SECTION 334213 - STORMWATER CULVERTS

This Section specifies corrugated-steel, aluminum, concrete, PE, and PVC pipe culverts and accessories, and includes excavating, bedding, and backfilling. Concrete box sections are also specified.

If specialized end treatments (for example, wing walls) are required, indicate requirements on Drawings or edit this Section accordingly.

1. GENERAL
   * + 1. SUMMARY
          1. Section Includes:

Corrugated steel pipe culvert.

Concrete pipe culvert.

Concrete box sections.

PE pipe culvert.

PVC pipe culvert.

* + - * 1. Related Requirements:

List other Sections directly related to or affecting Work of this Section. Include Sections specifying information expected to be found in this Section as well as Sections required to describe complete system or assembly requirements.

Section 032000 - Concrete Reinforcing: Reinforcement of concrete cradles.

Section 033000 - Cast-in-Place Concrete: Encasement and cradles.

Section 036000 - Grouting: Cementitious grout fill for pipe ends.

Section 061300 - Heavy Timber Construction: Timber cradle construction.

Section 310000 – Earthwork

Section 310001 – Earthwork Materials: Material Specifications for Earthwork items.

Section 313213.16 - Cement Soil Stabilization: Soil-cement material blend for fill at pipe ends.

Section 310001 – earthwork Materials: Riprap fill at pipe ends.

Section 316219 - Timber Piles: Piles for pipe support in poor bearing soils.

* + - 1. REFERENCE STANDARDS

List reference standards included within text of this Section, with designations, numbers, and complete document titles.

LEED requires compliance with specific editions of referenced standards. Consider including publication dates for referenced standards in this Section to ensure the correct standard is used for LEED compliance.

* + - * 1. American Association of State Highway and Transportation Officials:

AASHTO M36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.

AASHTO M86 - Standard Specification for Nonreinforced Concrete, Sewer, Storm Drain, and Culvert Pipe.

AASHTO M170 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

AASHTO M196 - Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains.

AASHTO M206 - Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.

AASHTO M207 - Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

AASHTO M252 - Standard Specification for Corrugated Polyethylene Drainage Pipe.

AASHTO M259 - Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers.

AASHTO M273 - Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less Than 2 ft of Cover Subjected to Highway Loadings.

AASHTO M278 - Standard Specification for Class PS46 Poly(Vinyl Chloride) (PVC) Pipe.

AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.

AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 12- to 60-in. Diameter.

AASHTO M304 - Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter.

AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 18-in. Drop.

* + - * 1. ASTM International:

ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

ASTM A760 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.

ASTM B745 - Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains.

ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.

ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

C506 - Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe.

ASTM C507 - Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.

ASTM C1433 - Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers.

ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3).

ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3).

ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

* + - 1. COORDINATION
         1. Coordinate Work of this Section with termination of [**storm sewer**] <**\_\_\_\_\_\_\_\_**>, trenching, connection to [**public storm sewer**] [**, and**] <**\_\_\_\_\_\_\_\_**>.
      2. SUBMITTALS

Only request submittals needed to verify compliance with Project requirements.

* + - * 1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
        2. Manufacturer’s installation instructions shall be provided along with product data.
        3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
        4. Product Data: Submit manufacturer information regarding pipe, fittings, and accessories.

USE PARAGRAPH BELOW WITH EPD REQUIREMENT WHEN PROJECT ESTIMATE IS $1M OR MORE.

* + - * 1. Submit an Environmental Product Declaration (EPD) from the manufacturer for steel pipe and concrete pipe within this specification section, if available. A statement of the contractor’s good faith effort to obtain the EPD shall be provided if not available.

Manufacturer-provided EPDs must be Product Specific Type III (Third-Party Reviewed), in adherence with ISO 14025 *Environmental labels and declarations*, ISO 14044 *Environmental management – Life cycle assessment*, and ISO 21930 *Core rules for environmental product declarations of construction products and services.*

* + - * 1. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

Include separate paragraphs for additional certifications.

