

LETTER OF TRANSMITTAL

TO:

Merkel Bros. Construction, Inc.
Marvin Sledge Underground Utilities, LLC
Ware Excavating, Inc.
Passons Underground Utilities, LLC
Wilamut Construction Co. LLC

Norris Brothers Excavating, LLC
Wright Brothers
HL Management Service, LLC

Morgan Contracting, Inc.
Brown Bros., Inc.
Dirt Guys, Inc.
Nitzschke Communications, inc.

The Blue Book
Dodge Data & Analytics
Builders Exchange of Tennessee
Associated General Contractors
ConstructConnect
North America Procurement Council (NAPC)

Calhoun-Charleston Utility District

pneas@mbctn.biz
marvin@msuullc.com
wareexcavating2@gmail.com
passonsunderground@yahoo.com
info@wilamutconstruction.com;
kurt@wilamutconstruction.com
patriciadelight@norrisbrosexcavating.com
jwhitehead@wbcci.com
sarah@hlconstructionsites.com
melissa@hlconstructionsites.com
estimating@morgan1.com
mbrockbbi@gmail.com
codyharrington28@gmail.com
holly@ncitn.com; daryl@ncitn.com
bobby@ncitn.com

emcveigh@mail.thebluebook.com
dodge.bidding@construction.com
heather@bxtn.org
planroom@agcctn.org
gwen.perew@constructconnect.com
francejenn@napc.me

tylerccud@gmail.com

FROM: Philip Schofield, P.E.

DATE: August 19, 2026

PROJ. NO.: C25004

SUBJECT: Addendum No. 2
Calhoun-Charleston Utility District
Highway 163 Waterline Extension

PAGES: 152 pages to follow

**PLEASE
RESPOND****TO CONFIRM RECEIPT OF THIS ADDENDUM NO. 2
PLEASE SIGN AND EMAIL TO CTI**vvisco@ctiengr.com

Company _____

Signature _____

Title _____

Date _____

ADDENDUM NO. 2

CONTRACT DOCUMENTS, SPECIFICATIONS, AND DRAWINGS

CALHOUN-CHARLESTON UTILITY DISTRICT

HIGHWAY 163 WATERLINE EXTENSION

The following changes and clarifications shall be made to the Contract Documents, Specifications, and Drawings.

I. CONTRACT DOCUMENTS

A. Section 00 11 00 – Advertisement for Bids.

On Page 00 11 00-1, revise the first paragraph to read as follows:

“Sealed bids for the Highway 163 Waterline Extension Project will be received by the Calhoun-Charleston Utility District at 144 Main Street, Calhoun, Tennessee 37309 until **2:00 o’clock P.M., ET, Thursday, September 24, 2026**, and then at said office publicly opened and read aloud.”

B. Section 00 21 00 – Information for Bidders

On Page 00 21 00-1, Paragraph 1, **Receipt and Opening of Bids**, DELETE “**September 10, 2026**” and REPLACE with “**September 24, 2026.**”

The revised sentence shall read:

“Bids will be received by the Owner at the office of Calhoun-Charleston Utility District at 144 Main Street, Calhoun, Tennessee, until **2:00 o’clock P.M., ET, September 24, 2026** and then at said office publicly opened and read aloud.”

C. Section 00 42 00 – Bid Schedule.

DELETE Page 00 42 00-1 and REPLACE with the attached pages **00 42 00-1.1 through 00 42 00-2.1.**

D. Reference Documents

ADD the **Calhoun-Charleston Utility District Standard Technical Specifications and Standard Details for Water System Construction** as a reference document for the project.

II. CLARIFICATIONS

A. Mainline Valves

All mainline valves shall **be open-left (counterclockwise to open).**

B. Tree Removal

Pay Item **31 00 00b – Large Tree Removal** includes removal of the following trees: **trees at Station 51+00 and one (1) tree at Station 40+50.** All other tree removal required for the project shall be included in Pay Item **31 00 00a – Clearing and Grubbing.**

C. Rip Rap Ditch Stabilization

Rip rap ditch stabilization from **Station 32+50 to Station 37+00**, and at other areas as directed by the Engineer, shall be included under Bid Schedule Item **31 25 00d – Type 3 (6" to 12") Rip Rap Stone with Filter Fabric**.

Date: August 20, 2026

Calhoun-Charleston Utility District
/s/ Tyler Richesin, General Manager

BID SCHEDULE FOR UNIT PRICE
HIGHWAY 163 WATERLINE
CALHOUN-CHARLESTON UTILITY DISTRICT
CALHOUN, TENNESSEE

Note: Unless otherwise stated, all bid items shall be a complete installation as specified and/or shown on the drawings.

SCHEDULE I

Item No.	Description	Unit	Est. No. of Units	Unit Price	Item Total
00 66 13	Performance and Payment Bonds (Maximum 2% of Schedule I)	LS	1		\$
00 72 00	Mobilization (Maximum 2.5% of Schedule I), Including Equipment and Material Handling, Locating and Excavating (Pot-holing) the Existing Utilities, Project Layout and Staking	LS	1		\$
01 22 00a	Traffic Control Devices for Traffic Control in Accordance with MUTCD and County Requirements.	LS	1		\$
03 30 00	Cast-in-Place Concrete , Complete in Place as Specified and/or Shown on the Drawings				
03 30 00a	Cast-In-Place Concrete - 3,000 PSI Class B for Thrust Blocks, Pipe Encasement, and Pipe Protection for Open Cut Trenches in Paved Areas	CY	15		\$
31 00 00	Earthwork - Site Clearing				
31 00 00a	Clearing and Grubbing Along Highway 163 , Including Stripping Topsoil and Stockpiling, Hedge, Brush, and Tree Removal and Disposal	LF	4,000		\$
31 00 00b	Large Tree Removal (Greater than 18-inch diameter) Along CR 28 and not in Clearing and Grubbing Area	EA	4		\$
31 20 00	Earthwork - Crushed Stone Bedding and Backfill				
31 20 00a	Crushed Stone Backfill in Trench for Water Lines in Asphalt Streets, Pavement Shoulders, Parking Lots, and Gravel, Asphalt, or Concrete Driveways as Shown on the Plans or as Directed by the Engineer from Top of Bedding to Finished Grade	LF	8,500		\$
31 20 00b	Crushed Rock Bedding Material , in Excess of that Required for Earth or Rock Trench Bedding	CY	100		\$
31 20 00c	Compacted Crushed Base Stone (GAB) for Gravel, Asphalt, and Concrete Driveways and Parking Areas , Including Stone Placement, Compaction, and Fine Grading for Roads, Parking Lots, Driveways, and Transitions to Existing Driveways	Tons	100		\$
31 20 00d	Final Grading and Cleanup (Not Including Grassing and Mulch)				
31 20 00d1	Final Grading and Cleanup , Including Re-grading Areas Disturb and Existing Ditches to Match Existing Grade and to Allow Proper Drainage, Rock and Debris Removal	LF	13,300		\$
31 20 00d2	Mailbox Removal, Re-setting, or Replacement , Including New Mailbox if Necessary, Complete-in-Place	EA	6		\$
31 25 00	Sedimentation and Erosion Control - Including all Labor, Equipment, and Materials				
31 25 00a	Straw Wattles / Tubes , Including Overlap and Staking	LF	400		\$
31 25 00b	Straw Matting for Slope or Ditch Stabilization, Including Staples	SY	1,000		\$
31 25 00c	Topsoil , Fine Sifted Topsoil (Purchased and Imported to Project Site) Approved by the Engineer, not Including On-Site Soil	CY	100		\$
31 25 00d	Type 3 (6" to 12") Rip Rap Stone with Filter Fabric for Slope Protection, Ditch Check Dams, Inlet Protection, or other Erosion Control Devices	Tons	220		\$
32 10 00	New and Replacement Paving - Including Materials				
32 10 00a	Heavy Duty Asphalt Pavement Replacement for Roads, Trench-Width with 2.5" of Binder, TDOT Grading "B-M2" and 1.5" of TDOT Surface, Grading "E", Including Saw-cutting	Tons	25		\$
32 10 00b	Replace or Relocate and Re-Set Traffic Signs , Including Coordination with the County Road Department	Each	2		\$

Item No.	Description	Unit	Est. No. of Units	Unit Price	Item Total
32 92 19	Seeding and Mulching - Including Materials				
32 92 19a	Temporary Seeding and Mulching (Ds2)	LF	13,300		\$
32 92 19b	Permanent Seeding And Mulch (Ds3), Including Topsoil placement, Seed Fertilizer, Limestone, and Mulch	LF	13,300		\$
33 05 23.14	Horizontal Direction Drilling				
33 05 23-14a	6-Inch SDR 9 HDPE by Directional Drilling Method, Including All Labor, Equipment, and Materials	LF	600		\$
33 11 00	Polyvinyl Chloride (PVC) Pressure Pipe				
33 11 00a	6-inch SDR17, Class 250 PVC Pipe in Trench	LF	12,800		\$
33 11 00b	Connections to Existing Lines				
33 11 00b1	Connection to an Existing 6-Inch Water Line, Including 6-Inch Tapping Sleeve and Valve Installation and Testing, Excavation, Stone Bedding, Backfill, and Site Cleanup for Complete Installation	EA	1		\$
33 11 00b2	Connection of 6-Inch PVC to 6-Inch HDPE, Including Fusible MJ Adaptors and Associated Fittings As Needed for Complete Connection	EA	4		\$
40 05 13.53	Installation of 6-Inch Fittings and Gaskets, Including Labor, Equipment, and Materials				
40 05 13.53a	6-Inch MJ 11 1/4-Degree Bend	EA	6		\$
40 05 13.53b	6-Inch MJ 22 1/2-Degree Bend	EA	3		\$
40 05 13.53c	6-Inch MJ 45-Degree Bend	EA	1		\$
40 05 13.53d	6-Inch Mechanical Joint Restrained Joints (Mega Lugs)	EA	30		\$
40 05 13.53e	6-Inch Bell Restrained Joints / Gaskets	EA	12		\$
40 05 13.53f	6-in MJ Sleeve	EA	2		\$
40 05 13.53g	6-Inch x 6-Inch MJ Anchor Tee	EA	2		\$
40 05 13.53h	6-inch MJ Misc. Fittings Not Itemized	LBS	1,000		\$
40 05 23	Valves - Including Labor, Equipment, and Materials				
40 05 23a	Furnish and Install 6-Inch Gate Valve, Including Valve Box & Cover, Concrete Support Block, Thrust Block, and Valve Box Extensions	EA	6		\$
41 05 23b	Furnish and Install Blow-off Assembly, Including all Fittings for Complete Installation	EA	2		\$
42 05 23c	Furnish and Install Air Release Valve Assembly, Including all Fittings for Complete Installation	EA	3		\$
TOTAL SCHEDULE I				\$	
Notes:					
1. Bidders shall submit a bid on a unit price basis.					
2. Contract will be awarded (if it is awarded) to the responsible and responsive bidder submitting the lowest bid.					
3. Contractor certifies that he has reviewed the Drawings and Specifications and that all work not specifically listed in the Bid Schedule is included in the prices for various items listed in the Bid Schedule.					
BIDDER _____ DATE _____					
BY _____ (Signature) TITLE _____					
ADDRESS _____					
CITY _____ STATE _____ ZIP CODE _____					
PHONE _____ FAX _____ E-MAIL _____					



STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES

Davy Crockett Tower, 9th Floor
500 James Robertson Parkway
Nashville, Tennessee 37243-1204

July 30, 2026

Mr. Philip Schofield
CTI Engineers, Inc.
e-copy: pschofield@ctiengr.com
1122 Riverfront Parkway
Chattanooga, TN 37402

Subject: **CALHOUN-CHARLESTON U.D. (PWSID TN0000106)**
McMinn County
Project Number: DW20260512
Standard Technical Specifications Water System Construction

Dear Mr. Schofield:

The Tennessee Department of Environment and Conservation, Division of Water Resources, acknowledges the receipt of your engineering documents on July 29, 2026.

Review of these Standard Drinking Water Specifications shows that they are in conformance with our guidelines. Therefore, they have been stamped "APPROVED." This approval will remain in effect until July 30, 2031. This approval shall not be construed as creating a presumption of accuracy or as warranting by the commissioner that the approved specifications are all inclusive.

To expedite matters, please reference the assigned water project number DW20260512 on any future correspondence or plan submittals. If we may be of any assistance, please feel free to contact Ms. Kaylee Sabo, EI at (731) 676 – 6604 or by E-mail at Kaylee.Sabo@tn.gov.

Sincerely,

Angela Jones, PE, CPM
Manager, Engineering Services Unit

cc: Mr. Tyler Richesin, General Manager, Calhoun-Charleston Utility District, tylerrccud@gmail.com
Ms. Jennifer H. Innes, Unit Manager, TDEC - Chattanooga Environmental Field Office, Jennifer.Innes@tn.gov

STANDARD TECHNICAL SPECIFICATIONS AND STANDARD DETAILS

WATER SYSTEM CONSTRUCTION

CALHOUN-CHARLESTON



UTILITY DISTRICT

DW20260512

APPROVED WATER SPECIFICATIONS

THE DOCUMENT BEARING THIS STAMP HAS BEEN RECEIVED AND REVIEWED BY THE

TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION

DIVISION OF WATER RESOURCES

AND IS HEREBY APPROVED FOR USE IN CONSTRUCTION BY THE COMMISSIONER

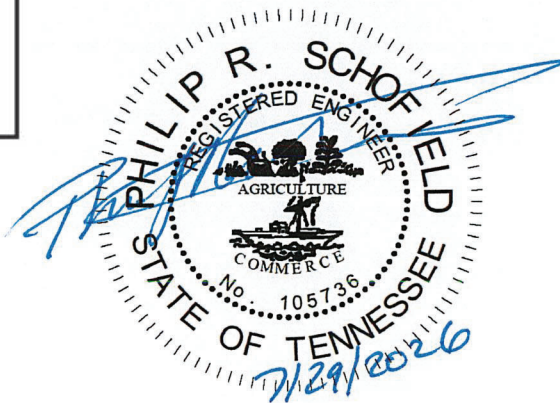
Kylee Salo
07/30/2026

THIS APPROVAL SHALL NOT BE CONSTRUED AS CREATING A
PRESUMPTION OF CORRECT OPERATION OR AS WARRANTING BY THE
COMMISSIONER THAT THE APPROVED FACILITIES WILL REACH THE
DESIGNED GOALS.

APPROVAL EXPIRES FIVE YEARS FROM ABOVE DATE

Prepared For

**I-CHARLESTON UTILITY DISTRICT
CALHOUN, TENNESSEE**



July 2026

CTI Project No. C24045



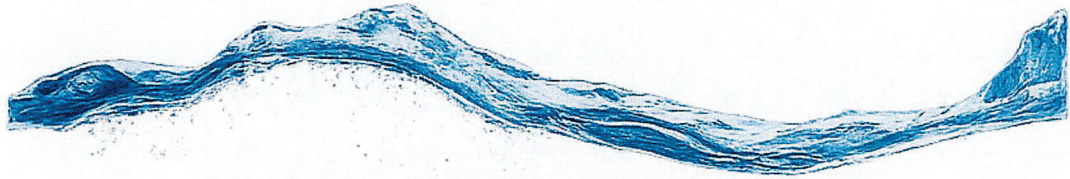
CTIENGINEERS

CTI Engineers, Inc.
1122 Riverfront Parkway
Chattanooga, Tennessee 37402
423.267.7613

**STANDARD TECHNICAL SPECIFICATIONS
AND STANDARD DETAILS**

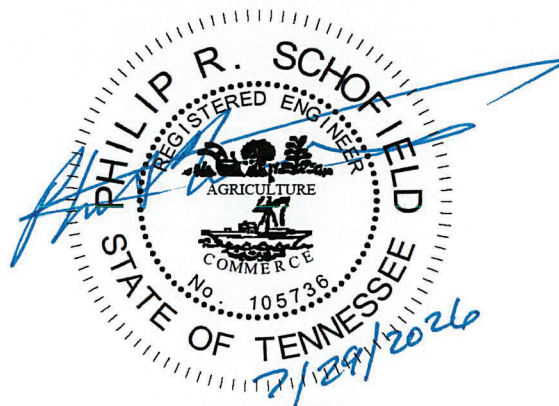
WATER SYSTEM CONSTRUCTION

CALHOUN-CHARLESTON



UTILITY DISTRICT

Prepared For
**CALHOUN-CHARLESTON UTILITY DISTRICT
CALHOUN, TENNESSEE**



Prepared By
**CTI ENGINEERS, Inc.
Chattanooga, TN
Project No. C24045
July 2026**

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APPENDIX

A. Standard Water Details

DIVISION 01

GENERAL REQUIREMENTS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. These Standard Technical Specifications establish minimum requirements for the design, materials, installation, testing, and acceptance of water system infrastructure within the CCUD water system.
- B. These specifications apply to all work constructed within the system, including but not limited to:
 - 1. CCUD-performed work
 - 2. Contractor-constructed, bid projects
 - 3. Developer-installed infrastructure intended for public ownership
 - 4. Repairs, replacements, and system upgrades
- C. Where referenced herein, the term "Work" and/or "Project" shall mean any construction, installation, replacement, or modification of water system facilities governed by these standards, regardless of project delivery method.
- D. All work shall be performed in accordance with the approved plans, these Specifications, applicable CCUD standards, and requirements of all authorities having jurisdiction.
- E. For purposes of these Standard Technical Specifications, references to the "Contractor" shall be understood to include any entity performing work governed by these Specifications, including but not limited to:
 - 1. CCUD personnel and work crews
 - 2. Contractor-constructed, competitively bid projects
 - 3. Developer-installed infrastructure intended for public ownership
 - 4. System repairs, replacements, and upgrades
- F. All such work shall comply with the applicable requirements of these Specifications unless otherwise approved by CCUD.

1.2 QUALITY ASSURANCE

- A. Contractor shall comply with all applicable codes, ordinances, rules, regulations, permits, and lawful orders of public authorities having jurisdiction over the work.
- B. All materials, workmanship, testing, and installation practices shall conform to current

CCUD water system standards and applicable State of Tennessee and TDEC requirements.

C. Pipe Material Selection

1. Where these Standard Technical Specifications permit more than one acceptable pipe material, CCUD reserves the right to require a specific pipe material during the plan review and approval process.
2. Pipe material selection shall be based on system compatibility, operational and maintenance considerations, installation conditions, location, lifecycle performance, and other factors deemed relevant by CCUD.
3. Once approved as part of the construction plans, the specified pipe material shall not be changed without prior written approval from CCUD.

1.3 JOB CONDITIONS

A. Except as specifically noted, the Contractor shall provide and pay for all:

1. Materials, labor, tools, and equipment
2. Concrete, bedding stone, tie rods, and incidentals
3. Water, power, heat, and utilities required for construction
4. Other facilities and services necessary for proper execution and completion of the work.

B. Contractor shall secure and pay for, as required, all temporary:

1. Permits
2. Government fees
3. Licenses

C. The Contractor shall be solely responsible for construction means, methods, techniques, sequences, and safety procedures.

D. Contractor shall give notice to owners of adjacent property and to utilities when prosecution of the work may affect them. Utilities and other concerned agencies shall be contacted at least 24 hours prior to cutting or closing streets, excavating near underground utilities, or disturbing traffic areas.

E. Prior to commencement of construction, the Contractor shall contact Tennessee One Call to locate existing utilities.

1.4 RIGHT-OF-WAY AND SITE USE

A. The rights-of-way for the water line will be provided by CCUD. Contractor shall confine construction operations within the limits indicated on the approved plans and shall exercise due care to minimize damage to property and interference with traffic.

B. Contractor shall be responsible for restoring all disturbed areas, whether inside or outside the right-of-way, to equal or better condition than existed prior to construction.

1.5 HOUSEKEEPING AND CLEANUP

- A. There shall be continuous cleanup on the job such that no more than 800 linear feet of water line shall be laid at a time before the construction area is cleaned of all rock (except at driveways) and affected yards are restored.
- B. If less than 800 linear feet is constructed in a day, cleanup shall occur daily unless weather conditions prevent restoration, as determined by CCUD.

1.6 WORK SEQUENCE

- A. During performance of this project, the Contractor shall:
 - 1. Coordinate the construction schedule and operations with CCUD and other affected agencies.
 - 2. Construct the water line within public rights-of-way with minimum interference to existing utilities and services. Any planned service interruptions shall be coordinated in advance with CCUD and affected customers. Work shall proceed continuously (around the clock) if necessary to complete operations in the minimum time. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of CCUD.
 - 3. Survey road crossings and critical depth installations as required by the approved plans. Documentation shall be made available to CCUD upon request.
- B. Construct the Work in stages to provide for public convenience. Do not close or restrict public use of roads or facilities until completion of a construction stage provides reasonable alternative access, unless otherwise approved in writing by CCUD.
- C. Construct the Work in accordance with the following sequence, unless prior written consent is obtained from CCUD:
 - 1. Prior to commencement of construction, document existing site conditions, including yards, culverts, pavements, and other significant features, using photographs or video. Documentation shall be retained by the Contractor and provided to CCUD upon request.
 - 2. All erosion control and related measures identified in the approved Storm Water Pollution Prevention Plan (SWPPP) shall be installed prior to initiating land-disturbing activities.
 - 3. WATER MAINS – Work shall begin at the approved source and proceed to the next valve or designated terminus. No work shall proceed beyond that point until the water main has been pressure tested, disinfected, and bacteriologically cleared; applicable services and connections have been completed; and rough cleanup has been performed to a condition acceptable to CCUD. All debris and excess material shall be removed prior to proceeding.
- D. Coordinate all work with local utility companies regarding overhead and underground utilities. The Contractor shall be responsible for any damage to existing utilities resulting from construction activities.

1.7 CONTRACTOR'S USE OF PREMISES

- A. Contractor shall limit use of the premises for work and storage and shall allow for:
 - 1. Access by the CALHOUN-CHARLESTON UTILITY DISTRICT
 - 2. Public use
 - 3. Other utility or construction activities
- B. Coordinate use of premises and utilities under the direction of CCUD.
- C. Contractor shall assume full responsibility for protection and safekeeping of materials stored on or near the site.
- D. Move any stored products, under Contractor's control, which may interfere with operations of CCUD or separate contractors.
- E. Construct temporary fence as necessary in all areas that contain livestock to keep livestock away from construction activities during the period of construction.

1.8 BENEFICIAL USE BY CCUD

- A. The CCUD may place completed portions of the water line into service prior to final completion. Such use shall not relieve the Contractor of responsibility for completing the Work in accordance with the Specifications. Contractor shall cooperate with CCUD in all construction operations to minimize conflict, and to facilitate CCUD usage.
- B. Contractor shall at all times conduct his operations as to ensure the least inconvenience to the general public.
 - 1. Coordinate work with the Calhoun- Charleston Utility District Road Department and/or Bradley County Road Department.
 - 2. Coordinate work with CCUD and other utility companies.

1.9 UNFAVORABLE CONSTRUCTION CONDITIONS

- A. During unfavorable weather, wet ground, or other unsuitable construction conditions, the Contractor shall confine his operations to work which will not be affected adversely by such conditions. No portion of the Work shall be constructed under conditions which would affect adversely the quality or efficiency thereof, unless special means or precautions are taken by the Contractor to perform the Work in a proper and satisfactory manner.

