access to the work and construction of the work in this contract.

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1. Clearing within easements and rights-of-way shall be limited to the limits of disturbance shown on the Drawings or as directed by the Engineer.

2. Remove and dispose of cleared materials and debris unless otherwise directed by the Engineer.

3. Remove topsoil and stockpile for use in restoration of excavated areas.

E. Provide demolition and removal of pipe, manholes, vaults, and structures as called for and dispose of properly in accordance with Section 516 of the VDOT Road Bridge Specifications. Abandon structures where noted in accordance with the Standard Details. Pipelines may be abandoned in-place. Plug all open ends of pipe abandoned in-place in accordance with Standard Details.

3.2 WORK IN RIGHT-OF-WAY

A. Length of Open Trenches: The maximum length of open trench at any time, including backfill portion of same, not immediately suitable for traffic, shall not exceed 100 feet. At no time will the Contractor be permitted to leave the trench open at the end of a working day.

B. Repair of Damage: When pavement edge or shoulder is damaged due to diversions of traffic away from the pipe laying operation, repairs shall be made as directed.

C. Open Cut Requirements: Wherever pavement is permitted to be cut, not over one-half of the width shall be disturbed at one time. For crossings, the first opening shall be completely restored to satisfactory travel conditions, including steel plating as required, before the second half is opened. No steel plates are allowed in roadways from November 1 to April 1 due to snow removal operations. Where the pavement is disturbed, or deemed weakened, it shall be restored or replaced as directed in its entirety, or such portion or portions as deemed necessary.

D. Equipment Restrictions: No cleated equipment shall be used on pavement. Where track equipment must enter paved areas, protect pavement with a sufficient layer of sand or approved substitute material.

E. Traffic Maintenance:

1. Traffic Control: Traffic shall not be blocked or re-routed without special written permission from the responsible authority. Where one-way traffic is permitted to be maintained, it shall be flagged 24 hours per day. Traffic shall at all times be properly protected by adequate lights, barricades, signs and flagmen when needed. Signs shall be in accordance with the current specifications of the Virginia Manual on Uniform Traffic Control Devices and the Virginia Work Area Protection Manual.

2. Entrances: Road and street connections and private entrances shall be kept in a satisfactory condition. Entrances shall not be blocked, and ample provision shall...
**TECHNICAL SPECIFICATIONS**

be made for safe ingress and egress to adjacent property at all times.

3. Pedestrian Traffic: If sidewalk or trail is blocked by construction activities, the pedestrian traffic shall be re-routed around the construction area. Traffic shall at all times be properly protected by adequate lights, barricades, signs and fencing in accordance with the Virginia Work Area Protection Manual and Contract Documents.

4. Refer to Section 02700 and Contract Documents for additional information regarding work and scheduling of work within Rights of Way.

F. Correction of Hazardous Situations: The Contractor shall immediately correct any situation which may arise which the Engineer deems hazardous to the traveling public.

G. Drainage Requirement: Maintain all drainage facilities free from sediment and debris in accordance with the Virginia Erosion and Sediment Control Handbook and Contract Documents.

H. Dust Control: The Contractor shall ensure that dusty conditions are controlled at all times.

I. Pavement Restoration: Refer to Section 02700 for pavement restoration requirements.

### 3.3 EARTH EXCAVATION

A. Shaping and Trimming: Excavate trenches to the widths and depths specified below and shown on the Drawings

1. Trench Width at bottom of pipe:

<table>
<thead>
<tr>
<th>Nominal Pipe Diameter (Inches)</th>
<th>RCP</th>
<th>ERCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>15” - 36”</td>
<td>ID + 24</td>
<td>ID + 24</td>
</tr>
<tr>
<td>36” - 60”</td>
<td>ID + 36</td>
<td>ID + 36</td>
</tr>
</tbody>
</table>

2. Trench Bottom: Grade and align pipe trench bottoms to provide bearing for the full length of the pipe barrel. Provide bell holes for the proper assembly of pipe joints.

3. Rock Trench: Remove rock to a minimum of 9 inches below the bottom of the pipe and replace with 9 inches of Type B select fill material for pipe bedding.

4. Excavation for all vaults shall be extended a minimum of 12 inches below bottom of base slab elevation. The undercut excavation shall be covered with a non-woven geotextile fabric and refilled to the required grade with coarse aggregate, VDOT Size No. 57.

B. Additional Excavation: If unsuitable sub base materials are encountered at the specified elevation or if additional depth is required for other reasons, no additional
payment will be made unless such further excavation is carried to the depth as directed and approved in writing by the Engineer. It is the responsibility in the first instance of the Contractor to evaluate the suitability of bedding materials and to notify the Engineer of any irregularity or unsuitability. Notwithstanding the foregoing, in the event the Engineer determines the bedding materials in any area to be unsuitable, with or without the concurrence of the Contractor, the Contractor shall promptly follow the direction of the Engineer in addressing such condition. Where additional excavation has been ordered and approved, the Contractor shall replace the removed material with Class D concrete or Type A or Type B select fill material as directed by the Engineer.

C. Unauthorized Excavation: Wherever the excavation is carried beyond or below the lines and grades given by the Engineer, except as specified above, all such excavated space shall be refilled with such material and in such manner as may be directed in order to ensure the stability of the various structures. Beneath all structures, space excavated without authority shall be refilled by the Contractor at his own expense, with Class D concrete or select fill materials, as ordered by the Engineer.

D. Disposal of Material: Top soil suitable for final grading shall be stored on the site separately from other excavated material. Other surplus excavated material unsuitable for backfilling or in excess of that required for constructing fills and embankments as shown on the Drawings, shall be removed by the Contractor at no additional expense to the County.

3.4 ROCK EXCAVATION

A. Limits of Rock Excavation: Excavate rock within the widths and depths specified for earth excavation and specified in this paragraph.

1. Proposed Structures: Excavate to the grades shown on the Drawings or as directed by the Engineer.

2. Rock Trench: Refer to the Provisions for Earth Excavation of this specification section.

3. Existing Structures: Excavate rock within 55 feet of existing structures and utilities by wedging, barring or other approved method.

B. Blasting

1. Blasting shall not be allowed without the express written consent of the County Engineer. All blasting, when permitted, shall comply with any applicable permits, standards, and restrictions imposed by the County of Fairfax.

2. When permitted by the Engineer, blasting shall be performed in accordance with the approved plan. The contractor and all personnel performing blasting shall be certified by the State of Virginia, Office of the Fire Marshal to perform blasting in the State of Virginia. Contractor shall obtain and pay for all permits necessary to perform the blasting including a blasting permit and a site permit from the Arlington
TECHNICAL SPECIFICATIONS

County Fire Marshal's Office. Blasting shall comply with all laws, ordinances, applicable safety code requirements, and regulations concerning the transportation, handling, storage, loading, preparation, and usage of explosives and blasting agents and relative to the protection of life and property including the Virginia State Fire Prevention Code, the Arlington County Fire Prevention Ordinance, and the BOCA National Fire Prevention Code.

3. Contact the local and/or job site Fire Marshal's Office or other regulating agency regarding blasting regulations and comply with requirements for posting signs, advanced warning, and permitting to use blasting. Obtain permits as required from Federal, state, county, and County officials prior to blasting and prior to bringing blasting agents on-site. Explosives shall not be stored on site.

4. Prepare overall blasting plan, individual blast pattern, and shot charge plans to ensure against blasting which may result in property damage or loss of life. Use blasting mats, or in-place overburden in order to prevent flying debris and/or rock fragments. Blasting mats shall be required within 300 feet of any residence, structure, parking facility or roadway. Perform pre-splitting, buffer blasting, line drilling with light blasting, or broaching as determined necessary to limit overblast fracturing of rock, limit blast vibration damage to adjacent facilities and/or to assure that rock breaks along predetermined and desired lines. If blasting might result in overblast fracturing of rock or unacceptable vibration damage, discontinue blasting locally and perform rock excavation by hoe ram, jackhammer, wedging, barring, or other suitable method.

5. Drill and blast in a manner which shall limit the degree of disturbance to adjacent excavation faces and reduce the extent of overblast. Drill and blast, including pre-split blasting, rock not removable by other excavation methods, in a manner that completes the excavation to lines indicated or acceptable and required for access, with the least disturbance to adjacent material.

6. Blasting shall only be performed by persons who are qualified by the state of Virginia, competent, and thoroughly experienced in the use of explosives for rock excavation. Only personnel carrying their current State of Virginia certification card will be allowed to perform the blasting.

7. Locate charge holes properly and drill to correct depth for charges used.

8. Limit charges in size to minimum required for reasonable removal of material by excavating equipment.

9. Determine spacing of drill holes, size of explosive charges, time delays, and blasting techniques, including pre-splitting and confined blasting procedures, to avoid overblast or damage to adjacent structures, equipment, utilities, or buried pipelines and conduits.

10. Cover each blast with heavy timber or steel mats as necessary to prevent flying rock.
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11. Contractor shall assume full liability for any damage to adjacent structures, equipment, new construction, utilities, or buried pipelines and conduits caused by blasting operations.

12. Blasting near utilities shall be subject to approval of owning agency.

13. Before delivery of any explosives at job sites, Contractor shall have obtained a blasting endorsement on his public liability and property damage insurance policy. A copy of such endorsement shall be provided to both the Owner and Engineer. Explosives shall not be stored onsite.

14. Remove overblasting rock materials to competent rock immediately following blasting and replace as indicated.

15. Contractor shall monitor blasting operations at necessary locations throughout all blasting activities. Monitoring shall consist of equipment capable of recording amplitude (peak particle velocity), frequency (hertz), and displacement.

C. Pre-Blast Survey

1. Contractor shall arrange and pay for a separate firm that is certified firm to perform the pre-blast survey:

   a. Personnel performing the survey shall be certified by the State of Virginia in Blasting and shall be registered Professional Structural or Geotechnical Engineers experienced in and qualified for performing such survey.

   b. The contractor/subcontractor shall notify all owners of residences, buildings, etc. within 300 linear feet of the blasting of the schedule for the blasting. Also, a physical survey of all existing storm and sanitary sewers, roads, bridges, utility piping, structures, residences and buildings within 150 linear feet of the blasting shall be required. The physical survey shall include an inspection of the site, an evaluation of the potential damages for damage from the blasting, and a photographic or video graphic record of the pre-blast conditions. Contractor to TV the storm and sanitary sewers within 150 feet of the proposed water main as part of pre-blast survey.

   c. Submit report, photographs, and other finalized data to Owner, including copy of notification document, notifications list of property owners and copies of property owners’ written responses.

   d. Determine locations to set up seismographs or where to position during various stages of blasting activities.

   e. Measure background vibration response and air response noise prior to commencing blasting.
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f. Perform background monitoring during construction at time corresponding to those times of proposed construction operations.

g. Monitor blasting operations at necessary locations along the excavation throughout all blasting operations.

h. Provide a permanent record of every blast event from each seismograph, referencing location of seismographs and distance away from blast.

i. Use a minimum of two seismographs capable of detecting peak particle velocities in three mutually perpendicular components, otherwise known as the X, Y, and Z axes.

j. Peak particle velocities and/or displacements at adjacent exposed or buried structures, equipment, pipelines, and conduits shall not exceed the level of criteria as determined by United States Department of Interior, Bureau of Mines in Figure B-1 from Report of Investigation 8507 by D. E. Siskind, et. al. Figure B-1 is included at the end of this section.

D. Post-Blast Survey

1. The contractor shall subcontract with the same certified firm performing the pre-blast survey to perform a post-blast survey. Contractor shall pay for post-blast survey.

a. Perform post-blast survey of the same facilities and structures evaluated during the pre-blast survey to detect any effects resulting from either blasting operations or subsidence settlement.

b. Perform post-blast survey upon the existing storm and sanitary sewers, roads, utility piping, structures and all other existing or new facilities on the site and those facilities and structures in which the individuals owning or occupying the structures provide complaints or register a concern to potential damage resulting from either blasting or subsidence. Contractor shall notify all property owners of structures within the pre-blast survey boundary within five calendar days following completion of blasting and excavation operations, whichever operation is completed last, and indicate to the property owners the limited written response period of 30 calendar days to register complaints or notify Contractor of potential damage. Contractor shall re-TV all storm and sanitary surveyed in the pre-blast survey.

c. Conduct post-blast survey commencing 45 calendar days after completion of blasting and excavation operation, whichever operation is completed last.

d. Submit report, photographs, and other finalized data to Owner, including copy of notification document, notifications list of property owners and copies of property owners’ written responses.
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3.5 EXCAVATION NEAR EXISTING STRUCTURES AND UTILITIES

A. Conduct all excavation near pipes, conduits or other underground structures with extreme care. If manual excavation is required to locate utilities and/or underground structures, or if excavation by hand is required in the installation of any piping or other structures included in the project, no extra compensation is authorized. Protection of existing utilities and structures is the responsibility of the Contractor.

B. Unscheduled interruptions of existing utilities are not authorized.

C. Existing sewer laterals are generally 4 or 6". Contractor to verify size, material, fitting type and closure method prior to start of construction and have available on-site such materials as may be required to expeditiously repair damage by construction.

D. Excavation near structures will not be allowed closer to the structure than the depth of the excavation below the bottom of the foundation without shoring the excavation with sheeting.

E. The Contractor shall carefully protect all land monuments and property markers from disturbance and damage until an authorized agent has witnessed or otherwise referenced their locations. These monuments and/or markers shall then only be removed when authorized by the agent or Owner. Monuments and/or markers shall be reinstalled by the Contractor to the satisfaction of the property owner or agent.

3.6 PROTECTION OF EXISTING STRUCTURES

A. All existing pipes, structures, poles, signs, wires, fences, curbings, property-line markers, storm water management and other structures which must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from damage by the Contractor.

B. In case of damage to any structure, the Contractor shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. If the owner of the structure wishes to make his own repairs, the Contractor shall reimburse the owner of the structure for all the time and materials required to make his repairs.

C. When the owners of the damaged structures do not wish to make the repairs themselves, all damages shall be repaired by the Contractor, or, if not promptly done by him, the Owner may have the repairs made at the expense of the Contractor.

D. All utility services shall be supported by suitable means so that the services shall not fail when tamping and settling occurs.

E. The Contractor shall not be compensated for any additional work involved if the utilities or underground structures cross the trench line transversely above or below the pipe.
3.7 CARE AND RESTORATION OF PROPERTY

A. Excavating machinery and cranes shall be operated with care to prevent damage to existing structures, paving and/or wires.

B. To protect the pavement and shoulders, all equipment shall have rubber wheels or runners and shall have rubber, wood or similar protective pads between the outriggers and the surface unless otherwise authorized by the Owner or local jurisdiction. In the event that other than rubber equipped machinery is authorized for use, the pavement and shoulders should be protected by the use of matting, wood or other suitable protective material having a minimum thickness of 4 inches. In any event it shall be the Contractor's responsibility to take whatever steps necessary to protect pavement and shoulders.

C. The Contractor must exercise care not to damage paving, curb, inlets, or sidewalks beyond the limits shown on the Plans. Any damages to areas outside the limits as shown on the Plans shall be replaced in kind by the Contractor at his own expense, to the satisfaction of the Owner unless the Drawings indicate they are to be replaced.

D. The restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

3.8 TRENCHING

A. Trenches shall be dug to the depth required by the Contract Documents adding, however, to such depths the thickness of the pipe and required bedding. The width of the trench shall be as indicated or as specified. A recess sufficiently large enough to receive the couplings, where applicable, and to permit making the joints, shall be cut out of the bottom of the trench.

B. During installation, upon encountering quicksand or a wet spongy material, or soft and yielding soil conditions that are judged by the Engineer to be unsuitable for bedding pipe and/or appurtenance, the Engineer will order the Contractor in writing to excavate below the specified grade to a depth where, in the judgement of the Engineer, unsuitable soil conditions exist. The resultant over excavation shall be backfilled to the specified grade using clean aggregate, 21A, approved by the Engineer for such use. Once the depth of the soft material has been determined, one of the following methods of construction work shall be used as determined by the Engineer:

1. Crushed stone foundation as specified in paragraph 3.12.

2. Concrete cradle or encasement as specified in paragraph 3.11.

3.9 SHEETING AND SHORING

A. Where sheeting, shoring, bracing, or trench boxes are used, they must be designed by a Professional Engineer licensed to practice in the State of Virginia. Said Engineer shall provide the Contractor with a certification signed and sealed by him stating that the
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design of the sheeting and bracing conforms to all applicable requirements of the Virginia Construction Safety Code and the Occupational Health and Safety Act. Copies of this certification shall be submitted to the Engineer.

