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SECTION 334200 - STORMWATER CONVEYANCE

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

Ductile-iron, culvert pipe and fittings.

Drains.

Encasement for piping.

Catch basins.

Stormwater inlets.

Stormwater detention structures.

Pipe outlets.

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a project. Include only essential definitions or acronyms not well understood by the affected industry or trade.

* + - * 1. FRP: Fiberglass-reinforced plastic.
			1. ACTION SUBMITTALS

Action submittals are submittals requiring responsive action and return of reviewed documents to Contractor.

* + - * 1. Product Data: For each type of product.
				2. Shop Drawings:

Manholes: Include plans, elevations, sections, details, frames, and covers.

[**Catch basins**] [**stormwater inlets**] [**and**] [**dry wells**]. Include plans, elevations, sections, details, frames, covers, and grates.

Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

* + - 1. INFORMATIONAL SUBMITTALS

Informational submittals are submittals that require review by Architect, but they do not require Architect's responsive action and return of reviewed documents to Contractor, provided submittals comply with requirements. If rejected, submittals with responsive action must be returned to Contractor.

Retain "Coordination Drawings" Paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installation of products and materials by separate installers.

* + - * 1. 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.

Retain "Profile Drawings" Paragraph below if profiles are not indicated on Drawings.

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

Retain "Product Certificates" Paragraph below to require submittal of product certificates from manufacturers.

* + - * 1. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
				2. Field quality-control reports.
			1. QUALITY ASSURANCE
				1. Piping materials are to bear label, stamp, or other markings of specified testing agency.
			2. DELIVERY, STORAGE, AND HANDLING
				1. Do not store plastic manholes, pipe, and fittings in direct sunlight.
				2. Protect pipe, pipe fittings, and seals from dirt and damage.
				3. Handle manholes in accordance with manufacturer's written rigging instructions.
				4. Handle [**catch basins**] [**and**] [**stormwater inlets**] in accordance with manufacturer's written rigging instructions.
			3. FIELD CONDITIONS

Retain this article if interruption of existing storm drainage service is required.

* + - * 1. 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 in accordance with requirements indicated:

Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than [**two**] <**Insert number**> days in advance of proposed interruption of service.

Do not proceed with interruption of service without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.

1. PRODUCTS
	* + 1. DUCTILE-IRON, CULVERT PIPE AND FITTINGS

Pipe in "Pipe" Paragraph below should be available in NPS 14 to NPS 64 (DN 350 to DN 1600). Joints are gasketed type.

* + - * 1. Pipe: ASTM A716, for push-on joints.

Fittings in "Standard Fittings" Paragraph below should be available in NPS 3 to NPS 48 (DN 80 to DN 1200).

* + - * 1. Standard Fittings: AWWA C110/A21.10, ductile or gray iron, for push-on joints.

Fittings in "Compact Fittings" Paragraph below are available in NPS 3 to NPS 64 (DN 80 to DN 1600).

* + - * 1. Compact Fittings: AWWA C153/A21.53, for push-on joints.
				2. Gaskets: AWWA C111/A21.11, rubber.
			1. DRAINS
				1. Cast-Iron Area Drains:

Retain "Basis-of-Design Product" Subparagraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed.

Basis-of-Design Product: Subject to compliance with requirements, provide **Zurn Industries, LLC; Z546** or comparable product by one of the following:

<**Insert manufacturer's name**>

Source Limitations: Obtain cast-iron area drains from single manufacturer.

Description: ASME A112.6.3 gray-iron round body with anchor flange and round[ **secured**] grate. Include bottom outlet with inside caulk or spigot connection, of sizes indicated.

Top-Loading Classification(s): [**Medium Duty**] [**and**] [**Heavy Duty**].

* + - * 1. 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**].
			1. ENCASEMENT FOR PIPING
				1. Standard: ASTM A674 or AWWA C105/A21.5.
				2. Material: [**Linear low-density polyethylene film of 0.008-inch**] [**or**] [**cross-laminated HDPE film of 0.004-inch**] minimum thickness.
				3. Form: [**Sheet**] [**or**] [**tube**].
				4. Color: [**Black**] [**or**] [**natural**] <**Insert color**>.
			2. CONCRETE
				1. General: Cast-in-place concrete in accordance with ACI 318, ACI 350, and the following:

Cement: ASTM C150/C150M, Type II.