1.10 CUTTING AND PATCHING

- A. The Contractor shall perform all cutting and patching required for the Work, and as may be necessary in connection with uncovering Work for inspection or for the correction of defective Work.

PART 2 – SALVAGED MATERIALS

2.1 SALVAGED MATERIALS

- A. Salvaged materials, equipment, or supplies that occur are the property of CCUD and shall be cleaned and stored in a workmanlike manner. Surplus excavated materials remain the property of CCUD and shall be spoiled in a workmanlike manner.

PART 3 - MAINTAINING TRAFFIC

3.1 TRAFFIC CONTROL

- A. Traffic shall be maintained on all roads and streets which must be crossed by the water line. If the open cut method is used, two separate cuts shall be made, keeping one lane open to traffic at all times.

END OF SECTION

SECTION 01 33 23

SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section specifies administrative and procedural requirements for the submittal of shop drawings, product data, and samples to verify that products, materials, and systems proposed for use comply with the Contract Documents and applicable regulatory approvals.
- B. Shop drawings are required for all materials, products, and equipment furnished on this project, unless otherwise specified.
- C. Standard information prepared without specific reference to the project is not considered to be shop drawings.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions or General Provisions and other Division 1 specification sections, apply to this section.

1.3 CONTRACTOR'S RESPONSIBILITY

- A. It is the Contractor's responsibility to review, check, and coordinate all submittals prior to submission. Each submittal shall bear the Contractor's stamp certifying that field measurements, field construction criteria, materials, catalog numbers, and coordination with other trades have been verified.
- B. Submittals submitted without the Contractor's stamp will be returned without review.
- C. The Contractor shall determine and verify:
 - 1. Field measurements.
 - 2. Field construction criteria.
 - 3. Catalog numbers and similar data.
 - 4. Conformance with Specifications.
- D. Clearly identify and describe any deviations from the Contract Documents in the submittal transmittal. Failure to identify deviations shall not relieve the Contractor of the obligation to comply with the Contract Documents.
- E. Do not begin fabrication, purchasing, or installation of work requiring submittals until the submittal has been reviewed and released by CCUD.

1.4 SUBMITTAL SCHEDULE AND TIMING

- A. Submit all shop drawings and related submittals sufficiently in advance of construction to allow a minimum of twenty-one (21) calendar days for review by CCUD.
- B. Stagger submittals and identify priority items to avoid delays. No extensions of Contract Time will be granted due to late or incomplete submittals.

1.5 REVIEW BY CALHOUN-CHARLESTON UTILITY DISTRICT

- A. Review by CCUD is for general administrative conformance with the Contract Documents and applicable regulatory approvals only.
- B. Review does not constitute approval of dimensions, quantities, fabrication processes, means and methods of construction, safety procedures, or installation details.
- C. Review shall not relieve the Contractor of responsibility for errors, omissions, or deviations from the Contract Documents.
- D. CCUD may return submittals without review if they are incomplete, improperly prepared, or not coordinated.

1.6 ACTION STAMPS

- A. Each submittal will be marked by CCUD with one of the following actions:
 - 1. NO EXCEPTIONS – Submittal is administratively acceptable; work may proceed in accordance with the Contract Documents.
 - 2. EXCEPTIONS AS NOTED – Work may proceed provided comments are incorporated.
 - 3. REVISE AND RESUBMIT – Do not proceed with the work; revise and resubmit.
 - 4. REJECTED – Submittal does not comply and shall not be used.
 - 5. ACTION NOT REQUIRED – Submitted for record or information only.
- B. Submittals marked “REVISE AND RESUBMIT” or “REJECTED” shall not be used at the job site.

1.7 SUBMISSION REQUIREMENTS

- A. Submit the number of copies required by CCUD. Electronic (PDF) submittals may be accepted if approved by CCUD.
- B. Each submittal shall include:
 - 1. Project name and number

2. Contractor, supplier, and manufacturer names
3. Specification section reference
4. Sequential submittal number (1, 1A, 1B, etc.)
5. Identification of revisions
6. Clearly identified field dimensions
7. Minimum approval stamp area of 8 in. by 4 in.

1.8 RESUBMITTALS

- A. Resubmittals shall clearly indicate all changes from previous submissions. Changes other than those specifically requested shall be identified in writing.

1.9 DISTRIBUTION

- A. Distribute reviewed submittals to jobsite files, record documents, subcontractors, suppliers, and other affected parties. Only CCUD marked submittals may be used for construction.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 01 42 13

ABBREVIATIONS

PART 1 - GENERAL

1.1 GENERAL

- A. Wherever in these Specifications and Contract Documents the abbreviations, or pronouns in place of them are used, the intent and meaning shall be interpreted as specified herein.

1.2 ABBREVIATIONS

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Anti-Friction Bearing Manufacturers Association
AF&PA	American Forest & Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ALSC	American Lumber Standard Committee
ANSI	American National Standards Institute
AMCA	Air Moving and Conditioning Association
AMMP	Association for Materials Protection and Performance (formerly NACE International)
APA	American Plywood Association
APHA	American Public Health Association
API	American Petroleum Institute
APWA	American Public Works Association
ARC	Appalachian Regional Commission
AREA	American Railroad Engineering Association
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials (<i>ASTM International</i>)
AWPA	American Wood Protection Association
AWS	American Welding Society
AWWA	American Water Works Association
BIA	Brick Institute of America
CFR	Code of Federal Regulations
CRSI	Concrete Reinforcing Steel Institute
CTI	Cooling Tower Institute

DIPRA	Ductile Iron Pipe Research Association
EIA	Electronic Industries Association
EPA	Environmental Protection Agency
EPD	Tennessee Environmental Protection Division
FM	Factory Mutual
FmHA	Farmers Home Administration
FS	Federal Specifications
HEI	Heat Exchange Institute
IBC	International Building Code
ICC	International Code Council
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IPCEA	Insulated Power Cable Engineers Association
IPC	Institute of Printed Circuits
ISA	Instrument Society of America
MBMA	Metal Building Manufacturers Association
MSS	Manufacturers Standardization Society of the Valve and Fitting Industry
MUTCD	Manual on Uniform Traffic Control Devices
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NAPF	National Association of Piping Fabricators
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards
NCMA	National Concrete Masonry Association
NCPI	National Clay Pipe Institute
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NRMCA	National Ready Mixed Concrete Association
NSF	National Sanitation Foundation (NSF International)
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
SBC	Southern Building Code Congress International, Inc
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSCRB	Standard Specification Construction of Roads and Bridges, Department of Transportation, State of Tennessee
SSPC	SSPC: The Society for Protective Coatings
SSRBC	Standard Specifications for Road and Bridge Construction, Tennessee Department of Transportation
SSRS	Standard Specifications for Roads and Structures, latest edition, North Carolina Department of Transportation, Division of Highways
TCA	Tile Council of America
TDEC	Tennessee Department of Environment and Conservation
TEMA	Tubular Exchangers Manufacturers Association
UBC	Uniform Building Code
UL	Underwriters Laboratories
USDA	USDA Rural Development (formerly (FmHA)
USDC	United States Department of Commerce
WEF	Water Environment Federation (Formerly WPCF)
WPCF	Water Pollution Control Federation

END OF SECTION

SECTION 01 42 19

APPLICABLE CODES AND STANDARDS

PART 1 - GENERAL

1.1 GENERAL

- A. All materials, equipment, fabrication, and installation practices shall comply with the following applicable codes and standards, unless the Contractor's quality standards establish more stringent quality requirements, as determined by the Engineer.

1. Pressure Piping and Tubing

ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
AWWA	American Water Works Association
NAPF	National Association of Piping Fabricators
NSF	NSF International

2. Materials

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials (ASTM International)

3. Painting and Surface Preparation

AMPP	Association for Materials Protection and Performance
NACE	National Association of Corrosion Engineers
SSPC	SSPC: The Society for Protective Coatings

4. Gear Reducers and Bearings

AFBMA	Anti-friction Bearing Manufacturers Association
AGMA	American Gear Manufacturers Association

5. Ventilating Fans

AMCA	Air Moving and Conditioning Association
PFMA	Power Fan Manufacturers Association

6. Electrical and Instrumentation

EIA	Electronic Industries Association
IEEE	Institute of Electrical and Electronics Engineers
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISA	Instrument Society of America
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
UL	Underwriters Laboratories

7. Aluminum Structures

AA Aluminum Association
AAMA Architectural Aluminum Manufacturers Association

8. Steel Structures

AISC American Institute of Steel Construction
API American Petroleum Institute
AWWA American Water Works Association
SJI Steel Joist Institute

9. Concrete Structures

ACI American Concrete Institute

10. Welding

ASME American Society of Mechanical Engineers
AWS American Welding Society

11. Safety

OSHA Occupational Safety and Health Administration

12. General Building Construction

FM Factory Mutual Fire Insurance Corporation
IBC International Building Code by the International Code Council
NFPA National Fire Protection Association

13. Subgrades and Pavement

SSCRB Standard Specification Construction of Roads and Bridges, Department of Transportation, State of Tennessee, and Supplemental Specifications

SSRBC Standard Specifications for Road and Bridge Construction, Tennessee Department of Transportation

SSRS Ductwork and Sheet Metal Work

SMACNA Sheet Metal and Air Conditioning Contractors National Association

14. Plumbing

AGA American Gas Association
NSF NSF International
PDI Plumbing Drainage Institute
SPC SBCC Standard Plumbing Code

15. Refrigeration, Heating, and Air Conditioning

ARI American Refrigeration Institute

ASHRAE American Society of Heating, Refrigeration, and Air Conditioning Engineers

16. Pressure Vessels

ASME American Society of Mechanical Engineers

17. Wood

AF&PA American Forest & Paper Association

AWC American Wood Council

AWPA American Wood Protection Association

- B. In addition, all work shall comply with the applicable requirements of local codes, utilities, and other authorities having jurisdiction.
- C. All material and equipment, for which a UL Standard, an AGA approval, or an ASME requirement is established, shall be so approved and labeled or stamped. Label or stamp shall be conspicuous and not covered, painted, or otherwise obscured from visual inspection.

END OF SECTION

SECTION 01 42 19

APPLICABLE CODES AND STANDARDS

PART 1 - GENERAL

1.1 GENERAL

- A. All materials, equipment, fabrication, and installation practices shall comply with the following applicable codes and standards, unless the Contractor's quality standards establish more stringent quality requirements, as determined by the Engineer.

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 - AAMA Architectural Aluminum Manufacturers Association
8. Steel Structures
 - AISC American Institute of Steel Construction
 - API American Petroleum Institute
 - AWWA American Water Works Association
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 - ACI American Concrete Institute
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 - AWS American Welding Society
11. Safety
 - OSHA Occupational Safety and Health Administration
12. General Building Construction
 - FM Factory Mutual Fire Insurance Corporation
 - IBC International Building Code by the International Code Council
 - NFPA National Fire Protection Association
13. Subgrades and Pavement
 - SSCRB Standard Specification Construction of Roads and Bridges, Department of Transportation, State of Georgia, 1993 Edition, and Supplemental Specifications
 - SSRBC Standard Specifications for Road and Bridge Construction, Tennessee Department of Transportation
 - SSRS Standard Specifications for Roads and Structures, latest edition, North Carolina Department of Transportation, Division of Highways.
14. Ductwork and Sheet Metal Work
 - SMACNA Sheet Metal and Air Conditioning Contractors National Association
15. Plumbing
 - AGA American Gas Association
 - NSF NSF International
 - PDI Plumbing Drainage Institute
 - SPC SBCC Standard Plumbing Code
16. Refrigeration, Heating, and Air Conditioning
 - ARI American Refrigeration Institute

ASHRAE American Society of Heating, Refrigeration, and Air Conditioning Engineers

17. Pressure Vessels

ASME American Society of Mechanical Engineers

18. Wood

AF&PA American Forest & Paper Association

AWC American Wood Council

AWPA American Wood Protection Association

- B. In addition, all work shall comply with the applicable requirements of local codes, utilities, and other authorities having jurisdiction.
- C. All material and equipment, for which a UL Standard, an AGA approval, or an ASME requirement is established, shall be so approved and labeled or stamped. Label or stamp shall be conspicuous and not covered, painted, or otherwise obscured from visual inspection.

END OF SECTION

DIVISION 03

CONCRETE

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SCOPE

- A. This Section establishes minimum requirements for cast-in-place concrete associated with waterline installation. It applies to concrete used for thrust blocks, anchor blocks, valve pads, meter boxes, vaults, encasements, and other water system appurtenances shown on approved plans. This Section is not intended to govern architectural concrete or building construction unless specifically required by CCUD.

1.2 RELATED DOCUMENTS

- A. Drawings, approved development plans, and applicable CCUD standards apply to this Section.

1.3 SUBMITTALS

- A. Product data for proprietary materials and items, including reinforcement, admixtures, curing compounds, waterstops, and bonding agents, when requested by CCUD or its Engineer.
- B. Shop drawings for formwork shall be required only where structural concrete elements beyond typical waterline appurtenances are proposed, as determined by CCUD or its Engineer.

1.4 QUALITY ASSURANCE

- A. Codes and Standards. Concrete work shall comply with the latest applicable editions of the following standards, unless more stringent requirements are shown on the approved plans:
 - 1. ACI 318, Building Code Requirements for Structural Concrete.
 - 2. ACI 350, Code Requirements for Environmental Engineering Concrete Structures, where water-retaining structures are required.
 - 3. Applicable ASTM standards referenced herein.
- B. Concrete Testing. CCUD may require testing by an independent testing laboratory to verify compliance with this Section. When required, testing shall be performed at the Developer's expense. Materials and installed work may be subject to testing or retesting as directed by CCUD or its Engineer. Specification.

1.5 CONCRETE PRE-CONSTRUCTION MEETING

- A. A pre-construction concrete meeting may be required at the discretion of CCUD or its Engineer.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete. Plywood, metal, metal-framed plywood-faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.
 - 1. Use overlaid plywood complying with U.S. Product Standard PS-1 "A-C or B-B High Density Overlaid Concrete Form," Class 1.
 - 2. Plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class 1, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
- B. Forms for Unexposed Finish Concrete. Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns and Supports. Metal, fiberglass-reinforced plastic, or paper or fiber tubes. Provide paper or fiber tubes of laminated plies with water-resistant adhesive and wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.
- D. Form Coatings. Provide commercial formulation form-coating compounds with a maximum VOC of 350 g/l that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- E. Form Ties. Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1½ inches to exposed surface. Provide ties that, when removed, will leave holes not larger than 1-inch diameter in concrete surface. Tie holes shall be filled with non-shrink grout.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars. ASTM A 615, Grade 60, deformed.
- B. Epoxy-Coated Reinforcing Bars. ASTM A 775.
- C. Steel Wire. ASTM A 82, plain, cold-drawn steel.
- D. Welded Wire Fabric. ASTM A 185, welded steel wire fabric.
- E. Welded Deformed Steel Wire Fabric. ASTM A 497.
- F. Supports for Reinforcement. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire-bar-type supports complying with CRSI specifications.
 - 1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.3 CONCRETE MATERIALS

- A. Portland Cement. ASTM C 150, Type I. Use one brand of cement throughout project unless otherwise approved.
- B. Fly Ash. ASTM C 618, Type C or Type F.
- C. Coarse Aggregate. ASTM C 33, Class Designation 3S, Grading Size No. 67, and as herein specified. Provide coarse aggregate from a single source for all exposed concrete.
- D. Fine Aggregate. Natural siliceous river sand, consisting of hard, clean, sharp, strong, durable, and uncoated particles, conforming to the requirements of ASTM C 33.
 1. Fine aggregate shall have a fineness modulus of 2.40 minimum and 3.00 maximum and the material passing the No. 200 sieve shall not exceed 3.0 percent by weight of the total sample. Coal and lignite shall not exceed 0.5 percent by weight of the total sample for all concrete. The fineness modulus of fine aggregate incorporated in the work shall not vary more than 0.10 plus or minus from the fineness modulus of the fine aggregate in the appropriate preliminary mix design approved by CCUD or Engineer.
- E. Water: Clean and potable.
- F. Admixtures, General. Provide admixtures for concrete that contain not more than 0.1 percent chloride ions.
 1. Available Manufacturers: Provide admixtures from single source manufacturer for air entrainment and water reducing admixtures. Manufacturers of admixtures shall include but not be limited to the following provided single source availability requirements are met:
 - a. Master Builders, Inc.
 - b. W. R. Grace and Company.
 - c. Euclid Chemical Company.
 2. Air-Entraining Admixture. ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
 3. Water-Reducing Admixture: ASTM C 494, Type A.
 4. High-Range Water-Reducing Admixture (Super Plasticizer). ASTM C 494, Type F or Type G.
 5. Water-Reducing, Accelerating Admixture. ASTM C 494, Type E. Accelerating admixtures must be nonchloride type and are for use only when specifically authorized by CCUD or Engineer. Submittal of separate mix design using accelerating admixture will be required.
 6. Water-Reducing, Retarding Admixture. ASTM C 494, Type D. Retarding admixtures must be nonchloride type and are for use only when specifically authorized by CCUD or Engineer. Submittal of separate mix design using retarding admixture will be required.

2.4 RELATED MATERIALS

- A. Waterstops. Provide waterstops at construction joints and other joints as indicated on the Drawings.
 - 1. Polyvinyl Chloride Waterstops. Corps of Engineers CRD-C 572.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:
 - 1) The Burke Company.
 - 2) Greenstreak Plastic Products Company.
 - 3) W. R. Meadows, Inc.
 - 4) Progress Unlimited.
 - 5) Schlegel Corp.
 - 6) Vinylex Corp.
 - 2. Bentonite Clay Waterstops. Specially formulated joint sealant, manufactured in coils with a rectangular cross section, which swells upon contact with water. Adhesive supplied by the water stop manufacturer shall be used to secure the waterstop to existing concrete prior to placing adjoining concrete.
- B. Granular Base. Evenly graded and compacted washed coarse aggregate conforming to ASTM C33, Class Designation 3S, Grading Size No. 57.
- C. Sand Cushion. Clean, manufactured, or natural sand.
- D. Vapor Retarder. Provide polyethylene sheet vapor retarder cover not less than 8 mils thick over prepared base material where indicated below slabs on grade. Use only materials that are resistant to deterioration when tested in accordance with ASTM E 154.
- E. Liquid Membrane-Forming Curing Compound. Liquid-type membrane-forming curing compound with fugitive dye complying with ASTM C 309, Type I-D, Class A. Moisture loss not more than 0.055 gr./sq. cm. when applied at 200 sq. ft./gal.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers whose products may be incorporated in the work include, but are not limited to, the following:
 - a. Dayton Superior Corp.
 - b. Euclid Chemical.
 - c. Sonneborn Rexnord.
- F. Epoxy Bonding Agent. ASTM C 881, two-component material suitable for use on dry or damp surfaces. Provide material "Type," "Grade," and "Class" to suit project requirements.
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - a. "Burke Epoxy M.V.," The Burke Company.
 - b. "Euco Epoxy System #452 or #620," Euclid Chemical Co.
 - c. "Sikadur 32 Hi-Mod," Sika Corporation.
- G. Chemical Hardener. U.S. Army Corps of Engineers Specification 204, liquid hardener composed of magnesium and zinc fluorosilicates combined with an anionic surfactant to improve wetting penetration. Hardener to be colorless, nontoxic, nonflammable,

and compatible with and providing good adhesion for subsequent topping and/or coatings. Install hardener in accordance with manufacturer's recommendations on interior concrete floors of shops, garages, vehicle service areas, and elsewhere as indicated on the Drawings.

- H. Joint Filler. At joints in slabs and elsewhere as indicated on the Drawings, use preformed strips of asphalt saturated fiberboard (1/2-inch nominal thickness) complying with ASTM D 1751.

1. All joints to be placed using an expansion board cap or "zip" cap to allow joint to be properly sealed, unless shown otherwise on drawings.
2. See Section 07 90 00, Joint Sealants, for proper sealant material.

2.5 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method used, use an independent testing facility acceptable to CCUD or Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

1. Fly ash may be substituted for cement in amounts not to exceed 20 percent of the specified cement content by weight providing that the mix conforms with all other requirements.

- B. Submit written reports to CCUD or Engineer of each proposed mix for each class of concrete at least 15 days prior to start of concrete placement. Do not begin concrete production until proposed mix designs have been reviewed by CCUD or Engineer.

- C. Design mixes to provide normal weight concrete with the following properties:

Property	Concrete Class	
	A	B
28-day Compressive Strength:		
Average of Three Consecutive Specimens	4,000 psi	2,500 psi
Minimum Any One Specimen	3,200 psi	2,000 psi
Minimum Cement Content (sacks/cubic yard)	6.5	5.0
Maximum Water-to-Cement Ratio:		
By Weight (pound/pound)	0.49	0.54
By Sack (gallon/sack)	5.5	6.0
Air Content** (percent by volume):		
Minimum	4.0	4.0
Maximum	6.0	6.0
Ratio of Coarse to Fine Aggregate (by weight):		
Minimum	1.0	1.0
Maximum	2.0	2.5
Class "A" concrete shall be used for all concrete work unless Class "B" is specifically called for on the Drawings		
**Air Entrainment may be omitted for interior slabs		

- D. Adjustment to Concrete Mixes. Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or

other circumstances warrant, as accepted by CCUD or Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by CCUD or Engineer before using in work.

2.6 ADMIXTURES

- A. Use water-reducing admixture or high-range water-reducing admixture (Superplasticizer) in all concrete.
- B. Use nonchloride accelerating admixture in concrete placed at ambient temperatures below 50°F (10°C) when authorized by CCUD or Engineer.
- C. Use high-range water reducing admixture (HRWR) in pumped concrete.
- D. Admixtures. Use admixtures for water reduction and set control in strict compliance with manufacturer's directions.

2.7 SLUMP LIMITS.

- A. Proportion and design mixes to result in concrete slump at point of placement as follows:
 - 1. Ramps, slabs, and sloping surfaces: Not more than 3 inches.
 - 2. Walls: 2½ to 4 inches.
 - 3. Floors and slabs: 2 to 3 inches.
 - 4. Beams: 2 to 3 inches.
 - 5. Blocks and Footings: 2 to 4 inches.
- B. Concrete having a slump greater than 1 inch over the specified maximum shall be rejected.
- C. Pumped Concrete: the maximum slump of the concrete at the suction of the pump may be increased above the maximum specified slump by the amount of slump loss in the pumping system up to a maximum of 1 inch.
- D. Congested Placement. When specifically requested in writing by the Contractor and approved by CCUD or Engineer, increases in discharge slumps may be considered in placements that include congested areas of reinforcement or areas otherwise deemed to be difficult to place concrete and achieve necessary consolidation. The increases in slump, if approved, shall be achieved by the addition of high range water reducing agent at the site in accordance with the manufacturer's instructions. The request shall include the proposed amount of slump increase and the amount of high range water reducer to be added. CCUD or Engineer will evaluate each request independently.

2.8 CONCRETE MIXING

- A. Job-Site Mixing. Only allowed when specifically authorized by CCUD or Engineer.
- B. Ready-Mix Concrete. Comply with requirements of ASTM C 94, and as specified.