B. Trench shall, at all times be properly protected to prevent accidents, caving of the sides of the trench or breaking of the ground outside of the lines of the trenches proper or damage to buildings or other structures along the line of construction. Underground structures of all types shall be protected by the Contractor who shall use all necessary shoring, bracing or other appliances for the protection of same. Care must be taken not to damage water mains, water service pipes, drain pipes, sanitary or stormwater sewers, gas mains, oil mains, electrical conduits or other structures encountered on the lines of the Work.

C. The Contractor must follow the proposed sheeting plans submitted. No deviations may be made from the filed procedure without first submitting a revised sheeting and bracing plan, signed and certified as required for the original submission, by the same licensed Professional Engineer who prepared the original submission.

D. No shoring shall be left in place unless so authorized by the Engineer.

E. All sheeting and bracing not to be left in place shall be carefully removed in such a manner as not to endanger the construction or other structures. All voids left or caused by withdrawal of sheering shall be immediately backfilled with well-compacted material.

F. When installing pipe the sheeting and shoring shall not project below a point one foot above the top of pipe, except during quicksand excavation or to stabilize trench bottom.

G. If when installing pipe, sheeting must be placed below the pipe invert to stabilize trench bottoms, the sheeting shall be left in place from the trench bottom to a point 1 foot 6 inches above the top of the pipe, and the remainder of the sheeting cut and removed before final backfilling.

H. The cost of providing bracing, sheeting and shoring shall be included in the unit price bid for pipe. No separate payment will be made for this work.

3.10 KEEPING TRENCH DRY

A. All ground water which may be found in the trenches and any water which may get into them from any cause whatsoever shall be pumped or bailed out so that the trench shall be dry during pipe laying period. No water shall be permitted to reach concrete until it has set sufficiently. All water pumped from the trenches shall be disposed of in accordance with Section 02020, EROSION AND SEDIMENTATION CONTROL. The Contractor shall provide a minimum of two pumps for each trench opened in wet ground, one operating and one standby. The standby pump shall be of a size that will replace the largest operating pump.
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B. The Contractor shall provide and place all necessary flumes or other channels of adequate size to temporarily carry all streams, brooks, stormwater or other water which may flow along or across the lines of the pipe line. All flumes or channels thus utilized shall be tight so as to prevent leakage into the trenches. Water pumped from trenches shall be led to a natural watercourse in accordance with Section 02020, EROSION AND SEDIMENTATION CONTROL.

3.11 PIPE BEDDING

A. General

1. Avoid contact between the pipe and compaction equipment. The tampers shall be hand or pneumatic of the proper size to operate between trench wall and pipe.

2. Compaction equipment shall not be used directly over the pipe while placing the pipe bedding.

B. Aggregate Stone Encasement

1. Pipe bedding shall be as specified in Paragraph 2.1 for backfilling and shall be VDOT aggregate, 21A, in accordance with the Virginia Department of Transportation Road and Bridge Specifications. The trench shall be excavated to the depth shown on the Construction Details. The clean aggregate stone shall be placed in the trench for its full width to uniformly support the pipe at the required line and grade.

2. Encasement material shall be spread in 4-inch layers and each layer shall be compacted with tampers until the required total depth of bedding has been built-up as specified herein.

C. Concrete Encasement

1. Where specified or required in the field, the pipe shall be supported by Concrete Encasement.

2. The trench shall be excavated to a minimum depth as shown on the Construction Details. The excavated space shall then be completely filled with, and the entire pipe encased in concrete such that the concrete measures a minimum 1 foot above the top of the pipe. The total minimum width of the Concrete Encasement shall equal the width of trench excavation. Unless otherwise shown on the Drawings or specified herein, concrete shall be Class B in accordance with the requirements of Section 03300 Cast-in-Place Concrete. Freshly poured concrete shall be maintained free from ground water for at least the first four hours. No backfilling of the trench shall begin until a minimum time period of 24 hours has elapsed after the encasement has been poured.
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D. Concrete Cradle

1. Where unstable conditions are encountered, the pipe shall be supported on Concrete Cradle. Concrete Cradles shall be installed where no suitable supporting soil or rock stratum exists within two feet of the bottom of the pipe.

2. The concrete cradle shall be furnished and installed equal to the "Concrete Encasement," except that only that portion of the encasement at the below horizontal diameter of the pipe shall be poured, forming a true cradle under the bottom half of the pipe.

3. The balance of the backfilling shall be as specified in Paragraph 3.13 for backfilling within public rights-of-way as specified herein.

3.12 FOUNDATION

A. Crushed Stone - For Foundation

1. In all bedding conditions where a suitable supporting soil or rock stratum occurs at a depth greater than required on the Construction Details or Drawings but less than 2 feet below the pipe, where moderately unstable soil conditions are encountered, where the trench is excavated below the specified depth or where required by the Engineer, the foundation shall be modified as follows:

   a. Except in the case of over-excavation where no extra excavation will be required, the trench shall be excavated to the depth necessary to reach the suitable supporting stratum. Crushed stone or 21A, clean aggregate, shall be spread in 4-inch layers, and each layer shall be compacted with 20 pound hand or pneumatic tampers.

   b. The foundation shall carry vertically from the supporting stratum up to the required level depending on the pipe diameter and the type of bedding specified.

3.13 BACKFILLING

A. General

1. No backfilling shall be done before the Engineer gives permission. After pipes have been checked for alignment and bedding, the backfilling may be started. Backfill material may be deposited in trench either by hand or machine. Sufficient number of men shall be available to spread the backfill in 6-inch uniform layers.

2. At least 24 inches of cover over the top of the pipe shall be provided before the trench is wheel-loaded.

B. Initial Backfilling of Pipe

1. This portion of the pipe trench shall be backfilled with clean aggregate, 21A, to provide bedding, installed as described under Paragraph 3.11 of this Section.
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2. When concrete cradle is used the initial backfill will start at the top of the concrete and then continue as specified above.

3. When concrete encasement is used, the initial backfill of clean aggregate, 21A will not be required.

C. Backfilling

1. Backfill within public road rights-of-way according to Virginia Department of Transportation Road and Bridge Specifications, latest edition, where those requirements may be more stringent than the procedures outlined below.

2. Backfill as promptly as is consistent with non-damage to the structures, but do not backfill before the Inspector gives permission.

3. Place and compact bedding as directed in Paragraph 3.11 of this section for the type employed.

4. Use backfill and bedding conforming to Par. 2.1.

5. In all cases of backfilling, tamp earth backfill carefully over the pipe in 6-inch lifts up to a point twelve (12) inches below the bottom of the finished pavement. Thoroughly compact each layer for the full trench width using mechanical tampers capable of achieving compacted density specified in Par. 3.14, below. The top 12 inches shall be compacted to 100% maximum dry density.

6. Do not backfill in freezing weather except by permission of the Engineer and do not use any frozen material. Make no fill where the material already in the trench is frozen.

7. If settlement occurs, deposit additional backfill and mechanically compact to required elevation.

8. After sufficient compaction and settlement has been obtained, provide temporary hot-mix pavement patch within the travel-ways. In areas outside the travel-way, complete the grading of the trench by smoothing off the trench surface and making it conform to the surface of the adjacent ground.

D. Settlement

1. If settlement occurs, additional backfill shall be deposited and mechanically compacted to the required elevation.

3.14 COMPACTION AND TESTING

A. In all areas, thoroughly compact the backfill over the pipe by use of vibratory tamping pads or, where these cannot be used, by mechanical or hand tamping. Compact backfill to within the following percentage ranges of maximum density at optimum moisture content:
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1. Unpaved Areas - Not less than ninety-five percent (95%).

2. Paved Areas - Not less than ninety-five percent (95%).

3. State Highway - VDOT requirements if more stringent than the above.

B. Determine the optimum moisture content and the maximum density of each type of material used for backfill by "Tests for Moisture-Density Relations of Soils, Using 10 lb. Rammer and 18 inch Drop," (ASTM D1557) or (AASHTO T-180), or by Nuclear Methods (ASTM D3017).

C. Determine the field moisture content of materials being compacted by "Laboratory Determination of Moisture Content of Soil," (ASTM D2216). Determine the field density of compacted material by "Density of Soil in Place by Sand Cone Method," (ASTM D1556) or by Nuclear Density testing equipment (ASTM D2922).

D. Perform sufficient field density and field moisture content tests on each lift of material at locations specified by the Engineer or his representative, to assure the Engineer that the requirements of this Section of the Specifications are complied with. Perform a minimum of one test for each 500 feet of pipeline per each one (1) foot lift of backfill.

E. Submit reports verifying these test result to the Engineer. The Engineer may order additional compaction and testing if the above tests prove inadequate compaction is being obtained. Additional compaction and testing shall be at the Contractor's sole expense until compaction meets minimum standards.

F. Obtain and pay for the services of a qualified independent testing laboratory acceptable to the Engineer, to perform the above tests.

3.15 MAINTENANCE OF BACKFILLED EXCAVATIONS

A. Maintain backfilled and repaved areas in proper conditions until the end of the guarantee period for the project.

B. Promptly correct all defects. If the Contractor fails to do so within a reasonable time after the receipt of written notice from the County, the County may remedy such defects and deduct the cost thereof from any monies due or to become due the Contractor under the contract. In an emergency, the Owner may correct any dangerous condition without giving previous notice to the Contractor and retain the cost of so doing from any monies due the Contractor. The Contractor is responsible for any injury or damage that may result from improper maintenance of trenches or pavement any time before the end of the guarantee period.
3.16 DISPOSAL OF MATERIALS

A. Remove rock, macadam and other rock like street surfacing materials from the work sites as the work progresses. Remove surplus materials of all types when performing final surface restoration. Do not deposit any material removed from the site on private property without written consent of the owner.

END OF SECTION 02200
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Pipe and fittings.
   2. Nonpressure transition couplings.
   3. Pressure pipe couplings.
   4. Expansion joints and deflection fittings.
   5. Backwater valves.
   6. Cleanouts.
   7. Drains.
   8. Encasement for piping.
  10. Channel drainage systems.
  11. Catch basins.
  13. Stormwater detention structures.
  15. Dry wells.
  16. Stormwater disposal systems.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:
   1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. [Catch basins] [stormwater inlets] [and] [dry wells]. Include plans, elevations, sections, details, frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet (1:500) and vertical scale of not less than 1 inch equals 5 feet (1:50). Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

C. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

D. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.
PART 2 - PRODUCTS

A. Mechanical-Joint Piping:

1. Pipe: AWWA C151, with bolt holes in bell.
2. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell.
4. Glands: Cast or ductile iron, with bolt holes and high-strength, cast-iron or high-strength, low-alloy steel bolts and nuts.
5. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands.

2.2 PVC PIPE AND FITTINGS

A. PVC Underdrain Piping:

1. Pipe: ASTM D 1785, Schedule 40 and Schedule 80 PVC, with plain ends for solvent-cemented joints.

2.3 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76.

1. Bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C 443, rubber gaskets sealant joints with ASTM C 990, bitumen or butyl-rubber sealant
2. Class I, Wall A Wall B.
3. Class II, Wall A Wall B Wall C.
4. Class III, Wall A Wall B Wall C.
5. Class IV, Wall A Wall B Wall C.

2.4 DRAINS

A. Cast-Iron Area Drains:

1. Description: ASME A112.6.3 gray-iron round body with anchor flange and round secured grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.
2. Top-Loading Classification(s): Medium Duty, Medium and Heavy Duty, Heavy Duty.

B. Cast-Iron Trench Drains:
TECHNICAL SPECIFICATIONS

1. Description: ASME A112.6.3, 6-inch wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular secured grate. Include units of total length indicated and quantity of bottom outlets with inside calk or spigot connections, of sizes indicated.


C. Steel Trench Drains:

1. Description: Factory fabricated from ASTM A 242/A 242M, welded steel plate, to form rectangular body with uniform bottom downward slope of 2 percent toward outlet, anchor flange, and grate. Include units of total length indicated, bottom outlet of size indicated, outlet strainer, acid-resistant enamel coating on inside and outside surfaces, and grate with openings of total free area at least two times cross-sectional area of outlet.

3. Plate Thicknesses: [1/8 inch] [1/8 inch and 1/4 inch] [1/4 inch].

4. Overall Widths: [7-1/2 inches] [7-1/2 inches and 12-1/3 inches] [12-1/3 inches].

a. Grate Openings: [1/4 inch circular] [3/8 inch circular] [3/8 inch circular or 3/8-by-3-inch slots] [3/8-by-3-inch slots].

2.5 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

2.6 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

2. Diameter: 48 inches minimum unless otherwise indicated.

3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
**TECHNICAL SPECIFICATIONS**

4. **Base Section**: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.

5. **Riser Sections**: 4-inch minimum thickness, and lengths to provide depth indicated.

6. **Top Section**: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.

7. **Joint Sealant**: ASTM C 990, bitumen or butyl rubber.

8. **Resilient Pipe Connectors**: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.

9. **Steps**: [Individual FRP steps or FRP ladder] [Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP] wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.

10. **Adjusting Rings**: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.

11. **Grade Rings**: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

**B. Designed Precast Concrete Manholes:**

1. **Description**: ASTM C 913; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.

2. **Ballast**: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.

3. **Joint Sealant**: ASTM C 990, bitumen or butyl rubber.

4. **Resilient Pipe Connectors**: ASTM C 923, cast or fitted into manhole walls, for each pipe connection.

5. **Steps**: [Individual FRP steps or FRP ladder] [Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP], wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.

6. **Adjusting Rings**: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
TECHNICAL SPECIFICATIONS

7. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match
diameter of manhole frame and cover, and of height required to adjust
manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers:

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch- minimum
width flange and 26-inch- diameter cover. Include indented top design with
lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: [ASTM A 536, Grade 60-40-18 ductile] [ASTM A 48/A 48M,
Class 35 gray] iron unless otherwise indicated.

2.7 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R and the
following:

1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum
water/cementitious materials ratio.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed
steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland
cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious
materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with
height of vertical sides to three-fourths of pipe diameter. Form curved
channels with smooth, uniform radius and slope.
   a. Invert Slope: 1 to 2 percent through manhole.

2. Benches: Concrete, sloped to drain into channel.
   a. Slope: 4 to 8 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with
0.58 maximum water/cementitious materials ratio.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed
steel.
TECHNICAL SPECIFICATIONS

2.8 PLASTIC, CHANNEL DRAINAGE SYSTEMS

A. General Requirements for Plastic, Channel Drainage Systems:
   1. Modular system of plastic channel sections, grates, and appurtenances.
   2. Designed so grates fit into frames without rocking or rattling.
   3. Number of units required to form total lengths indicated.

B. Fiberglass Systems:
   1. Channel Sections:
      a. Interlocking-joint, fiberglass modular units, with built-in invert slope of approximately 1 percent and with end caps.
      b. Rounded or inclined inside bottom surface, with outlets in quantities, sizes, and locations indicated.
      c. Width: [6 inches] [6 or 8 inches] [8 inches].
   2. Factory- or field-attached frames that fit channel sections and grates.
      a. Material: [Galvanized steel] [Stainless steel] [Manufacturer's standard metal].
   3. Grates with slots or perforations that fit frames.
      a. Material: [Fiberglass] [Galvanized steel] [Gray iron] [Stainless steel].
   4. Covers: Solid gray iron if indicated.
   5. Drainage Specialties:
      a. Large Catch Basins: 24-inch- square plastic body, with outlets in quantities and sizes indicated. Include gray-iron frame and slotted grate.
      b. Small Catch Basins: 12-by-24-inch plastic body, with outlets in quantities and sizes indicated. Include gray-iron frame and slotted grate.

D. PE Systems:
   1. Channel Sections: Interlocking-joint, PE modular units, 4 inches wide, with end caps. Include rounded bottom, with level invert and with outlets in quantities, sizes, and locations indicated.
   2. Grates: PE, ladder shaped; with stainless-steel screws.
   3. Color: Gray unless otherwise indicated.
   4. Drainage Specialties: Include the following PE components:
      a. Drains: 4-inch- diameter, round, slotted top; with NPS 4 bottom outlet.
      b. Drains: 8-inch- diameter, round, slotted top; with NPS 6 bottom outlet.
      c. Drains: 4-inch- square, slotted top; with NPS 3 bottom outlet.
      d. Drains: 8-inch- square, slotted top; with NPS 6 bottom outlet.
**TECHNICAL SPECIFICATIONS**

e. Catch Basins: 12-inch square plastic body, with outlets in quantities and sizes indicated. Include PE slotted grate 11-3/4 inches square by 1-1/8 inches thick.

E. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.

F. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.9 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch diameter frame and grate.
8. Steps: [Individual FRP steps or FRP ladder] [Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP], wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.
9. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Designed Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for joint sealants.

1. Joint Sealants: ASTM C 990, bitumen or butyl rubber.
TECHNICAL SPECIFICATIONS

2. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.

3. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.

4. Steps: [Individual FRP steps or FRP ladder] [Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP], wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60 inches.

5. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

D. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.10 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to utility standards.

B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

D. Frames and Grates: Heavy duty, according to utility standards.
TECHNICAL SPECIFICATIONS

2.11 STORMWATER DETENTION STRUCTURES

A. Cast-in-Place Concrete, Stormwater Detention Structures: Constructed of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete as required to prevent flotation.
2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.
3. Steps: [Individual FRP steps or FRP ladder] [Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP] wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of structure to finished grade is less than 60 inches.

B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.12 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."


2.13 DRY WELLS

A. Description: ASTM C 913, precast, reinforced, perforated concrete rings. Include the following:
## TECHNICAL SPECIFICATIONS

1. **Floor**: Cast-in-place concrete.
2. **Cover**: Liftoff-type concrete cover with cast-in lift rings.
3. **Wall Thickness**: 4 inches minimum with 1-inch diameter or 1-by-3-inch-maximum slotted perforations arranged in rows parallel to axis of ring.
   
   a. **Total Free Area of Perforations**: Approximately 15 percent of ring interior surface.
   
   b. **Ring Construction**: Designed to be self-aligning.

4. **Filtering Material**: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.

**B. Description**: Manufactured PE side panels and top cover that assemble into 50-gal. storage capacity units.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. **Side Panels**: With knockout ports for piping and seepage holes.
3. **Top Cover**: With knockout port for drain.
4. **Filter Fabric**: As recommended by unit manufacturer.
5. **Filtering Material**: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.

**C. Description**: Constructed-in-place aggregate type. Include the following:

1. **Lining**: Clay or concrete bricks.
2. **Lining**: Concrete blocks or precast concrete rings with notches or weep holes.
3. **Filtering Material**: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.
4. **Cover**: Precast, reinforced-concrete slab, designed for structural loading according to ASTM C 890 and made according to ASTM C 913. Include slab dimensions that will extend 12 inches minimum beyond edge of excavation, with bituminous coating over entire surface. Cast cover with opening for manhole in center.
5. **Manhole**: 24-inch-diameter, reinforced-concrete access lid with steel lift rings. Include bituminous coating over entire surface.

## 2.14 STORMWATER DISPOSAL SYSTEMS

**A. Chamber Systems**:

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. **Storage and Leaching Chambers**: Molded PE with perforated sides and open bottom. Include number of chambers, distribution piping, end plates, and other standard components as required for system total capacity.
3. **Filtering Material**: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.
TECHNICAL SPECIFICATIONS

4. Filter Mat: Geotextile woven or spun filter fabric, in one or more layers, for minimum total unit weight of 4 oz./sq. yd.

B. Pipe Systems: Perforated manifold, header, and lateral piping complying with AASHTO M 252M for NPS 10 and smaller, AASHTO M 294M for NPS 12 to NPS 60. Include proprietary fittings, couplings, seals, and filter fabric.

1. Double click here to find, evaluate, and insert list of manufacturers and products.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 02200 Excavating, Backfilling and Compacting.

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
TECHNICAL SPECIFICATIONS

3. Install piping with [36-inch] [48-inch] [60-inch] [72-inch] minimum cover.
5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
6. Install ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
7. Install corrugated steel piping according to ASTM A 798/A 798M.
8. Install corrugated aluminum piping according to ASTM B 788/B 788M.
9. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
10. Install PE corrugated sewer piping according to ASTM D 2321.
11. Install PVC cellular-core piping according to ASTM D 2321 and ASTM F 1668.
12. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
13. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
14. Install PVC water-service piping according to ASTM D 2321 and ASTM F 1668.
15. Install fiberglass sewer piping according to ASTM D 3839 and ASTM F 1668.
16. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
17. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

G. Install force-main pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
2. Install piping with [36-inch] [48-inch] [60-inch] [72-inch] minimum cover.
3. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
4. Install ductile-iron special fittings according to AWWA C600.
5. Install PVC pressure piping according to AWWA M23, or ASTM D 2774 and ASTM F 1668.
6. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.

H. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:

2. Hubless cast-iron soil pipe and fittings.
3. Ductile-iron pipe and fittings.
4. Expansion joints and deflection fittings.
3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, non-pressure drainage piping according to the following:

4. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.

B. Join force-main pressure piping according to the following:

1. Join PVC underdrain piping according to ASTM D 2855 for solvent-cemented joints.
2. Join dissimilar pipe materials with pressure-type couplings.

3.4 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping where indicated.

B. Install combination horizontal and manual gate-valve type in piping and in manholes where indicated.

C. Install terminal-type backwater valves on end of piping and in manholes where indicated.

3.5 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use Light-Duty, top-loading classification drains in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification drains in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification drains in roads.

B. Embed drains in 4-inch minimum concrete around bottom and sides.

C. Fasten grates to drains if indicated.
TECHNICAL SPECIFICATIONS

D. Set drain frames and covers with tops flush with pavement surface.
E. Assemble trench sections with flanged joints.
F. Embed trench sections in 4-inch minimum concrete around bottom and sides.

3.6 MANHOLE INSTALLATION
A. General: Install manholes, complete with appurtenances and accessories indicated.
B. Install precast concrete manhole sections with sealants according to ASTM C 891.
C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

3.7 CATCH BASIN INSTALLATION
A. Construct catch basins to sizes and shapes indicated.
B. Set frames and grates to elevations indicated.

3.8 STORMWATER INLET AND OUTLET INSTALLATION
A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
B. Construct riprap of broken stone, as indicated.
C. Install outlets that spill onto grade, anchored with concrete, where indicated.
D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
E. Construct energy dissipaters at outlets, as indicated.

3.9 DRY WELL INSTALLATION
A. Excavate hole to diameter of at least 6 inches greater than outside of dry well. Do not extend excavation into ground-water table.
B. Install precast, concrete-ring dry wells according to the following:
   1. Assemble rings to depth indicated.
TECHNICAL SPECIFICATIONS

2. Extend rings to height where top of cover will be approximately 8 inches below finished grade.
3. Backfill bottom of inside of rings with filtering material to level at least 12 inches above bottom.
4. Extend effluent inlet pipe 12 inches into rings and terminate into side of tee fitting.
5. Backfill around outside of rings with filtering material to top level of rings.
6. Install cover over top of rings.

C. Install manufactured, PE dry wells according to manufacturer’s written instructions and the following:

1. Assemble and install panels and cover.
2. Backfill bottom of inside of unit with filtering material to level at least 12 inches above bottom.
3. Extend effluent inlet pipe 12 inches into unit and terminate into side of tee fitting.
4. Install filter fabric around outside of unit.
5. Install filtering material around outside of unit.

D. Install constructed-in-place dry wells according to the following:

1. Install brick lining material dry and laid flat, with staggered joints for seepage. Build to diameter and depth indicated.
2. Install block lining material dry, with staggered joints and 20 percent minimum of blocks on side for seepage. Install precast concrete rings with notches or weep holes for seepage. Build to diameter and depth indicated.
3. Extend lining material to height where top of manhole will be approximately 8 inches below finished grade.
4. Backfill bottom of inside of lining with filtering material to level at least 12 inches above bottom.
5. Extend effluent inlet pipe 12 inches into lining and terminate into side of tee fitting.
6. Backfill around outside of lining with filtering material to top level of lining.
7. Install manhole over top of dry well. Support cover on undisturbed soil. Do not support cover on lining.

3.10 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.11 CHANNEL DRAINAGE SYSTEM INSTALLATION

A. Install with top surfaces of components, except piping, flush with finished surface.

B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
**TECHNICAL SPECIFICATIONS**

C. Embed channel sections and drainage specialties in 4-inch minimum concrete around bottom and sides.

D. Fasten grates to channel sections if indicated.

E. Assemble channel sections with flanged or interlocking joints.

F. Embed channel sections in 4-inch minimum concrete around bottom and sides.

3.12 **STORMWATER DISPOSAL SYSTEM INSTALLATION**

A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.

B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill, according to piping manufacturer's written instructions.

3.13 **CONNECTIONS**

A. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

   a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

   b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
TECHNICAL SPECIFICATIONS

B. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
   a. [Unshielded] [Shielded] flexible couplings for same or minor difference OD pipes.
   b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
   c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

3.14 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

   1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
   2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

   1. Remove manhole or structure and close open ends of remaining piping.
   2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Section 002200 Excavating, Backfilling and Compacting.

3.15 IDENTIFICATION

A. Materials and their installation are specified in Section 002200 Excavating, Backfilling and Compacting. Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

   1. Use warning tape or detectable warning tape over ferrous piping.
TECHNICAL SPECIFICATIONS

2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

END OF SECTION 02600
TECHNICAL SPECIFICATIONS

SECTION 02610

Testing

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Testing and inspection of storm sewers.

1.2 DESCRIPTION OF WORK

A. Test and inspect storm sewers, culverts, and all appurtenances.

1.3 SCHEDULING

A. Notify Engineer when installation is complete and ready for testing, at least 72 hours prior to performing testing.

B. Representative of Engineer must be present to review testing procedures and to witness results.

1.4 MEASUREMENT FOR PAYMENT

Video inspection will generally be performed by the County on all pipe installations unless otherwise agreed to with the Contractor. Unit prices for video inspection are included in the Contract Documents only as an option available to the County.

Testing and inspection of storm sewers and pipe rehabilitation is considered incidental to construction and no additional payment will be made.

PART 2 – PRODUCTS

2.1 TESTING EQUIPMENT

All testing equipment will be provided by the contractor as required for any test methods. Testing equipment shall conform will all applicable ASTM standards.

PART 3 – EXECUTION

3.1 CLEANING

A. Clean all storm sewers by flushing with water and by removing sheeting, bracing, shoring, forms, soil sediment, concrete, or other debris as directed by Engineer prior to testing.

B. Do not discharge soil sediment or debris to drainage channels or existing storm sewer systems.

3.2 VISUAL INSPECTION

A. Contractor to visually inspect each section of pipe.
B. Repair or replace defective pipe or joints or remove and relay pipe not meeting alignment tolerances as directed by Jurisdictional Engineer.

3.3 VIDEO INSPECTION

A. Video inspection of all new and rehabilitated storm sewers shall be conducted by the County after all backfill and compaction operations are completed.

B. The County may elect to pay the Contractor for this service at the contract price. It is expected that the County will video-inspect all installations less than 500’ in length using its own inspection team and equipment.

C. Notify the County 72 hours prior to desired inspection date.

D. Inspection Procedure:

1. Prior to video inspection, the sewer will be cleaned by the Contractor to remove all debris and sediment. Sufficient water shall be run through the pipe so as to saturate any potential low spots so that they may be detected during inspection.

2. The inspection will be performed with closed circuit video equipment.

3. The inspection will begin at one end of the project and will continue in the same direction until the inspection is complete.

4. All lateral connections and other observations shall be inspected at right angles utilizing the pan and tilt capabilities of the camera.

E. Low spots (bellies) in excess of 1" for pipe diameters 18” or less and 5% of the pipe diameter for pipes 24” and larger shall be considered unacceptable. If unacceptable low spots exist, as indicated by standing water during video inspection, the contractor shall remove and replace defective installations as necessary and re-inspect at their cost.

3.4 STORM SEWER LEAKAGE TESTING

A. Maximum allowable infiltration or exfiltration for new storm sewer section including manholes is 100 gallons per inch of diameter per mile of pipe per day.

B. Test storm sewer manholes separately as specified in paragraph 3.5 of this section.

C. Test for storm sewer line using one of the methods described in paragraphs 3.6, 3.7, or 3.8 of this section.

3.5 MANHOLE TESTING

A. Exfiltration Testing:

1. Manholes may be tested for exfiltration at the same time as gravity sewer lines provided that their entire depth is tested.
TECHNICAL SPECIFICATIONS

2. Securely plug all connections to the manhole and fill to the rim with water. Allow water level to stabilize for 1 hour at minimum.

3. Refill manhole to rim and begin test.

4. Leakage shall not exceed 0.25 gallons per hour per foot of depth. If the manhole fails this test the Contractor shall make necessary repairs and test again.

B. Air or Vacuum Testing

1. Air or vacuum testing will be permitted on a case-by-case basis and only with the approval of the Engineer.

3.6 STORM SEWER INFILTRATION TESTING

A. Use only where ground water is more than 2 feet above top of pipe at highest point in section being tested.

B. Provide documented verification of ground water elevations for not less than 24 hours before measurement of infiltration.

C. Measure infiltration in storm sewer with a V-notch weir in downstream manhole and report results in gallons per day per and gallons per inch of diameter per mile of pipe per day.

3.7 STORM SEWER EXFILTRATION TESTING

A. Use exfiltration test when ground water level is less than 2 feet above top of pipe at highest point in section being tested.

B. Sectionalize test section so that internal pressure in pipe does not exceed 5 feet of water.

C. Test Procedures:

1. Install watertight plug in inlets of upstream and downstream manhole of sewer section being tested.

2. Fill sewer and upstream manhole with water until water elevation in upstream manhole is 2 feet higher than outside top of pipe in section being tested or 2 feet above existing ground water level, whichever is highest elevation.

3. Allow water level to stabilize for 1 hour, then refill upstream manhole with water to original level and begin test.

4. Measure amount of water lost in upstream manhole in one hour. Use amount to determine exfiltration per inch of diameter per mile of pipe per day.

END OF SECTION 02610
PART 1 - GENERAL

1.1 SUMMARY

A. This section includes:

1. Temporary Pavement

2. Restoration of Paved and Unpaved Surfaces: Includes restoration of pavement structure including surface, base, and subbase courses where applicable, placed on subgrade; and restoration of aggregate surfaces.

   a. Roads: Includes travel lanes and shoulders
      1) County Roads
      2) VDOT & Fairfax County Roads
      3) Private Roads

   b. Driveways and Parking Areas

   c. Curb and Gutter

   d. Sidewalks, Trails

   e. Paved Ditches

   f. Pavement Markings

1.2 REFERENCES

A. Road and Bridge Specifications. Virginia Department of Transportation

B. County of Fairfax Standard Details

1.3 DEFINITIONS

A. Planing: Preparing rigid or flexible pavement for repair or overlay by removal of existing pavement to a depth of 2 inches. This term shall be considered to have the same meaning as the term “milling.”

B. Pavement Overlay: An asphalt concrete surface course up to 2 inches in thickness applied over an existing, prepared, paved surface to restore the surface.

C. Paved: Covered with gravel, stone, brick, asphalt, concrete or other material, making a firm level, or convenient surface for vehicle travel.
1.4 SUBMITTALS

A. Mix Design Data for Asphalt Concrete
B. Sieve Analysis for Aggregate Materials
C. Submit plant tickets for hot and cold bituminous mix deliverables stating type of mix, date mixed and gradation of mineral aggregate.
D. Refer to Section 03300 for concrete submittals.

1.5 REGULATORY REQUIREMENTS

A. Fulfill all provisions of the VDOT permit and applicable sections of the Road and Bridge Specifications. Comply with all jurisdictional requirements for work within the right-of-way.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregates: Aggregates include the granular materials used in the base and subbase courses of the pavement structure and the top course on gravel surfaces.

1. Crusher Run: Crusher run shall conform to the requirements of the VDOT Road and Bridge Specifications.
   a. Crusher Run shall be size number 25.

2. Aggregate Base: Aggregate Base shall conform to the requirements of the VDOT Road and Bridge Specifications.
   a. Aggregate base shall be Type I, Size 21A.

3. Course Aggregate: Course Aggregate shall conform to the requirements of the VDOT Road and Bridge Specifications.
   a. Course Aggregate shall be size 57.