Fine Aggregate: ASTM C33/C33M, sand.

Coarse Aggregate: ASTM C33/C33M, crushed gravel.

Water: Potable.

* + - * 1. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.

Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

* + - * 1. 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.

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.

Invert Slope: [**1**] [**2**] percent through manhole.

Benches: Concrete, sloped to drain into channel.

Slope: [**4**] [**8**] percent.

* + - * 1. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.

Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

* + - 1. CATCH BASINS
				1. Standard Precast Concrete Catch Basins:

Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

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.

Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.

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

Joint Sealant: ASTM C990, bitumen or butyl rubber.

Retain "Adjusting Rings" or "Grade Rings" Subparagraph below if required.

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.

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

Steps: [**Individual FRP steps or FRP ladder**] [**Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP**] [**ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP**] <**Insert material**>, 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**] <**Insert inches**>.

Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

* + - * 1. Designed Precast Concrete Catch Basins: ASTM C913, precast, reinforced concrete; designed in accordance with ASTM C890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for joint sealants.

Joint Sealants: ASTM C990, bitumen or butyl rubber.

Retain "Adjusting Rings" or "Grade Rings" Subparagraph below if required.

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.

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

Steps: [**Individual FRP steps or FRP ladder**] [**Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP**] [**ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP**] <**Insert material**>, 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**] <**Insert inches**>.

Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

Retain "Rectangular Frames and Grates" Paragraph below for rectangular structures.

* + - * 1. Rectangular Frames and Grates: ASTM A536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), structural loading. Include flat grate with small square or short-slotted drainage openings.

Size: 24 by 24 inches minimum unless otherwise indicated.

Grate Free Area: Approximately 50 percent unless otherwise indicated.

Retain "Round Frames and Grates" Paragraph below for round, manhole-type structures.

* + - * 1. Round Frames and Grates: ASTM A536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), 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.

Grate Free Area: Approximately 50 percent unless otherwise indicated.

* + - 1. STORMWATER INLETS

Stormwater inlets are made of precast concrete and brick. Retain options in "Curb Inlets," "Gutter Inlets," "Combination Inlets," and "Frames and Grates" paragraphs below to require compliance with utility standards. Delete if dimensions are indicated on Drawings.

* + - * 1. Curb Inlets: Made with vertical curb opening[**, of materials and dimensions in accordance with utility standards**].
				2. Gutter Inlets: Made with horizontal gutter opening[**, of materials and dimensions in accordance with utility standards**]. Include heavy-duty frames and grates.
				3. Combination Inlets: Made with vertical curb and horizontal gutter openings[**, of materials and dimensions in accordance with utility standards**]. Include heavy-duty frames and grates.

See Section 055313 "Bar Gratings" for bar grating.

* + - * 1. Frames and Grates: Heavy duty[**, in accordance with utility standards**].
			1. STORMWATER DETENTION STRUCTURES

Detail these structures on Drawings. They are usually made of cast-in-place concrete or sections of large piping and often include features for special applications.

* + - * 1. Cast-in-Place Concrete, Stormwater Detention Structures: Constructed of reinforced-concrete bottom, walls, and top; designed in accordance with ASTM C890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

Ballast: Increase thickness of concrete as required to prevent flotation.

Retain "Grade Rings" Subparagraph below if grade rings are required.

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

Steps: [**Individual FRP steps or FRP ladder**] [**Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP**] [**ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP**] <**Insert material**>, 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**] <**Insert inches**>.

Revise "Manhole Frames and Covers" Paragraph below if casting frame in concrete top.

* + - * 1. Manhole Frames and Covers: ASTM A536, 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."
			1. PIPE OUTLETS

Detail outlets on Drawings. Delete "Head Walls" Paragraph below if piping includes flared outlet fittings and concrete head walls are not required.

* + - * 1. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.
				2. Riprap Basins: Broken, irregularly sized and shaped, graded stone in accordance with NSSGA's "Quarried Stone for Erosion and Sediment Control."

Average Size:

Retain one of three subparagraphs below or insert another grade. See NSSGA's "Quarried Stone for Erosion and Sediment Control" for sizes.

NSSGA No. R-3, screen opening 2 inches.

NSSGA No. R-4, screen opening 3 inches.

NSSGA No. R-5, screen opening 5 inches.