* + - * 1. Manufacturer Instructions: Submit special procedures required to install specified products.
        2. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
        3. Qualifications Statement:

Coordinate following subparagraph with requirements specified in QUALIFICATIONS Article.

Submit qualifications for manufacturer.

Remove paragraph if not a LEED project.

* + - 1. SUSTAINABLE DESIGN SUBMITTALS
         1. Section 018113 - LEED Documentation Requirements: Requirements for sustainable design submittals.
         2. Manufacturer's Certificate:

Certify that products meet or exceed specified sustainable design requirements.

Insert material certifications list below to suit products specified in this Section and Project sustainable design requirements. Specific certificate submittal and supporting data requirements are specified in Section 018113.

Materials Resources Certificates:

Certify source and origin for [**salvaged**] [**and**] [**reused**] products.

Certify recycled material content for recycled content products.

Certify source for regional materials and distance from Project Site.

* + - * 1. Product Cost Data:

Submit cost of products to verify compliance with Project sustainable design requirements.

Exclude cost of labor and equipment to install products.

Provide cost data for following products:

Edit list of material cost data below to suit products specified in this Section and Project sustainable design requirements. Specific cost data requirements are specified in Section 018113.

Salvaged, refurbished, and reused products.

Products with recycled material content.

Regional products.

<**\_\_\_\_\_\_\_\_**>.

* + - 1. CLOSEOUT SUBMITTALS
         1. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
      2. QUALITY ASSURANCE

Include this Article to specify compliance with overall reference standards affecting products and installation included in this Section.

Include following paragraph only when cost of acquiring specified standards is justified.

* + - * 1. Maintain <**\_\_\_\_\_\_\_\_**> [**copy**] [**copies**] of each standard affecting Work of this Section on Site.
      1. QUALIFICATIONS

Coordinate following paragraph with requirements specified in SUBMITTALS Article.

* + - * 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum [**three**] <**\_\_\_\_\_\_\_\_**> years' [**documented**] experience.
      1. DELIVERY, STORAGE, AND HANDLING
         1. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
         2. Storage:

Store materials according to manufacturer instructions.

Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.

Do not store pipe flat on ground.

Store UV-sensitive materials out of direct sunlight.

* + - * 1. Protection:

Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

Block individual and stockpiled pipe lengths to prevent moving.

Cradle pipe to prevent point stress.

Provide additional protection according to manufacturer instructions.

* + - 1. EXISTING CONDITIONS
         1. Field Measurements:

Verify field measurements prior to fabrication.

Indicate field measurements on Shop Drawings.

1. PRODUCTS
   * + 1. PIPE CULVERT

Select one or more of following pipe types. If one culvert size is used throughout Project, include size in following paragraphs. If two or more sizes are used, consider using schedule following END OF SECTION.

* + - * 1. Corrugated Steel Pipe:

[Manufacturers](http://www.specagent.com/LookUp/?ulid=13257&mf=04&src=wd):

Contech Engineered Solutions LLC, (800) 338-1122, 9025 Centre Pointe Dr., West Chester, OH 45069.

TrueNorth Steel Inc., (866) 982-9511, 702 13th Ave. East, West Fargo, ND 58078.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following subparagraph insert "State of New York Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to [**NYS Department of Transportation**] <**\_\_\_\_\_\_\_\_**> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

Comply with [**ASTM A760**] [**AASHTO M36**].

Finish: Galvanized.

Joints: [**Helical;**] [**annular**] [**lock seam**] <**\_\_\_\_\_\_\_\_**>.

Coating: [**Inside and out with 0.050-inch-thick bituminous coating**] [**Inside and out with <\_\_\_\_\_\_\_\_>-inch-thick bituminous coating**].

Shape: [**Circular with nominal diameter of <\_\_\_\_\_\_\_\_> inches**] [**Elliptical with width of <\_\_\_\_\_\_\_\_> inches and height of <\_\_\_\_\_\_\_\_> inches**] [**Arch with width of <\_\_\_\_\_\_\_\_> inches and height of <\_\_\_\_\_\_\_\_> inches**].