B. Concrete: Concrete shall be Class A, meeting the requirements as specified in Section 03300, except where jurisdictional requirements apply. Approved concrete accelerators will be permitted when the temperature is below 40 degrees F.
C. Pavement Marking: Provide reflective, thermoplastic pavement marking materials conforming to the VDOT Road and Bridge Specifications.

2.2 EQUIPMENT

A. Roller: The roller shall be a self-powered, self-propelled unit with a manufacturer's rating of 7 to 10 tons.

2.3 MIXES

A. Asphalt Concrete: Asphalt concrete shall conform to the requirements of the type designated in accordance with the VDOT Road and Bridge Specifications and County of Fairfax Standard Detail R.01.

B. Portland Cement Concrete: Refer to Section 03300 for requirements.

C. Asphalt Tack Coat: Asphalt tack coats shall conform to the requirements of the VDOT Road and Bridge Specifications.

PART 3 - EXECUTION

3.1 PREPARATION

A. Removal of Temporary Pavement: Remove and dispose of temporary pavement materials in an approved manner, prior to installation of permanent pavement.

B. Trench Backfill: Backfill trench according to the requirements of Section 02200 and provide required subgrade and subbase for temporary or permanent pavement as specified.

C. Provide temporary or permanent pavement immediately upon completion of backfill.

D. Weather Conditions: Refer to VDOT Road and Bridge Specifications for restrictions to paving operations due to unfavorable weather conditions.

3.2 REMOVAL OF EXISTING PAVEMENT

A. Cut existing pavement in advance of excavating to neat lines as shown on the plans. Remove paving before excavating trench.

B. Saw cut existing concrete pavement to a minimum depth of two inches. Remove transfer devices where they exist.

C. For walkways and curb and gutter, provide temporary facilities as directed by the Engineer.
3.3 INSTALLATION

A. Temporary Pavement: Temporary pavement shall consist of a compacted 3-inch thick, hot asphalt concrete mix, Type BM-2 or approved substitute, course placed on the aggregate base and subbase materials required in Section 02200, under existing pavement.

1. Use of temporary pavement: Provide temporary pavement in all travel lanes and as directed by the Engineer. Provide temporary pavement immediately upon completion of backfill.

2. Maintenance of Temporary Pavement: Maintain temporary pavement to the satisfaction of the Engineer until permanent pavement restoration is completed. Provide mark with an appropriate label as designated by “Miss Utility” within the temporary pavement area.

B. Permanent Pavement: Permanent restoration of pavement shall be with the same type of material as that removed or damaged during construction.

1. Patches: Patches shall be as detailed on the drawings, extending a minimum of 1 foot beyond the trench width, and shall conform to the grade of the existing pavement. Provide permanent pavement immediately upon completion of backfill.

   a. On VDOT roads, provide a patch which is in accordance with the guidelines of the permit.

   b. On private roads, sidewalks and trails, provide a patch which consists of layers of material which are equal in thickness to those of the existing pavement.

   c. Replacement Curb and curb gutter shall match that which was removed in style and dimensions.

      1) Portland Cement Concrete curb and curb and gutter shall be completely replaced between expansion joints.

      2) Asphalt Concrete curb shall be saw cut at the interface between new and existing.

   d. Maintain grades, alignment and configuration of paved ditches.

2. Asphalt Concrete:

   a. All Work to comply with County of Fairfax standard details or other jurisdictional or permit requirements.

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TECHNICAL SPECIFICATIONS

b. The surface course shall consist of a minimum 2-inch thick layer.

c. Base courses for roads shall consist of a minimum 8-inch course of well compacted, stabilized aggregate base materials as defined in this Specification Section.

d. Provide an asphalt tack coat between each layer of the pavement structure, under pressure, at the rate of 0.1 to 0.5 gallons per square yard of area.

e. Cover cut surfaces which are to receive a bituminous concrete patch with a prime, applied under pressure, at the rate of 0.1 to 0.5 gallons per square yard of area.

f. Roll the patch with a self-powered, self-propelled unit as described in this specification Section.

3. Pavement Overlay: Provide overlay surface in accordance with the Drawings or as directed by the Engineer.

a. Prepare existing paved surface by planning and applying a tack coat in accordance with the VDOT Road and Bridge Specifications and as directed by the Engineer.

4. Driveways and Other Replacement: Replace in accordance with VDOT Road and Bridge Standards and Specifications or County of Fairfax Standard Details

C. Aggregate Surfaces:

1. Aggregate surfaced roads, road shoulders, driveways and trails: Provide a 10-inch well compacted stabilized layer of crusher run material over the entire width of the trench excavation.

a. Cap the original width of the aggregate surfaces with a 1-inch layer of crusher run material.

2. Pavement Marking: Install pavement line marking in accordance with the requirements of the VDOT Road and Bridge Specifications.

3.3 SCHEDULE

A. Time of Completion of Restoration: Permanent restoration of street surfaces shall be made in accordance with the time requirements of VDOT or other governmental agency having jurisdiction and in accordance with completion times given in the Instructions to Bidders.
TECHNICAL SPECIFICATIONS

B. Provide temporary pavement for a maximum of 21 days, subject to weather conditions.

3.4 USE OF STEEL PLATES

A. Whenever steel plates are required or used during construction within a paved roadway, outside of the travelway, the following requirements shall apply.

1. Notify the Engineer at least 48 hours in advance of placing steel plates in roadway.

2. Steel plates shall be at least one inch thick and large enough to allow a minimum of one foot of bearing on three sides of the excavation. Pin plates to prevent movement.

3. Provide hot bituminous mix on all edges of the steel plate tapered from the height of the steel plate extending a minimum of one foot to the existing road surface.

4. If an emergency condition occurs due to the excavation and plate placement that the Owner must correct, the Contractor will be charged for the cost of the corrective measures required.

5. During months of the year when snowfall may be expected, mark steel plates with a 2-inch square stake painted International Orange, and extending 4 feet above the ground, placed adjacent to the edge of the roadway.

6. Comply with the latest edition of all regulatory guidelines and requirements.

END OF SECTION 02700
1. GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Seeding and Fertilizing
   2. Sodding

1.2 REFERENCES


1.3 SUBMITTALS

A. Certified Analysis: Provide a certified analysis of fertilizer proposed for use, in accordance with the requirements of Section 01300.

B. Submit Certificates of Compliance upon request of the Engineer for the following:
   1. Topsoil
   2. Seed
   3. Fertilizer
   4. Lime
   5. Mulch

1.4 REGULATORY REQUIREMENTS

A. Seeding and Mulching Requirements: Seeding and mulching procedures shall conform with the applicable provisions of the VESCH.

1.5 STORAGE AND PROTECTION

A. Sod: Store sod in piles of tight rolls or layers laid grass to grass or roots to roots. Sprinkle sod piles with water and cover with straw or moist burlap. Keep sod moist. Sod which is allowed to dry out will be rejected by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Seed: Provide grass seed mixture composed of 70 percent Kentucky 31 tall Fescue and 30 percent common Kentucky Blue Grass. Under no circumstances shall rye grass be added to the grass mixture. Seed shall be mixed by the seedman to the satisfaction of the Engineer. Seed analysis shall be marked on the containers. The seed components shall be free of noxious weed seeds and shall have not less than the following purity and germination:
**TECHNICAL SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Purity</th>
<th>Germination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kentucky Blue Grass</td>
<td>85</td>
<td>75</td>
</tr>
<tr>
<td>Kentucky Fescue</td>
<td>98</td>
<td>90</td>
</tr>
</tbody>
</table>

Temporary seed for stabilization or sediment and erosion control shall be per the VESCH.

B. Sod: Sod shall be well rooted, healthy, pasture type sod, reasonably free from weeds and shall be selected from areas approved by the Engineer. Cut sod into square or rectangular sections of equal width and of a size that will permit them to be lifted without breaking. Cut to a depth approximately equal to the depth of the roots, but in no case shall the depth be less than 1 inch.

1. Sod shall be provided on all residential private property to an equal or better condition than existing.

C. Fertilizer: Provide a commercial fertilizer mixture for use on lawn areas which contains a complete plant food including nitrogen, phosphorus and potash in the proportions of 5 percent water soluble nitrogen, 10 percent available phosphorous, and 5 percent water soluble potash.

D. Topsoil: Suitable topsoil shall be stripped from excavations and stockpiled for reuse in accordance with Section 02200. The Contractor shall supply any additional material required at no cost to the County. This soil shall be friable loam, and shall be obtained from naturally well-drained areas. It shall be free from subsoil, clay lumps, stones, stumps, roots, brush, weeds, litter, trash or other harmful material.

**PART 3 - EXECUTION**

3.1 **PREPARATION**

A. Topsoil: Upon completion of construction in the area to be seeded or sodded, spread a uniform layer of topsoil over the compacted subgrade.

1. Depth of Topsoil: Provide a minimum 4-inch topsoil layer for areas to be seeded and a minimum 3-inch layer of topsoil for areas to be sodded.

2. Finish grading of topsoil: Compact topsoil with an approved roller weighing between 250 and 750 pounds.
   a. Provide finished surface without irregularities to the grade shown on the Drawings or, if not shown, the grade which conforms to the existing finished grade.
   b. In areas to be sodded, loosen soil to a minimum depth of 2 inches,
TECHNICAL SPECIFICATIONS

restore to a uniform grade and sprinkle with water.

B. Fertilizer: Spread fertilizer uniformly, by means of a mechanical spreader, at the rate of 50 pounds per 1000 square feet. Apply fertilizer at least 24 hours prior to seeding or sodding.

3.2 INSTALLATION

A. Seeding: Permanent grass seed shall be sown by a mechanical seeder operated in two directions. Total application shall be 5 pounds to 1000 square feet. Rake seed lightly into the surface and roll with a light, hard roller. Sprinkle seeded areas with a fine spray in such a manner as not to wash out the seed. Use care in raking not to destroy the finished grade nor to disturb uniform distribution of seed. Perform seeding on a still day and only with the approval of the Engineer.

Temporary seeding shall be applied as specified in the VESCH.

B. Hydroseeding: Application of seed, lime or fertilizer by Hydrosseeder will be permitted.

C. Sodding: Provide sod where shown on the Drawings. Place sod by hand with close joints. Do not overlap. Fill all gaps with sod and after the sections are set, fill all joints with loamy topsoil. Following sodding operation, sprinkle area with water and roll or tamp to incorporate sod with sod bed in order to assure a tight joint between strips.

1. Sodding on Slopes: Sod placed on slopes steeper than a 2:1 shall be anchored in place by sod pins driven flush with the surface after the tamping and rolling have been completed. Stakes shall be at least 8 inches long and shall be placed in such a manner as to hold the sod securely in place.

3.3 PROTECTION

A. General: The Contractor shall be responsible for protecting and maintaining sodded and seeded areas until acceptance by the County.

B. Protection against Washouts: The Contractor shall protect seeded areas against washouts by covering the area with burlap or straw or by other approved means. Eroded areas shall be regraded and reseeded until a good sod is established, to the Engineer's satisfaction.

C. Watering: The Contractor shall keep the sodded or seeded areas sufficiently moist in order to maintain and promote life and growth of the sod until the Work is accepted.

END OF SECTION 0292
TECHNICAL SPECIFICATIONS

SECTION 02960

TEMPORARY BYPASS PUMPING SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

Section includes requirements for implementing a temporary pumping system for the purpose of diverting existing sewage flow around the work area for duration of any task.

1.2 QUALITY ASSURANCE

A. Follow national standards and as specified herein

B. Perform leakage and pressure tests on discharge piping using clean water, before operation. Notify Engineer 24 hours prior to testing.

C. Bypass pumping may be required to operate 24 hours per day. Contractor shall provide all necessary monitoring devices to notify the Contractor of any pump failure.

D. Keep and maintain spare parts for pumps and piping on site, as required, including one spare pump of each size used.

E. Maintain adequate hoisting equipment and accessories on site for each pump.

1.3 SUBMITTALS

A. Submit following Section 01300 and DPW General Provisions:

1. Detailed plan and description of proposed pumping system. Indicate number, size, material, location and method of installation of suction and discharge piping, size of pipeline or conveyance system to be bypassed, staging area for pumps, site access point, and expected flow.

a. Size and location of manhole or access points for suction and discharge hose or piping.

b. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill, if buried.

c. Temporary pipe supports and anchoring required.

d. Thrust and restraint block sizes and locations.
TECHNICAL SPECIFICATIONS

e. Sewer plugging method and type of plugs.

f. Bypass pump sizes, capacity, number of each size to be on site and power requirements.

g. Backup pump, power and piping equipment.

h. Calculations of static lift, friction losses, and flow velocity. Pump curves showing pump operating range.

i. Design plans and computation for access to bypass pumping locations indicated on drawings.

j. Calculations for selection of bypass pumping pipe size.

k. Method of noise control for each pump and/or generator.

l. Method of protecting discharge manholes or structures from erosion and damage.

m. Schedule for installation and maintenance of bypass pumping lines.

n. Procedures to monitor upstream mains for backup impacts.

o. Procedures for setup and breakdown of pumping operations.

p. Emergency plan detailing procedures to be followed in event of pump failures, sewer overflows, service backups, and sewage spillage.

q. Maintain copy of emergency plan on site for duration of project.

B. Submit following Section 01300 and DPW General Provisions:

1. Certify bypass system will meet requirements of codes, and regulatory agencies having jurisdiction.

1.4 CONTRACTORS RESPONSIBILITY FOR OVERFLOWS AND SPILLS

A. Schedule and perform work in manner that does not cause or contribute to incidence of overflows, releases or spills of sewage from storm sewer system or bypass operation.

1.5 DELIVERY AND STORAGE

A. Transport, deliver, handle, and store pipe, fittings, pumps, ancillary equipment and materials to prevent damage and following manufacturer’s recommendations.

B. Inspect all material and equipment for proper operation before initiating work.
TECHNICAL SPECIFICATIONS

C. Material found to be defective or damaged due to manufacturer or shipment.

D. When Engineer deems repairable: Repair as recommended by manufacturer.

E. When Engineer deems not repairable: Replace as directed by Engineer before initiating work.

F. Repair or replacement of defective or damaged material and equipment will be at no cost to County.

1.6 PAYMENT

A. Bypass pumping shall be considered incidental to the Work when less than 24 hours of continuous operation and requiring a 3” diameter pump or less. Only upon prior approval of the Engineer will additional payment be made for pumping of greater than 24 hours or requiring a 4” or greater pump.

PART 2 PRODUCTS

2.1 MATERIALS

A. Discharge and Suction Pipes: Approved by Engineer.

1. Discharge piping: Determined according to flow calculations and system operating calculations.

2. Suction piping: Determined according to pump size, flow calculations, and manhole depth following manufacturer’s specifications and recommendations.

B. Polyethylene Plastic Pipe:

1. High density solid wall and following ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-DR) based on Outside Diameter, ASTM D1248 and ASTM D3550

2. Homogenous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, blisters, or other deleterious faults.

C. High-Density Polyethylene (HDPE).

1. Homogenous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, blisters, or other deleterious faults.

   a. Defective areas of pipe: Cut out and joint fused as stated herein.

2. Assembled and joined at site using couplings, flanges or butt-fusion method to provide leak proof joint. Follow manufacturer’s instructions and ASTM D
TECHNICAL SPECIFICATIONS

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a. Threaded or solvent joints and connections are not permitted.

3. Fusing: By personnel certified as fusion technicians by manufacturer of HDPE pipe and/or fusing equipment.

4. Butt-fused joint: True alignment and uniform roll-back beads resulting from use of proper temperature and pressure.
   a. Allow adequate cooling time before removal of pressure.
   b. Watertight and have tensile strength equal to that of pipe.
   c. Acceptance by Engineer required before insertion.

5. Use in streams, storm water culverts and environmentally sensitive areas.

D. Flexible Hoses and Associated Couplings and Connectors.

1. Abrasion resistant.

2. Suitable for intended service.

3. Rated for external and internal loads anticipated, including test pressure.

   a. External loading design: Incorporate anticipated traffic loadings, including traffic impact loading.

4. When subject to traffic loading utilize a system such as traffic ramps or covers. Install system and maintain H-20 loading requirements while in use or as directed by the Engineer.

E. Valves and Fittings: Determined according to flow calculations, pump sizes previously determined, and system operating pressures.

F. Plugs: Selected and installed according to size of line to be plugged, pipe and manhole configurations, and based on specific site.