1. When air temperature is between 85°F (30°C) and 90°F (32°C), reduce mixing and delivery time from 1½ hours to 75 minutes, and when air temperature is above 90°F (32°C), reduce mixing and delivery time to 60 minutes.

2.9 EPOXY ANCHORS AND DOWELS

- A. Anchors. Unless shown otherwise, dowels or anchors placed in existing or hardened concrete shall be stainless steel Type 316 ASTM F 593 and ASTM F 594, threaded rod with hex nuts.
- B. Epoxy adhesive shall be as follows:
 1. Two component, 100% solid (containing no solvents), non-sag paste, insensitive to moisture.
 2. Conform to NSF Standard 61 for use in conjunction with drinking water systems.
 3. Adhesive shall have been tested and qualified in accordance with ACI 355.4 and ICC-ES Acceptance Criteria 308 for cracked concrete and seismic applications. Design bond strength has been based on cracked concrete, ACI 355.4 Temperature Range B, and installations into dry holes drilled into concrete that has cured for at least 21 days using a carbide drill bit qualified by the manufacturer. Adhesive shall be installed by a certified adhesive anchor installer when required per ACI 318. Installations requiring certified installers shall be inspected per ACI 318.
 4. Epoxy adhesive shall be:
 - a. Red Head C-6+-, manufactured by ITW Construction Products.
 - b. Simpson Strong-Tie SET-3G.
 - c. Hilti HIT-RE 500 V3.
 - d. Or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Concrete execution requirements apply only to waterline-related concrete elements unless otherwise shown on approved plans.

3.2 SUBGRADE AND BEARING CONDITIONS

- A. Concrete bearing surfaces shall be placed against undisturbed native soil unless otherwise approved.
- B. Soil on the bearing face of thrust blocks and anchor blocks shall not be disturbed or formed.

3.3 CONCRETE PLACEMENT

- A. Inspection. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work.

- B. General. Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.
- C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete to avoid segregation at its final location.
- D. Placing Concrete in Forms. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 - 1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
 - 2. One operable, back-up, mechanical vibrator shall be on site prior to beginning concrete placement.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- E. Placing Concrete Slabs. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
 - 1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
 - 3. Maintain reinforcing in proper position during concrete placement.
- F. Cold-Weather Placing. If permitted by CCUD or Engineer, comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C) and not more than 80°F (27°C) at point of placement.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators unless authorized by the CCUD or Engineer.

4. Provide adequate means for maintaining the temperature of the air surrounding the concrete at 70°F for three days, or 50°F for five days, or for as long as is necessary to ensure proper curing of the concrete. Rapid cooling of the concrete shall be prevented. Housing, covering, or other protection used in connection with heating shall remain in place and intact at least 24 hours after the artificial heat is discontinued.
- G. Hot-Weather Placing. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 85°F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
 3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, when acceptable to CCUD or Engineer.

3.4 FINISH OF FORMED SURFACES

- A. Provide rough form finish for formed concrete surfaces not exposed to view in the finish work or concealed by other construction. This is the concrete surface having texture imparted by form-facing material, with tie holes and defective areas repaired and patched and fins and other projections exceeding ¼-inch in height rubbed down or chipped off.
- B. Provide smooth form finish for formed concrete surfaces exposed to view or to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.
- C. Grout-Cleaned Finish. Provide grout-cleaned finish as follows to concrete surfaces that have received smooth form finish treatment not to be coated with paint, waterproofing, dampproofing, or other similar system.
1. Combine one part portland cement to 1½ parts fine sand by volume, and a 50:50 mixture of acrylic-based bonding admixture and water to consistency of thick paint. Blend standard portland cement and white portland cement, amounts determined by trial patches, so that final color of dry grout will match adjacent surfaces.

2. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
 3. A polymer-modified, Portland-cement based waterproofing coating may be substituted for the cement sand grout finish specified above. A two-coat application is required. Surface preparation, product mixing, product application, and product curing shall be in strict accordance with the manufacturer's written recommendations.
- D. Related Unformed Surfaces. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.5 MONOLITHIC SLAB FINISHES

- A. Float Finish. Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified; slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo; and as otherwise indicated.
1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a tolerance of plus or minus 1/4-inch as measured from a 10-foot straight edge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- B. Trowel Finish. Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
- C. Trowel and Fine Broom Finish. Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
- D. Nonslip Broom Finish. Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with CCUD or Engineer before application.

3.6 CONCRETE CURING AND PROTECTION

- A. General. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control

material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

- B. Initial Curing. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.
- C. Curing Methods. Perform curing of concrete by curing and sealing compound, by moist curing, by moisture-retaining cover curing, and by combinations thereof, as herein specified. Select curing method appropriate for subsequent coating and finishing requirements.
 - 1. Provide moisture curing by either of the following methods or combination thereof, maintaining concrete surface moisture for seven days:
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Use continuous water-fog spray.
 - c. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.
 - 2. Moisture-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Maintain concrete surface moisture for seven days.
 - 3. Curing and sealing compound, when utilized, shall be applied as follows:
 - a. Flatwork: Apply curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within two hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - b. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
 - c. Formed Surfaces: Apply curing and sealing compound upon removal of form work.
 - 4. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
 - 5. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces, by application of appropriate curing method.
 - a. Cure concrete surfaces to receive liquid floor hardener or other finish by use of moisture-retaining cover, unless otherwise directed.

3.7 REMOVAL OF FORMS

- A. General. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10°C) for 72 hours after placing concrete, provided curing and protection operations are maintained.

- B. Formwork supporting weight of concrete, such as beams, soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days and until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.
- C. Form-facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.8 REUSE OF FORMS

- A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces except as acceptable to CCUD or Engineer.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In. Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Curbs. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Concrete Embedment and Encasement of Pipe. Install concrete for embedment and encasement where indicated on the Drawings and at such locations where installation conditions require such pipe support as determined by CCUD or Engineer. Embedment and encasement of pipe shall be preceded by the following preliminary steps:
 - 1. Remove all loose material from the trench prior to placing concrete. All concrete shall have a continuous contact with undisturbed soil on sides and bottom of trench.
 - 2. Accurately place a base course of concrete to such grade and elevation that the pipe will be at specified grade when pipe bells are supported on, and in contact with, the top surface of the base course.
 - 3. Restrain each length of pipe to maintain alignment and prevent floatation in a manner acceptable to CCUD or Engineer.

3.10 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas. Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to CCUD or Engineer.
 - 1. Cut out honeycomb, rock pockets, voids over 1/4-inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth

of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried.

2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- B. Repair of Formed Surfaces. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of CCUD or Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with bonding agent.
1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
- C. Repair of Unformed Surfaces. Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope.
1. Repair finished unformed surfaces that contain defects that affect durability of concrete. Surface defects, as such, include crazing and cracks in excess of 0.01-inch wide or that penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
 2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
 3. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into adjacent concrete.
 4. Repair defective areas, except random cracks and single holes not exceeding 1-inch-diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least $\frac{3}{4}$ -inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- D. Repair isolated random cracks and single holes not over 1-inch-diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part portland cement to $2\frac{1}{2}$ parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for

handling and placing. Place dry-pack before bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

- E. Perform structural repairs with prior approval of CCUD or Engineer for method and procedure, using specified epoxy adhesive and mortar.
- F. Repair methods not specified above may be used, subject to acceptance of CCUD or Engineer.

3.11 FIELD QUALITY CONTROL

- A. CCUD may observe concrete placement and require corrective actions where work does not conform to this Section.

3.12 LOADS APPLIED TO NEW CONCRETE

- A. Loads including, but not limited to, earth loads, loads exerted from bracing or shoring, wind loads, hydrostatic or hydraulic loads, equipment or vehicle loads, or loads exerted by stacked materials, shall not be applied to fresh concrete until the concrete has reached its specified 28-day strength.
- B. Concrete which has cracked due to overloading, loading before required strength has developed, or otherwise damaged shall be repaired or replaced as determined by CCUD or Engineer.

3.13 INSTALLATION OF EPOXY ANCHORS AND DOWELS

- A. Verify number, size, depth, and location of anchors or dowels to be installed.
- B. Drill holes in concrete to the depth specified on the Drawings using methods as instructed by the epoxy manufacturer. The diameter of holes shall be as instructed by the epoxy manufacturer for the anchor or dowel being installed. Clean holes as instructed by the epoxy manufacturer.
- C. Install epoxy in strict accordance with the manufacturer's instructions using guns with self-mixing nozzles provided by the manufacturer. Verify epoxy is mixed prior to placement into the hole using methods per manufacturer's instructions. Insert dowel or anchor into the hole and hold steady as instructed by the manufacturer.

END OF SECTION

DIVISION 31

EARTHWORK

SECTION 31 14 00

REMOVAL OF STRUCTURES AND OBSTRUCTIONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The work shall consist of the removal, wholly or in part, and satisfactory disposal of all buildings, fences, structures, old pavements, abandoned pipe lines, and any other obstructions which are not designated or permitted to remain, except for the obstructions to be removed and disposed of under other items in the Contract. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits. Where removal of structures and obstructions is not specifically identified as a separate item, the cost of such work shall be included in the Developer's construction costs.

PART 2 - EQUIPMENT

2.1 EQUIPMENT

- A. All equipment necessary for the satisfactory performance of this work shall be on the project and approved before the work will be permitted to begin.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall raze, remove, and dispose of all buildings and foundations, structures, fences and other obstruction, any portions of which are on the rights-of-way, except utilities, and those for which other provisions have been made for removal. All material from such work designated to become the property of CCUD shall be removed without unnecessary damage, in sections or pieces which may be readily transported, and shall be stored and protected by the Contractor at specified places within the project limits, and all material not so designated will become the property of the Contractor and shall be disposed of at an approved off-site location in accordance with applicable regulations. If the material is disposed of on private property, the Contractor shall secure written permission from the property owner. A copy of each agreement with property owners is to be furnished to CCUD. This Section applies within public rights-of-way, easements, and private property areas subject to approved development plans.
- B. CCUD reserves the right to dispose of buildings on any tract prior to their being torn down or removed by the Contractor.
- C. Foundations of buildings and structures shall be removed to a depth of not less than one foot below natural ground, except that within construction limits, removal shall be to a depth of not less than 2 feet below subgrade elevation. Basement floors shall be broken up to prevent holding of water. Basements or cavities left by

structure removal shall be filled to the level of the surrounding ground and within the prism of construction and below subgrade elevation shall be compacted in accordance with the provisions of Section 31 20 00, Earthwork.

3.2 REMOVAL OF BRIDGES, CULVERTS, AND OTHER DRAINAGE STRUCTURES

- A. Bridges, culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic.
- B. Substructure of Bridges. Unless otherwise specifically designated or directed, the substructure of bridges shall be razed to the adjacent ground level or natural stream bottom for such portions located in a stream, except that such portions of the substructure of a bridge located in a navigable stream shall be subject to the laws of the U. S. Government and requirements set out in the standard permit form of the applicable government agency approving the location and plans and authorizing the construction of the structure. Where such portions of existing structures lie wholly or in part within the limits for a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.
- C. Steel bridges and wood bridges, when specifically designated by CCUD, shall be carefully dismantled without unnecessary damage. All such material shall be stored in a manner as to prevent damage.
- D. Blasting or other operations necessary for the removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to placing the new work, or adequate precautions shall be taken to prevent such damage.

3.3 REMOVAL OF PIPE

- 3.2 Pipe, when specifically designated by CCUD, shall be carefully removed and every precaution taken to avoid breaking or damaging the pipe. Pipes shall be removed, and stored when necessary, so that there will be no loss or damage. The Contractor will be required to replace sections damaged by negligence or by use of improper methods.

3.4 REMOVAL OF PAVEMENT, SIDEWALKS, CURBS, ETC., CONSTRUCTED OF PORTLAND CEMENT CONCRETE

- 3.2 All pavement, base course, sidewalks, curbs, and gutters, etc., constructed of portland cement concrete designated for removal shall be disposed of as directed.
- 3.2 Concrete pavement, parking strip, and base, all with or without bituminous overlay, concrete curb and gutter, sidewalk, driveways, etc., shall be removed and disposed of as follows:
 - 1. Remove and dispose of items below subgrade elevation, but by not more than 2 feet. The cost of this work shall be included in the unit price bid for other items of construction and shall not be paid for directly.
 - 2. If the items are more than 2 feet below subgrade elevation, they shall be broken into size not to exceed 2 feet in maximum dimension and remain in

place, unless it interferes with succeeding items of construction. The cost of this work shall be included in the unit price bid for other items of construction and shall not be paid for directly.

3. If the items are above subgrade elevation, the removal and disposal of same shall be paid for as provided in Section 31 20 00, Earthwork.
4. When specified, ballast, gravel, bituminous pavement or other pavement materials shall be removed and stockpiled as in an appropriate manner. Otherwise, such materials shall be disposed of as directed.

END OF SECTION

SECTION 31 20 00

EARTHWORK

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes earthwork and related operations, including but not limited to clearing and grubbing the construction site; dewatering; excavating all classes of material encountered; pumping, draining, and handling of water encountered in the excavations; handling, storage, transportation, and disposal of all excavated and unsuitable material; construction of fills and embankments; backfilling around structures and pipe; backfilling all trenches and pits; compacting; all sheeting, shoring, and bracing; preparation of subgrades; surfacing and grading; and any other similar, incidental, or appurtenant earthwork operation which may be necessary to properly complete the work.
- B. Provide all services, labor, materials, and equipment required for all earthwork and related operations necessary or convenient to the Contractor for furnishing a complete work as shown on the Drawings or specified in these Approved plans.
- C. CCUD review or approval of material sources or disposal locations is limited to determining compliance with these Standard Specifications and does not constitute approval of property rights, access agreements, or regulatory permits.

1.2 GENERAL

- A. The elevations shown on the Drawings as existing are taken from the best available data and are intended to give reasonable, accurate information about the existing elevations. They are not precise, and the Contractor should satisfy himself as to the exact quantities of excavation and fill required.
- B. Perform earthwork operations in a safe and proper manner taking appropriate precautions against all hazards.
- C. Maintain in good condition at all times all excavated and fill areas for structures, trenches, fills, topsoil areas, embankments, and channels until final acceptance by the Owner. Repair all damage caused by erosion or other construction operations using material of the same type as the damaged materials.
- D. If soil borings are available for the area of this work, they will be on file at the Owner's address where they will be made available for review. This information is made available for such use as Contractor may choose to make of it in the development approval, but the Owner gives no guarantee, either expressed or implied, that it represents a true or complete cross section of all of the material to be encountered in performing the excavation and earthwork on this project.
- E. Earthwork operations within the rights-of-way of the State Department of Transportation, the County Road Department, and the respective cities shall be conducted in accordance with the requirements and provisions of the permits issued by those agencies for the construction within their respective rights-of-way. Such requirements and provisions, where applicable, shall take precedence over and supersede the provisions of these Specifications.

- F. Control grading to prevent water running into excavations. Obstruction of surface drainage shall be avoided and a means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains. Material for backfill or for protection of excavation in public roads from surface drainage shall be neatly placed and kept shaped so as to cause the least possible interference with public travel. Free access must be provided to all fire hydrants, valves, meters, and private drives.
- G. No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.
- H. CCUD may require compaction and density testing by an independent testing laboratory at the Developer's expense. Documents.
- I. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, "Excavations, Trenching, and Shoring," and Subpart O, "Motor Vehicles, Mechanized Equipment, and Marine Operations," and shall be conducted in a manner acceptable to CCUD or Engineer.
- J. It is understood and agreed that a thorough investigation by the Contractor has been made of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and floodplains, particularly in areas where construction activities may encounter water-bearing sands and gravels or limestone solution channels. Provide all services, labor, equipment, and materials necessary or convenient for completing the work.

PART 2 - EXECUTION

2.1 INITIAL SITE PREPARATION

- A. Preparatory to beginning construction operations, remove from the site all vegetative growth, trees, brush, stumps, roots, debris, and any other objectionable matter, including fences, buildings, and other structures shown on the Drawings in the construction areas which are designated for removal or which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or would form obstructions therein.
- B. Grub and remove stumps and roots to a depth not less than 5 feet below grade. Fill all holes or cavities which extend below the subgrade elevation of the proposed work with compacted layers of crushed rock or earth backfill conforming to the requirements specified here for backfill. Do not incorporate organic material from clearing operations in excavation backfill or embankment material.
- C. Exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences, buildings, and other structures located in the construction area but not within designated clearing limits as shown on the Drawings or within the limits of embankments, excavations, or proposed structures. Repair or replace any of the aforementioned items damaged by Contractor's operation or construction activities.
- D. Remove and dispose of any excess material resulting from clearing or site preparation operations. Dispose of such materials in a manner acceptable to CCUD

or Engineer and at an approved location where such materials can be lawfully placed.

2.2 DEWATERING

- A. Provide and maintain at all times during construction ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Methods of dewatering may include sump pumps, well points, deep wells, or other suitable methods which do not damage or weaken structures, foundations, or subgrades. Shallow excavations may be dewatered using open ditches, provided such ditches are kept open and free-draining at all times. The actual dewatering methods used shall be acceptable to CCUD or Engineer.
- B. Do not place concrete or mortar in water nor allow water to rise over newly placed concrete or mortar for at least 24 hours after placement, unless specifically authorized by CCUD or Engineer. No concrete structure shall be exposed to unequal hydrostatic forces until the concrete has reached its specified 28-day strength. Do not allow water to rise above bedding during pipe-laying operations. Exercise care to prevent damage to pipelines or structures resulting from flotation, undermining, or scour. Dewatering operations shall commence when ground or surface water is first encountered and shall be continuous until water can safely be allowed to rise in accordance with the provisions of this section. Protect excavations from the entrance of surface water to the extent possible by the use of dikes and/or covers.
- C. Standby pumping equipment shall be on the jobsite. A minimum of 1 standby unit (a minimum of 1 for each 10 in the event well points are used) shall be available for immediate installation should any pumping unit fail. The design and installation of well points or deep wells shall be suitable for the accomplishment of the work. Submit drawings or diagrams on proposed well point or deep well dewatering systems to CCUD or Engineer for review.
- D. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, excavate and replace the affected areas with crushed rock at no cost to the Owner.
- E. Dispose of the water from the work in a suitable manner without damage to adjacent property. Conveyance of the water shall not interfere with traffic flow or treatment facilities operation. Do not drain water into work built or under construction without prior consent of CCUD or Engineer. The Contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.
- F. Provide sedimentation and desilting basins as necessary or when directed by CCUD or Engineer to prevent the entrance of excessive or injurious amounts of sand and silt from surface runoff or dewatering operations into storm drains or receiving waters. The system used for desanding or desilting the water shall be a baffled structure and shall provide not less than 5 minutes detention time and shall be designed to have a "flow-through" velocity not exceeding 0.2 foot per second at the anticipated peak flow. The method of desanding or desilting and the point of disposal shall be subject to the approval of CCUD or Engineer.

- G. Dispose of water safely and in accordance with applicable Environmental Protection Agency, U.S. Army Corps of Engineers, and State Water Quality Control Division standards and permits.

2.3 SHEETING, SHORING, AND BRACING

- A. The sides of all excavations shall be sufficiently sheeted, shored, and braced as necessary to prevent slides, cave-ins, settlement, or movement of the banks; to maintain the excavation clear of all obstructions; and to provide safe working conditions. Wood or steel sheeting shall be used in wet, saturated, or flowing ground. All sheeting, shoring, and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain shape and position under all circumstances.
- B. Correctly assessing the need for sheeting, analyzing the stresses induced, and maintaining regulatory compliances shall be totally the responsibility of the Contractor. Since CCUD or Engineer does not dictate or determine the Contractor's sequence or limits of excavation, CCUD or Engineer assumes no responsibility for sheeting and shoring. The Contractor must employ or otherwise provide for adequate professional structural and geotechnical engineering supervision to assess the need for sheeting and shoring and design same. Results of sheeting and shoring analysis and design shall be submitted to CCUD or Engineer on request.
- C. Excavations adjacent to existing or proposed buildings and structures, or in paved streets or alleys, shall be sheeted, shored, and braced adequately to prevent undermining beneath or subsequent settlement of such structures or pavements. Underpinning of adjacent structures shall be done when necessary to maintain structures in safe condition. Any damage to structures or pavements occurring through settlements, water or earth pressures, slides, caves, or other causes due to failure or lack of sheeting or bracing, or improper bracing or occurring through negligence or fault of the Contractor in any other manner shall be repaired by the Contractor at his own expense.
- D. Sheeting, shoring, or bracing materials shall not be left in place unless otherwise specified or shown on the Drawings or ordered by CCUD or Engineer in writing. Such materials shall be removed in such manner that no danger or damage will occur to new or existing structures or property, public or private, and so that cave-ins or slides will not take place. Trench sheeting shall be left in place until backfill has been brought to a level 12 inches above the top of the pipe. It shall then be cut off and the upper portion removed. Sheeting for structures shall be left in place until backfill has been brought to a level 12 inches above the top of the bottom footing. It shall then be cut off and the upper portion removed.
- E. All holes and voids left in the work by the removal of sheeting, shoring, or bracing shall be filled and thoroughly compacted.

2.4 EXCAVATION

A. General

- 1. Excavation shall include the removal of all material from an area necessary for the construction of a pipeline or structure. Excavations shall provide adequate working space and clearances for the work to be performed therein.

2. All material excavated below the bottom of concrete walls, footings, and foundations shall be replaced, by and at the expense of the Contractor, with Class B concrete to the lines and grades shown on the Drawings, except where otherwise shown on the Drawings, specified herein, or authorized by CCUD or Engineer.
3. Where quicksand, soft clay, spongy or swampy earth, or other materials unsuitable for subgrade or foundation purposes are encountered below the excavation limits, they shall be removed and disposed of to the level of suitable material. Areas so excavated shall be backfilled with Class B concrete or with compacted layers of crushed rock, sand, or other approved material conforming to the requirements specified herein for backfill to the lines and grades shown on the Drawings.
4. Place barriers at each end of all excavation and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations. Place lights along excavations from sunset each day to sunrise of the next day until the excavations are backfilled. Barricade all excavations in such a manner as to prevent persons from falling or walking into any excavation.

B. Rock Excavation

1. Rock encountered in the process of excavation for structures shall be uncovered and stripped of all loose materials over the entire limits of excavation. Rock encountered for removal in a trench section shall be uncovered for a distance of not less than 50 feet.
2. Excavate rock and large boulders in trenches over the horizontal limits of excavation and to depths as shown on the Drawings.
3. Backfill the space below grade for pipelines to the proper grade with compacted layers of crushed rock or sand conforming to the requirements specified herein for backfill. Where pipe sewers are constructed on concrete cradles, excavate rock to the bottom of the cradle as shown on the Drawings.
4. Excavate rock under structures to lines and grades shown on the Drawings. Unless specified otherwise, where rock excavation has been carried below grade, the Contractor shall backfill to grade with Class B concrete at his own expense.
5. Where rock foundation is obtained at grade for over 50 percent of the area of any one structure, the portion of the foundation that is not rock shall be excavated below grade to reach a satisfactory foundation of rock. The portion below grade shall be backfilled with Class B concrete.
6. Where rock foundation is obtained at grade for less than 50 percent of any one structure and satisfactory rock cannot be found over the remaining area by reasonable additional excavation, the rock shall be removed for a depth of 12 inches below grade and the space below grade shall be backfilled to the proper grade with compacted layers of crushed rock conforming to the requirements specified herein for backfill.
7. Drilling and blasting operations shall be conducted with due regard for the safety of persons and property in the vicinity and in strict conformity with

requirements of all ordinances, laws, and regulations governing blasting and the use of explosives. Conduct rock excavation near existing pipelines or other structures with the utmost care to avoid damage. Promptly repair injury or damage to other structures and properties to the satisfaction of the Owner by the Contractor at his own expense. The Contractor is advised to hire qualified consultants to perform a "preblast survey" in area where damage could occur due to blasting; all expenses for such survey must be borne by the Contractor, and no separate payment for same will be made.