Tapered Ends:

Material: Same as pipe.

Machine cut for joining to pipe end.

Coupling Bands:

Material: Galvanized steel.

Minimum Size: [**0.052**] <**\_\_\_\_\_\_\_\_**> inch thick by [**10**] <**\_\_\_\_\_\_\_\_**> inches wide.

Connection: [**Two**] <**\_\_\_\_\_\_\_\_**> neoprene O-ring gaskets and [**two**] <**\_\_\_\_\_\_\_\_**> galvanized-steel bolts.

Reinforced concrete pipe is normally used in applications where subsoil pressure requires greater pipe strength than nonreinforced concrete type. Pipe sizes range from 12 to 108 inches (300 to 2 740 mm) depending on Class and Wall type.

* + - * 1. Reinforced Circular Concrete Pipe:

[Manufacturers](http://www.specagent.com/LookUp/?ulid=13260&mf=04&src=wd):

Forterra Drainage Pipe & Products, (469) 458-7973, 511 E John Carpenter Freeway, Ste. 600, Irving TX 75062.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following subparagraph insert "State of New York Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to [**NYS Department of Transportation**] <**\_\_\_\_\_\_\_\_**> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

In following subparagraph, ASTM C76 and AASHTO M170 are same document.

Comply with [**ASTM C76**] [**AASHTO M170**], Class [**I**] [**II**] [**III**] [**IV**] [**V**] and Wall Type [**A**] [**B**] [**C**].

Reinforcement: [**Mesh**] [**Bar**].

Shape: [**Circular with nominal diameter of <\_\_\_\_\_\_\_\_> inches**] [**Elliptical with width of <\_\_\_\_\_\_\_\_> inches and height of <\_\_\_\_\_\_\_\_> inches**].

End Joints: [**Bell and spigot**] <**\_\_\_\_\_\_\_\_**>.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Reinforced Non-Circular Concrete Pipe:

[Manufacturers](http://www.specagent.com/LookUp/?ulid=13261&mf=04&src=wd):

Forterra Drainage Pipe & Products, (469) 458-7973, 511 E John Carpenter Freeway, Ste. 600, Irving TX 75062.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following subparagraph insert "State of New York Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to [**NYS Department of Transportation**] <**\_\_\_\_\_\_\_\_**> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

In following subparagraph, ASTM C506 and AASHTO M206 are same document.

Reinforced Concrete Arch Pipe:

Comply [**ASTM C506**] [**AASHTO M206**], Class [**A-II**], [**A-III**], [**A-IV**].

Size: <**\_\_\_\_\_\_\_\_**> inches wide by <**\_\_\_\_\_\_\_\_**> inches high.

Joints: Comply with [**ASTM C506**] [**AASHTO M206**].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Precast Concrete Box Sections:

Comply with [**ASTM C1433**] [**AASHTO M259**] [**AASHTO M273**], Class [**A-II**], [**A-III**], [**A-IV**].

Size: <**\_\_\_\_\_\_\_\_**> inches wide by <**\_\_\_\_\_\_\_\_**> inches high.

Joints: Comply with [**ASTM C1433**] [**AASHTO M259**] [**AASHTO M273**].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Reinforced Horizontal Elliptical Concrete Pipe:

Comply with [**ASTM C507**] [**AASHTO M207**], Class [**HE-A**], [**HE-I**], [**HE-II**], [**HE-III**], [**HE-IV**].

Equivalent Round Size: <**\_\_\_\_\_\_\_\_**> inches.

Rise: <**\_\_\_\_\_\_\_\_**> inches.

Span: <**\_\_\_\_\_\_\_\_**> inches

Joints:

Comply with ASTM C443.

Type: Rubber, compression.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Reinforced Vertical Elliptical Pipe:

Comply with [**ASTM C507**] [**AASHTO M207**], Class [**VE-II**], [**VE-III**], [**VE-IV**], [**VE-V**], [**VE-VI**].