Retain "Filter Stone" and "Energy Dissipaters" paragraphs below to require specific stone sizes.

* + - * 1. Filter Stone: In accordance with NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size graded stone.
				2. Energy Dissipaters: In accordance with NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton average weight armor stone, unless otherwise indicated.
1. EXECUTION
	* + 1. EARTHWORK
				1. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."
			2. INSTALLATION OF PIPING
				1. 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.
				2. 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 in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
				3. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
				4. 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.
				5. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
				6. Install gravity-flow, nonpressure drainage piping in accordance with the following:

Install piping pitched down in direction of flow.

Install piping [**NPS 6**] <**Insert value**> 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.

Install piping with [**36-inch-**] [**48-inch-**] [**60-inch-**] [**72-inch-**] <**Insert inch-**> minimum cover.

Install hub-and-spigot, cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook."

Install hubless cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."

Install ductile-iron piping and special fittings in accordance with AWWA C600 or AWWA M41.

Install corrugated-steel piping in accordance with ASTM A798/A798M.

Install corrugated-aluminum piping in accordance with ASTM B788/B788M.

Install ABS sewer piping in accordance with ASTM D2321 and ASTM F1668.

Install PE corrugated sewer piping in accordance with ASTM D2321.

Install PVC cellular-core piping in accordance with ASTM D2321 and ASTM F1668.

Install PVC sewer piping in accordance with ASTM D2321 and ASTM F1668.

Install PVC profile gravity sewer piping in accordance with ASTM D2321 and ASTM F1668.

Install PVC water-service piping in accordance with ASTM D2321 and ASTM F1668.

Install fiberglass sewer piping in accordance with ASTM D3839 and ASTM F1668.

Install nonreinforced-concrete sewer piping in accordance with ASTM C1479 and ACPA's "Concrete Pipe Installation Manual."

Install reinforced-concrete sewer piping in accordance with ASTM C1479 and ACPA's "Concrete Pipe Installation Manual."

* + - * 1. Install force-main pressure piping in accordance with the following:

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.

Install piping with [**36-inch-**] [**48-inch-**] [**60-inch-**] [**72-inch-**] <**Insert inch-**> minimum cover.

Install ductile-iron pressure piping in accordance with AWWA C600 or AWWA M41.

Install ductile-iron special fittings in accordance with AWWA C600.

Install PVC pressure piping in accordance with AWWA M23, or ASTM D2774 and ASTM F1668.

Install PVC water-service piping in accordance with ASTM D2774 and ASTM F1668.

* + - * 1. Install corrosion-protection piping encasement over the following underground metal piping in accordance with ASTM A674 or AWWA C105/A21.5:

Hub-and-spigot, cast-iron soil pipe and fittings.

Hubless cast-iron soil pipe and fittings.

Ductile-iron pipe and fittings.

Expansion joints and deflection fittings.

* + - 1. PIPE JOINT CONSTRUCTION
				1. Join gravity-flow, nonpressure drainage piping in accordance with the following:

Join hub-and-spigot, cast-iron soil piping with gasketed joints in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

Join hub-and-spigot, cast-iron soil piping with caulked joints in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum caulked joints.

Join hubless cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

Join ductile-iron culvert piping in accordance with AWWA C600 for push-on joints.

Join ductile-iron piping and special fittings in accordance with AWWA C600 or AWWA M41.

Join corrugated-steel sewer piping in accordance with ASTM A798/A798M.

Join corrugated-aluminum sewer piping in accordance with ASTM B788/B788M.

Join ABS sewer piping in accordance with ASTM D2321 for elastomeric-seal joints.

Join corrugated-PE piping in accordance with ASTM D3212 for push-on joints.

Join PVC cellular-core piping in accordance with ASTM D2321 and ASTM F891 for solvent-cemented joints.

Join PVC corrugated sewer piping in accordance with ASTM D2321 for elastomeric-seal joints.

Join PVC sewer piping in accordance with ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasketed joints.

Join PVC profile gravity sewer piping in accordance with ASTM D2321 for elastomeric-seal joints or ASTM F794 for gasketed joints.

Join fiberglass sewer piping in accordance with ASTM D3839 for elastomeric-seal joints.

Join nonreinforced-concrete sewer piping in accordance with ASTM C14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.