   1. Additional plugs: Available in the event a plug fails. Plugs will be inspected before use for defects which may lead to failure.

G. Aluminum “irrigation type” piping or glued PVC piping will not be permitted.

H. Discharge hose will only be allowed in short sections when approved by Engineer.

2.2 EQUIPMENT

A. Pumps.
TECHNICAL SPECIFICATIONS

1. Fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in priming system.

2. Electric or diesel powered.

3. Constructed to allow dry running for long periods of time to accommodate cyclical nature of effluent flows.

4. When operating 24 hours per day pumps shall register no more than 70 decibels measured at 30’ from the source. Such pumps will are on the Bid Sheet as “Silenced Pumps.”

B. Provide.

1. Necessary stop/start controls for each pump.

2. One standby pump of each size maintained on site; on-line, isolated from primary system by a valve.

3. Silenced pumps at request of Engineer.

2.3 DESIGN REQUIREMENTS

A. Bypass pumping systems

1. Sufficient capacity to pump peak flow of 2 MGD.
   a. Peak flows greater than 2 MGD as approved by Engineer.
   b. County will provide flow data for bypass system.
   c. Operate 24 hours per day.

B. Provide pipeline plugs and pumps of adequate size to handle peak flow, and temporary discharge piping to ensure total flow of main can be safely diverted around section to be repaired.

PART 3 EXECUTION

3.1 PUBLIC NOTIFICATION

A. Follow Special Provisions in this contract

3.2 PREPARATION

A. Determining location of bypass pipelines.

1. Minimal disturbance to existing utilities.
   a. Field locate existing utilities in proposed bypass area.
**TECHNICAL SPECIFICATIONS**

2. Obtain approvals for placement within public or private property.

3. Obtain Engineer’s approval of location.

4. Costs associated with relocation of utilities and obtaining approvals at no cost to the County.

3.3 INSTALLATION AND REMOVAL

A. Provisions and requirements must be reviewed by Engineer before starting construction.

B. Remove manhole sections or make connections to existing sewer and construct temporary bypass pumping structures at access location indicated on Drawings and as required to provide adequate suction conduit.

C. Plugging or blocking of sewage flows shall incorporate a primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance of work, remove in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging or causing other major disturbances downstream.

D. When working inside manhole or force main, exercise caution. Follow OSHA, Local, State and Federal requirements. Take required measures to protect workforce against sewer gases and/or combustible or oxygen-deficient atmosphere.

E. Installation of Bypass Pipelines:

1. Pipeline may be placed along shoulder of roads.
   a. Do not place in streets or sidewalks.

2. When bypass pipeline crosses local streets and private driveways, place in roadway ramps.
   a. When roadway ramps cannot be used, place bypass in trenches and cover with temporary pavement as approved by Engineer.

   b. Follow Section 02700.

F. During bypass pumping operation, protect sewer lines from damage inflicted by equipment.

G. Upon completion of bypass pumping operations, and after the receipt of written permission from Engineer, remove piping, restore property to pre-construction condition and restore pavement.

**PART 4 MEASUREMENT AND PAYMENT**
TECHNICAL SPECIFICATIONS

4.1 Except as otherwise specified herein, providing for and complying with requirements in this Section will not be measured for payment, but cost will be considered incidental to Contract.

END OF SECTION 02960
TECHNICAL SPECIFICATIONS
SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Steel Reinforcing Bars
B. Steel Reinforcing Fabric

1.2 UNIT PRICES

A. Refer to bid sheet

1.3 REFERENCES

A. ACI-318 Building Code requirements for reinforced concrete
B. Concrete Reinforcing Steel Institute (CRSI) Manual of Practice
C. ASTM A615 Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement
D. ASTM A185 Welded Steel Wire Fabric for Concrete Reinforcement
E. ASTM A497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement
F. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures

1.4 SUBMITTALS

A. Shop Drawings: Submit completely detailed shop drawings and schedules for steel reinforcing bars in accordance with Section 01330 - Submittals.
B. Certificates: Submit mill test certificates for the Chemical and Physical properties of steel reinforcing bars and steel welded wire fabric in accordance with the requirements of Section 01300.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery: Reinforcing steel, as delivered to the Work, shall be in bundles strongly tied. Each group of both bent and straight bars shall be identified with a metal tag giving the identifying number corresponding to the bar schedules and diagrams. All reinforcing shall be properly stored in an orderly manner, at least 12-inches off the ground, and keep clean and protected from the weather.
TECHNICAL SPECIFICATIONS

B. Protection: Reinforcing steel shall be delivered without rust other than such as may have been accumulated during transportation to the Work. It shall at all times be fully protected from moisture, grease, dirt, mortar, or concrete. Before being placed in position, it shall be thoroughly cleaned of all loose mill scale and rust and of any dirt, coatings or other material that might reduce the bond. If there is a delay in depositing concrete, the steel shall be inspected and satisfactorily cleaned immediately before the concrete is placed.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Steel: Reinforcing steel shall be in accordance with the provisions of ACI 318 and Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice and the following.

B. Bars: Bars for concrete reinforcement shall be new steel rolled from open hearth steel billets and shall meet the requirements of ASTM A615, Grade 60. Rerolled materials shall not be permitted. Bars shall be deformed in conformity with ASTM A615 and shall be free of defects. Spiral reinforcing steel shall be fabricated from cold drawn wire in accordance with ASTM A82 or hot rolled plain or deformed bars conforming to ASTM A615, Grade 60.

C. Welded Wire Fabric: Fabric shall be of the electrically welded type, with wires arranged in rectangular patterns of the sizes shown or specified.
   1. Welded smooth wire fabric shall conform to ASTM A185
   2. Welded deformed wire fabric shall conform to ASTM A497

2.2 FABRICATION

A. Bending Steel Bars: Bars shall be cut to required length and accurately bent by approved methods before placing. Bars shall be bent in the shop unless written approval of field bending is obtained from the Engineer. If field bending is permitted, it shall be done only when the air temperature is above 30 degrees F where the bending operation is performed. Bars shall have a minimum inside radius of bend as specified in the CRSI Manual of Standard Practice.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Bars:
   1. Placement: The bars shall be placed in the exact positions and with the spacing shown or required, and shall be securely fastened in position at the intersections to prevent displacement during the placing of the concrete. The bars shall be fastened with black annealed wire of not less than 16 gauge or other approved devices. Spacing chairs of type approved
TECHNICAL SPECIFICATIONS

by the Engineer shall be furnished and properly placed to support and hold reinforcing bars in position in all beams and slabs, including slabs poured directly on the subgrade. Except where otherwise shown, splices in tension reinforcement shall be as specified in the latest edition of ACI 318. Bar splices shall be staggered, where possible.

a. The lap lengths for reinforcement bars spaced less than 6” on center shall be increased by 25%. Where a smaller bar laps with a larger bar, the lap length for the smaller bar shall govern.

b. Maintain minimum 1-1/2” clearance between rebar and pipes, sleeves or anchor rings.

c. The length of laps not otherwise indicated on plans or details shall be approved by the Engineer.

2. Projecting Ends: On any section of the Work where horizontal bars run further than the length of the forms, the form or head against which the work ends shall be perforated at the proper places to allow the bars to project through a distance at least equal to the lap specified. The projecting ends, however, unless otherwise directed by the Engineer, shall be of different lengths so that laps in bars in the same plane do not occur adjacent to each other.

B. Welded Wire Fabric: Steel reinforcing fabric shall be placed in the positions shown, specified, or required to fit the Work. Suitable spacing chairs or supports shall be furnished and placed to maintain the mesh in correct location. Where flat mesh is required, the mesh shall be rolled or otherwise straightened to make a perfectly flat surface before placing. The length of laps not indicated shall be approved by the Engineer.

1. Extend all slab reinforcement into the floor slab, wall or roof in accordance with the ACI Code. If such extensions are not obtainable, the bars shall terminate with a standard hook.

2. Cut or bend reinforcing steel bars as needed so that they do not continue through openings in slabs and walls.

3.2 PROTECTION

A. Unless otherwise noted on the plans, the following concrete covers shall be provided for reinforcement in cast-in-place concrete: Concrete cast against and permanently exposed to earth: 3” (75 millimeters) Formed concrete exposed to earth, liquid or weather: #5 and Smaller: 1-1/2” (38 millimeters) #6 and #11: 2” (50 millimeters) Formed concrete not exposed to earth, liquid or weather: 1-1/2” (38 millimeters)

END OF SECTION 03200
03200-3
TECHNICAL SPECIFICATIONS
SECTION 03300
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Concrete Materials
   1. Cement
   2. Aggregates
      a. Sand
      b. Stone and Gravel
   3. Water
   4. Admixtures

1.2 REFERENCES

A. ACI 212 Guide for Use of Admixtures in Concrete.
B. ACI 301 Standard Specifications for Structural Concrete
C. ACI 304 Placing Concrete by Pumping Methods
D. ACI 306 Recommended Practice for Cold Water Concreting.
E. ACI 308 Recommended Practice for Curing Concrete
F. ACI 318 Building Code Requirements for Reinforced Concrete
G. ACI 347 Recommended Practice for Concrete Formwork
H. ACI 350 Testing Reinforced Concrete Structures for Watertightness
I. ACI 614 Recommended Practice for Measuring, Mixing and Placing Concrete
J. ASTM C33 Specification for Concrete Aggregates
K. ASTM C39 Compressive Strength of Cylindrical Concrete Specimens
L. ASTM C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
M. ASTM C94 Specification for Ready Mix Concrete
**TECHNICAL SPECIFICATIONS**

N. ASTM C109 Compressive Strength of Hydraulic Cement Mortars  
O. ASTM C136 Sieve Analysis of Fine and Coarse Aggregates  
P. ASTM C138 Test for Unit Weight, Yield and Air Content of Concrete  
Q. ASTM C143 Test for Slump of Portland Cement Concrete  
R. ASTM C150 Specification for Portland Cement  
S. ASTM C171 Sheet Materials for Curing Concrete  
T. ASTM C172 Sampling Fresh Concrete  
U. ASTM C173 Test for Air Content of Freshly Mixed Concrete by Volumetric Method  
V. ASTM C191 Time of Setting of Hydraulic Cement by Vicat Needle  
W. ASTM C192 Making and Curing Concrete Specimens in the Laboratory  
X. ASTM C260 Air-entraining Admixtures for Concrete  
Y. ASTM C309 Liquid Membrane-Forming Compounds for Curing Concrete  
Z. ASTM C494 Chemical Admixtures for Concrete  
AA. ASTM C596 Measuring the Drying of Shrinkage of Mortar Containing Portland Cement  
BB. ASTM C827 Tests for Early Volume Change of Cementitious Mixtures  
CC. ASTM D412 Specification for Concrete Drain Tile  
DD. Federal Specification TT-S227E  
EE. Federal Specification TT-S230C  
FF. Corps of Engineers C572  
EE. VDOT Road and Bridge Specifications, Latest Edition.

1.3 **DEFINITIONS**

A. Class A. Concrete: Class A concrete is high-strength concrete intended principally for precast concrete units.
TECHNICAL SPECIFICATIONS

B. Class B. Concrete: Class B concrete is designed for high strength and watertightness and is intended for use in reinforced concrete structures such as thrust collars, columns, walls, beams, slabs, and, in general, where forms, other than simple forms, are required.

C. Class C Concrete: Class C concrete is designed for high strength and watertightness and is intended for use for bottoms of structures, electrical duct encasement, and, in general, where concrete is deposited directly on the bottoms of slopes or excavations and where only simple forms are required.

D. Class D Concrete: Class D concrete is designed as low-strength, plain or reinforced concrete and is intended for use in workmats beneath structures, soil stabilization, pipe cradles, encasement, corrosion control test station pads, guard posts, thrust anchors, filling and other similar purposes.

1. Boulders or Rock Fragments: Clean boulders or rock fragments excavation during construction may be embedded, in quantities approved by the Engineer, in large volumes of concrete to provide added bulk.

   a. Place boulders or rock fragments carefully so that no voids are left in the concrete.

E. Flowable Fill: Flowable concrete shall be used when specified on the plans as backfill material or for plugging designated abandoned pipes and culverts.

F. Architectural Concrete: Is defined as the ultimately exposed areas of exterior and interiors of buildings, chambers, galleries, vaults, foundations, parapets (including portions to be covered by roofing or flashing material), tanks and basins limited on the interior to a point that is 2 feet below the normal water level.

G. Mass Concrete: Mass concrete is any cast-in-place concrete with dimensions large enough to require that measures be taken to cope with the generation of heat and attendant volume change to reduce cracking.

1.4 SUBMITTALS

A. Submit Shop Drawings in accordance with the requirements of Section 01300.

B. Concrete Mix Design: Certified concrete mix designs shall be prepared and submitted to the Engineer for approval for each type required, including proposed admixtures.

C. Submit plant tickets for ready-mix concrete including date and time mixed, time of arrival on-site, start and end time of placement, and design slump.
TECHNICAL SPECIFICATIONS

1.5 REGULATORY REQUIREMENTS

A. American Concrete Institute: Perform Work covered by this Section in accordance with the requirements of the American Concrete Institute.

B. Concrete shall conform to applicable sections of VDOT Road and Bridge Specifications.

1.6 DELIVERY, STORAGE AND HANDLING

A. Cement:

1. Delivery: Cement delivered to the jobsite shall be in strong, well made bags marked with the brand, name of manufacturer and net weight.

2. Storage: Store cement in weathertight building with a wood floor raised above the ground and protected from dampness.
   a. Stack and store individual shipment in a manner which permits each shipment to be readily accounted for at all times.
   b. Provide all facilities necessary to permit sampling and inspection of each shipment.
   c. Do not use cement which has deteriorated.
   d. Cement remaining in storage prior to shipment for a period exceeding 6-months after testing shall be re-tested and rejected if it fails to meet any requirements of these Specifications.
   e. Do not use previously accepted cement which has been in storage more than 1 year from the time of original acceptance.

B. Aggregate: Keep aggregates clean and free from all other materials during transportation and handling. Keep fine and coarse aggregates separated from each other until measured in batches and placed in the mixture.

   1. Stockpiling: Unless finish screening is provided at the batch plant, stockpile aggregates in a manner to prevent segregation and in accordance with ACI Standard 614.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved equal products to those indicated in Contract Documents will be considered for approval by the Engineer.
2.2 MATERIALS

A. Cement: Provide Standard Portland Cement, Type I or Type II, which meets the requirements of ASTM C150.

B. Fine Aggregate: Fine aggregate shall be natural sharp sand meeting the requirements of ASTM C33 except as modified herein:

1. Limits for deleterious substances: The limits for deleterious substances shall be as set forth in Table 1 of ASTM C33 for concrete subject to abrasion.

2. Color: Fine aggregate for architectural concrete shall be of one type and color.
   a. Fine aggregate subjected to the test for organic impurities and producing a color darker than standard will be rejected without exceptions.

3. Soundness: Fine aggregate shall meet the requirements of the soundness test set forth in paragraph 7.1 of ASTM C33.

4. Fine aggregate for mortar and grout: Fine aggregate for mortar and grout shall be well graded within the following limits by weight when tested in accordance with ASTM C1126.

<table>
<thead>
<tr>
<th>SIEVE</th>
<th>PERCENTAGE PASSING</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 4</td>
<td>100</td>
</tr>
<tr>
<td>No. 8</td>
<td>96 to 100</td>
</tr>
<tr>
<td>No. 16</td>
<td>40 to 65</td>
</tr>
<tr>
<td>No. 30</td>
<td>15 to 35</td>
</tr>
<tr>
<td>No. 50</td>
<td>5 to 15</td>
</tr>
</tbody>
</table>

C. Coarse Aggregate: Coarse aggregate shall consist of gravel or crushed stone and shall meet the requirements of ASTM C33. The limits for deleterious substances and physical property requirements given in Table 3 of ASTM C33 shall apply for each class designation without exception. Coarse aggregate shall be graded according to Sizes 46 and 57 in Table 11 of the Standard.

1. Coarse Aggregate Specification: Size No. 57 shall be used for all thin or closely reinforced concrete work, such as floors and roofs less than 7-inches thick, walls less than 9-inches thick, and all beams. For all other concrete work, Size No. 46 shall be used.