Equivalent Round Size: <**\_\_\_\_\_\_\_\_**> inches.

Rise: <**\_\_\_\_\_\_\_\_**> inches.

Span: <**\_\_\_\_\_\_\_\_**> inches

Joints:

Comply with ASTM C443.

Type: Rubber, compression.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Corrugated PE pipe sizes range from 12 to 36 inches in diameter and are available in smooth-lined or corrugated interior.

* + - * 1. [**Perforated**] PE Culvert Pipe:

[Manufacturers](http://www.specagent.com/LookUp/?ulid=13262&mf=04&src=wd):

ADS, (800) 821-6710, 4640 Trueman Blvd., Hilliard, OH 43026.

Contech Engineered Solutions LLC, (800) 338-1122, 9025 Centre Pointe Dr., West Chester, OH 45069.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following subparagraph insert "State of New York Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to [**NYS Department of Transportation**] <**\_\_\_\_\_\_\_\_**> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

Comply with AASHTO [**M252**] [**M294**].

Interior: [**Smooth lined**] [**Corrugated**].

Joints:

Comply with AASHTO M294.

Interior: [**Corrugated**] [**Smooth lined**] [**Match pipe**].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Joints: PE sleeve with gasket.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. [**Perforated**] PVC Culvert Pipe:

[Manufacturers](http://www.specagent.com/LookUp/?ulid=13263&mf=04&src=wd):

ADS, (800) 821-6710, 4640 Trueman Blvd., Hilliard, OH 43026.

Approved equivalent.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

In following subparagraph insert "State of New York Department of Transportation," "Municipality of \_\_\_\_\_\_\_\_ Department of Public Works," or other agency as appropriate.

Furnish materials according to [**NYS Department of Transportation**] <**\_\_\_\_\_\_\_\_**> standards.

Insert descriptive specifications below to identify Project requirements and to eliminate conflicts with products specified above.

Comply with AASHTO [**M278**] [**M304**].

Joints: Comply with AASHTO [**M278**] [**M304**].

* + - 1. PILE SUPPORT SYSTEMS

Consider using this Article for sewer line installations in poor bearing capacity soils. Consult local codes and ordinances when editing this Article.

* + - * 1. Timber Piles: As specified in Section 316219 - Timber Piles.
        2. Timber for Cradle:

[**Southern yellow pine**] [**Douglas fir**], well-seasoned.

As specified in Section 061300 - Heavy Timber Construction.

Surfacing: Preservative treatment on four sides.

* + - * 1. Preservative Treatment for Timber: As specified in Section 316219 - Timber Piles.
      1. CONCRETE ENCASEMENT AND CRADLES
         1. Concrete:

Description: [**Reinforced**] concrete, as specified in Section 033000 - Cast-in-Place Concrete.

Compressive Strength: [**4,000**] <**\_\_\_\_\_\_\_\_**> psi at [**28**] <**\_\_\_\_\_\_\_\_**> days, [**reinforced**] concrete, [**air-entrained**] rough troweled finish.

* + - * 1. Reinforcement: As specified in Section 032000 - Concrete Reinforcing.

Remove paragraph below if not a LEED project.

* + - 1. SUSTAINABILITY CHARACTERISTICS

Insert sustainable design characteristics in this Article to suit content of this Section and Project sustainable design requirements as specified in Section 018113.

* + - * 1. Section 018113 - LEED Documentation Requirements: Requirements for sustainable design compliance.
        2. Material and Resource Characteristics:

Recycled Content Materials: Furnish materials with maximum available recycled content [**including:**] [**.**]

Insert list of materials specified in this Section required to have recycled content.

<**\_\_\_\_\_\_\_\_**>.

Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project Site [**including:**] [**.**]

Insert list of materials specified in this Section required to be regional materials.

<**\_\_\_\_\_\_\_\_**>.

* + - 1. MATERIALS

Select bedding and cover material type based on Project conditions. If more than one type is required, edit following paragraph.