8. Complete rock excavation for all structures and adjacent trenches under this Contract and any other rock excavation directed by CCUD or Engineer before construction of any structure is started in the vicinity.

C. Borrow Excavation

1. Wherever the backfill of excavated areas or the placement of embankments or other fills requires specified material not available at the site or material in excess of suitable material available from the authorized excavations, such materials shall be obtained from other sources. This may require the opening of borrow pits at points not immediately accessible from the work. In such cases The Developer shall make all arrangements with property owners, obtain all required permissions, permits, and approvals, and pay all costs incident to borrowed material, including royalties, access agreements, and restoration. Before a borrow pit is opened, the quality and suitability of the material to be obtained therefrom shall be approved by CCUD or Engineer.
2. Borrow pits shall be cleared, grubbed, and finish-graded in accordance with the requirements specified herein.

- D. Roadway Excavation. Roadway excavation shall consist of excavation for roadways and parking areas in conformity with lines, grades, cross sections, and dimensions shown on the Drawings. After shaping to line, grade, and cross section, the subgrade shall be rolled until compacted to a depth of at least 6 inches to 100 percent of the maximum density at optimum water content as determined by AASHTO T99, Method A. This operation shall include any reshaping and wetting required to obtain proper compaction. All soft or otherwise unsuitable material shall be removed and replaced with suitable material.

E. Trench Excavation

1. Trench excavation shall consist of the removal of materials necessary for the construction of water, sewer, and other pipelines and all appurtenant facilities including manholes, inlets, outlets, headwalls, collars, concrete saddles, piers, and pipe protection called for on the Drawings.
2. Excavation for pipelines shall be made in open cut unless shown otherwise on the Drawings. Trenches shall be cut true to the lines and grades shown on the Drawings or established by CCUD or Engineer on the ground. The banks of trenches shall be cut in vertical, parallel planes equidistant from the pipe centerline. From an elevation 12 inches above the top of the pipe to the bottom of the trench, the horizontal distances between vertical planes for different sizes of pipe shall not exceed those shown on the Drawings. When sheeting is used, the width of the trench shall be considered as the distance between the inside faces of the sheeting. The bottom of the trench shall be cut

carefully to the required grade of the pipe except where bedding materials or cradles are shown, in which case the excavation shall extend to the bottom of the bedding or cradles as shown on the Drawings. Minimum pipe cover shall be as shown on the Drawings or specified in these Approved plans.

3. The use of a motor-powered trenching machine will be permitted, but full responsibility for the preservation, replacement, and/or repair of damage to any existing utility services and private property shall rest with the Contractor.
4. Bell holes for bell and spigot pipe and/or mechanical joint pipe shall be excavated at proper intervals so the barrel of the pipe will rest for its entire length upon the bottom of the trench. Bell holes shall be large enough to permit proper installation of all joints in the pipe. Bell holes shall not be excavated more than 10 joints ahead of pipe laying. No part of any bell or coupling shall be in contact with the trench bottom, trench walls, or granular embedment when the pipe is jointed.
5. Excavation for manholes, outlets, collars, saddles, piers, and other pipeline structures shall conform to the additional requirements specified herein for structural excavation.
6. Pipe trenches shall not be excavated more than 400 feet in advance of pipe laying and all work shall be performed to cause the least possible inconvenience to the public. Adequate temporary bridges or crossings shall be constructed and maintained where required to permit uninterrupted vehicular and pedestrian traffic.
7. Wherever pipe trenches are excavated below the elevation shown on the Drawings, the Contractor, at his own expense, shall fill the void thus made at the proper grade with Class B concrete or with compacted layers of crushed rock or sand conforming to the requirements specified herein for backfill, unless otherwise specified herein or shown on the Drawings.
8. In all cases where materials are deposited along open trenches, they shall be placed so that no damage will result to the work and/or adjacent property in case of rain or other surface wash.

F. Structural Excavation

1. Structural excavation shall consist of the removal of all materials necessary for the construction of structures, including tanks, foundations, footings, wet wells, dry wells, box culverts, flumes, channels, buildings, and other miscellaneous structures.
2. The bottoms of structural excavations shall be true to the lines and grades shown on the Drawings. Faces of excavations shall not be undercut for extended footings. Except as provided herein for excavation of unsuitable material or rock, where the excavation is carried below the grade elevation shown on the Drawings, the Contractor shall backfill the void thus made to the proper grade with Class B concrete at his own expense.

2.5 BACKFILLING

- A. Materials for backfilling shall conform to the following requirements:

1. Select Earth Backfill: Fine, sound, loose earth containing optimum moisture content for compaction to 90 percent of maximum density, free from all wood, vegetable matter, debris, and other objectionable material, and having scattered clods, stones, or broken concrete less than 2 inches in maximum dimension except that the maximum particle size shall be ½ inch when used with PVC or other flexible thermoplastic pipe.
2. Common Earth Backfill: Sound, loose earth containing optimum moisture content for compaction to 90 percent of maximum density, free from all wood, vegetable matter, debris, and other objectionable material, and having scattered clods, stones, or broken concrete and pavement less than 6 inches in maximum dimension.
3. Sand: Natural or imported sand conforming to ASTM D 1073.
4. Crushed Rock: Crushed rock conforming to Section 903.22, Size 7 (½-inch to No. 4) of the SSRBC.
5. Class B Concrete: Class B concrete as specified elsewhere in these Specifications or on the Drawings.

B. General

1. Earth backfill shall be compacted to not less than 90 percent of the maximum density as determined by ASTM D 698 at a moisture content within 3 percentage points, unless otherwise specified herein. Crushed stone and sand shall be compacted to not less than 83 percent of the solid volume density as determined from the bulk specific gravity by AASHTO T-84 and T-85 and the dry weight of the aggregate.
2. Material that is too dry for adequate compaction shall receive a prior admix of sufficient water to secure optimum moisture content. Material having excessive water content shall not be placed at any time.
3. Backfill material required to be compacted shall be placed in horizontal layers not to exceed 6 inches in thickness (before compaction) and compacted in place by ramming, tamping, or rolling, unless otherwise specified herein. Compaction shall be accomplished by power-driven tools and machinery wherever possible. Compaction and consolidation of sand and crushed stone backfill shall be accomplished using vibrating equipment in a manner acceptable to CCUD or Engineer.

C. Backfilling Trenches

1. The backfilling of sewers, water, and other pipeline trenches shall be started immediately after the construction of same has been inspected and approved by CCUD or Engineer. Select backfill or crushed stone as shown on the Drawings shall be placed in the trench under and on each side of the pipe in 6-inch layers for the full width of the trench and thoroughly and uniformly compacted by ramming and/or tamping to a minimum of 90 percent of the maximum density determined as specified herein. Select earth backfilling or crushed stone as shown on the Drawings shall start above the pipe bedding. Sufficient select backfill or crushed stone as shown on the Drawings shall be placed around the pipe and compacted to provide a cover of not less than 12 inches over the top of the pipe. Mechanical compactors or tampers shall not

be used within 12 inches of pipe. Compaction in this area shall be accomplished by hand methods. Sand or specified crushed stone bedding material shall be substituted for select earth backfill when the pipe material is other than ductile iron or when crushed stone trench backfill is required. Backfilling shall proceed simultaneously on both sides of the pipe to prevent lateral displacement.

2. Caution shall be used during backfill operations for PVC or other flexible thermoplastic pipe to prevent pipe deformation. PVC or other flexible thermoplastic pipe shall not be subjected to roller or wheel loads until a minimum of 30 inches of backfill has been placed over the top of the pipe. A hydrohammer shall NOT be used until a minimum depth of 48 inches of backfill has been placed over the top of the pipe.
3. Backfilling of PVC pressure pipe or other flexible thermoplastic pipe (water pipe) shall be as described in Paragraph 1 above.
4. In streets and alleys, across sidewalks and driveways, and at any other places subject to vehicular traffic or other superimposed loads, crushed rock backfill shall be placed and compacted in 12-inch layers from the bottom of the trench upward for the full depth of the trench. Crushed rock backfill shall be compacted by use of a hydrohammer or approved vibratory compactor. The top 6 inches of the finished subgrade shall be equal to not less than 100 percent of the maximum density as determined by ASTM D 698 at a moisture content of within 3 percentage points of optimum. When field tests show failure to meet the density requirement, the subgrade shall be loosened by disking, harrowing, or other approved methods to a depth of not less than 6 inches, then reshaped and recompactd as indicated in this paragraph.
5. Trenches under concrete slabs and footings of structures shall be completely backfilled with compacted sand or crushed rock or filled with Class B concrete as shown on the Drawings.
6. All backfilling shall be done in such a manner that the pipe or structure over or against which it is being placed will not be disturbed or injured. Any pipe or structure injured, damaged, or moved from its proper line or grade during backfilling operations shall be removed and repaired to the satisfaction of CCUD or Engineer and then rebackfilled.

D. Backfilling Around Structures

1. Backfilling around structures shall consist of common earth backfill placed in 6-inch layers and compacted by tamping to a minimum of 90 percent of the maximum density determined as specified herein for the full depth of the excavation from the bottom to the finished grade. No backfill shall be placed against concrete structures until the concrete has reached its specified 28-day compressive strength. Where practical, compaction of structural backfill shall be accomplished by power-driven tamping equipment.
2. Where crushed rock mats under slabs and foundations are called for on the Drawings, excavate below grade to the depth of the crushed rock mat as shown on the Drawings and install a compacted crushed rock bed. This shall be finished to a true line or plane and even with the subgrade of the concrete foundations, piers, footings, or slabs. Before placing any crushed stone,

remove all loose earth or debris. This crushed rock mat shall extend 12 inches beyond all slabs and foundations or to edges of sheet piling.

3. Crushed rock mats 12 inches or less in thickness shall be constructed of compacted layers of crushed rock conforming to Section 903, Size 7 (½-inch to No. 4) of the Tennessee Department of Transportation's Standard Specifications Road and Bridge Design (latest edition).
4. Crushed rock mats of thickness greater than 12 inches shall have the top 12 inches constructed of compacted layers of crushed rock as specified above. That portion below the top 12 inches shall be constructed of compacted layers of crushed rock conforming to Section 903, Tennessee Department of Transportation Specifications, with a modified gradation of 6 inches to dust as received from the crusher.
3. The use of earth backfill to support footings, foundations, and structures shall not be permitted, unless otherwise shown on the Drawings.

2.6 FILLS AND EMBANKMENTS

- A. Fills and embankments shall consist of all earth fills except backfills in trenches or around structures. Unless special material is specified or shown on the Drawings, material for fills and embankments shall consist of excavated material from structures or of a mixture of such excavated materials and materials borrowed from other sources by the Contractor. All material used for fills and embankments shall be free from wood, vegetable matter, debris, soft or spongy earth or clay, large rock, or other objectionable material and shall be acceptable to CCUD or Engineer.
- B. Materials shall be placed in the fill or embankment in successive layers 8 inches or less in thickness before compaction, each layer being approximately horizontal and extending to the full limit of the required cross section, and shall be compacted over the entire surface to not less than 95 percent of the maximum density as determined by ASTM D 698 at a moisture content of within 3 percentage points of optimum. The process shall be repeated for each layer of material until the fill or embankment conforms to the plan lines, grades, and cross sections. The degree of compaction and moisture content required, the method of tamping, and the equipment used shall be approved by CCUD or Engineer.
- C. The area over which the fill or embankment is to be constructed shall first be cleared of all vegetation, debris, and other objectionable material and, if the ground is in a loose, uncompacted condition, it shall be compacted to a minimum 95 percent of maximum density determined as specified herein.
- D. No material shall be placed beyond the sloping lines of embankment unless so ordered by CCUD or Engineer. Material allowed to be placed beyond the lines of embankment shown on the Drawings will be compacted as required above unless otherwise authorized by CCUD or Engineer.
- E. Material for embankments or roadway fills shall be placed in 6-inch maximum lifts and shall be compacted by rolling with power rollers weighing not less than 10 tons, with sheepfoot rollers, with vibrating rollers, or with pneumatic tire rollers, as required to accomplish the work. While and as each layer is deposited, water shall be applied in sufficient amount to ensure optimum moisture to secure the compaction specified.

- F. The use of trucks, carryalls, scrapers, tractors, or other heavy hauling equipment shall not be considered as rolling in lieu of rollers, but the traffic of such hauling equipment shall be distributed over the fill in such a manner as to make the use of the compaction afforded thereby as an addition to compaction by the use of rollers.
- G. Wherever a trench passes through a fill or embankment, the fill or embankment material shall be placed as compacted to an elevation 12 inches above the top of the pipe before the trench is excavated.
- H. Subgrades for all roadbeds shall meet the requirements of Subsection 2.5 C.4.

2.7 DISPOSAL OF WASTE AND UNSUITABLE MATERIALS

- A. All materials removed by excavation which are suitable for the purpose shall be used to the extent possible for backfilling pipe trenches, foundations, and footings and for making embankment fills or for such other purposes as may be shown on the Drawings. All materials not used for such purposes shall be considered as waste materials and the disposal thereof shall be made in a manner and at locations approved by CCUD or Engineer.
- B. Waste materials shall be spread in uniform layers and neatly leveled and shaped. Spoil banks shall be provided with sufficient and adequate openings to permit surface drainage of adjacent lands.
- C. Unsuitable materials, consisting of wood, vegetable matter, debris, soft or spongy clay, peat, and other objectionable material so designated by CCUD or Engineer, shall be removed from the work site and disposed of in a manner and at a location approved by CCUD or Engineer.
- D. All permits, approvals, easements, agreements, and regulatory compliance associated with disposal locations shall be the sole responsibility of the Developer.
- E. The Contractor is responsible for any and all permits and other requirements, such as sediment runoff control necessitated by the disposal of waste material.

2.8 FINAL GRADING

- A. After other earthwork operations have been completed, the sites of all structures, roads, and embankments shall be graded within the limits and to the elevations shown on the Drawings. Grading operations shall be so conducted that materials shall not be removed or loosened beyond the required limits. The finished surfaces shall be left in smooth and uniform planes such as are normally obtainable from the use of hand tools. If Contractor is able to obtain the required degree of evenness by means of mechanical equipment, the use of hand labor methods will not be required. Neatly trim and finish slopes and ditches to slopes shown on the Drawings unless otherwise approved by CCUD or Engineer.
- B. Grade and dress all finished ground surfaces to present a surface varying not more than plus or minus 0.10 foot as regards local humps or depressions, unless otherwise specified or shown on the Drawings, and shall be acceptable to CCUD or Engineer.

2.9 TOPSOIL

- A. All areas to be planted with trees or shrubs, or with sprigged grass as shown on the plans, shall be prepared by grading to a smooth, even surface to a level 4 inches below the elevation of the finished grade shown on the Drawings. It shall then be brought to a neat and finished grade by the addition of 4 inches of approved topsoil.
- B. Topsoil removed from the construction area may be stockpiled and reused or topsoil may be obtained from approved borrow areas. If obtained from borrow areas, make suitable arrangements with the property owner and pay all costs incident to the borrowed material including royalties.

2.10 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within 1 year after final acceptance of the work by the Owner.
- B. Make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after receipt of written notice from CCUD or Engineer.

2.11 DUST CONTROL

- A. The Contractor shall use all means necessary to control dust on and near the work and all off-site borrow areas.
- B. The Contractor shall thoroughly moisten all surfaces as required to prevent dust being a nuisance to the public, neighbors and concurrent performance of work on the site.

END OF SECTION

SECTION 31 23 19.16

DEWATERING

PART 1 - GENERAL

1.1 SCOPE

- A. This section shall apply to all excavation, except trench excavation. Dewatering associated with trench excavation for utilities shall comply with Section 31 20 00 – Earthwork.
- B. Construct all permanent work in areas free from water. Design, construct and maintain all wells, pumps, vacuum systems, sumps, dikes, levees, cofferdams and diversion and drainage channels as necessary to maintain the areas free from water and to protect the areas to be occupied by permanent work from water damage. Remove temporary works after they have served their purpose.
- C. The Contractor shall be responsible for the stability of all temporary and permanent slopes, grades, foundations, materials and structures during the course of the Contract. Repair and replace all slopes, grades, foundations, materials and structures damaged by water, both surface and subsurface, to the lines, grades and conditions existing prior to the damage, at the Developer's expense and at no additional cost to the CCUD.
- D. This Section supplements, and does not replace, the dewatering requirements included in Section 31 20 00 – Earthwork.
- E. References to the Engineer shall mean CCUD or its designated representative.
- F. All permits, approvals, and regulatory compliance associated with dewatering discharge and disposal are the sole responsibility of the Developer.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 CARE OF WATER

- A. Except where the excavated materials are designated as materials for permanent work, material from required excavation may be used for dikes, levees, cofferdams and other temporary backfill.
- B. Furnish, install, maintain and operate necessary pumping and other equipment for dewatering the various parts of the work and for maintaining the foundation and other parts free from water as required for constructing each part of the work.
- C. Install all drainage ditches, sumps and pumps to control excessive seepage on excavated slopes, to drain isolated zones with perched water tables and to drain impervious surfaces at final excavation elevation.

- D. Dewater by means which will insure dry excavations, preserve final lines and grades, do not disturb or displace adjacent soil.
- E. All pumping and drainage shall be done with no damage to property or structures and without interference with the rights of the public, owners of private property, pedestrians, vehicular traffic or the work of other contractors, and in accordance with all pertinent laws, ordinances and regulations.
- F. Do not overload or obstruct existing drainage facilities.
- G. After they have served their purpose, remove all temporary protective work at a satisfactory time and in a satisfactory manner. All diversion channels and other temporary excavations in areas where the compacted fill or other structures will be constructed shall be cleaned out, backfilled and processed under the same Specifications as those governing the compacted fill. Fill or grout all temporary dewatering wells unless otherwise directed by the Engineer.
- H. When the temporary works will not adversely affect any item of permanent work or the planned usage of the Project, the Contractor may be permitted to leave such temporary works in place. In such instances, breaching of dikes, levees and cofferdams may be required. Any temporary works left in place shall not interfere with future maintenance, access, or operation of public infrastructure and shall be documented as part of project record drawings.

3.2 DEWATERING

- A. By the use of well points, pumps, tile drains or other approved methods, the Contractor shall prevent the accumulation of water in excavated areas. Should water accumulate, it shall be promptly removed.
- B. Excavations shall be continuously dewatered to maintain a ground water level no higher than three to four feet below the lowest point in the excavation. Dewatering systems shall be designed to allow for localized variations in the depth of excavations required to reach a suitable foundation. Dewatering shall be accomplished well enough in advance of excavation to ensure that groundwater is already lowered prior to completing the final excavation to finish subgrade.
- C. All destabilized subgrade conditions caused by inadequate or untimely dewatering operations shall be undercut and backfilled with suitable backfill material at the Developer's expense and at no additional cost to CCUD.
- D. Piezometric observation wells may be required where excavation extends below the static groundwater table, as determined by CCUD or its Engineer.

END OF SECTION

SECTION 31 25 00

SLOPE PROTECTION AND EROSION CONTROL

PART 1 - GENERAL

1.1 SCOPE

- A. This section shall consist of temporary control measures that may be required during the life of the Contract to control erosion and water pollution through the use of berms, dikes, dams, sediment basins, fiber mats, netting, mulches, grasses, slope drains, temporary silt fences, and other control devices.
- B. Erosion and sediment control measures shall comply with applicable TDEC Construction General Permit requirements and the approved Stormwater Pollution Prevention Plan (SWPPP).
- C. The term Contractor shall include the Developer and its contractors.

PART 2 - PRODUCTS

2.1 TEMPORARY BERMS

- A. A temporary berm is constructed of compacted soil, with or without a shallow ditch, at the top of fill slopes or transverse to centerline on fills.
- B. These berms are used temporarily at the top of newly constructed slopes to prevent excessive erosion until permanent controls are installed or slopes stabilized.

2.2 TEMPORARY SLOPE DRAINS

- A. A temporary slope drain is a facility consisting of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half-round pipe, metal pipe, plastic pipe, sod, or other material acceptable to the Engineer that may be used to carry water down slopes to reduce erosion.

2.3 SEDIMENT STRUCTURES

- A. Sediment basins, ponds, and traps are prepared storage areas constructed to trap and store sediment from erodible areas in order to protect properties and stream channels below the construction areas from excessive siltation.

2.4 CHECK DAMS

- A. Check dams are barriers composed of logs and poles, large stones, sand bags, or other materials placed across a natural or constructed drainway.
- B. Stone check dams shall not be utilized where the drainage area exceeds 50 acres. Log and pole structures shall not be used where the drainage area exceeds five acres.

2.5 TEMPORARY SEEDING AND MULCHING

- A. Temporary seeding and mulching are measures consisting of seeding, mulching, fertilizing, and matting utilized to reduce erosion. All cut and fill slopes, including waste sites and borrow pits, shall be seeded when and where necessary to eliminate erosion.

2.6 BRUSH BARRIERS

- A. Brush barriers shall consist of brush, tree trimmings, shrubs, plants, and other approved refuse from the clearing and grubbing operation.
- B. Brush barriers are placed on natural ground at the bottom of fill slopes, where the most likely erodible areas are located, to restrain sedimentation particles.

2.7 BALED HAY OR STRAW CHECKS

- A. Baled hay or straw erosion checks are temporary measures to control erosion and prevent siltation. Bales shall be either hay or straw containing 5 cubic feet or more of material.
- B. Baled hay or straw checks may be used where the existing ground slopes toward or away from the embankment along the toe of slopes, in ditches, or other areas where siltation, erosion, or water run-off is a problem.

2.8 TEMPORARY SILT FENCES

- A. Silt fences are temporary measures utilizing woven wire or other approved material attached to posts with filter cloth composed of burlap, plastic filter fabric, etc., attached to the upstream side of the fence to retain the suspended silt particles in the run-off water.

PART 3 - EXECUTION

3.1 CONSTRUCTION REQUIREMENTS

- A. The Developer or contractor shall limit the surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow, and fill operations. The Developer or contractor shall provide immediate, permanent, or temporary pollution control measures to prevent contamination of adjacent streams or other watercourses, lakes, ponds, or other water impoundment. Such work may involve the construction of temporary berms, dikes, dams, sediment basins, or slope drains, and the use of temporary mulches, mats, seeding, or other control devices or methods as necessary to control erosion. Cut and fill slopes shall be seeded and mulched as the excavation proceeds.
- B. The Developer or contractor shall incorporate all erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Temporary pollution control measures shall be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent pollution control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.