2. Color: Coarse aggregate for concrete shall be of one type and color.
TECHNICAL SPECIFICATIONS

D. Admixtures: The use of admixtures shall be limited to the following:

1. Air-entraining: All concrete, except Class D, shall contain an air-entraining admixture conforming to ASTM C260 and sufficient to produce from 4.5 to 6.5 percent entrained air in the concrete.

2. Water reducing: Water reducing admixtures, conforming to ASTM C494, Type A, shall be used when approved by the Engineer.

3. Set retarding: Set retarding admixtures, conforming to ASTM C494, Type D, shall be used when approved by the Engineer.

4. Fly ash: Fly ash, for use in flowable fill, shall conform to Section 241 of the VDOT Road and Bridge Specifications.

E. Water: Water used in mixing concrete shall be clean and shall not contain deleterious amounts of acids, alkalies or organic materials. All water shall be furnished from sources approved by the Engineer.

F. Expansion Joint Material: Joint filler shall be closed-cell PVC form of the thickness shown, and shall be Rodofoam No. 327 as manufactured by W.R. Grace and Co., Vinylfoam No. 327 as manufactured by W.R. Grace and Co., or Vinylfoam No. 327 as manufactured by Sonneborn-Cotech, or approved equal.

G. Waterstops: Provide waterstops made of extruded polyvinyl chloride.

1. Requirements for plastic and waterstops: Provide plastic waterstops which meet the requirements of Corps of Engineer Specification ORD-C572, except as modified herein.

   a. The Shore A durometer hardness shall be between 65 and 75.
   
   b. The minimum tensile strength shall be 1850 psi.
   
   c. Specific gravity shall not exceed 1.38.
   
   d. Waterstops shall have ribbed longitudinal strips.

2. Dimensions: Unless otherwise shown, provide waterstops which are flat, a minimum of 6-inches wide, not less than 1-1/4-inches thick at the narrowest point, and not less than 3/8-inches thick immediately adjacent to the center.

H. Membrane Waterproofing: Provide membrane waterproofing which meets the requirements of ASTM C309 and is a semi-flexible material composed of an asphaltic core to which is bonded on independent weather proof coating. The coating is to be bonded during the manufacturing process.
TECHNICAL SPECIFICATIONS

1. Protective coating requirements: Protective coating shall form a continuous layer over the waterproofing core.

2. Membrane vapor transmission rate: Membrane shall have a constant rate of water vapor transmission not greater than 0.0066 grains per square foot per hour measured in accordance with ASTM E96.

I. Joint Sealant: Joint sealant materials may be either a single component urethane compound meeting the requirements of Fed. Spec. TT-S-230C, or a two-component urethane compound meeting the requirements of Fed. Spec. TT-S-227E, except as modified herein.

1. Urethane sealant: The urethane sealant shall be 100 percent polymer, non-extended, containing no solvent, lime, or coal tar. Color shall be as selected by the Engineer, but shall not be black. Sealant properties shall conform to the following Table:

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>VALUE</th>
<th>TEST METHOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Final cure (days)</td>
<td>10</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Tensile strength (psi)</td>
<td>75-50</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Minimum elongation (1%)</td>
<td>400</td>
<td>ASTM D412</td>
</tr>
<tr>
<td>Modulus @ 100% elongation (psi)</td>
<td>35-50</td>
<td>Fed. Spec.</td>
</tr>
<tr>
<td>Shore A hardness</td>
<td>20-35</td>
<td>Shore Durometer</td>
</tr>
<tr>
<td>Solid content (1%)</td>
<td>98-100</td>
<td></td>
</tr>
<tr>
<td>Peel content (1%)</td>
<td></td>
<td>Fed. Spec.</td>
</tr>
</tbody>
</table>

2. Joint sealant for unbonded joints: Where removable concrete slabs are not poured in place, horizontal and vertical joints shall be filled with self-leveling or non-sagging colma joint sealer, respectively, as manufactured by the Sika Chemical Corporation of Lyndhurst, NJ, or approved equal.

J. Sheet Curing Materials:

1. Paper shall consist of only ply of an approved type of fiber reinforced waterproof building paper, consisting of cross fibers embedded in asphalt between two layers of waterproof building paper.

2. Polyethylene film shall be white, opaque sheeting a minimum of 4 mils (0.1 millimeter) in thickness. The sheeting shall be manufactured from virgin resins and shall contain no scrap or additives.
2.3 MIXES

A. Concrete: Concrete to be used in the respective places shown on the Drawings or as specified shall be divided according to compressive strength.

B. Concrete classifications: Refer to these Specifications and the Drawings to determine which class of concrete to use in a given application.

1. Class A concrete shall have a 7-day test strength of 3400 psi and a 28-day test strength of 5000 psi.

2. Class B concrete shall have a 7-day test strength of 2700 psi and a 28-day test strength of 4000 psi.

3. Class C concrete shall have a 7-day test strength of 2700 psi and a 28-day test strength of 4000 psi.

4. Class D concrete shall have a 7-day test strength of 1300 psi and a 28-day test strength of 2000 psi.

5. Flowable Fill concrete shall have a 28-day test strength of 30 to 200 psi when used as backfill in pipe installation or a 28-day test strength of 30 to 1200 psi when used for plugging abandon pipes and culverts. Flowable Fill shall have a slump of no less than 8” when placed.

C. Concrete mix design: Prepare mix designs for each type of concrete required in accordance with ACI 613.

1. Concrete of any class which is to be placed by pumping methods shall require a separate mix design.

D. Admixtures: Admixtures shall be used as directed in these Specifications and Drawings.

1. When more than one admixture is to be used, each admixture shall be dispensed separately into the mix, and at separate times during the mixing in accordance with ACI 212.

E. Cement content: Concrete, except Class D, shall not contain less than 517 pounds of cement per cubic yard.

F. Water-cement ratio: Concrete mixtures shall be proportioned to give adequate workability for the use intended without exceeding the following prescribed quantities of mixing water:
TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>TOTAL WATER – U.S. GALLONS PER 94 LB. SACK OF CEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>5-1/2</td>
</tr>
<tr>
<td>C</td>
<td>5-1/2</td>
</tr>
<tr>
<td>D</td>
<td>7-1/4</td>
</tr>
</tbody>
</table>

1. For Class A concrete, the quantity of mixing water shall be determined on the basis of either laboratory trial batches or field experience in accordance with ACI 318.

2. The quantity of water used in each batch shall be the total quantity, including surface moisture contained in the aggregates.

G. Ready mixed concrete: Ready mixed concrete shall meet the requirements of ASTM C94 except as modified in these Specifications.

H. Reinforcement

1. Unless otherwise indicated, reinforcing bars shall meet requirements of ASTM A615 including S1 with a minimum yield strength of 60,000 psi.

2. Welded wire fabric shall meet requirements of ASTM A185, size and spacing of wires as indicated on drawings.


2.4 GROUT

A. Grout: Grout shall be a flowable, prepackaged, non-shrink and non-stain grout without dependence on gas expansion forces or enlargement of metal particles for its non-shrink characteristics.

B. Dry Pack, Non-Shrink Grout: Dry pack grout for packing under structural steel and equipment shall be Master Flow 713 as manufactured by Master Builders, or multi-purpose as manufactured by Upcon, or approved equal.

C. Packaging: The grout shall be packed in moisture-proof bags with general instructions for placement printed on the bag.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measurement and Mixing: Measurement and mixing of concrete shall be subject to the review of the Engineer in all respects and shall be performed in accordance with the recommendations of ACI 304, as modified herein.
TECHNICAL SPECIFICATIONS

1. Measuring requirements: Measure cement, fine and coarse aggregates separately by weight by equipment providing an accuracy within 1 percent of the net load weighed. Water shall be measured by a suitable device, accurate to within 1 percent of the total amount required for the batch.

2. Measuring equipment: The accuracy of the weighting equipment shall meet the requirements of the United States Bureau of Standards and standard testing weights and other necessary equipment shall be available at all times for testing the equipment.

3. Mixing: Concrete shall be mixed in rotary, batch type mixer of adequate design to produce a thorough mix, homogenous in composition and uniform in color. Each batch of 1 cubic yard or less shall be mixed not less than 1-1/2 minutes after the last of the ingredients have been added to the mixer. The mixing time shall be increased 15 seconds for each additional cubic yard or fraction thereof.

B. Ready-Mixed Concrete:

1. Rate of delivery: The rate of delivery of the mixed concrete shall be such that the interval between placing of fresh concrete in contact with concrete already placed from previous batches shall not exceed 45 minutes. The elapsed time between the introduction of mixing water to the cement and aggregates and depositing concrete in the Work shall not exceed 60 minutes, including mixing and agitating time.

2. Delivery equipment: Delivery of concrete in non-agitating equipment shall not be permitted.

3. Addition of water: No water shall be added to the concrete at the site unless accepted by the Engineer for a specific batch. Acceptance of such addition to one batch shall not be construed as acceptance of additions to subsequent deliveries.

3.2 INSTALLATION

A. Forms:

1. General: The design and engineering of the formwork, as well as its construction, shall be the responsibility of the Contractor. Forms shall be designed, detailed and constructed in accordance with ACI 347 including all tolerances, except as modified herein. Beam and girder soffits shall be erected with a camber as indicated on the Drawings. Where camber is not given, a minimum camber of ¼-inch in 10-feet of span shall be provided. The forms shall be sufficiently braced, shored, and wedged to prevent deflection.

   a. Provide ¾-inch bevel strips at the external angles of walls, beams, pilasters and columns and girders.
**TECHNICAL SPECIFICATIONS**

b. Provide sufficient forms for repeated uses to ensure the required rate of progress.

1) Thoroughly clean and inspect all forms before use.

c. Apply a suitable form oil to the inside surface immediately before, during, or after erection of forms or thoroughly wet form just prior to placing concrete.

1) No form oil shall be permitted on the reinforcing steel.

d. The Contractor shall be responsible for remedying any defects resulting from form use, inspection and prior acceptance by the Engineer notwithstanding.

2. Plywood forms: Forms for all interior exposed concrete surfaces and designated areas of exterior exposed concrete surfaces shall be constructed of plywood not less than 5/8-inch thick for straight sections and 3/8-inch thick for curved sections. Plywood shall be Douglas Fir, 5-ply for 5/8-inch or thicker, and 3-ply for 3/8-inch, made with a waterproof glue and manufactured especially for concrete formwork. Edges shall be square in both directions, and adjoining panels shall match in thickness, width, and length. Full-size sheets of plywood shall be used. Forms shall be placed so that marking will be symmetrical. Plywood shall be thoroughly oiled on contact faces and edges with raw linseed oil or other form of lacquer as accepted by the Engineer.

3. Steel forms: Construct forms accurately in modular sizes and in such minor multiple widths and lengths as will permit plates and filler to be erected to correct alignment.

a. Coat steel forms prior to each use with a light, clear paraffin-base oil or other acceptable commercial preparation which shall not discolor concrete.

b. Wire brush plates after each use.

4. Form ties: Provide form ties, hangers and clamps, acceptable to the Engineer, which are of a type such that no metal will be closer than 1-inch from the concrete surface after removal of the forms.

a. Lugs, cones, washers and other devices which leave holes or depressions at the surface of the concrete in excess of 7/8-inch diameter shall not be fit within the forms.

b. Provide ties to be left in place with swaged washers or other acceptable devices which prevent moisture seepage along the tie.

c. Space form ties, hangers, and clamps in accordance with the manufacturer’s directions.
TECHNICAL SPECIFICATIONS

d. Coat clamps with cup grease or other approved material.

e. Space form ties for architectural concrete in a uniform pattern, vertically and horizontally with respect to the building height and column centerlines.

f. Removable form ties will not be permitted in water retaining structures.

B. Placing Reinforcement: Unless otherwise indicated, place reinforcement in accordance with ACI 301 and with concrete cover as specified in ACI 318.

C. Inserts and Sleeves: Encase pipes, anchor bolts, sleeves, steps, castings, floor drains, manhole frames and other inserts in the concrete as shown on the Drawings.

1. Setting Inserts: Place and maintain inserts at the proper lines and grades; insofar as possible, set inserts before placing concrete. Brace thoroughly to prevent movement during the progress of the Work.

   a. Thoroughly compact concrete around inserts and sleeves to prevent the passage of water.

   2. Dovetail Anchor Slots: Provide dovetail anchor slots for concrete walls to be faced with masonry, as indicated on the Drawings, but not more than 24-inches apart.

D. Placing Concrete:

1. General: Place concrete only in presence of the Engineer in forms which have been accepted by him. Where procedure is not specified, place concrete in accordance with ACI 304.

2. Continuous Operation: Concreting operations shall be continuous until the section, panel, or scheduled placement is completed. Should the concreting operations be unavoidably interrupted, construction joints shall be formed at proper locations as specified.

3. No Placement After Initial Set: No concrete shall be placed after its initial set has occurred, and no re-tempered concrete shall be used under any conditions.

4. Placement in Layers: Place concrete in layers shallow enough so that the previous layer is still soft when the next layer is added. The two layers can be vibrated together.

   a. The maximum layer depth shall not exceed 18-inches.
   b. The elapsed time between placing layers shall not exceed 45 minutes.

5. Placement of Wall and Column Concrete: Deposit wall and column
TECHNICAL SPECIFICATIONS

concrete through heavy duck canvass or galvanized steel chutes equipped with suitable hopper heads.

a. Chutes shall be of variable lengths in order that the free fall of concrete not exceed a maximum of 3-feet.

b. Provide illumination, as required, inside the forms so that concrete is visible from the deck and runways at the point of deposit.

6. Elimination of Voids: Take special care to place concrete against the forms, particularly in angles, and corners in order to prevent voids, pockets and rough areas and to assure continuous contact of the entire surface of the reinforcing steel and inserts with concrete.

a. Rod or spade concrete, if needed, to work coarse material away from forms.

7. Vibrating: Consolidate all concrete by means of mechanical internal vibrators applied directly into the concrete in a vertical position.

E. Special Requirements:

1. Hot Weather Requirements: Follow the requirements of ACI 305 and the following for placement of concrete during hot weather.

a. Concrete in excess of 90 degrees F. (32 degrees C) at the time of placement shall not be used.

b. A water reducing set retarding admixture may be used in accordance with the provisions of these Specifications when concrete temperature is consistently about 75 degrees F. (24 degrees C) and a noticeable decrease in slump or an increase in mixing water demands occur.

2. Cold Weather Requirements: Follow the requirements of ACI 306 and the following for placement of concrete during cold weather.

a. Set accelerators shall not be permitted.

b. Protect concrete placed in the Fall from the time of the first frost until mean daily temperature at the site falls below 40 degrees F. (4 degrees C) from freezing for a minimum period of 24 hours after it is placed.

c. While mean daily temperatures are below 40 degrees F. (4 degrees C), the temperature of the concrete shall be not less than 50 degrees F. (10 degrees C) and shall be maintained at this temperature for at least 72 hours, or, if structural requirements are critical, until such time as is required to develop the necessary compressive strength. The internal temperature for concrete at the time of placing during this period shall not exceed 60 degrees F.
TECHNICAL SPECIFICATIONS

d. Protect concrete, placed in the Spring after mean daily temperature rises above 40 degrees F. from freezing in a similar manner to that described in the preceding sentences, until danger of freezing is past.

F. Curing:

1. General: Follow recommendations of ACI 318 and the following for curing concrete.

   a. Protect concrete surfaces, which will normally be exposed to the atmosphere, against drying too rapidly for a minimum period of 7 days.

      1) Refer to requirements of applicable subparagraphs on hot or cold weather curing.

   b. Curing procedure shall begin immediately following placing the concrete.

      1) If a delay in application of curing procedure occurs, cover concrete with moistened burlap held in complete contact with the surface or kept moist by continuous sprinkling.

   c. Use one of the following methods, subject to approval of the Engineer, for curing concrete.

2. Water Curing: Use quilted covers, wetted and applied to the concrete surface as soon as forms have been removed or, in the case of slabs, as soon as concrete has set sufficiently to prevent marring of finish.

   a. Quilted covers shall consist of an outer covering of burlap or cotton, and a needled, punched or sandwiched inner layer of cotton batting, in all weighing a minimum of 20 ounces per square yard.

   b. Maintain covering materials in a thoroughly saturated condition sufficient to show the presence of free water between mat and concrete surface at all times throughout curing period.