* + - * 1. Bedding and Cover:

Bedding: <\_\_\_\_\_\_>, as specified in Section [**310001- Earthwork Materials**].

Cover: Fill Type <\_\_\_\_\_>, as specified in Section [**310001- Earthwork Materials**].

* + - 1. MIXES

Supplement following paragraphs for special mixtures, if required.

* + - * 1. Fill at Pipe Ends:

[**Soil-cement material blend as specified in Section 313214 - Cement Soil Stabilization, with 6 percent cement,**] premixed and burlap-bagged for moist cure on Site.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Fill at Pipe Ends:

Riprap as specified in Section [**310001 - Earthwork Materials**].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Rock: Nominal size of <**\_\_\_\_\_\_\_\_**> inches.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Fill at Pipe Ends:

Concrete grout fill as specified in Section [**036000 - Grouting**] <**\_\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_\_\_**>.

* + - 1. FINISHES
         1. Steel:

ASTM A123/A123M includes minimum coating thickness grade based on type of material and steel thickness of component.

Galvanizing:

Comply with ASTM A123.

Hot-dip galvanize after fabrication.

* + - 1. ACCESSORIES
         1. Pipe Support Brackets: [**Galvanized**] [**Unfinished**] structural steel coated with bituminous paint.
         2. Geotextile Filter Fabric: As specified in Section 310001 – Earthwork Materials.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

* + - * 1. Geotextile Filter Fabric:

Comply with AASHTO M288 for subsurface drainage.

Type:

Class [**A**] [**B**], non-biodegradable.

[**Woven**] [**Non-woven**] <**\_\_\_\_\_\_\_\_**>.

<**\_\_\_\_\_\_\_\_**>, as manufactured by <**\_\_\_\_\_\_\_\_**>.

* + - * 1. End-of-Culvert Mesh Gratings:

Material: [**Square**] [**, woven**] [**, welded**] steel wire.

Wire Size: <**\_\_\_\_\_\_\_\_**> inches.

Grid Size: <**\_\_\_\_\_\_\_\_**> by <**\_\_\_\_\_\_\_\_**> inches.

1. EXECUTION
   * + 1. EXAMINATION
          1. Verify that [**trench cut**] [**excavation base**] is ready to receive Work of this Section.
          2. Verify that excavations, dimensions, and elevations are as indicated on [**layout drawings**] [**Drawings**].
       2. PREPARATION
          1. Correct over-excavation with [**fine aggregate**] [**coarse aggregate**] [**lean concrete**].
          2. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
       3. INSTALLATION
          1. Excavation and Bedding:

If rigid pipe is to be used, consider directing Contractor to design bedding according "Design Data 40" by the American Concrete Pipe Association and submit to Director’s Representative for review.

Verify bedding requirements for corrugated PE pipe with manufacturer.

Excavate culvert trench to [**12**] <**\_\_\_\_\_\_\_\_**> inches below pipe invert, and as specified in Section [**310000 - Earthwork**].

Hand trim excavation for accurate placement of piping to indicated elevations.

Place bedding material at trench bottom.

Maintain optimum moisture content of bedding material to attain required compaction density.

Level fill materials in continuous layers not exceeding [**6**] [**8**] <**\_\_\_\_\_\_\_\_**> inches in depth, and compact to [**95**] <**\_\_\_\_\_\_\_\_**> percent maximum density.

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Install pipe on compacted subgrade meeting bedding requirements[**, and cradle bottom 20 percent of diameter**].

\*\*\*\*\*\* [OR] \*\*\*\*\*\*

Install pile support system as specified in Section [**316219 - Timber Piles**] <**\_\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_\_\_**>.

Consider using following subparagraph to suit Project conditions.

Place geotextile fabric over compacted bedding.

* + - * 1. Culvert:

Positioning:

Lift or roll culvert into position; do not drop or drag culvert over prepared bedding.

Shore culvert to required position, and retain in place until after compaction of adjacent fills.