- C. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, erosion control measures may be required between successive construction stages. Preconstruction vegetation ground cover shall not be destroyed, removed, or disturbed more than 20 calendar days prior to grading or earth moving unless approval is granted otherwise.
- D. Developer or contractor shall limit the area of excavation, borrow, and embankment operations in progress commensurate with the Developer or contractor's capability and progress to keep the finish grading, mulching, seeding, and other such permanent pollution control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified.
- E. Under no conditions shall the amount of surface area or erodible earth material exposed at one time by excavation or fill within the project area exceed 750,000 square feet without prior approval by the Engineer.
- F. The Engineer may increase or decrease the amount of surface area of erodible earth material to be exposed at one time by clearing and grubbing, excavation, and borrow and fill operations as determined by his analysis of project conditions.
- G. In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

3.2 CONSTRUCTION MANAGEMENT TECHNIQUES

- A. Clearing and grubbing must be held to the minimum necessary for grading and equipment operation.
- B. Construction must be sequenced to minimize the exposure time of cleared surface area.
- C. Construction must be staged or phased for large projects. Areas of one phase must be stabilized before another phase can be initiated. Stabilization shall be accomplished by temporarily or permanently protecting the disturbed soil surface from rainfall impacts and runoff.
- D. Erosion and sediment control measures must be in place and functional before earth moving operations begin, and must be constructed and maintained throughout the construction period. Temporary measures may be removed at the beginning of the work day, but must be replaced at the end of the work day.
- E. All control measures shall be checked, and repaired as necessary, weekly in dry periods and within 24 hours after any rainfall of 0.5 inch within a 24-hour period. During prolonged rainfall, daily checking and repairing is necessary. The Developer or contractor shall maintain records of checks and repairs.
- F. A specific individual shall be designated to be responsible for erosion and sediment controls on each project site.
- G. Inspections shall be documented and made available to CCUD upon request.

3.3 CONSTRUCTION OF EROSION CONTROL FEATURES

- A. Temporary Berms. A temporary berm shall be constructed of compacted soil, with a minimum width of 24 inches at the top and a minimum height of 12 inches with or without a shallow ditch, constructed at the top of fill slopes or transverse to centerline on fills. Temporary berms shall be graded so as to drain to a compacted outlet at a slope drain. The area adjacent to the temporary berm in the vicinity of the slope drain must be properly graded to enable this inlet to function efficiently and with minimum ponding in this area. All transverse berms required on the downstream side of a slope drain shall extend across the grade to the highest point at approximately a 10 degree angle with a perpendicular to centerline. The top width of these berms may be wider and the side slope flatter on transverse berms to allow equipment to pass over these berms with minimum disruptions. When practical and until final roadway elevations are approached, embankments should be constructed with a gradual slope to one side of the embankment to permit the placement of temporary berms and slope drains on only one side of the embankment.
- B. Temporary Slope Drains
 - 1. Temporary slope drains shall consist of stone gutters, fiber mats, plastic sheets, concrete or asphalt gutters, half-round pipe, metal pipe, plastic pipe, flexible rubber, or other materials which can be used as temporary measures to carry water accumulating in the cuts and on the fills down the slopes prior to installation of permanent facilities or growth of adequate ground cover on the slopes.
 - 2. Fiber matting and plastic sheeting shall not be used on slopes steeper than 4:1 except for short distances of 20 feet or less.
 - 3. All temporary slope drains shall be adequately anchored to the slope to prevent disruption by the force of the water flowing in the drains. The base for temporary slope drains shall be compacted and concavely formed to channel the water or hold the slope drain in place. The inlet end shall be properly constructed to channel water into the temporary slope drain. Energy dissipaters, sediment basins, or other approved devices shall be constructed at the outlet end of the slope drains to reduce erosion downstream. An ideal dissipater would be dumped rock or a small sediment basin which would slow the water as well as pick up some sediment. All temporary slope drains shall be removed when no longer necessary and the site restored to match the surroundings.
- C. Sediment Structures
 - 1. Sediment structures shall be utilized to control sediment at the foot of embankments where slope drains outlet, at the bottom as well as in the ditch lines atop waste sites, and in the ditch lines or borrow pits. Sediment structures may be used in most drainage situations to prevent excessive siltation of pipe structures. All sediment structures shall be at least twice as long as they are wide.
 - 2. When use of temporary sediment structures is to be discontinued, all sediment accumulation shall be removed, and all excavation backfilled and properly compacted. The existing ground shall be restored to its natural or intended condition.

D. Check Dam

1. Utilize check dams to retard stream flow and catch small sediment loads. Materials utilized to construct check dams are varied and should be clearly illustrated or explained in the Developer or contractor's erosion control plan.
2. Key all check dams into the sides and bottom of the channel a minimum depth of 2 feet. A design is not needed for check dams but some typical designs are shown in the standard plans.
3. Do not use stone check dams where the drainage area exceeds 50 acres. Log and pole structures should generally not be used where the drainage area exceeds five acres.

E. Temporary Seeding and Mulching. Perform seeding and mulching in accordance with Section 32 92 19, Seeding.

F. Brush Barriers. Brush barriers shall consist of brush, tree trimmings, shrubs, plants, and other approved refuse from the clearing and grubbing operation. The brush barriers shall be constructed approximately parallel to original ground contour. Each brush barrier shall be compressed to an approximate height of 3 to 5 feet and approximate width of 5 to 10 feet. The embankment shall not be supported by the construction of brush barriers.

G. Baled Hay or Straw Erosion Checks. Hay or straw shall be embedded in the ground 4 to 6 inches to prevent water flowing underneath. The bales shall also be anchored securely to the ground by wooden stakes driven through the bales into the ground. Bales can remain in place until they rot, or be removed after they have served their purpose, as determined by the Engineer. Keep the checks in good condition by replacing broken or damaged bales immediately after damage occurs.

H. Temporary Silt Fences

1. Temporary silt fences shall be placed on the natural ground, at the bottom of fill slopes, in ditches, or other areas where siltation is a problem. Silt fences are constructed of wire mesh fence with a covering of burlap or some other suitable material on the upper grade side of the fence and anchored into the soil.
2. Maintain the silt fence in a satisfactory condition for the duration of the project or until its removal. The silt accumulation at the fence may be left in place and seeded or removed. The silt fence becomes the property of the Developer or contractor whenever the fence is removed.

3.4 MAINTENANCE

- A. The erosion control features installed by the Developer or contractor shall be acceptably maintained by the Developer or contractor until no longer needed or permanent erosion control methods are installed. Any materials removed shall become the property of the Developer or contractor.
- B. In the event that temporary erosion and pollution control measures are required due to the Developer or contractor's negligence, carelessness, or failure to install permanent controls as a part of work as scheduled, and are ordered by the

Engineer, such work shall be performed by the Developer or contractor at his own expense.

3.5 EROSION CONTROL OUTSIDE PROJECT AREA

- A. Temporary erosion control shall include construction work outside the project area where such work is necessary as a result of construction such as borrow pit operations, haul roads, and equipment storage sites. Bid price in such cases shall include all necessary clearing and grubbing, construction incidentals, maintenance, and site restoration when no longer needed. All erosion and sediment control shall be performed by the Developer or contractor at his own expense.

END OF SECTION

SECTION 31 49 00

UTILITY LINE CROSSINGS OF STREAMS

PART 1 - GENERAL

1.1 SCOPE

- A. This Section establishes minimum requirements for construction of utility line crossings of streams and other Waters of the State. It applies to waterlines, sewer lines, and associated appurtenances constructed by Developers and their contractors where stream crossings are required by approved plans.

1.2 REGULATORY COMPLIANCE

- A. All work shall comply with applicable federal, state, and local regulations and permits, including but not limited to:
 - 1. U.S. Army Corps of Engineers (USACE) Nationwide Permits (including NWP 12, as applicable).
 - 2. Tennessee Department of Environment and Conservation (TDEC) Aquatic Resource Alteration Permit (ARAP), if required.
 - 3. TDEC Construction General Permit (CGP).
 - 4. Approved Stormwater Pollution Prevention Plan (SWPPP).

1.3 HYDROLOGIC DETERMINATIONS

- A. Where required by the Tennessee Department of Environment and Conservation (TDEC), the U.S. Army Corps of Engineers, or other regulatory agencies, the Developer shall obtain a hydrologic determination to classify the waterbody as ephemeral, intermittent, or perennial prior to construction.
- B. Hydrologic determinations shall be prepared by a qualified professional in accordance with applicable regulatory guidance and submitted to the appropriate regulatory agencies.
- C. CCUD's review of hydrologic determinations, if any, is limited to confirming that required documentation has been provided and does not constitute acceptance, approval, or certification of the determination. New utility line crossings shall be located such as to avoid permanent alteration or damage to the integrity of the stream channel. Large trees, steep banks, rock outcroppings, etc., should be avoided.

1.4 RESPONSIBILITY

- A. The Developer is solely responsible for obtaining all required permits and approvals and for complying with permit conditions during construction.
- B. References to the Engineer shall mean CCUD or its designated representative.

PART 2 - MATERIALS

2.1 GENERAL

- A. Materials used for stream crossings, erosion control, stabilization, and restoration shall be suitable for the intended application and approved under the applicable permits and SWPPP. Specific materials shall be as shown on the approved plans or otherwise approved by CCUD.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Utility line crossings shall be designed and constructed to minimize impacts to stream channels, banks, riparian vegetation, and aquatic resources.
- B. Crossings shall be aligned as close to perpendicular to the stream channel as practicable and, in no case, at an angle less than 45 degrees to the stream centerline unless otherwise approved.
- C. The number of stream crossings shall be minimized. Utility alignments paralleling streams shall avoid unnecessary crossings.

3.2 ISOLATION OF WORK AREAS

- A. Where required by permits or plans, flowing water shall be isolated from excavation and fill activities using cofferdams, diversion channels, flumes, or piping.
- B. Cofferdams and diversion measures shall be constructed of non-erodible materials and installed to prevent sediment-laden water from entering the stream.
- C. Temporary isolation measures shall be removed upon completion of the crossing and restoration of the stream channel.

3.3 DEWATERING AND DISCHARGE

- A. Slurry water and dewatering discharge shall be treated by settling, filtration, or other approved methods prior to discharge.
- B. Discharge shall be released in a manner that does not cause erosion, turbidity increases, or damage to downstream channels.
- C. All dewatering and discharge activities shall comply with permit conditions and the approved SWPPP.

3.4 EXCAVATION AND INSTALLATION

- A. Excavation and backfill operations shall be conducted to maintain stability of the stream bed and banks.
- B. Backfill materials shall be clean, suitable, and free of contaminants.
- C. Utility lines shall be installed to maintain stream flow and shall not create impoundment or long-term alteration of channel hydraulics.

- D. Where bedrock must be excavated, measures shall be implemented to prevent loss of stream flow through fractured rock, including concrete encasement or sealing where required by design or permits.

3.5 EROSION AND SEDIMENT CONTROL

- A. Erosion and sediment control measures shall be installed prior to earth-disturbing activities, maintained throughout construction, and adjusted as site conditions require.
- B. Control measures shall be selected and implemented in accordance with the approved SWPPP and permit requirements.
- C. Clearing and grubbing within riparian areas shall be limited to the minimum necessary to complete the work.

3.6 RESTORATION AND STABILIZATION

- A. Upon completion of construction, stream beds and banks shall be restored to pre-construction contours and conditions as nearly as practicable.
- B. Disturbed areas shall be stabilized promptly in accordance with permit requirements and the approved SWPPP.
- C. Stabilization methods may include seeding, mulching, matting, live vegetation, riprap, or other approved measures as shown on the plans or permitted.

3.7 EQUIPMENT AND ACCESS

- A. Streams shall not be used as travel paths for construction equipment except at approved crossing locations.
- B. Temporary access pads or crossings shall be constructed of clean, non-erodible material and removed upon completion of work.

3.8 POLLUTION PREVENTION

- A. Construction debris shall be prevented from entering streams.
- B. Spills of fuel, oil, or other pollutants shall be immediately contained and reported in accordance with applicable regulations.

PART 4 - COMPLIANCE AND CORRECTIVE ACTION

4.1 NONCOMPLIANCE

- A. The Developer shall be responsible for correcting violations, restoring impacted areas, and addressing enforcement actions or penalties resulting from noncompliance with this Section or applicable permits.

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32 10 00

NEW AND REPLACEMENT PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section establishes minimum requirements for new paving and pavement restoration associated with utility construction, including trench-width restoration, full-width restoration, and pavement replacement in streets, driveways, parking areas, and other paved surfaces disturbed by construction.
- B. Prepared subgrade and earthwork are specified in Section 31 20 00 – Earthwork.

1.2 REFERENCES

- A. All materials, construction methods, and testing shall comply with the Tennessee Department of Transportation (TDOT) Standard Specifications for Road and Bridge Construction, latest edition, unless more stringent requirements are shown on the approved plans or required by CCUD.

1.3 RESPONSIBILITY

- A. All paving and pavement restoration required as a result of utility construction shall be performed by the Developer at the Developer's expense.
- B. References to the Engineer shall mean CCUD or its designated representative.

1.4 SUBMITTALS

- A. Material certifications for asphalt mixes, aggregates, and tack or prime coats, when requested by CCUD.
- B. Pavement marking layout and restoration plan where markings are impacted by construction, including Americans with Disabilities Act (ADA)–required markings.

1.5 WEATHER LIMITATIONS

- A. Comply with TDOT temperature, surface condition, and weather limitations for asphalt paving operations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hot-Mix Asphalt (HMA): TDOT-approved Superpave or other TDOT-approved asphalt mixes suitable for the intended use. Refer to TDOT Standard Specifications Sections 407 and 411, including all applicable Supplemental Specifications.
- B. Aggregate Subbase: Provide mineral aggregate base material meeting TDOT Standard Specifications Section 303.

- C. Tack Coat: Provide tack coat meeting TDOT Standard Specifications Section 403 (materials per 403.02 and Section 904).
- D. Prime Coat: Where shown/required, provide prime coat meeting TDOT Standard Specifications Section 402 (materials per Section 904).
- E. Geotextile Fabric: Where required, provide geotextile/geosynthetic materials meeting TDOT Standard Specifications Section 740 and 921.12, and listed on TDOT's applicable Qualified Products List
- F. Pavement Marking Materials: Provide pavement marking materials and placement meeting TDOT Standard Specifications Section 716 and Section 919; apply markings in conformance with MUTCD and applicable ADA/PROWAG requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. All paving work shall be performed in accordance with TDOT Standard Specifications and accepted industry practice to produce a durable, smooth, and properly compacted pavement surface.

3.2 SURFACE PREPARATION

- A. Saw-cut existing pavement to neat, straight lines prior to removal to minimize damage to adjacent pavement.
- B. Remove unsuitable material and correct unstable subgrade areas prior to placement of aggregate base or paving.
- C. Prepare and compact subgrade and subbase in accordance with Section 31 20 00 – Earthwork and TDOT requirements.

3.3 PAVEMENT RESTORATION TYPES

- A. Trench-Width Pavement Restoration
- B. Restore pavement over utility trenches to match or exceed the thickness and section of the existing pavement.
- C. Extend pavement restoration beyond trench limits as necessary to achieve proper compaction and joint performance.
- D. Full-Width Pavement Restoration
- E. Where required by CCUD or shown on the approved plans, restore pavement for the full width of the roadway, driveway, or paved area.
- F. Full-width restoration shall match or exceed existing pavement structure and condition.
- G. Concrete Pavement Restoration
- H. Where existing portland cement concrete pavement is disturbed, restore with concrete pavement matching existing thickness, reinforcement, jointing, and surface

finish in accordance with TDOT standards and Section 03 30 00 – Cast-In-Place Concrete.

3.4 PLACEMENT OF ASPHALT PAVEMENT

- A. Clean and prepare all contact surfaces prior to paving.
- B. Apply tack coat to all interfaces between existing pavement and new pavement.
- C. Place and compact asphalt pavement to achieve density, smoothness, and thickness requirements in accordance with TDOT specifications.

3.5 JOINTS AND TRANSITIONS

- A. Construct longitudinal and transverse joints to provide a tight, durable bond between new and existing pavement. Joints shall be straight, well-compacted, and sealed as required by TDOT standards.

3.6 COMPACTION AND FINISH

- A. Compact pavement to meet TDOT density requirements. Finished pavement shall be smooth, free of segregation, and flush with adjacent pavement surfaces.

3.7 TRAFFIC AND PAVEMENT MARKINGS

- A. Restore all pavement markings disturbed by construction to their original condition or as required by current standards.
- B. Pavement markings shall comply with TDOT standards and applicable ADA requirements.

3.8 PROTECTION AND TRAFFIC CONTROL

- A. Protect newly placed pavement from traffic until it has cooled and achieved sufficient strength. Provide temporary traffic control in accordance with TDOT and local requirements.

PART 4 - QUALITY CONTROL

4.1 INSPECTION AND TESTING

- A. CCUD may require inspection or testing to verify compliance with this Section and TDOT requirements.
- B. Any required testing shall be performed at the Developer's expense.

4.2 DEFICIENCIES

Remove and replace pavement that does not meet thickness, density, smoothness, or performance requirements at no additional cost to CCUD.

END OF SECTION

SECTION 32 16 21

CONCRETE CURB, GUTTER, OR COMBINED CURB AND GUTTER

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This work shall consist of curb, gutter, or combined curb and gutter constructed of Portland Cement Concrete in accordance with these Specifications, at the locations and in reasonably close conformity with the lines, grades and dimensions shown on the Plans, or established by CCUD or Engineer. It shall also include removal of existing curb and gutter as directed.

1.2 MATERIAL

- A. Materials shall meet the applicable requirements of:

- 1. Section 31 20 00, Earthwork
- 2. Section 32 10 00, New and Replacement Paving
- 3. Section 03 30 00, Cast-In-Place Concrete

Concrete for curb, gutter, and combined curb and gutter shall be Class A concrete, meeting all of the requirements prescribed in Section 03 30 00, Cast-In-Place Concrete, with the modification specified hereinafter.

- B. When the use of an approved curb machine is authorized, the following combination of materials shall be used:

- | | |
|--|-----------------------|
| 1. Water: | 4.0 Gallons (Maximum) |
| 2. Cement: | 94.0 Pounds |
| 3. Coarse Aggregate - Size No. 78, conforming to the requirements of ASTM C33: | 260.0 Pounds |
| 4. Clean Sand: | 245.0 Pounds |

- C. Fine aggregate shall conform to ASTM C33.
- D. Entrained air will not be required in curb concrete made with the aforementioned combination.
- E. The water and percentages of fine and coarse aggregate may be adjusted within the above limits to permit satisfactory placement.
- F. Compressive test specimens shall be made by vibratory method in accordance with AASHTO T 23, "Standard Method for Making and Curing Concrete, Compression and Flexural Strength Test Specimens in the Field," or other approved methods.
- G. Forms. Forms, except the templates between 10-foot sections, may be either wood or metal meeting the requirements prescribed in Section 03 30 00, Cast-In-Place Concrete. The templates shall be 1/8-inch-thick metal, of the same width as that of the curb, gutter, or combination curb and gutter, and not less than 1/2 inch more in

depth than the respective depth of the type curb and gutter being constructed. The templates shall have lugs, or other devices to hold them in position during placing of the concrete and shall be of such design as to permit strike-off template of the form, and shape of the gutter shall be used to shape the top surface of the gutter.

H. Compaction Equipment. Compaction of subgrade shall be accomplished by any type of tamping or rolling equipment that will produce the desired results.

I. Mixing and Finishing Equipment

1. Mixers shall meet the requirements of Section 03 30 00, Cast-In-Place Concrete, except that the stipulation requiring the use of a broom and bucket will be waived.
2. Any extruding type curb machine may be used when approved by CCUD or Engineer.
3. Finishing equipment shall include satisfactory floats, trowels, edgers, spades and tamps.

1.3 SUBGRADE PREPARATION

A. Subgrade preparation for curb, gutter, and combined curb and gutter shall be made to the required depth, and to a width that will permit the installation and bracing of the forms. The subgrade shall be shaped and compacted to a firm, even surface, in reasonably close conformity with the grade and section shown on the Plans. All soft and yielding material shall be removed and replaced with acceptable material, which shall then be compacted as directed. The subgrade shall be finished and brought to true line and grade with a minimum 2-inch compacted layer of mineral aggregate base (GAB) meeting the requirements of Section 32 10 00, New and Replacement Paving.

1.4 EXPANSION JOINTS

A. Expansion joints shall be formed at the intervals and locations shown on the Drawings, using preformed filler ¼ -inch thick, unless otherwise specified. They shall be placed in line with corresponding expansion joints in adjoining pavement or other construction. Joint filler shall be cut to the full cross-section of the curb, gutter, or combined curb and gutter.

1.5 MIXING, PLACING, AND FINISHING CONCRETE

- A. Concrete shall be mixed in accordance with requirements of Section 03 30 00, Cast-In-Place Concrete.
- B. Immediately before placing the concrete, the subgrade shall be thoroughly wetted, and the forms given a coating of light oil. Where removed and used again, the forms shall be thoroughly cleaned and oiled each time before using. Placing concrete shall be performed as provided for under Section 03 30 00, Cast-In-Place Concrete.
- C. The concrete shall be placed immediately after mixing. The edges, sides, or faces, shall be thoroughly spaded and vibrated sufficiently to consolidate the concrete thoroughly and bring the mortar to the surface, after which the surface shall be finished smooth and even by means of a float.

- D. Concrete curb, gutter, or combined curb and gutter, shall be constructed reasonably true to line, grade and cross-section and, unless otherwise specified on the Plans, in sections having uniform lengths of 10 feet. The length of these sections may be reduced where necessary for closures, but no section less than 6 feet will be permitted. The templates shall be set carefully before the placing of the concrete and allowed to remain in-place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in-place. The forms on the face of all curbs shall be removed as soon as the concrete will hold shape and the surface then floated with a float to a smooth and even finish. No plastering will be permitted. Unless otherwise specified, the top edges of the curb and the edge of the gutter shall be rounded to a radius of 3/4 inch, and the edges on each side of templates and expansion joint material shall be finished with an edging tool with a radius of not over 1/4 inch, and then all lines or marks shall be removed with a wet brush. Any exposed surface or surfaces against which some rigid type of construction is to be made shall be left smooth and uniform so as to permit free movement of the curb, gutter or combined curb and gutter.
- E. All tool marks shall be removed with a wetted brush or float, and the finished surface shall present a uniform and pleasing appearance.
- F. Extruding type curb machines may be used at the option of the Contractor and with approval of CCUD or Engineer where feasible, provided the mix meets requirements of Paragraph 1.2, Materials, of this section.
- G. When the use of extruding type curb machines is permitted, finishing shall be performed as specified above.
- H. Weep holes or drainage openings shall be placed through curbs as indicated on the Plans or as directed by CCUD or Engineer, but when so placed, unless otherwise indicated or directed, there shall be placed at least 1/2 cubic foot of coarse aggregate behind each opening.

1.6 PROTECTION AND CURING

- A. Immediately after finishing the concrete, protection and curing shall be performed in accordance with the provisions of Section 03 30 00, Cast-In-Place Concrete.
- B. The Contractor shall protect the curb, gutter, and combined curb and gutter until finally accepted. Any concrete that is damaged during that period shall be repaired by removing and reconstructing each 10-foot section that has been damaged. This reconstruction shall be at the Contractor's expense.