3. Sheet Curing: Sheet curing of concrete slabs is accomplished through use of sheet materials such as waterproof paper or polyethylene film, both meeting the requirements of ASTM C171, applied to the concrete surface as soon as it has set sufficiently to prevent marring.

   a. Wet concrete surface thoroughly, then place sheet goods in direct contact and anchor in a manner which assures continuous contact during curing period.

   b. Lap sheet materials a minimum of 3-inches, then tape, glue or cement seams.
**TECHNICAL SPECIFICATIONS**

c. Sheeting materials shall not discolor concrete surface.

4. Membrane Curing: Begin membrane curing immediately after removal of forms, or in the case of uniformed surfaces, as soon as water sheen is no longer visible on the concrete surface.

   a. Coat the entire exposed surface with a liquid membrane forming compound containing a temporary color indicator.

   b. Apply membrane coating by means of an approved pressure spray distributor at the rate of 1 gallon of material per 200 square feet of concrete surface.

      1) Do not apply membrane curing to the faces of construction joints or other surfaces against which additional concrete will be placed. Keep those surfaces continuously wet by other means.

      2) Do not apply membrane coating to surfaces which are to be covered with a coating material applied directly to the concrete or with a covering material bonded to the concrete, unless otherwise specified.

5. Special Requirements:

   a. During hot weather, protect concrete surfaces from drying by continuous moist curing for a period of at least 24 hours.

      1) Start curing procedure as soon as concrete surface has hardened sufficiently to withstand surface damage.

      2) If moist curing is not carried beyond 24 hours, cover surface, while damp, with a suitable heat-reflecting plastic covering or spray with a white pigmented curing compound.

   b. During cold weather, protect concrete against freezing in accordance with ACI 306 and the following:

      1) When protection against low temperatures is removed at the end of the required period, remove it in a manner such that the resulting temperature drop in any part of the concrete does not exceed 40 degrees F. during the first 24-hour period.

      2) Do not permit concrete in heated enclosures to dry out.

G. Joints and Bonding: Make construction joints where indicated or permitted. Locate joints to assure stability, strength and watertightness.
TECHNICAL SPECIFICATIONS

1. Corners: Build all corners monolithically. Concrete on either side of the corners shall be continuous to the points shown on the Drawings or as directed.

2. Placing Concrete in Beams, Girders, or Slabs: Allow a minimum of 2 hours to elapse after concrete in the columns or walls before depositing concrete in beams, girders, or slabs supported thereon.

3. Horizontal Keyways: Build horizontal keyways to facilitate the drainage of flushing water from the keyways.

4. Requirements for Joints: Provide joints with continuous straight, and regular keys or grooves.
   a. Bring exposed concrete surfaces to a true level line at the top of all horizontal construction joints.
   b. In the case of exposed construction joints, locate a row of form ties in the concrete 4- to 6-inches from the joint to tighten the forms for subsequent sections of construction.
   c. Install waterstops, where required, in accordance with the provision of these Specifications.

5. Continuous Placing Between Construction Joints: The placing of concrete shall be carried on continuously between the construction joints shown on the Drawings or as directed by the Engineer.
   a. If, for any reason, it becomes necessary to stop placing concrete at locations other than those indicated, both the proposed location and method of making the joint shall be subject to the Engineer's approval.

6. Placement Against Existing Concrete: Concrete surfaces, against which the new concrete is to be placed, shall be thoroughly cleaned and wetted. Just prior to placing new concrete, horizontal surfaces and joints shall be slushed with at least 2-inches of cement grout of the same mixture as the concrete but with coarse aggregate omitted. Special care shall be used in placing and puddling concrete at vertical joints to ensure a bond with existing concrete. Vertical construction joints shall not be made in watertight construction, unless shown on the Drawings.

H. Finishing Concrete Surfaces:

1. General: Finish exposed interior and exterior concrete surfaces to achieve neat and smooth architectural effects except where textured surface is indicated.
TECHNICAL SPECIFICATIONS

a. Finish top edges of wall within a 1/2-inch radius, unless beveled edges or other details are shown.

b. Immediately after stripping the forms, without exception, inspect all concrete surfaces. Remove all fins, offsets, burrs, ridges or other unsightly marks from the concrete surfaces.

c. Tie holes, pour joints, voids, stone pockets, or other defective areas shall be patched, in accordance with the recommendations of the manufacturers of the various bonding compounds, before the concrete is thoroughly dry. The material for patching shall consist of the same material and of approximately the same proportions as used for the concrete, omitting the coarse aggregate and mixing with water and an additive as previously specified. For exposed concrete, white cement shall be substituted for part of the gray cement so that the patch will match the color of the surrounding concrete. The amount of water shall be as little as consistent with the requirements of handling and placing. The mortar shall not be re-tempered. The mortar shall be thoroughly compacted and screed off so as to leave the patch slightly higher than the surrounding surface.

2. Exterior concrete surfaces: Exposed exterior concrete surfaces defined as architectural concrete, except in the case of textured concrete surfaces, shall be given a uniform light rubbed finish.

a. After the patching has been completed, the surfaces shall be given a uniform rubbed finish as follows: Mix 1 part Portland Cement and 1-1/2 parts fine sand with sufficient water to make a grout having the consistency of thick paint. Wet the concrete surface, and brush the grout uniformly over the entire area, completely filling air bubbles and holes. Immediately after applying the grout, float the surface with a wood float, scouring the wall vigorously. Allow the cement to set for 1 or 2 hours, depending upon the weather. If hot and dry, keep the wall damp during this period using a fine fog spray. When the grout has hardened sufficiently so that it can be scraped from the surface with the edge of a steel trowel without removing the grout from the small air holes, cut off all that can be so removed. Allow the surface to dry thoroughly, then rub it vigorously with burlap to remove completely all dried grout. There should be no visible film of grout remaining after this rubbing, and no grout shall be left on the surface overnight. Sufficient time shall be allowed for grout to dry after it has been cut with the trowel, so that it can be wiped off clean with the burlap. The finished surfaces shall have a uniform, fine sand finish.

3. Interior concrete surfaces. Provide a rubbed finish for all exposed interior concrete surfaces defined as architectural concrete.
TECHNICAL SPECIFICATIONS

a. Surfaces to receive a rubbed finish shall be thoroughly wetted and kept in that condition until the rubbing work in each section is complete. The surfaces shall be rubbed with wood blocks or stone and water until all hollows, lines, and form marks have been smoothed out and surplus materials have been removed. Grout or mortar shall not be used in the rubbing process, and plastering of surfaces will not be permitted. All rubbing shall be completed within 1 day after the removal of forms. Rubbing shall be continued until the surfaces are uniformly smooth, but the total obliteration of all marks will not be required. Mechanical rubbing will be permitted if a demonstrated technique and result meets the approval of the Engineer.

4. Floor slabs: Screed all surfaces of floor slabs to a true uniform surface and to the elevation shown on the Drawings.
   a. Float and trowel the surfaces of floor slabs in buildings and tunnels to a smooth, dense surface, except in areas to receive equipment bases, which shall be rough finished.
   b. Trowelled surfaces shall be true planes within 1/4-inch in 10-feet.
   c. Float and trowel the surfaces of treads and landings of concrete stairs to a smooth, dense surface.
   d. Float the surfaces of floor slabs in tanks and conduits with metal floats to a finish free of lumps, pockets, and as directed.

I. Expansion Joints: Provide joint filler for all expansion joints, finish expansion joints with a joint sealant where shown or specified.

1. Placing joint filler: Place joint filler against the completed portion of the Work before concrete for next section is placed.
   a. Fasten filler to hardened concrete with a compatible adhesive in accordance with the manufacturer’s instructions.
   b. Extend filler through the thickness of the wall or slab.
      1) Joint filler shall be flush with the finished surface, except where a joint sealant is shown.
   c. In joints having a waterstop, fit filler accurately on each side of the waterstop to prevent intrusion of concrete.

2. Joint prime and sealant application: Prepare joint surfaces by removing all foreign matter and concrete laitance so that concrete surfaces are free of all oil, grease, wax, waterproofing compounds or form release materials prior to application of primer and sealant.
TECHNICAL SPECIFICATIONS

a. Prime all concrete joint surfaces without exceptions.

b. Priming of other surfaces shall be according to the sealant manufacturer’s recommendations and subject to Engineer’s approval.

c. Apply primer by brushing or spraying on joint surfaces.

d. Apply sealant within 2- to 24-hours after application of the primer.

e. For horizontal joints, apply sealant by pouring directly from a suitably shaped container or by flowing from a bulk-loading gun.

f. Fill vertical joints from a gun, beginning at the bottom to avoid bulging and the formation of air voids.

g. Fill overhead joints from a gun, by laying a bead along each side of the joint and then filling the middle.

h. Immediately after application, tool sealant in accordance with manual instructions in order to establish contact with joint surfaces and to provide a smooth sealant face.

3. Joint Depth: Control joint depth with the use of joint fillers and backup materials.

a. Fillers and backup material in contact with sealant shall be non-impregnated and free from asphalt, creosote, oil or extractable plasticizer.

b. Backup material shall be closed cell polyethylene form, such as Sealtight Backer Rod or Sonofoam Backer Rod or approved equal with a diameter ¼-inch larger than the joint width.

c. Joint widths and sealant depths shall be as shown, except that sealant depth shall not exceed ½-inch.

J. Waterstops: Waterstops for corners and intersections shall be prefabricated so that only butt joints need to be made in the field.

1. Corners and Intersections: Field fabrication of corners and intersections requires the Engineer’s approval. Miter and assemble corners and intersections with approved equipment as described for field joints.

2. Field Joints: Make field joints by cutting the ends of the sections to be spliced so they will form a smooth, even butt joint.

a. Heat the cut ends with splicing tool until plastic melts. Press ends together until the plastic cools.
**TECHNICAL SPECIFICATIONS**

b. Splicing shall cause as little damage to the continuity of the ribbed strips as possible.

K. Unbonded Joints: Where removable concrete slabs are poured in place, slab must be prevented from bonding to walls or other rigid parts of the structure.

1. Preventing bonding: Prevent bonding by the use of membrane waterproofing material
   
a. Place material over the bearing surface of the wall or other supporting part of the structure in order to isolate it from the new concrete being placed.
   
b. Install material in layers as required to produce a total thickness of at least 1/8-inch.

2. Filling unbonded joints: Where removable concrete slabs are not poured in place, fill horizontal and vertical joints with self-leveling or non-sagging Colma joint sealer or approved equal.

L. Membrane Waterproofing: Coat all exterior concrete wall surfaces below grade, except for precast section, with a membrane waterproofing.

1. Application of Membrane Waterproofing: Bond membrane to the wall, in accordance with the manufacturer’s instructions, with either cold applied bonding asphalt or hot applied mopping asphalt conforming to ASTM D312 Type 3.
   
a. Butt edges together tightly and cut all intersection surfaces to fit.
   
b. Seal joints with a 6-inch wide overlay or gusset strips bonded to the membrane.

M. Mass Concrete: Any concrete placement of 100 or more cubic yards with a minimum dimension of 3 feet will be considered mass concrete.

1. Provisions During Placement: Make special provision to lower the temperature of the concrete as it is placed and to limit the maximum temperature rise in the concrete during hydration.
   
a. The provisions may include pre-cooling the mix, reduction in cement content and substitution of possolan or blast furnace slag cement for part of the Portland Cement, as approved by the Engineer.

2. Provisions After Placement: Make provisions to avoid thermal shock due to too rapid cooling of the concrete after the initial curing period.
N. Grouting: Place grout under column setting plates, under equipment bases, around anchors or dowels set in holes drilled in the concrete, and elsewhere as specified.

1. Non-shrink Grout: There shall be no shrinkage below placement volume under ASTM C827 and no drying shrinkage under CRD 588-76.
   
a. Furnish Engineer with recent independent laboratory tests showing that grout is non-shrink from the time of placement, shows no expansion after set, develops 3000 psi with a trowable mix within 24 hours, and has a placement time based on an initial set of not less than 60 minutes in accordance with ASTM C191. Supply test results showing that in projects of similar scope and size, the effective bearing area was between 95 and 100 percent.

2. No Discoloration: Where grout is exposed to the weather, it shall be free of discoloration without the necessity of special surface treatments.

3.3 PIPE CRADLES AND ENCASEMENT

A. General:

1. When providing pipe cradle or encasement, the Contractor shall use concrete blocks shaped to accommodate and support the pipe at each end. Low slump mortar shall be used between the pipe and the concrete blocks at point of contact to bring the pipe to the exact grade.

2. Placing of concrete at one side until its level rises above the pipe’s invert. The remainder of the concrete can be placed on both sides. Adequate measures shall be taken to prevent any movement in the pipe during construction.

B. Dimensions: Except as shown on the Drawings, encasement will be rectangular in shape and shall extend from a minimum of 6 inches below the pipe invert to 6 inches above the pipe crown. The width of the encasement shall be identical to the trench width specified in Section 02200. Cradles shall be the same dimensions as specified above, except that concrete shall extend up to the spring line of the pipe, unless shown otherwise on the Drawings.

3.4 CONCRETE CURB AND GUTTER

A. Concrete curb and gutter shall be constructed in accordance with the applicable sections of the VDOT Road and Bridge specifications.

B. Connect to existing concrete curb and gutter where shown on the drawings and as directed and match existing curb and gutter in line and grade. Provide smooth transitions. Remove existing curb and gutter damaged by construction to the nearest joint beyond the damaged section.
TECHNICAL SPECIFICATIONS

3.4 FIELD TESTS

A. The following tests shall be performed at the request of the Engineer

B. Slump Tests: Conduct slump tests in accordance with ASTM C143 and the following

1. Allowable Slump: Provide a concrete mixture which has a slump of 5-inches or less if placement is to be done by pumping, and 4-inches or less if placement is to be accomplished by methods other than pumping.

2. Tolerances: A tolerance of up to 1-inch greater than these amounts shall be allowed for individual batches provided the average to all batches or the 10 most recent batches, whichever is fewer, does not exceed the maximum allowable slump.

3. Excessive Slump: Concrete with excessive slump shall be rejected and no additional concrete shall be delivered until the case of the deficiency is determined and corrected.

C. Air Content Tests: Tests to determine air content of fresh concrete shall be taken twice daily, at least 4 hours apart and shall be performed in accordance with the applicable ASTM Standards.

1. Number of tests required. Unless otherwise required, a minimum of one strength test shall be made for each 50 cubic yards or fraction thereof for each mix design of concrete placed in any one day, except that in case shall a given mix design be represented by less than 5 tests.

2. Sample collection and storage: Sampling of fresh concrete shall be in accordance with ASTM C172. Laboratory and field test cylinders shall be made and, for the first 24 hours, cured and stored in a tightly constructed, firmly braced wooden box, constructed to maintain the temperature immediately adjacent to the specimens in range of 60 degrees F. to 80 degrees F. and prevent loss of moisture from the specimens. The storage temperature shall be thermostatically controlled when necessary.

   a. Loss of moisture shall be prevented by covering cylinders with wet burlap, damp sand or other approved means. Test cylinders cast in cardboard molds shall not be stored in contact with wet burlap, damp sand or any other material that will allow the outside surfaces of the mold to absorb water for the first 24 hours. Cylinders shall be removed from storage after 24 hours, and after removal of molds, the laboratory-cured cylinders shall be stored in a moist condition in the laboratory at a temperature of 65 degrees F. to 75 degrees F until the time of the test. The field-cured cylinders shall be removed from storage after 24 hours and stored in the structure as near the point of sampling as practicable, with the same protection on all surfaces as the structure which they represent.
3. Testing: Cylinders shall be tested in accordance with ASTM C39. Each strength test will consist of 3 laboratory-cured and 1 field-cured cylinders. One laboratory-cured cylinder shall be tested at 7 days. Normally 2 laboratory-cured cylinders and 1 field cured cylinder shall be tested at 28 days. If the 7-day laboratory cured-cylinder is not satisfactory, one of the remaining laboratory-cured cylinders shall be tested at 7 days instead of 28 days.

4. Testing Laboratory: The Contractor shall retain the services of an independent laboratory subject to the approval of the County or the County’s Engineer for testing concrete. The concrete testing laboratory will be employed directly by the Contractor, who will pay all fees associated with concrete testing work. The Contractor shall assist the testing laboratory whenever necessary to accomplish the required tests.