Join reinforced-concrete sewer piping in accordance with ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.

Join dissimilar pipe materials with nonpressure-type flexible couplings.

* + - * 1. Join force-main pressure piping in accordance with the following:

Join ductile-iron pressure piping in accordance with AWWA C600 or AWWA M41 for push-on joints.

Join ductile-iron special fittings in accordance with AWWA C600 or AWWA M41 for push-on joints.

Join PVC pressure piping in accordance with AWWA M23 for gasketed joints.

Join PVC water-service piping in accordance with ASTM D2855 for solvent-cemented joints.

Join dissimilar pipe materials with pressure-type couplings.

* + - 1. INSTALLATION OF BACKWATER VALVES
				1. Install horizontal-type backwater valves in piping where indicated.
				2. Install combination horizontal and manual gate-valve type in piping and in manholes where indicated.
				3. Install terminal-type backwater valves on end of piping and in manholes where indicated.
			2. INSTALLATION OF CLEANOUTS
				1. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

Use Light-Duty, top-loading classification cleanouts in [**earth or unpaved foot-traffic**] <**Insert area type**> areas.

Use Medium-Duty, top-loading classification cleanouts in [**paved foot-traffic**] <**Insert area type**> areas.

Use Heavy-Duty, top-loading classification cleanouts in [**vehicle-traffic service**] <**Insert area type**> areas.

Use Extra-Heavy-Duty, top-loading classification cleanouts in [**roads**] <**Insert area**>.

* + - * 1. Set cleanout frames and covers in earth in cast-in-place concrete block, [**18 by 18 by 12 inches**] <**Insert inches**> deep. Set with tops [**1 inch**] <**Insert inch(es**> above surrounding earth grade.
				2. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.
			1. INSTALLATION OF DRAINS
				1. Install type of drains in locations indicated.

Use Light-Duty, top-loading classification drains in [**earth or unpaved foot-traffic**] <**Insert area type**> areas.

Use Medium-Duty, top-loading classification drains in [**paved foot-traffic**] <**Insert area type**> areas.

Use Heavy-Duty, top-loading classification drains in [**vehicle-traffic service**] <**Insert area type**> areas.

Use Extra-Heavy-Duty, top-loading classification drains in [**roads**] <**Insert area**>.

* + - * 1. Embed drains in 4-inch- minimum concrete around bottom and sides.
				2. Fasten grates to drains if indicated.
				3. Set drain frames and covers with tops flush with pavement surface.
				4. Assemble trench sections with flanged joints.
				5. Embed trench sections in [**4-inch-**] <**Insert inch-**> minimum concrete around bottom and sides.
			1. INSTALLATION OF MANHOLES
				1. General: Install manholes, complete with appurtenances and accessories indicated.
				2. Install precast concrete manhole sections with sealants in accordance with ASTM C891.
				3. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
				4. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops [**3 inches**] <**Insert inches**> above finished surface elsewhere unless otherwise indicated.
			2. INSTALLATION OF CATCH BASINS
				1. Construct catch basins to sizes and shapes indicated.
				2. Set frames and grates to elevations indicated.
			3. INSTALLATION OF STORMWATER INLETS/OUTLETS
				1. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
				2. Construct riprap of broken stone, as indicated.
				3. Install outlets that spill onto grade, anchored with concrete, where indicated.
				4. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
				5. Construct energy dissipaters at outlets, as indicated.
			4. INSTALLATION OF DRY WELLS
				1. Excavate hole to diameter of at least 6 inches greater than outside of dry well. Do not extend excavation into ground-water table.
				2. Install precast, concrete-ring dry wells in accordance with the following:

Assemble rings to depth indicated.

Extend rings to height where top of cover will be approximately 8 inches below finished grade.

Backfill bottom of inside of rings with filtering material to level at least 12 inches above bottom.

Extend effluent inlet pipe 12 inches into rings and terminate into side of tee fitting.

Backfill around outside of rings with filtering material to top level of rings.

Install cover over top of rings.

* + - * 1. Install manufactured, PE dry wells in accordance with manufacturer's written instructions and the following:

Assemble and install panels and cover.

Backfill bottom of inside of unit with filtering material to level at least [**12 inches**] <**Insert inches**> above bottom.

Extend effluent inlet pipe [**12 inches**] <**Insert inches**> into unit and terminate into side of tee fitting.