1.7 BACKFILLING

- A. Immediately after the concrete has set sufficiently and the forms have been removed, the space back of the curb or combined curb and gutter shall be filled with suitable material. This material shall be placed in layers not exceeding 4 inches in loose thickness, and compacted until firm and stable.

END OF SECTION

SECTION 32 16 23

CONCRETE SIDEWALKS AND DRIVEWAYS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This work shall consist of constructing sidewalks and driveways, exclusive of sidewalks and driveways that are integrally a part of structures, of portland cement concrete on a prepared subgrade, in accordance with these Specifications and in reasonably close conformity with the lines, grades, and typical cross-sections shown on the Plans or established by CCUD. It shall, also, include removal of existing sidewalks and driveways as directed by CCUD.

1.2 MATERIALS

- A. Materials shall meet the requirements of:
 - 1. Section 31 20 00, Earthwork
 - 2. Section 32 10 00, New and Replacement Paving
 - 3. Section 03 30 00, Cast-in-Place Concrete
- B. Concrete for sidewalk and driveway pavement shall be Class A Concrete, unless specified otherwise on the Drawings, meeting all the requirements prescribed in Section 03 30 00, Cast-In-Place Concrete.

1.3 EQUIPMENT

- A. Forms. Forms shall be of wood, metal, or other suitable material and shall extend for the full depth of the concrete. All forms shall be true to line, free from warp, and of sufficient strength to resist the pressure of the concrete without springing. Curved forms of proper radius shall be used on all radial sections and shall be of a design acceptable to CCUD. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.
- B. Mixing, Finishing and Transportation
 - 1. Mixers and transportation of equipment shall meet the requirements of Section 03 30 00, Cast-In-Place Concrete.
 - 2. Satisfactory floats, trowels, templates, straightedges, edgers, spades, and tamps shall be furnished. Compaction of subgrade shall be accomplished by any type of tamping or rolling equipment that will produce the desired results.

1.4 CONSTRUCTION REQUIREMENTS

- A. Subgrade Preparation. Subgrade preparation for sidewalks and driveways shall be made to the required depth and to a width that will permit the installation and bracing of the forms. The subgrade shall be shaped and compacted to a firm, even surface in reasonably close conformity with the grade and section on the Drawings.

All soft and yielding material shall be removed and replaced with acceptable material, which shall then be compacted as directed. The prepared subgrade shall then be brought to true line and grade with a minimum depth of 2 inches of mineral aggregate base, unless specified otherwise on the Drawings, meeting the requirements of Section 32 10 00, New and Replacement Paving.

B. Expansion Joints

1. Unless otherwise indicated on the Drawings or directed by CCUD, premolded expansion joint filler, $\frac{3}{4}$ -inch in thickness, shall be placed at the locations and in line with expansion joints in the adjoining pavement, gutter or curb. When expansion joints are not required or have not been installed in the adjoining pavement or gutter, unless otherwise indicated on the Plans, a $\frac{3}{4}$ -inch premolded expansion joint filler shall be placed at intervals of not over 40 feet). All premolded expansion joint filler shall be cut to full width or length of the proposed construction and shall extend to within $\frac{1}{2}$ -inch of the top or finished surface. All longitudinal expansion joints shall be placed as indicated on the Drawings or as directed by CCUD. All expansion joints shall be true, even, and present a satisfactory appearance.
2. Construction joints shall be formed around all appurtenances, such as manholes, utility poles, etc., extending into and through the sidewalk. Premolded expansion joint filler, $\frac{1}{4}$ -inch thick, shall be installed in these joints. Expansion joint filler of the thickness indicated shall be installed between concrete sidewalks and any fixed structure, such as a building or bridge. A $\frac{1}{4}$ inch-thick expansion joint filler shall be installed between concrete curb and sidewalk. This expansion joint material shall extend for the full depth of the walk.

C. Limitations of Mixing. Limitations on the mixing of concrete shall be as prescribed in Section 03 30 00, Cast-In-Place Concrete.

D. Mixing and Placing Concrete. Concrete shall be mixed in accordance with the provisions of Section 03 30 00, Cast-In-Place Concrete. Immediately before placing the concrete, the subgrade shall be thoroughly wetted, and the forms given a coating of form release compound. Where removed and used again, the forms shall be thoroughly cleaned and oiled each time before using.

E. Finishing

1. The concrete shall be struck-off with a transverse template resting upon the side forms. After the concrete has been struck-off to the required cross-section, it shall be finished with floats, trowels, and straightedges until the surface requirements have been obtained.
2. When the surface of the concrete is free from water and just before the concrete obtains its initial set, it shall be gone over and finished with a float and swept lightly with a broom in order to produce a sandy texture. The longitudinal surface variations shall be not more than $\frac{1}{4}$ inch under a 12-foot straightedge, nor more than inch on a 5-foot transverse section. The surface of the concrete shall be so finished as to drain completely at all times. The edges of

the sidewalks and driveways shall be carefully finished and rounded with an edging tool having a radius of $\frac{1}{2}$ inch.

3. The surface of sidewalks shall be divided into blocks by use of a grooving tool. Grooves shall be so placed as to cause expansion joints to be placed at a groove line. The grooves shall be spaced approximately 5 feet apart, and the blocks shall be rectangular unless otherwise ordered by CCUD. The grooves shall be cut to a depth of not less than $\frac{1}{2}$ inch and not more than 1 inch. The edges of the grooves shall be edged with an edging tool having a radius of $\frac{1}{4}$ inch.
4. The edges of the concrete at expansion joints shall be rounded with an edging tool having a radius of $\frac{1}{4}$ inch. All marks caused by the edging shall be removed with a wetted brush or float. The top and ends of expansion joint material shall be cleaned of all concrete, and the expansion joint material shall be so trimmed as to be slightly below the surface of the concrete.

F. Protection and Curing

1. Forms may be removed at any time that removal will not damage the concrete. No pressure shall be exerted upon the concrete in removing forms.
2. Curing and protection during cold weather shall be performed as provided for under Section 03 30 00, Cast-In-Place Concrete.
3. Pedestrians will not be allowed upon concrete sidewalks or driveways until 72 hours after finishing concrete, and no vehicles or loads shall be permitted on any sidewalk or driveway until CCUD has determined that the concrete has attained sufficient strength for such loads.
4. The Contractor shall construct and place such barricades and protection devices as are necessary to keep pedestrians and other traffic off the sidewalk or driveway.
5. Any sidewalk or driveway damaged prior to final acceptance of the project shall be repaired, at the Contractor's expense, by removing concrete within groove limits and replacing it with concrete of the type and finish in the original construction.

- G. Backfilling. Immediately after removing the side forms, the spaces along the edges of sidewalk or driveway shall be filled with suitable material. This material shall be placed in layers not exceeding 4 inches in loose thickness, and compacted until firm and stable.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section covers temporary and permanent vegetative stabilization of areas disturbed by utility construction, including but not limited to waterlines, services, appurtenances, and related work.
- B. This Section is intended to provide performance-based requirements for stabilization and does not establish landscape or aesthetic standards.

1.2 RELATED SECTIONS

- A. Section 31 20 00 – Earthwork
- B. Section 31 25 00 – Erosion Control

1.3 REGULATORY REQUIREMENTS

- A. All stabilization work shall comply with:
 - 1. The approved Storm Water Pollution Prevention Plan (SWPPP);
 - 2. The Tennessee Construction General Permit (CGP);
 - 3. Applicable requirements of the Tennessee Department of Environment and Conservation (TDEC);
 - 4. Local requirements of CCUD.
- B. Where conflicts occur, the more restrictive requirement shall govern.

1.4 RESPONSIBILITY

- A. The Developer or contractor shall be responsible for providing all temporary and permanent stabilization required as a result of utility construction activities.

PART 2 - MATERIALS

2.1 SEED

- A. Deliver seed in new bag or bags that are sound and labeled in accordance with the U.S. Department of Agriculture Federal Seed Act.
- B. All seed shall be from the last crop available at time of purchase and shall not be moldy, wet, or otherwise damaged in transit or storage.
- C. Seed shall bear the grower's analysis testing to 98 percent for purity and minimum 85 percent for germination. At the discretion of the Engineer, samples of seed may be taken for check against the grower's analysis.

- D. Species, rate of seeding, fertilization, and other requirements are shown in the Seeding Requirements Table.

2.2 FERTILIZER AND LIMING MATERIALS

- A. Fertilizer and liming materials shall comply with applicable state, local, and federal laws concerned with their production and use.

TEMPORARY SEEDING RECOMMENDATION FOR FALL

Species**Rate (lb/acre)**

Oats

30

Winter wheat

30

Seeding dates

East Aug. 15 – Dec. 15

Middle Aug. 15 – Dec. 30

West Aug. 15 – Dec. 30

Soil amendments

Follow recommendations of soil tests or apply 2,000 lb/acre ground agricultural limestone and 750 lb/acre 10-10-10 fertilizer.

Mulch

Apply 4,000 lb/acre straw. Anchor straw by tacking with asphalt, netting, or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance

Refertilize if growth is not fully adequate. Reseed, refertilize and mulch immediately following erosion or other damage. If necessary to extend temporary cover beyond June 15, overseed with 50 lb/ac crimson clover in late February or early March.

TEMPORARY SEEDING RECOMMENDATION FOR LATE WINTER AND EARLY SPRING

Species**Rate (lb/acre)**

Rye

120

Seeding dates

East Above 2500 feet: Feb. 15 - May 15

Below 2500 feet: Feb. 1 - May 1

Middle Jan. 1 - May 1

West Dec. 1 - April 15

Soil amendments

Follow recommendations of soil tests or apply 2,000 lb/acre ground agricultural limestone and 750 lb/acre 10-10-10 fertilizer.

Mulch

Apply 4,000 lb/acre straw. Anchor straw by tacking with asphalt, netting, or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance

Refertilize if growth is not fully adequate. Reseed, refertilize and mulch immediately following erosion or other damage.

TEMPORARY SEEDING RECOMMENDATION FOR SUMMER

Species

Oats
Brown top millet

Rate (lb/acre)

60
30

Seeding dates

East May 15 - Aug. 15
Middle May 1 - Aug. 15
West April 15 - Aug. 15

Soil amendments

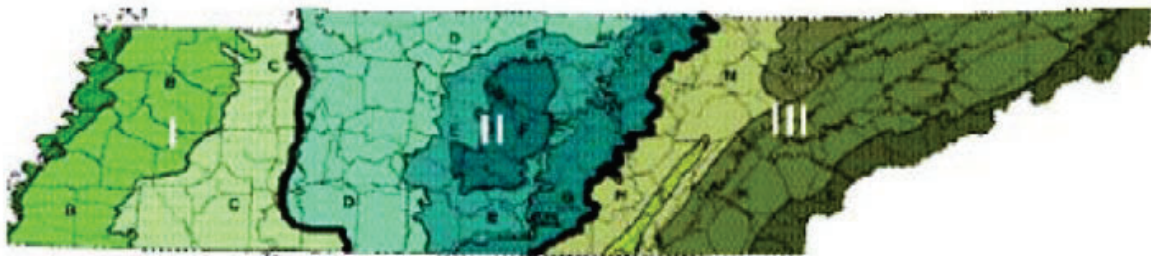
Follow recommendations of soil tests or apply 2,000 lb/acre ground agricultural limestone and 750 lb/acre 10-10-10 fertilizer.

Mulch

Apply 4,000 lb/acre straw. Anchor straw by tacking with asphalt, netting, or a mulch anchoring tool. A disk with blades set nearly straight can be used as a mulch anchoring tool.

Maintenance

Refertilize if growth is not fully adequate. Reseed, refertilize and mulch immediately following erosion or other damage.



TN Planting Regions

PREFERRED SEED MIXES USING NATIVES OR NATURALIZED PLANTS AND PLANTING DATES				
ZONE		BEST	MARGINAL	PREFERRED RATE/MIX (lb/ac PLS)
Region I	Poorly drained soils	Feb. 1 – Mar. 20 Sept. 1 – Sept. 30	Mar. 20 – April 30 Sept. 30 – Oct. 31	15 Browntop millet* (nurse crop) 2 switch grass 4 little bluestem 4 Virginia wild rye 4 purpletop 2 partridge pea 2 black-eyed susan
	Well drained soils	April 1 – July 15		15 Browntop millet* (nurse crop) 4 little bluestem 4 purpletop 2 sideoats gramma 2 partridge pea 2 black-eyed susan

PREFERRED SEED MIXES USING NATIVES OR NATURALIZED PLANTS AND PLANTING DATES				
ZONE		BEST	MARGINAL	PREFERRED RATE/MIX (lb/ac PLS)
	High maintenance	April 1 – July 15		15 Browntop millet* (nurse crop) 2 partridge pea 45 Red fescue* 45 hard fescue* 25 chewing fescue*
Region II	Low maintenance; Slopes and Poor, shallow soils	Aug. 25 – Sept. 15 Feb. 15 – May 30	Sept. 15 – Oct. 25 Mar. 21 – May 30	15 Browntop millet* (nurse crop) 5 little bluestem 2 switch grass 2 tall dropseed 5 sideoats gramma 2 black-eyed susan 2 partridge pea 1 greyheaded coneflower
	Low maintenance; Moderate slopes; soil >6 in. depth	Aug. 25 – Sept. 15 Feb. 15 – May 30	Sept. 15 – Oct. 25 Mar. 21 – April 15	15 Browntop millet* (nurse crop) 5 purpletop 5 little bluestem 5 Virginia wild rye 2 black-eyed susan 2 partridge pea 1 greyheaded coneflower
	High maintenance	Aug. 30 – Oct. 15	Feb. 15. – April 15	15 Browntop millet* (nurse crop) 2 partridge pea 45 Red fescue* 45 hard fescue* 25 chewing fescue*
Region III	>2500 ft elevation; steep slopes	Mar. 20 – April 30	Aug. 15 – Aug. 30 Mar. 1 – Mar. 20 April 20 – June 15	15 Browntop millet* (nurse crop) 5 purpletop 10 little bluestem 10 Indian grass 2 black-eyed susan 0.5 monarda (bergamot) 4 Maryland senna
	<2500 ft elevation; steep slopes	Aug. 15 – Sept 1 Mar. 1 – April 1	Sept. 1 – Sept. 15 April 1 – June 10	
	>2500 ft elev.; Shallow soils	Mar. 20 – April 20	Aug. 15 – Aug. 30 Mar. 5 – Mar. 20 April 20 – June 15	15 Browntop millet* (nurse crop) 4 purpletop 10 little bluestem 10 broomsedge 2 partridge pea 2 black-eyed susan 0.5 monarda (bergamot)
	<2500 ft elev.; Shallow soils	Aug. 15 – Sept. 1 Mar. 1 – April 1	Sept. 1 – Sept. 15 April 1 – June 10	
	>2500 ft. elev.; Moderate slopes	Mar. 20 – April 20	Aug. 15 – Aug. 30 Mar. 5 – Mar. 20 April 20 – June 15	15 Browntop millet* (nurse crop) 4 purpletop 10 little bluestem 10 Indian grass 2 black-eyed susan 0.5 monarda (bergamot) 4 Maryland senna
	<2500 ft. elev.; Moderate slopes	Aug. 15 – Sept. 1 Mar. 1 – April 1	Sept. 1 – Sept. 15 April 1 – June 10	
	>2500 ft. elev.; High maintenance	Mar. 20 – April 20	Aug. 15 – Aug. 30 Mar. 5 – Mar. 20 April 20 – June 15	15 Browntop millet* (nurse crop) 45 Red fescue* 45 hard fescue* 25 chewing fescue*
	<2500 ft. elev.; High maintenance	Aug. 15 – Sept. 1 Mar. 1 – April 1	Sept. 1 – Sept. 15 April 1 – June 10	

PREFERRED SEED MIXES USING NATIVES OR NATURALIZED PLANTS AND PLANTING DATES			
ZONE	BEST	MARGINAL	PREFERRED RATE/MIX (lb/ac PLS)
The bold dates are the preferred dates for seeding. Also, high maintenance areas include lawns and other grassed areas that will be maintained for aesthetics. *non-native but do not spread.			

ALLOWABLE SEED MIXES AND PLANTING DATES				
ZONE		BEST	MARGINAL	RATE/MIX (lb/ac PLS)
Region I	Poorly drained soils	Feb. 1 – Mar. 20 Sept. 1 – Sept. 30	Mar. 20 – April 30 Sept. 30 – Oct. 31	80 Pensacola bahiagrass 30 Bermudagrass (hulled) 20 Korean lespedeza** 10 Kobe lespedeza**
	Well drained soils	April 1 – July 15		50 Pensacola bahiagrass 15 Bermudagrass (hulled) 30 Korean lespedeza** 15 Foxtail millet**
	High maintenance	April 1 – July 15		40 Bermudagrass (hulled)
Region II	Low maintenance; Slopes and Poor, shallow soils	Aug. 25 – Sept. 15 Feb. 15 – Mar. 21	Sept. 15 – Oct. 25 Mar. 21 – Apr. 15	100 Pensacola bahiagrass 40 Bermudagrass (hulled) 20 Korean lespedeza** 10 Kobe lespedeza**
	Low maintenance; Moderate slopes; soil >6 in. depth	Aug. 25 – Sept. 15 Feb. 15 – Mar. 21	Sept. 15 – Oct. 25 Mar. 21 – Apr. 15	80 Pensacola bahiagrass 30 Bermudagrass (hulled) 20 Korean lespedeza** 10 Kobe lespedeza**
	High maintenance	Aug. 30 – Oct. 15	Feb. 15 – April 15	200 KY 31 fescue**
Region III	>2500 ft elevation; steep slopes	July 25 – Aug. 15 Mar. 20 – April 20	July 15 – July 25 Aug. 15 – Aug. 30 Mar. 1 – Mar. 20 April 20 – June 15	100 KY 31 fescue** 20 Kobe lespedeza** 10 Korean lespedeza**
	<2500 ft elevation; steep slopes	Aug. 15 – Sept. 1 Mar. 1 – April 1	July 25 – Aug. 15 Sept. 1 – Sept. 15 April 1 – May 10	5 Redtop
	>2500 ft elev.; Shallow soils	July 25 – Aug 15 Mar 20 – Apr 20	July 25 – Aug. 15 Aug. 15 – Aug. 30 Mar. 5 – Mar. 20 April 20 – June 15	40 KY 31 fescue** 10 Korean lespedeza** 10 Redtop
	<2500 ft elev.; Shallow soils	Aug. 15 – Sept. 1 Mar. 1 – April 1	July 25 – Aug. 15 Sept. 1 – Sept. 15 April 1 – May 10	10 Crown vetch**
	>2500 ft. elev.; Moderate slopes	July 25 – Aug. 15 Mar. 20 – April 20	July 15 – July 25 Aug. 15 – Aug. 30 Mar. 5 – Mar. 20 April 20 – May 15	60 KY 31 fescue** 15 Korean lespedeza** 15 Kobe lespedeza**
	<2500 ft. elev.; Moderate slopes	Aug. 15 – Sept. 1 Mar. 1 – April 1	July 25 – Aug. 15 Sept. 1 – Sept. 15 April 1 – May 10	

	>2500 ft. elev.; High maintenance	July 25 – Aug. 15 Mar. 20 – April 20	July 15 – July 25 Aug. 15 – Aug. 30 Mar. 5 – Mar. 20 April 20 – May 15	200 KY 31 fescue**
	<2500 ft. elev.; High maintenance	Aug. 15 – Sept. 1 Mar. 1 – Apr. 1	July 25 – Aug. 15 Sept. 1 – Sept. 15 April1 – May 10	
The bold dates are the preferred dates for seeding. Also, high maintenance areas include lawns and other grassed areas that will be maintained for aesthetics. **non-native but do not spread.				

- B. Commercial fertilizer shall be a ready-mixed material and shall be equivalent to the grade or grades specified in the Seeding Requirements Table. Container bags shall be labeled with the name and address of the manufacturer, brand name, net weight, and chemical composition.
- C. Agricultural limestone shall be a pulverized limestone with a calcium carbonate content not less than 85 percent by weight. Agricultural limestone shall be crushed so that at least 85 percent of the material will pass a No. 10 mesh screen and 50 percent will pass a No. 40 mesh screen.

2.3 MULCH MATERIAL

- A. All mulch materials shall be air-dried and reasonably free of noxious weeds and weed seeds or other materials detrimental to plant growth.
- B. Mulch shall be composed of wood fiber, straw, or stalks, as specified herein. Mulch shall be suitable for spreading with standard mulch-blowing equipment.
- C. Wood fiber mulch shall be as manufactured by Conwed Corporation, or equal.
- D. Straw mulch shall be partially decomposed stalks of wheat, rye, oats, or other approved grain crops.
- E. Stalks shall be the partially decomposed, shredded residue of corn, cane, sorghum, or other approved standing field crops.

2.4 MULCH BINDER

- A. Mulch on slopes exceeding a 3 to 1 ratio shall be held in place by the use of an approved erosion control fabric, such as Curlex I as manufactured by American Excelsior Company, or approved equal. Fabric shall consist of strips of biodegradable paper interwoven with yarn that is subject to degradation by ultraviolet light.

2.5 INOCULANTS FOR LEGUMES

- A. All leguminous seed shall be inoculated prior to seeding with a standard culture of nitrogen-fixing bacteria that is adapted to the particular seed involved.

2.6 WATER

- A. Water shall be clean, clear, and free from any objectionable or harmful chemical qualities or organisms and shall be furnished by the Contractor.

- B. During times of drought, water shall be applied at a rate not causing runoff and erosion. The soil shall be thoroughly wetted to a depth that will ensure germination of the seed. Subsequent applications should be made as needed. Newly seeded areas require more water than more mature plants.

PART 3 - EXECUTION

3.1 TEMPORARY STABILIZATION

- A. Areas disturbed by utility construction that will not receive permanent stabilization immediately shall receive temporary stabilization in accordance with the SWPPP and CGP requirements.
- B. Temporary stabilization shall be initiated within the timeframes required by the applicable permit following cessation of construction activities.

3.2 PERMANENT STABILIZATION

- A. Permanent stabilization shall be completed as soon as practicable following completion of utility construction and final grading.
- B. Permanent stabilization shall result in uniform vegetative cover sufficient to prevent erosion and sediment transport.
- C. Stabilized areas shall be reasonably consistent with adjacent ground cover where practicable.

3.3 MAINTENANCE

- A. The Developer shall maintain stabilized areas until permanent stabilization is established and accepted by CCUD.
- B. Long-term landscaping maintenance beyond establishment of stabilization is not required under this Section.

END OF SECTION

DIVISION 33

UTILITIES

SECTION 33 05 23

UTILITY CROSSINGS OF RAILROADS AND ROADWAYS

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, materials, service, and equipment required to properly complete sewer and/or water pipeline construction under railroads and federal or state highways, as described herein and/or shown on the Drawings.
- B. References to the Engineer shall mean CCUD or its designated representative.
- C. Nothing herein shall relieve the Developer from complying with the requirements of the affected railroad or highway authority.

1.2 PERMITS

- A. All permits, approvals, fees, bonds, insurance, flagging, and coordination required for railroad or highway crossings shall be the responsibility of the Developer.

1.3 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete engineering data and product information shall be submitted to the Engineer in accordance with the requirements of these Specifications.