Ensure that pipe remains in correct position and to required slope.

Following subparagraph applies to coated-steel culvert pipe only.

Repair surface damage to pipe protective coating with two coats of compatible bituminous paint coating.

Following subparagraph makes direct reference to Section 310000 for backfilling and compaction. Edit to include specific requirements if criteria as specified in Section 310000 are inappropriate.

Backfilling and Compaction:

As specified in Section [**310000 - Earthwork**] <**\_\_\_\_\_\_-\_\_\_\_\_\_\_\_\_\_\_\_**>.

Level fill materials in continuous layers not exceeding [**6**] [**8**] <**\_\_\_\_\_\_\_\_**> inches in depth, and compact to [**95**] <**\_\_\_\_\_\_\_\_**> percent maximum density.

Do not displace or damage pipe while compacting.

Install cover at sides [**and over top of pipe**].

[**Install cover to minimum compacted thickness of 12 inches**] [**Install cover to minimum compacted thickness of <\_\_\_\_\_\_\_\_> inches**], and compact to [**95**] <**\_\_\_\_\_\_\_\_**> percent maximum density.

Maintain optimum moisture content of bedding material to attain required compaction density.

Place geotextile fabric over backfill [**as indicated on Drawings**].

Install culvert end gratings.

* + - * 1. Pipe Ends:

Place fill at pipe ends[**, and**] [**at embankment slopes,**] [**at concrete aprons,**] [**to adjacent construction,**] [**as indicated on Drawings**].

Level fill materials in continuous layers not exceeding [**6**] [**8**] <**\_\_\_\_\_\_\_\_**> inches in depth, and compact to [**95**] <**\_\_\_\_\_\_\_\_**> percent maximum density.

* + - 1. TOLERANCES

Verify that culvert position and inverts are indicated on Drawings. Drawing details should describe location of coarse and fine aggregate in relation to pipe and pipe bedding, dimensions of cut trench width, and details of connections to other Work.

* + - * 1. Maximum Variation from Indicated Slope: [**1/8**] <**\_\_\_\_\_\_\_\_**> inch in [**10**] <**\_\_\_\_\_\_\_\_**> feet.
        2. Maximum Variation from Intended Elevation of Culvert Invert: [**1/2**] <**\_\_\_\_\_\_\_\_**> inch.
        3. Maximum Offset of Pipe from Indicated Alignment: [**1**] <**\_\_\_\_\_\_\_\_**> inch.
        4. Maximum Variation in Profile of Structure from Intended Position: [**1.0**] <**\_\_\_\_\_\_\_\_**> percent.
      1. FIELD QUALITY CONTROL
         1. Inspection: Request inspection from Director’s Representative prior to [**and immediately after**] placing aggregate cover over pipe.

Select from among test standards referenced in following paragraph as appropriate for fill materials and Project requirements.

Consult geotechnical report to select compaction test method appropriate to fill materials being used and Project requirements.

AASHTO T 180 in following paragraph is similar to ASTM D1557.

* + - * 1. Compaction Testing:

Comply with [**ASTM D1557**] [**ASTM D698**] [**ASTM D6938**].

If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.

Testing Frequency: <**\_\_\_\_\_\_\_\_**>.

* + - 1. PROTECTION
         1. Protect pipe and bedding from damage or displacement until backfilling operation is in progress.
      2. ATTACHMENTS

When relying on separate schedules, tables, illustrations, or forms to specify product requirements, include list of each attachment. Include identical list of attachments in Project Manual table of contents.

Consider including schedule if unusual site conditions are evident, if Drawings do not show details of culverts, or if different sizes and locations require description by schedule.

Insert attachments following END OF SECTION. Consider following examples when developing Project schedule.

* + - * 1. Culverts Parallel to Main Street: Reinforced concrete; size: 18 inches, riprap at pipe ends.
        2. Culverts within Site Area: Corrugated steel; sizes noted on Drawings, bagged soil cement at pipe ends.

END OF SECTION 334213