5. Strength requirements: The average strength of the test cylinders for any portion of a structure shall be equal to or greater than the strength specified, and at least 90 percent of all tests shall indicate a strength equal to or greater than the strength specified. In cases where the average strength of the test specimens for any portion of the structure falls below the specified requirements, the Engineer shall order a change in the mix proportions or water content for the remaining portion of the Work and shall require the Contractor to secure test specimens of the hardened concrete represented by these cylinders. The number of test cylinders for each concrete placement shall be as directed by the Engineer. Specimens shall be secured and tested in accordance with ASTM C42.

6. Failure to achieve required strength: If the specimen tests further substantiate that the concrete represented by the cylinders and specimens is below the specified strength requirements, the concrete shall be removed and replaced at the expense of the Contractor.

3.5 CLEANING

A. Removal of Forms: Forms shall not be removed until the concrete has hardened sufficiently to support its own load plus any superimposed loads which may be placed thereon. Forms, form ties and bracing shall not be removed without the specific permission of the Contractor’s registered professional engineer if applicable.

It shall be the responsibility of the Contractor to demonstrate conclusively that the strength of concrete specified has been obtained. The minimum strength level required for each cylinder shall equal the specified fc.

1. Minimum shoring times: Leave forms in place at least the minimum length of time specified below. Removal can proceed only if the minimum specified strength for the given period of time has been achieved.
TECHNICAL SPECIFICATIONS

<table>
<thead>
<tr>
<th></th>
<th>MIN. TIME</th>
<th>MIN. STRENGTH (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columns and Walls</td>
<td>2 days</td>
<td>1500</td>
</tr>
<tr>
<td>Side forms for girders and beams</td>
<td>2 days</td>
<td>1500</td>
</tr>
<tr>
<td><strong>Bottom forms of slabs:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 10-feet clear span</td>
<td>4 days</td>
<td>2300</td>
</tr>
<tr>
<td>10- to 20-feet clear span</td>
<td>7 days</td>
<td>2700</td>
</tr>
<tr>
<td>Over 30-feet clear span</td>
<td>10 days</td>
<td>2900</td>
</tr>
<tr>
<td><strong>Bottom forms of beams &amp; girders:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 10-feet clear span</td>
<td>7 days</td>
<td>2700</td>
</tr>
<tr>
<td>10- to 20-feet clear span</td>
<td>14 days</td>
<td>3200</td>
</tr>
<tr>
<td>Over 20-feet clear span</td>
<td>21 days</td>
<td>3600</td>
</tr>
</tbody>
</table>

a. The preceding times may be decreased if field concrete strengths, determined from test cylinders made in accordance with the provisions of these Specifications, equal or exceed the strengths listed previously.

b. Increase the minimum times if concrete temperature following placement is permitted to drop below 50 degrees F.

2. Re-shoring: The Contractor may elect to use re-shoring techniques where form panels are stripped in a pattern or sequence such that part of the original shores remain or re-shoring is simultaneously provided so that the partially cured concrete is not overstressed. Re-shoring shall not commence until the Contractor’s registered professional engineer has reviewed the re-shoring system and examined the concrete to satisfy himself that it has properly hardened and will not be damaged by re-shoring in any way.

3. Form ties: Withdraw the removable portion of the form ties from the concrete immediately after forms are removed.
   a. Fill holes with grout from a grout gun.
   b. Finish the surface with a steel spatula or by rubbing with sackcloth.
   c. On architectural concrete and on exposed interior surfaces of buildings where appearance is important, add white cement to patching grout.

4. Concrete finishing: Take care in removing forms, wales, shorings, supports and form ties to avoid spalling or marring the concrete. Start patching rubbed finish as required immediately following form removal without exception. Concrete placements shall be sequenced to minimize shrinkage cracks.

END OF SECTION 03300

03300-24
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Precast Concrete Vaults and Manholes
B. Precast Concrete Drainage Structures
C. Refer to Specification Section 05500 for metal fabrications and ferrous and non-ferrous castings.

1.2 REFERENCES

B. ASTM C 858 Underground Precast Utility Structures
C. ASTM C 478 Precast Reinforced concrete manhole Sections, Spec for.
D. ASTM C443 Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets, Spec. for
E. ASTM C 891 Installation of Underground Precast Concrete Utility Structures
F. ASTM C 1037 Inspection of Underground Precast Concrete Utility Structures
G. VDOT Road and Bridge Specifications
H. VDOT Road and Bridge Standards

1.3 DEFINITIONS

A. Class A Concrete: Refer to Section 03300 for definition

1.4 SUBMITTALS

A. Shop Drawings: Submit shop drawings for the following items in accordance with Section 01300 – Submittals.
   1. Precast concrete vaults
   2. Precast manholes
   3. Drainage Structures
TECHNICAL SPECIFICATIONS

B. Design Data: Submit design data for the following items in accordance with Section 01300–Submittals.
   1. Precast concrete vaults
   2. Precast manholes
   3. Drainage structures

C. Test Reports: Submit test reports for the following in accordance with Section 01330–Submittals.
   1. Slump
   2. Air content
   3. Compressive strength

D. A packing list or invoice shall accompany each shipment of material.

1.5 REGULATORY REQUIREMENTS

A. VDOT: Precast drainage structures and all precast manholes shall be in accordance with the requirements of the VDOT Road and Bridge Specifications and Standards.

B. All manholes shall be precast concrete unless otherwise noted in this section of the specifications and shall be approved by the Engineer. Precast concrete manholes shall consist of precast reinforced concrete sections, an eccentric conical section, and a base section with gaskets at all joints.

C. Related Specifications: Section 02600, Storm Sewers, Section 05500, Metal Fabrications and Section 02200, Excavating, Backfilling, and Compacting.

1.6 QUALITY ASSURANCE

A. Fabricator must be producer member of the Prestressed Concrete Institute (PCI) and/or participate in its Plant Certification Program.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall be in accordance with the referenced specifications and standards and these specifications.

2.2 MANUFACTURED UNITS

A. Precast Structures: Precast vaults, manholes and roof slabs shall be made of Type A concrete as defined in Section 03300, and reinforcing steel in accordance with
TECHNICAL SPECIFICATIONS

approved submittals.

B. Loading: Precast vaults, manholes and roof slabs shall accommodate the dead load corresponding to the earth cover shown on the drawings and AASHTO HS 20-44 live load with impact.

C. Vault and manhole joints and openings shall be designed and manufactured to be watertight. Vertical seams will not be permitted.

D. Vaults and manholes shall be non-buoyant when installed as shown on the Drawings and with water table at the ground surface.

2.3 TESTS

A. Slump: Perform slump tests in accordance with the requirements of ASTM C143 and Section 03300.

B. Air Content: Perform tests for air content in accordance with the requirements of ASTM C138 or ASTM C173.

C. Strength: Perform strength tests in accordance with ASTM C39 for each mix design of 6 concrete cylinders at intervals as follows:

<table>
<thead>
<tr>
<th>Test Intervals</th>
<th>Number of Cylinders</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Days</td>
<td>Test 1 cylinder</td>
</tr>
<tr>
<td>7 Days</td>
<td>Test 2 cylinders</td>
</tr>
<tr>
<td>28 Days</td>
<td>Test 3 cylinders</td>
</tr>
</tbody>
</table>

2.4 VAULT AND MANHOLE DETAILS

A. Manufacture vaults and manholes to the dimensions shown on the Drawings and in accordance with approved submittals. Comply with ASTM C 857, C 858, and C478.

B. Precast manhole sections shall be manufactured in accordance with current ASTM Standard C478. Each section shall have not more than two holes for the purpose of handling and laying. These holes shall be tapered and shall be plugged with rubber stoppers and mortar after installation is made watertight. Joint of the manhole sections shall be formed entirely of concrete employing a round rubber gasket and when assembled shall be self centering and make a uniform watertight joint. Except for these surfaces within the gasket groove, all inside surfaces of the bell or outside surfaces of the spigot, or both, on which the rubber gasket may bear during the closure of the joint and at any degree of partial closure shall be parallel within one (1) degree and have an angle of not more than two (2) degrees with the longitudinal axis of the pipe. In joints formed entirely of concrete, the distance from either side of the gasket to the end of the bell or spigot shall not be less than
TECHNICAL SPECIFICATIONS

¾-inch. The gasket spaces between the bell and spigot shall be so shaped as to provide either grooves or shoulders that will prevent the gasket from disengaging from its compression surface or being blown out by hydrostatic pressures. The gasket shall be the sole element utilized in sealing the joint from either internal or external hydrostatic pressure. In addition to rubber gaskets between manhole sections, grout and bituminous waterproofing compound shall be applied at each joint.

2.5 INSPECTION DURING MANUFACTURE

A. Comply with ASTM C 1037.
B. Inspector shall be an individual assigned by the manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with ASTM C 891.

3.2 PREPARATION

A. Field Measurements: Verify that accuracy of survey benchmark and elevations are as intended.
B. Excavation for Precast Vaults: Excavate for precast vaults in accordance with the requirements of Section 02200 - Excavating, Backfilling and Compacting.
C. Preparation for Setting Vaults: Prepare subgrade in accordance with manufacturer's recommendations.
D. Precast Base – Precast base sections shall be installed on a firm stabilized foundation prepared similar to that required for the proper installation for the adjacent pipeline as described elsewhere in the specifications. Precast base sections may be supplied by the manufacture with precast inverts, or the inverts may be cast in the field by the Contractor. Inverts shall be smooth and accurately shaped to a semi-circular bottom conforming to the inside of the adjacent sewer sections. Changes in direction of the sewer and entering branches shall have a circular curve of as large a radius as the manhole will permit. The invert channel is to be at least 0.8 times the diameter of the pipe depth. Manhole base shall be integrally case with walls. Changes in size and grade of the channels shall be made gradually and evenly.
E. The invert channels may be formed directly in the concrete of the manhole base, may be built up with brick and Portland cement mortar (1 cement to 2 sand), or may be formed with sewer pipe laid through the manhole and breaking out the top...
**TECHNICAL SPECIFICATIONS**

half after the surrounding concrete has hardened. The bench of the manhole outside the channels shall be smooth and shall slope toward the channels at ¼-inch; 1’ minimum. The invert channel is to be at least 0.8 times the diameter of the pipe depth.

F. Manholes shall be completely watertight. All leaks shall be repaired immediately with a non-shrink material, or the entire work removed and rebuilt.

Groundwater must be kept below all parts of the masonry or concrete foundations and walls until the mortar and concrete has obtained an adequate set.

3.3 INSTALLATION

A. Installation of Precast Vaults and Manholes: Install precast vaults in accordance with the manufacturer's recommendations and the requirements of these specifications.

B. Furnish and install a tight-fitting plug in unused vault and manhole openings.

C. Where manholes are required to have a watertight frame and cover, the cone shall contain cast iron inserts meeting current ASTM Specifications A-48. An approved joint Sealer, Ram-Nek or approved equal, shall be used between all sections of adjusting rings, cone section and casting, and be bolted so as to assure a tight seal.

END OF SECTION 03400
TECHNCIAL SPECIFICATIONS
SECTION 05500
METALFABRICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal Fabrications
   1. Access doors
   2. Vault ladders
   3. Safety posts
   4. Vent caps

B. Ferrous and Non-Ferrous Castings
   1. Miscellaneous castings
   2. Manhole frames and covers
   3. Manhole steps
   4. Cast iron brackets and supports
   5. Inlet grates and frames

1.2 REFERENCES

B. ASTM A47 Specification for Malleable Iron Castings
C. ASTM A48 Specification for Gray Iron Castings
E. ASTM B26 Specification for Aluminum-Alloy Sand Castings
F. ASTM B148 Specification for Aluminum-Bronze Sand Castings
H. Federal Specification QQ-B-726d
I. Navy Specification 46B28
J. AISC Steel Construction Manual, Ninth Edition
TECHNICAL SPECIFICATIONS

K. VDOT Road and Bridge Standards and Specifications, Latest Edition

L. Type 316 Stainless Steel

M. ASTM A536 Specification for Ductile Iron Castings

1.3 SUBMITTALS

A. Product Certification: Submit manufacturer’s certification in accordance with the requirements of Section 01300, showing the true weights of the castings or comply with the provisions of "Certification" Article of this Section.

B. Submit shop drawings and installation instructions for access doors safety posts, ladders and vent caps.

1.4 CERTIFICATION

A. Weighing Facilities: Provide facilities for weighing castings in the presence of the engineer if weight certification from the manufacturer is not available.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bilco Company, New Haven, Connecticut

B. Josam Manufacturing Company; Michigan City, Indiana

C. CertainTeed; Valley Forge, PA

D. Washington Aluminum Company, Baltimore, Maryland

E. Equal products will be considered for approval

2.2 MATERIALS

A. Standards: Metal castings shall meet the requirements of the following standards:

1. Gray Iron: ASTM A48
2. Malleable Iron: ASTM A47
3. Carbon Steel: ASTM A27
4. Alloy Steel: ASTM A148
5. Aluminum: ASTM B26
6. Aluminum Bronze: ASTM B148
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7. Silicon Bronze: Navy Specification 46B28

2.3 CASTINGS

A. Castings: Where noted, castings shall be made accurately to the dimensions shown on the Drawings. Castings to replace damaged castings shall be replaced in kind. Castings in general shall be manufactured in accordance with the applicable sections of the VDOT Road and Bridge specifications.

B. Grinding: Grind or plane castings where necessary to secure perfectly flat and true surfaces.

C. Thicknesses: Make allowances in patterns needed so that specified thicknesses are not reduced.

D. Manhole Covers and Frames: Manhole covers and frames shall conform to the details provided and shall be furnished with machined mating surfaces. Unless otherwise noted, manhole frames and covers shall be heavy duty, suitable for AASHTO HS20-44 live load with impact. Manhole covers shall have the wording “STORM SEWER” cast in them.

E. Defective Castings: No plugging of defective castings shall be permitted.

F. Manhole steps shall be made of plastic or rubber covered steel and shall conform to the requirements of ASTM C478 and VDOT requirements.

G. Where in the 100-year floodplain, or where specified by the Engineer, waterproof manhole covers and frames shall be used. Watertight manhole fame and cover to be East Jordan Iron Works Product #00103304 “1033 HINGECO” or approved equal.

2.4 VAULT ACCESS DOORS

A. Access doors shall be Type "J" or Type "JD", anti-corrosion construction, as manufactured by the Bilco Company or approved equal, and as shown on the Drawings. All door assemblies, including frame shall have a 25 year warranty.

1. Door leaf shall be ¼-inch aluminum diamond pattern. All doors, unless otherwise shown shall be reinforced to withstand an HS-20 loading.

2. Channel frame shall be ¼-inch aluminum with an anchor flange around the perimeter.

3. Each door leaf shall be equipped with the following:
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a. Heavy forged brass hinges with stainless steel pins

b. Stainless steel torsion spring

c. Automatic hold-open arm with release handle

d. Snap lock with removable handle and a recessed hasp covered by a hinged lid flush with surface

e. Stainless steel hardware

4. Frame shall have 1\(\frac{1}{2}\) -inch drainage coupling located in the front right corner of channel frame.

5. Hardware shall be zinc plated and chromate sealed.

6. Factory finish shall be mill finish with bituminous coating applied to exterior of the frame.

7. Manufacturer shall guarantee against defects in workmanship.

B. Provide with each access door a Model 2 "LadderUp" safety post as manufactured by The Bilco Company or approved equal. Device shall be manufactured of stainless steel with telescoping tubular section that locks automatically when fully extended. Upward and downward movement shall be controlled by a stainless steel spring balancing mechanism. Unit shall be completely assembled with stainless steel fasteners for securing to the ladder rungs in accordance with the manufacturer's instructions.

C. Each door shall be provided with insulation where specified, shown on the Drawings or required by the Engineer. Insulation shall be semi-rigid, 1\(\frac{1}{2}\)-inch thick with a minimum R value of 6.5. Maximum water absorption shall be less than 0.1% by volume of insulation. Insulation shall be bonded to door and factory installed. Vault insulation shall be covered with 18 gauge aluminum sheet for mechanical protection.

2.5 **ACCESS LADDERS**

A. Aluminum vault ladders with stainless steel hardware as shown on the Drawings and in accordance with OSHA requirements.

2.6 **VENT CAPS**

A. Cast iron, vandal proof, hooded vent caps; Josam 26700 or approved equal.
3.1 INSTALLATION

A. Install products as indicated in the Drawings and in accordance with manufacturer's instructions, VDOT Road and Bridge Specifications, and County of Fairfax Standard Details.