1.4 STORAGE AND DELIVERY

- A. All materials shall be stored and protected with strict conformance to the manufacturer's recommendations and as approved by the Engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel casing pipe for sizes 6 inches and smaller shall conform to ASTM A139 or ASTM A252, Grade 2 or Grade 3, of the latest standard specifications.
- B. Steel casing pipe, sizes 8 inches through 54 inches, shall be straight-seam welded steel pipe conforming to ASTM A 139, Grade B of the latest standard specification.
- C. Steel casing pipe for railroad crossings shall be bituminous coated inside and out unless otherwise required by the permitting authority.
- D. Structural steel liner plates shall be used for excavated tunnels where the casing pipe is 54 inches or greater in diameter. Liner plates shall be of the thickness shown on the Drawings. The liner plates shall be of the two-flange, lap-joint type. The corrugations shall be 3½ inches center to center. Bolts and nuts used shall be a minimum of 5⁄8-inch diameter and shall conform to the latest revision of ASTM A 307 for plate thickness less than 0.209 inch, and ASTM A 449 for plate thickness equal to or greater than 0.209 inch. Each plate shall have one 2-inch-diameter half coupling and plug for grouting.

- E. The void behind the casing pipe shall be filled with sand-cement grout. The sand-cement content shall be 1 part portland cement to 3 parts fine aggregate. The water-cement ratio shall be 0.62 by weight.
- F. An end-of-casing boot shall be used on each end of the casing to seal the space between the carrier and casing pipe. End seals shall be Cascade Model CCES End Seal, or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Any solidification of embankments, boring headings, or tunnel headings or sides shall be the Developer or contractor's responsibility and shall be done at his own expense.
- B. Bored installations shall have a bored-hole diameter essentially the same as the outside diameter of the casing pipe to be installed.
- C. The casing pipe shall be jacked into the boring as soon as possible after the boring is made. Lengths of casing pipe as long as practical shall be used. Joints between sections shall be completely welded as recommended for joining the particular type of pipe.
- D. Once the jacking procedure has begun, it should be continued without stopping until completed, subject to weather and conditions beyond the control of the Developer or contractor.
- E. Any replacement of carrier pipe in an existing casing shall be considered a new installation, subject to the applicable requirements of these Specifications.
- F. Open-cut installations, where permitted, shall be in accordance with the details and procedures shown on the Drawings.
- G. Steel liner plates shall be installed in excavated tunnels when called for on the Drawings. The liner plates shall be installed progressively as excavation proceeds. Excavation shall not continue more than 24 inches past the end of the liner plate already in place. At this time, an additional section of liner shall be installed before excavation shall continue. Grout shall be placed under pressure in the annular void as the excavation proceeds. Grout should be continuously placed as close to the heading as possible, using grout stops if necessary. Grout shall be injected in the lower holes first, moving upward as the back space is filled. Threaded plugs shall be installed after filling each grout hole.
- H. Care shall be taken to ensure that casing pipe installed by boring and jacking or open-cut method will be at the proper alignment and grade.
- I. Maintain and operate pumps, well points, and drainage system equipment to keep work dewatered at all times.
- J. Adequate sheeting, shoring, and bracing for embankments, operating pits, and other appurtenances shall be placed and maintained to ensure that work proceeds safely and expeditiously. Upon completion of the required work, the sheeting, shoring, and bracing shall be left in place, cut off, or removed, as designated by the Engineer.

- K. Trench excavation; mining for tunnels; all classes and types of excavation; the removal of rock, muck, and debris; the excavation of all working pits; and backfill requirements of Section 31 20 00, Earthwork, are included under this section.
- L. Carrier pipe for all lines 4 inches and larger shall have push-on joints and fittings.
- M. After the casing pipe or tunnel liner is installed, install the carrier pipe, exercising care at all times to protect the interior of the casing pipe and to maintain tight, full-seated joints in the carrier pipe. The carrier pipe shall be installed at the proper line and grade without any sags or high spots.
- N. The carrier pipe shall be held concentric with the casing pipe by the use of blocks spaced radially around the pipe and secured together so that they remain firmly in place. The spacing of such blocks longitudinally in the casing pipe may not be greater than 10 feet. Blocks used with sand or grout fill may be hardwood. Approved stainless steel blocks must be used when no sand or grout fill is used.
- O. Sand or grout shall be forced under pressure into the annular space between the carrier pipe and the casing pipe, except where prohibited. This shall begin at the center of the crossing and completely fill the space to each end. Care shall be exercised at all times to maintain the carrier pipe at its proper line and grade.

3.2 RAILROAD CROSSINGS

- A. Secure permission from the railroads to schedule work so as not to interfere with the operation of the railroads. All work will be done under the supervision of the Engineer and the railroads involved. Furnish the railroads with such additional insurance as may be required, cost of the same to be borne by the Developer or contractor.
- B. The casing pipe shall extend no less than 25 feet from the centerline of outside track to the end of the pipe. The casing pipe shall extend beyond the railway right-of-way limits, if necessary, to obtain this distance.
- C. All work on railway right-of-way, including necessary supporting of tracks, safety of operations, and other standard and incidental operation procedures, shall be under the supervision of the appropriate authorized representative of the railway system affected, and any decisions of this representative pertaining to construction and/or operations shall be final; constructions must be governed by such decisions.
- D. If it becomes necessary, in the opinion of the railway company, to provide flagging protection, watchmen, removal or replacement of tracks, or the performance of any other work in order to keep the tracks safe for traffic, the Developer or contractor shall reimburse the railroad in cash for such services, in accordance with accounting procedures agreed upon by the Developer or contractor and affected railway company before construction is started.

3.3 HIGHWAY CROSSINGS

- A. The Developer or contractor shall be held responsible and accountable for the coordinating and scheduling of all construction work within the state highway right-of-way.
- B. Work along or across the state highway department rights-of-way shall be under the supervision of the Engineer and state highway department engineer.

- C. Water and sewer pipelines installed under paved roads shall generally be encased; however, uncased installations may be permitted where allowed by the applicable permitting authority and approved by CCUD.
- D. For open trench cut installations, make satisfactory arrangements to detour traffic around the area of highway where work is in progress, with minimum inconvenience placed on the traveling public. Provide suitable flagmen, watchmen, safety devices, and other services and facilities as may be required by the state highway department. The cost of the same shall be borne by the Developer or contractor.
- E. Encasement shall be installed with 4 feet of cover below pavement and roadway surface and shall extend 5 feet beyond the highway embankment or back of side ditch, unless otherwise shown. On curbed portions of conventional highways, the casing pipe shall extend 3 feet beyond the back of curb or sidewalk.
- F. For open trench cut installations, the Developer or contractor shall be responsible for scheduling and coordinating all construction work. All work at one particular crossing shall be completed, with the trench backfilled, compacted, and a temporary crushed stone surface provided for traffic, before any work is started on another such crossing.
- G. All installations shall be designed to leave free flows in drainage ditches, pipes, culverts, or other surface drainage facilities of the highway, street, or its connections.
- H. All trench excavation within the right-of-way, but not under pavement, shall be backfilled by tamping in 6-inch layers.
- I. All surplus material shall be removed from the right-of-way and the excavation finished flush with surrounding ground.
- J. Grout backfill shall be used for unused holes or abandoned pipes.
- K. Boring, jacking, or driving of carrier or casing pipes under existing highways shall be accomplished without jetting, sluicing, or wet-boring.
- L. No excavated material or equipment shall be placed on the pavement or shoulders of the highway without the express approval of the state highway department engineer.
- M. In no instance will the Developer or contractor be permitted to leave equipment (trucks, backhoes, etc.) on the pavement or shoulder overnight. Construction materials to be installed which are placed on the right-of-way in advance of construction shall be placed in such a manner as not to interfere with the safe operation of the highway.

END OF SECTION

SECTION 33 11 00

WATER MAIN INSTALLATION

PART 1 - GENERAL

1.1 SCOPE

- A. This Section establishes minimum requirements for the installation of water mains and associated appurtenances within the Calhoun-Charleston Utility District water system.
- B. The requirements of this Section apply to all water-main materials approved by CCUD, including polyvinyl chloride pipe, ductile iron pipe, and other materials specifically approved by CCUD.
- C. Work includes, but is not necessarily limited to:
 - 1. Installation of water mains.
 - 2. Installation of fittings, valves, hydrants, services, and associated appurtenances.
 - 3. Coordination with existing and proposed utilities.
 - 4. Separation of water mains from sanitary sewers, storm sewers, sewer manholes, stormwater structures, and other potential sources of contamination.
 - 5. Water-main crossings of sanitary sewers, storm sewers, and other utilities.
 - 6. Special construction and protective measures required where standard separation criteria cannot be achieved.
- D. Water mains shall be installed in accordance with the approved construction drawings, these Specifications, applicable CCUD standards, and the requirements of authorities having jurisdiction.

1.2 RELATED SECTIONS

- A. Section 01 11 00 – Summary of Work.
- B. Section 01 42 19 – Applicable Codes and Standards.
- C. Section 03 30 00 – Cast-in-Place Concrete.
- D. Section 31 20 00 – Earthwork.
- E. Section 31 23 19.16 – Dewatering.
- F. Section 31 49 00 – Utility Line Crossings of Streams.
- G. Section 33 05 23 – Utility Crossings of Railroads and Roadways.
- H. Section 33 11 13.23 – Polyvinyl Chloride Pipe for Water.
- I. Section 33 12 16 – Valves.

- J. Section 33 12 19 – Hydrants.
 - K. Section 33 13 00 – Disinfection of Potable Water Lines and Water Storage Tanks.
 - L. Section 40 05 13.53 – Ductile Iron Pipe and Fittings.
- 1.3 REFERENCES
- A. The latest applicable editions of the following standards and criteria shall apply:
 - 1. Applicable American Water Works Association standards.
 - 2. Applicable Tennessee Department of Environment and Conservation rules, regulations, permits, approvals, and design requirements.
 - B. Where a conflict exists between these Specifications, the approved construction drawings, and applicable regulatory requirements, the more stringent requirement shall apply unless otherwise approved in writing by CCUD and the applicable regulatory authority.
- 1.4 SUBMITTALS
- A. Submit information required by the applicable water-main material specification.
 - B. Where standard water-main separation requirements cannot be achieved, submit a site-specific unusual-crossing detail prepared and sealed by a professional engineer licensed in the State of Tennessee.
 - C. The unusual-crossing submittal shall include, as applicable:
 - 1. Plan and profile views.
 - 2. Water-main pipe size, material, pressure class, and joint type.
 - 3. Sanitary sewer or stormwater pipe size, material, and joint type.
 - 4. Horizontal and vertical clearances between utilities.
 - 5. Existing and proposed pipe elevations.
 - 6. Locations of water-main and sewer or stormwater pipe joints relative to the crossing.
 - 7. Limits and details of restrained-joint pipe, pressure-rated pipe, casing, concrete encasement, flowable fill, structural support, or other proposed protective measures.
 - 8. Existing and proposed ground elevations.
 - 9. Construction sequencing.
 - 10. Measures proposed to protect the potable water system from contamination.
 - D. Unusual crossings shall not be constructed until shown on the State-approved Construction plans.

1.5 QUALITY ASSURANCE

- A. The Contractor shall verify the horizontal and vertical locations of existing utilities before beginning water-main installation.
- B. The Contractor shall immediately notify CCUD or its Engineer where field conditions prevent compliance with the approved drawings or the separation requirements of this Section.
- C. The Contractor shall not modify the approved water-main alignment, grade, separation, pipe material, or protective measures without prior approval by CCUD or its Engineer.

PART 2 - PRODUCTS

2.1 WATER-MAIN MATERIALS

- A. Water-main pipe, fittings, joints, and associated materials shall comply with the applicable material specification and the approved construction drawings.
- B. Pipe materials shall be approved by CCUD prior to installation.
- C. Where special pipe materials, restrained joints, pressure-rated sewer pipe, casing, concrete encasement, or other protective measures are required at a utility crossing, materials shall comply with the approved construction drawings and applicable specification sections.

2.2 PIPE JOINTS

- A. Water-main joints shall comply with the applicable pipe-material specification.
- B. Pipe joints shall be located as far as practicable from sanitary sewer and stormwater crossings.
- C. Where practicable, a full length of water-main pipe shall be centered over the sanitary sewer or stormwater pipe so that the water-main joints are located approximately equidistant from the crossing.
- D. Restrained joints shall be provided where indicated on the approved construction drawings or required by CCUD or its Engineer.

2.3 CONCRETE ENCASEMENT

- A. Concrete used for pipe encasement shall comply with Section 03 30 00 – Cast-in-Place Concrete.
- B. Concrete encasement shall be installed only where shown on the approved construction drawings or specifically authorized by CCUD or its Engineer.
- C. Concrete encasement shall not be used as a substitute for required water-main separation unless included as part of an approved unusual-crossing design.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Install water mains in accordance with the approved construction drawings, applicable pipe-material specifications, manufacturer recommendations, CCUD requirements, and applicable regulatory requirements.
- B. Water mains shall be installed to the alignment and grade shown on the approved construction drawings.
- C. Water mains shall be installed with sufficient cover to protect the pipe from anticipated loading, freezing, construction activities, and other potential damage.
- D. Water mains shall be installed on firm, stable bedding capable of maintaining the required alignment and grade.
- E. Water mains shall not be installed in direct contact with sanitary sewer pipe, storm sewer pipe, sewer manholes, stormwater structures, or other potential sources of contamination.
- F. The Contractor shall protect existing utilities and coordinate water-main installation with affected utility owners.

3.2 HORIZONTAL SEPARATION FROM SANITARY SEWERS AND STORMWATER FACILITIES

- A. Water mains shall be separated horizontally from existing and proposed sanitary sewers, storm sewers, sewer manholes, stormwater structures, and similar potential sources of contamination by a minimum distance of 10 feet, measured horizontally from the outside edge of the water main to the outside edge of the pipe or structure.
- B. Where a minimum horizontal separation of 10 feet cannot be maintained, the water main may be installed closer only where approved by CCUD and the applicable regulatory authority and where:
 - 1. The water main and sanitary sewer or stormwater facility are installed in separate trenches; and
 - 2. The bottom of the water main is at least 18 inches above the top of the sanitary sewer or stormwater pipe.
 - 3. Where the vertical separation specified above cannot be achieved, the sanitary sewer or stormwater pipe shall be constructed of materials and with joints equivalent to water-main standards of construction and shall be pressure tested to demonstrate water tightness prior to backfilling.
- C. Where the requirements of Paragraph 3.2.B cannot be achieved, the installation shall be considered an unusual crossing or special condition and shall comply with Article 3.4 of this Section.
- D. Water mains shall not pass through or come into contact with sanitary sewer manholes, stormwater manholes, catch basins, junction boxes, inlets, or similar structures.

3.3 VERTICAL SEPARATION AT SANITARY SEWER AND STORMWATER CROSSINGS

- A. Water mains crossing sanitary sewers or storm sewers shall normally be installed above the sanitary sewer or stormwater pipe.
- B. A minimum vertical separation of 18 inches shall be maintained between the bottom of the water main and the top of the sanitary sewer or stormwater pipe.
- C. Pipe joints shall be located as far as practicable from the crossing.
- D. Where practicable, a full length of water-main pipe shall be centered over the sanitary sewer or stormwater pipe so that water-main joints are located approximately equidistant from the crossing.
- E. Adequate structural support shall be provided to prevent settlement, deflection, or movement that could damage either utility or reduce the required separation.
- F. Bedding, backfill, and structural support at the crossing shall be installed to prevent differential settlement between the water main and the sanitary sewer or stormwater pipe.
- G. Where the water main must cross below a sanitary sewer or stormwater pipe, or where the minimum vertical separation cannot be maintained, the crossing shall be considered an unusual crossing and shall comply with Article 3.4 of this Section.

3.4 UNUSUAL CROSSINGS

- A. Where site conditions prevent compliance with the standard horizontal or vertical separation requirements of this Section, the installation shall be considered an unusual crossing. Unusual crossings shall comply with the requirements of this Article.
- B. Unusual crossings shall be evaluated individually and shall be shown on the State-approved construction plans.
- C. The approved construction drawings shall include a site-specific plan, profile, or crossing detail identifying:
 - 1. Water-main and sanitary sewer or stormwater pipe sizes.
 - 2. Pipe materials and pressure classes.
 - 3. Pipe-joint types.
 - 4. Horizontal and vertical clearances.
 - 5. Existing and proposed pipe elevations.
 - 6. Locations of pipe joints relative to the crossing.
 - 7. Limits and details of restrained-joint pipe, pressure-rated pipe, casing, concrete encasement, flowable fill, structural support, or other protective measures.
 - 8. Existing and proposed ground elevations.
 - 9. Construction sequencing.

10. Measures required to protect the potable water system from contamination.
- D. Sanitary sewers and storm sewers passing over or under water mains at an unusual crossing shall be constructed of materials and with joints equivalent to water-main standards of construction and shall be pressure tested to demonstrate watertightness prior to backfilling.
- E. Where a water main passes beneath a sanitary sewer or storm sewer:
1. A minimum vertical separation of 18 inches shall be provided between the bottom of the sewer and the top of the water main.
 2. Adequate structural support shall be provided for the sewer to prevent excessive joint deflection, settlement, or loading upon and damage to the water main.
 3. A full length of water-main pipe shall be centered at the crossing so that the water-main joints are approximately equidistant from and located as far as practicable from the sewer.
- F. Protective measures shall be designed and constructed so that leakage from a sanitary sewer or stormwater facility cannot enter the potable water system.
- G. Protective measures shall provide adequate structural support and shall prevent settlement, deflection, loading, construction activities, or other conditions from damaging either utility.
- H. Additional pipe restraint, casing, concrete encasement, flowable fill, structural support, or other protective measures shall be provided where shown on the State-approved construction plans.
- I. Concrete encasement shall not be used as a substitute for required separation unless specifically shown as part of an approved unusual-crossing design.
- J. Field modifications to an unusual crossing shown on the State-approved construction plans shall not be permitted without approval of revised State-approved construction plans.
- K. Protective measures shall be designed and constructed so that leakage from a sanitary sewer or stormwater facility cannot enter the potable water system.
- L. Protective measures shall provide adequate structural support and shall prevent settlement, deflection, loading, construction activities, or other conditions from damaging either utility.
- M. Concrete encasement shall not be used as a substitute for required separation unless specifically shown as part of an approved unusual-crossing design.
- 3.5 CROSSING DOCUMENTATION
- A. All proposed water-main crossings of sanitary sewers, storm sewers, culverts, sewer manholes, stormwater structures, or other potential sources of contamination shall be identified on the construction drawings.
- B. Crossings that comply with the standard separation requirements may be shown using an approved CCUD standard crossing detail.

- C. Crossings that do not comply with the standard separation requirements shall include a site-specific plan, profile, or crossing detail on the State-approved construction plans demonstrating compliance with the unusual-crossing requirements of this section.
- D. The Contractor shall verify utility elevations and separation distances before installing the crossing.
- E. Where actual field conditions differ from the approved construction drawings, work at the crossing shall stop until the proposed revision is shown on State-approved construction plans.

3.6 INSPECTION

- A. Water-main crossings of sanitary sewers and stormwater facilities shall remain exposed until the required separation and protective measures have been observed and accepted by CCUD or its authorized representative.
- B. The Contractor shall provide sufficient notice to CCUD before backfilling water-main crossings.
- C. CCUD may require documentation of crossing elevations, separation distances, pipe materials, joint locations, and protective measures before authorizing backfill.

3.7 TESTING AND DISINFECTION

- A. Water mains shall be pressure tested, disinfected, flushed, sampled, and bacteriologically cleared in accordance with the applicable specification sections before being placed into service.
- B. Completion of a sanitary sewer or stormwater crossing shall not relieve the Contractor of responsibility for satisfying all water-main testing and disinfection requirements.

3.8 RECORD DOCUMENTATION

- A. Record drawings shall identify the locations of water-main crossings of sanitary sewers and stormwater facilities.
- B. Record information for unusual crossings shall include:
 - 1. Final horizontal and vertical separation distances.
 - 2. Water-main and sanitary sewer or stormwater pipe elevations.
 - 3. Pipe sizes and materials.
 - 4. Locations of pipe joints.
 - 5. Limits of restrained-joint pipe, pressure-rated pipe, casing, concrete encasement, structural support, or other protective measures.
 - 6. Deviations from the approved crossing detail.

END OF SECTION

SECTION 33 11 13.23

POLYVINYL CHLORIDE PIPE FOR WATER

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, equipment and incidentals required and install in locations shown on the Drawings the plastic piping as specified herein.

1.2 RELATED WORK

- A. Section 33 12 16: Valves.
- B. Section 33 13 00: Disinfection of Potable Water Lines and Water Storage Tanks.
- C. Section 40 05 13.53: Ductile Iron Pipe and Fittings.

1.3 DESCRIPTION OF SYSTEM

- A. Plastic pipe shall be used for water main piping.
- B. Piping shall be installed in the locations as shown on the Drawings.

1.4 QUALIFICATIONS

- A. All plastic pipe shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the items to be furnished. The equipment shall be designed, constructed, and installed in accordance with ASTM and AWWA methods and shall comply with these Specifications.

1.5 SUBMITTAL

- A. Shop drawings shall be submitted to the Engineer for approval in accordance with these Specifications and shall include dimensioning and technical specification for all piping to be furnished.
- B. Submit samples of all materials specified herein to the Engineer for approval when requested.

1.6 PIPE MARKING

- A. All PVC pipe shall be marked with the following information:
 - 1. Manufacturer's name or trademark.
 - 2. Nominal pipe size and OD base.
 - 3. AWWA or ASTM material code designation.
 - 4. Dimension ratio.
 - 5. AWWA pressure class.
 - 6. AWWA or ASTM specification designation (AWWA C900, ASTM D 2241).
 - 7. Product record code.
 - 8. Certification seal(s), if required.