Install filter fabric around outside of unit.

Install filtering material around outside of unit.

* + - * 1. Install constructed-in-place dry wells in accordance with the following:

Install brick lining material dry and laid flat, with staggered joints for seepage. Build to diameter and depth indicated.

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.

Extend lining material to height where top of manhole will be approximately [**8 inches**] <**Insert inches**> below finished grade.

Backfill bottom of inside of lining with filtering material to level at least [**12 inches**] <**Insert inches**> above bottom.

Extend effluent inlet pipe [**12 inches**] <**Insert inches**> into lining and terminate into side of tee fitting.

Backfill around outside of lining with filtering material to top level of lining.

Install manhole over top of dry well. Support cover on undisturbed soil. Do not support cover on lining.

* + - 1. CONCRETE PLACEMENT
				1. Place cast-in-place concrete in accordance with ACI 318.
			2. INSTALLATION OF CHANNEL DRAINAGE SYSTEMS
				1. Install with top surfaces of components, except piping, flush with finished surface.
				2. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
				3. Embed channel sections and drainage specialties in [**4-inch-**] <**Insert inch-**> minimum concrete around bottom and sides.
				4. Fasten grates to channel sections if indicated.
				5. Assemble channel sections with flanged or interlocking joints.
				6. Embed channel sections in [**4-inch-**] <**Insert inch-**> minimum concrete around bottom and sides.
			3. INSTALLATION OF STORMWATER DISPOSAL SYSTEMS

Retain "Chamber Systems" or "Piping Systems" Paragraph below to match systems specified.

* + - * 1. Chamber Systems: Excavate trenches of width and depth, and install system and backfill in accordance with chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.
				2. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill, in accordance with piping manufacturer's written instructions.
			1. CONNECTIONS
				1. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 221414 "Storm Drainage Piping."
				2. Connect force-main piping to building's storm drainage force mains specified in Section 221414 "Storm Drainage Piping." Terminate piping where indicated.
				3. Make connections to existing piping and underground manholes.

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.

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.

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.

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

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

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.

* + - * 1. Connect to sediment interceptors specified in Section 221323 "Sanitary Waste Interceptors."
				2. 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.

Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

[**Unshielded**] [**Shielded**] flexible couplings for same or minor difference OD pipes.

Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.

Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

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

* + - 1. CLOSING ABANDONED STORM DRAINAGE SYSTEMS
				1. 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:

Close open ends of piping with at least [**8-inch-**] <**Insert inch-**> thick, brick masonry bulkheads.

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.

* + - * 1. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

Remove manhole or structure and close open ends of remaining piping.

Remove top of manhole or structure down to at least [**36 inches**] <**Insert inches**> below final grade. Fill to within [**12 inches**] <**Insert inches**> of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

* + - * 1. Backfill to grade in accordance with Section 312000 "Earth Moving."
			1. IDENTIFICATION
				1. Materials and their installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

Use[ **warning tape or**] detectable warning tape over ferrous piping.

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

* + - 1. FIELD QUALITY CONTROL
				1. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

Submit separate reports for each system inspection.

Defects requiring correction include the following:

Alignment: Less than full diameter of inside of pipe is visible between structures.

Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

Damage: Crushed, broken, cracked, or otherwise damaged piping.

Infiltration: Water leakage into piping.

Exfiltration: Water leakage from or around piping.

Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

Reinspect and repeat procedure until results are satisfactory.

* + - * 1. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

Do not enclose, cover, or put into service before inspection and approval.

Test completed piping systems in accordance with requirements of authorities having jurisdiction.

Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

Submit separate report for each test.

Gravity-Flow Storm Drainage Piping: Test in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:

Exception: Piping with soiltight joints unless required by authorities having jurisdiction.

Option: Test plastic piping in accordance with ASTM F1417.

Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than [**150 psig**] <**Insert psig**>.

Ductile-Iron Piping: Test in accordance with AWWA C600, "Hydraulic Testing" Section.

PVC Piping: Test in accordance with AWWA M23, "Testing and Maintenance" Chapter.

* + - * 1. Leaks and loss in test pressure constitute defects that must be repaired.
				2. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
			1. CLEANING
				1. Clean interior of piping of dirt and superfluous materials.[ **Flush with potable water.**]

END OF SECTION 334200