1.7 RECEIVING, HANDLING, AND STORAGE

- A. Receiving, handling, and storage of PVC pipe shall be in accordance with AWWA Manual No. M23, "PVC Pipe Design and Installation," except that all PVC pipe which is stored longer than 1 week shall be covered with an opaque material.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe shall meet NSF/ANSI Standard 14 - Plastic Piping System Components and Related Materials and ASTM D 2241, "Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR)," class as shown on Drawings; or AWWA C900, class as shown on Drawings. Length shall be 20 feet.
- B. Potable water service certification shall be NSF/ANSI Standard 61 Drinking Water System Components.
- C. Gasket shall be ASTM F 477, "Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe." Gaskets for pipe 6 inch and larger shall be supplied with retainer rings.
- D. Push-on joint shall be ASTM D 3139, "Standard Specification for Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals."
- E. PVC material 12364 (PVC 1120) shall be ASTM D 1784, "Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPC) Compounds."
- F. Fittings shall be short or long body ductile iron meeting ANSI/AWWA C110/A21.10: "Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in. for Water" and shall be equipped with EBAA Series 2000 PV restrainers, or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Alignment and Grade. All pipe shall be laid to, and maintained at, the established lines and grades. Fittings, valves, air vents, and hydrants shall be installed at the required locations with valve and hydrant stems plumb.
- B. Trench Construction
 - 1. Stockpiling Excavated Material: All excavated material shall be stockpiled in a manner that will not endanger the work or obstruct sidewalks and driveways. Hydrants under pressure, valve-pit covers, valve boxes, curb-stop boxes, fire and police call boxes, and other utility controls shall be kept accessible.
 - 2. Trench Width
 - a. Trench width at the ground surface may vary depending on depth, type of soil, and position of surface structures. The minimum clear width of

- the trench, sheeted or unsheeted, measured at the springline of the pipe shall be 1 foot greater than the outside diameter of the pipe. The maximum recommended clear width of the trench at the top of the pipe is equal to the pipe outside diameter plus 2 feet. If the maximum recommended trench width must be exceeded or if the pipe is installed in a compacted embankment, then pipe embedment shall be compacted to a point of at least 2½ pipe diameters from the pipe on both sides of the pipe or to the trench walls, whichever is less.
- b. Minimum cover for all installed water mains is 36 inches. Minimum cover under roadways and pavement is 48 inches.
 - c. Construction with a Trencher
 - 1) Provide at least 2 inches of clear space on each side of pipe to allow for pipe placement and embedment.
 - 2) For 1½- and 2-inch pipe, a trench width of 6 inches is recommended.
 - 3) For 3-, 4-, and 6-inch pipe, a trench width of 12 inches is recommended.
 - 4) For 8-, 10-, and 12-inch pipe, a trench width of 18 inches is recommended.
 - 5) In case of rock trenching, at least 6 inches of clear space on each side of pipe to allow suitable bedding and haunching of pipe.
 - d. Quantities of crushed stone embedment in rock trenches shall be based upon the actual width of trench, not to exceed 2 feet plus the pipe outside diameter, unless authorized by the Engineer.
 - e. Backfill above the pipe springline shall comply with Section 31 20 00 – Earthwork.
3. Dewatering: Where conditions are such that running or standing water occurs in the trench bottom or the soil in the trench bottom displays a "quick" tendency, the water shall be removed by pumps and other suitable means (such as well points or pervious underdrain bedding) until the pipe has been installed and the backfill has been placed to a sufficient height to prevent flotation of pipe. Generally, a depth of backfill over the top of the pipe equal to 1½ pipe diameters is sufficient to prevent flotation.
4. Preparation of Trench Bottom: The trench bottom shall be constructed to provide a firm, stable, and uniform support for the full length of the pipe. Bell holes shall be provided at each joint to permit proper assembly and pipe support. Any part of the trench bottom excavated below grade shall be backfilled to grade and shall be compacted as required to provide firm pipe support. When an unstable subgrade condition is encountered that could provide inadequate pipe support, additional trench depth shall be excavated and refilled with suitable foundation material. Ledge rock, boulders, and large stones shall be removed to provide 6 inches of cushion on all sides of the pipe and accessories.
5. Laying of Pipe: To prevent damage, proper implements, tools, and equipment shall be used for placement of the pipe in the trench. Under no circumstances shall pipe or accessories be dropped into the trench. All foreign matter or dirt shall be removed from the pipe interior. Pipe joints shall be assembled with

care. Field cut ends of pipe shall be beveled. Use factory bevel as a guide in preparing field cuts. Round off any sharp edges on the leading edge of the bevel. Sharp edges and improper field beveling can result in cut gaskets or gasket push outs. Apply lubricant to beveled spigot only or as recommended by the pipe manufacturer. Align spigot and bell and apply firm steady pressure by hand or by bar and block assembly until spigot easily slips through the gasket. Insert spigot up to the insertion mark. Do not over insert spigot or disturb previously assembled pipe joints. When pipe laying is not in progress, open ends of installed pipe shall be closed to prevent entrance of trench water, dirt, foreign matter, or small animals into the pipeline.

6. **Restrained Joints:** Unless otherwise shown, restraint devices shall be provided at each hydrant, valve, bend, tee, and at reducers and fittings where changes occur in pipe diameter or direction and for the distance shown on the Drawings in all directions from the joints. For joining PVC pipe to ductile iron MJ fittings, restraining devices shall be EBAA Series 2000PV, Ford Uni-Flange Series 1300, or approved equal. For joining together PVC pipe, restraining devices shall be EBAA Series 1600 or 6500, Ford Uni-Flange 1350, or approved equal. Install restraints in accordance with manufacturer's recommendations. Install number of restraints recommended by manufacturer for size of pipe, type of fitting, and type of soil. Thrust blocks may be required in addition to restraint devices where specifically shown on the Drawings.
7. **Pipe Embedment:** Pipe embedment materials (bedding, haunching, and initial backfill) for PVC pipe shall consist of crushed stone (less than ½ inch diameter), sand, or select earth backfill containing up to ¾-inch particles, placed and compacted in maximum 6-inch lifts. Crushed stone embedment material shall be used under roadways, driveways, and pavements where required by CCUD, shown on the approved plans, or where native materials are unsuitable. Sharp stones of a size which could cause significant scratching or abrasion of the pipe shall be excluded from the embedment materials. In rock trenches, 6 inches of additional bedding is required under the pipe. Bedding shall provide uniform longitudinal support for the pipe barrel. Envelope materials shall be worked under the sides of the pipe to provide satisfactory haunching support up to the springline, taking care not to displace the pipe. Initial backfill shall be placed and compacted to a minimum depth of 12 inches over the top of the pipe. Mechanical compaction shall not be allowed within 6 inches of the top of the pipe. Backfill above the pipe springline shall comply with Section 31 20 00 – Earthwork. Where crushed stone embedment is used, clay checks shall be installed at appropriate intervals, as directed by CCUD, to prevent longitudinal groundwater migration along the trench.
8. **Final Backfill:** After placement and compaction of pipe embedment materials and initial backfill, the balance of backfill materials may be machined placed. The material shall contain no large stones or rocks, frozen material or debris. Proper compaction procedures shall be exercised to provide required 90 percent density, standard proctor.
9. **Changes in Direction:** Changes in direction shall normally be accomplished using suitable pipe fittings or elbows. Some changes in direction may be accomplished in limited circumstances using either controlled bending or joint deflection, but not both for the same section of pipe. Minimum bending radius shall be 300 times the outside diameter of the pipe, unless a tighter radius is

allowed by the pipe manufacturer. If used, bending shall be accomplished manually. Joint deflection shall be limited to that allowed by the pipe manufacturer. Suitable blocking or bracing shall be used to ensure that allowable bending or deflection or deflection limits are not exceeded.

3.2 TESTING

- A. Testing. Pressure and leakage tests shall be performed in accordance with Section 33 13 00, Disinfection of Potable Water Lines and Water Storage Tanks.
- B. After all piping has been placed and backfilled between the joints, each run of newly laid pipe, or any valved section thereof, shall be tested by the Contractor in the presence of the Engineer, and tests shall be continued until all leaks have been made tight to the satisfaction of the Engineer.
- C. To prevent floating of the pipe, sufficient backfill shall be placed prior to filling pipe with water and subsequent field testing. Where local conditions require that the trenches be backfilled immediately after the pipe has been laid, the testing may be carried out after backfilling has been completed, but before placement of permanent surface.

At least seven days shall elapse after the last concrete thrust or reaction blocking, if used, has been cast with normal (Type I) portland cement. The elapsed time may be reduced to three days with the use of a high-early-strength (Type III) portland cement. It is suggested that testing be conducted first on short lengths of installed pipe line, thereby permitting the installer to verify that proper installation and joint assembly techniques have been employed.

- 1. Filling, Drainage, and Air Relief of Mains: Water mains shall be drained through drainage branches or blow-offs. Drainage branches and blow-offs shall be provided with valves and shall be located at low points and dead ends. Drainage branches or blow-offs must not be connected to any sewer, submerged in any stream, or be installed in any other manner that can permit back siphonage into the distribution system. Permanent air vents shall be installed at all high points. If permanent air vents are not required at all high points, the installer shall install corporation cocks at all such points to expel air during initial filling and pressure testing of the lines. Lines shall be filled slowly with maximum velocity of 2 fps, preferably 1 fps, while venting all air. After filling, lines shall be flushed at hydrants, blow-offs, and dead ends at minimum velocity of 2.5 fps. Valves shall be closed very slowly to prevent surges.
- 2. Procedure: The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time. Separate tests may be made if desired, in which case the pressure test shall be performed first. The specified test pressure shall be applied by means of a pump connected to the pipe. The test pressure shall be maintained (by additional pumping if necessary) for the specified time. While the line is under pressure, the system and all exposed pipe, fittings, valves, and hydrants shall be carefully examined for leakage. All defective elements shall be repaired or replaced and the test repeated until all visible leakage has been stopped and the allowable leakage requirements have been met.
- 3. Test Method: The installer may perform simultaneous pressure and leakage tests, or he may perform separate pressure and leakage tests on the installed system at test durations and pressures specified below.

SYSTEM TEST METHODS

Procedure	Pressure	Test Duration (hours)
Simultaneous pressure and leaking tests	150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation or the rated pressure of the pipe, whichever is greater	2
Separate pressure test	150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation or the rated pressure of the pipe, whichever is greater	1
Separate leakage test	150% of normal average working pressure of segment tested, but not less than the rated pressure of the pipe	2

Source: Recommended Standard for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe, UNI-B-3, Uni-Bell Plastic Pipe Association as modified by RD Instruction 1942-A, Paragraph 1942.18(d)(15)

4. Allowable Leakage: The duration of each leakage test shall be 2 hours, unless otherwise specified, and during the test the main shall be subjected to the pressure required in the following table.

Allowable Leakage Per 1,000 Feet or 50 Joints (gal/hr)										
Nominal Pipe Size (inches)	Average Test Pressure in Line (psi)									
	100	110	120	130	135	140	150	175	200	250
4	0.27	0.28	0.30	0.31	0.31	0.32	0.32	0.32	0.32	0.32
6	0.41	0.43	0.44	0.46	0.47	0.47	0.47	0.47	0.47	0.47
8	0.54	0.57	0.59	0.62	0.63	0.63	0.63	0.63	0.63	0.63
10	0.68	0.71	0.74	0.77	0.79	0.79	0.79	0.79	0.79	0.79
12	0.81	0.85	0.89	0.92	0.94	0.95	0.95	0.95	0.95	0.95
14	0.95	0.99	1.04	1.08	1.10	1.10	1.10	1.10	1.10	1.10
16	1.08	1.13	1.18	1.23	1.26	1.26	1.26	1.26	1.26	1.26
18	1.22	1.28	1.33	1.39	1.41	1.42	1.42	1.42	1.42	1.42
20	1.35	1.42	1.48	1.54	1.57	1.58	1.58	1.58	1.58	1.58
24	1.62	1.70	1.78	1.85	1.88	1.89	1.89	1.89	1.89	1.89

Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. For all test pressures less than 137 psi, no installation shall be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{ND\sqrt{P}}{7400}$$

Where: L = allowable leakage, gph
N = number of joints in the length of pipeline tested
D = nominal diameter of the pipe, inch
P = average test pressure during the leakage test, psig

For all test pressures equal to or exceeding 137 psi, pipeline leakage shall not exceed 10 gallons per nominal inch of pipe diameter per mile of pipe per 24 hours when tested at the specified test pressure.

Leakage values determined by the above formulas are to be found in the preceding table.

3.3 DISINFECTION

- A. All PVC potable water piping shall be flushed, disinfected, and bacteriologically tested prior to use in accordance with Section 33 13 00, Disinfection of Potable Water Lines and Water Storage Tanks.

END OF SECTION

SECTION 33 12 13

WATER SERVICE METERING

PART 1 - GENERAL

1.1 SCOPE

- A. The work described by this section includes furnishing all labor, materials, and equipment required to install new water meters, including all meter boxes and covers, meter yokes, valves, fittings, accessories, etc., as specified herein and/or shown on the Drawings. References to the Engineer shall mean CCUD or its designated representative.

PART 2 - PRODUCTS

- 2.1 The service assembly shall include a corporation stop, copper service pipe gooseneck, meter yoke, meter, meter box, and tapping saddle as required.

2.2 SERVICE TUBING

A. Service Line Material

- 1. Water service lines installed between the water main and the property line shall be cross-linked polyethylene (PEX) tubing conforming to ASTM F876 and ASTM F877 and certified for potable water service under NSF/ANSI Standard 61.
- 2. PEX tubing shall have a minimum pressure rating of 160 psi at 73°F and shall be suitable for direct burial.

B. PEX Type

- 1. PEX tubing shall be PEX-A or PEX-B.
- 2. PEX-C shall not be permitted.

C. Color

- 1. PEX service tubing shall be blue and clearly marked for potable water use.

D. Fittings

- 1. All fittings used with PEX service tubing shall be brass or engineered polymer fittings specifically manufactured and listed for PEX applications.
- 2. Push-fit fittings shall not be permitted unless specifically approved in writing by CCUD.

E. Tracer Wire

1. A continuous 12-gauge copper tracer wire with blue insulation shall be installed with all non-metallic service lines and shall be brought up into the meter box.

F. Installation Restrictions

1. PEX service tubing shall:
 - a. Be installed in a single continuous length between the corporation stop and meter yoke where practicable
 - b. Not be exposed to prolonged sunlight prior to installation
 - c. Be installed in accordance with the manufacturer's minimum bend radius requirements
 - d. Be bedded and backfilled to prevent kinking or point loading

2.3 METER FITTINGS AND ACCESSORIES

- A. Service saddles shall be utilized in connecting corporation stops and service lines to all ductile iron, cast iron, or PVC water mains.
- B. Corporation stops shall be provided on each service connection to the water main. Corporation stops shall be of the plug type and shall be designed and manufactured in accordance with AWWA Standard C800 and shall be constructed of red brass. Corporation stop shall be Ford, Series F-1000, or equivalent, for 1-inch service and shall have compression fittings.
- C. Water meters shall be of a type, size, and manufacturer approved by CCUD.
- D. Meter yokes shall be of a type and configuration approved by CCUD.
- E. Meter boxes for 5/8-inch by 3/4-inch assemblies shall be 18-inch deep plastic meter boxes and plastic lids with cast iron readers as manufactured by NDS, Inc., or approved equal.

PART 3 - EXECUTION

- A. A complete meter service shall be installed on each existing connection (where applicable) and all new connections to the water distribution system. Service lines shall be installed between the water main and the property line. Meter boxes and service assemblies shall be installed by the Developer. Water meters shall be furnished and installed by CCUD unless otherwise approved. The exact field location of the meter box shall be determined by CCUD and shall be located to provide easy access to the meter reader and serviceman; not be a hazard to the customer or public; and be reasonably well protected against frost, mechanical damage, and tampering. All PEX service lines shall be installed in

accordance with the manufacturer's published installation instructions and these Specifications.

- B. Water meters shall not be installed in meter boxes until construction of the residence has been completed and all pipelines have been flushed clean of all mud and grit deposits, and have been disinfected.
- C. Meter boxes and meters shall be installed in a neat and workmanlike manner. The elevation of the boxes shall be carefully adjusted so that the lid is flush with the ground surface or sidewalk. Soil around the meter box shall be tamped or settled in place so that hazard is eliminated and further settling is minimized.
- D. All service lines crossing new residential streets shall be installed within a minimum two (2) inch diameter Schedule 40 PVC casing pipe, or larger as required to accommodate the service line. All service lines crossing existing paved roads shall be bored and jacked and installed within a minimum two (2) inch diameter Schedule 40 PVC casing pipe.
- E. Where required due to system pressure, the customer valve box shall include a pressure reducing valve and gate valve, as directed by CCUD. It shall be installed between the meter box and the house in a neat and workmanlike manner. The elevation of the boxes shall be carefully adjusted so that the lid is flush with the ground surface or sidewalk and is aligned with the adjacent box to allow easy access to both boxes. The customer box shall include the pressure reducing valve and a 3/4-inch gate valve.

END OF SECTION

SECTION 33 12 16

VALVES

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to furnish and install all metal valves, including operators, boxes, and accessories, as specified herein, shown on the Drawings, or required for proper completion of the work under these Contract Documents.
- B. The Developer or contractor's attention is called to the fact that all valves, especially in the smaller sizes, are not necessarily shown completely on the Drawings, which are more or less schematic. Furnish and install all valves indicated or required for proper operation of the equipment or services requiring such valves.
- C. References to the Engineer shall mean CCUD or its designated representative.

1.2 SHOP DRAWINGS AND ENGINEERING DATA

- A. Submit complete shop drawings and engineering data to the Engineer in accordance with the requirements of Division 1.

1.3 STORAGE AND PROTECTION

- A. Store and protect valves and accessories in accordance with the requirements of the valve manufacturer or as directed by the Engineer.
- B. Completely drain valves prior to shipment. Protect ends of flanged and mechanical joint valves with full size wooden baffles securely bolted to the valve ends. Size of baffles shall be at least equal to outside diameter of flange. Secure valves 24 inches in size and larger to a wooden skid to facilitate handling and storage.

1.4 SHOP PAINTING

- A. Clean, shop prime, and shop paint valves and accessories in accordance with the requirements of these Specifications.
- B. All interior and exterior nonmachined, nonbearing ferrous surfaces on iron body valves, gates, and accessories shall be blast-cleaned and painted at the factory with two coats of asphaltic varnish conforming to Federal Specification TT-V-51c, unless otherwise specified. Exterior nonmachined, nonbearing ferrous surfaces on valve operators and on nonsubmerged or nonburied butterfly and eccentric plug valves shall be blast-cleaned and painted at the factory with one coat of zinc chromate primer conforming to Federal Specification TT-P-645 and one coat of compatible alkyd enamel. Other paint systems may be proposed by the valve supplier, subject to the Engineer's approval.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit complete operation and maintenance data on the valves in accordance with the requirements of Division 1, Operating and Maintenance Data.

1.6 QUALITY ASSURANCE

- A. The valve manufacturers shall furnish a written certification to the Engineer that all valves and operators furnished comply with all applicable requirements of the governing AWWA standards specified herein.

1.7 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with the requirements of Division 1, Warranties and Bonds.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All castings, regardless of material, shall be free from surface defects, swells, lumps, blisters, sandholes, or other imperfections.
- B. All valves shall have the name of the manufacturer, rated working pressure, and size of the valve cast upon the body or bonnet in raised letters. Alternately, the name of the valve manufacturer, rated working pressure, and size may be stamped on a stainless steel identification plate permanently attached to the valve body or bonnet. Valves specified to conform with AWWA requirements shall have the letters "AWWA" cast upon the valve body or bonnet in raised letters.
- C. Valves and operating mechanisms shall be of the proper size and dimensions to fit the pipe connections thereto and shall be installed in the position and within the space shown on the Drawings.
- D. The direction of rotation of the operator to OPEN the valve shall be to the LEFT (counterclockwise), unless otherwise specified. Each valve body or operator shall have cast thereon the word OPEN and an arrow indicating the direction to open.
- E. A union or coupling shall be provided within 2 feet on each side of a threaded end valve unless the valve can be otherwise easily removed from the piping. This shall not apply to soldered end valves in copper plumbing.
- F. All exposed bolts and nuts on buried or submerged valves and operators shall be brass or stainless steel for corrosion resistance. Exposed bolts and nuts on exposed valves and operators shall be of corrosion-resistant materials or shall be zinc or cadmium plated.
- G. Valves and operators shall be of the proper size to fit the pipe connections and shall fit in the position and space as shown on the Drawings.
- H. Valve operators shall be of sufficient size and capacity to seat, unseat, and operate the valve under the maximum specified differential pressure. Where no maximum differential pressure is specified, the operator shall be designed for a differential pressure equal to the maximum working pressure of the valve. Additional allowances shall be made for the lubricating and/or scale-forming tendencies of the fluid.

2.2 GATE VALVES

- A. All gate valves smaller than 2 inches and those larger than 24 inches shall be of the single disc, double sealed, solid tapered wedge type, unless otherwise specified. Gate valves in sizes 2 through 24 inches shall be M & H, resilient wedge gate valves, left opening (counterclockwise), of the single disc, resilient seated type, unless otherwise specified. Valves shall have non-rising stems and be capable of being repacked under pressure when valve is fully open. Minimum working pressures shall be 200 psi for valves through 14 inches in size and 150 psi for valves 16 inches and larger.
- B. Gate valves smaller than 2 inches shall be bronze body, bronze fitted valves, and have 150-pound, cast bronze body, union bonnet, Teflon-impregnated asbestos packing, and threaded ends per ANSI B2.1. Bronze shall conform to ASTM B62. Brass for nuts and gland shall conform to ASTM V16. Valve discs shall be reversible. Bronze gate valves shall be Stockham Fig. B-130, Nibco Fig. T-136, or equal. For use in copper plumbing, furnish gate valves with solder ends per ANSI B16.18.
- C. Gate valves larger than 24 inches in water and wastewater shall be iron body, bronze mounted valves conforming in all respects to the applicable material and dimensional requirements of AWWA C500. Gate valves shall have an O-ring or self-adjusting chevron packing stem seal, and 125-pound flanged ends per ANSI B16.1, except for valves to be buried underground, which shall have mechanical joint ends per ANSI A21.11 (AWWA C111). Body seat rings shall be ASTM B62 bronze and be screwed into the body so as to be field replaceable. Disc faces and all moving parts shall be bronze or bronze mounted. Cast iron for body and bonnet shall conform to ASTM A126, Grade B. Iron body gate valves with solid wedge discs shall be M&H (Dresser) Fig. 2067, or equal. Iron body gate valves with double discs shall be M&H (Dresser) Fig. 67, Mueller Fig. A-2380, or equal.
- D. Gate valves in sizes 2 through 24 inches for use in water and wastewater shall be of the ductile iron body, resilient seated type, manufactured in conformance with AWWA C509. Gate shall be of ductile iron with bonded resilient seat and integral flush drain. Minimum working pressure shall be 200 psi when unbalanced pressure is applied to either side of the gate. Gate valves shall have a minimum of two O-ring stem seals; one above and one below the integral stem collar. The area between the O-rings shall be filled with permanent lubricant. Valve shall have no metal fasteners or screws exposed in the wetted portion of the valve. All ferrous surfaces shall be shot-blasted to a white metal finish. All interior and exterior valve surfaces, including the interior of the gate and all bolt holes shall be coated with an epoxy coating in accordance with AWWA C550. The minimum thickness of the coating shall be 8 mils. Valve ends shall be of the type required for the installation as specified herein or shown on the Drawings and meet the requirements as specified in Paragraph C of this section. Resilient-seated gate valves shall be as manufactured by Mueller, M&H (Dresser), Clow, or approved equal.
- E. Gate valves 3 inches in size and larger in steam service shall have 125-pound cast iron body, bronze trim, and outside stem and yoke.
- F. Furnish gate valves with nut, wrench, chain, or handwheel operators as shown on the Drawings. Unless otherwise shown or specified, valves shall have operators as specified in this section. Extension stems, floor stands, and valve boxes and covers shall be furnished where shown or required.
- G. Resilient wedge valves for buried service 16-inch-diameter and larger shall have bevel gear operators, unless otherwise noted.

2.3 BUTTERFLY VALVES

- A. Unless otherwise shown or specified, butterfly valves shall be of the resilient seated, tight-closing type and conform in all respects to the applicable material and dimensional requirements of AWWA C504. Wafer-type butterfly valves in sizes 24 inches and larger shall conform to all general requirements of AWWA C504 except laying length. Butterfly valves shall operate from fully open to fully closed with a 90-degree rotation of the valve stem.
- B. Valves shall be designed for the working pressures and/or pressure class designations shown on the Drawings or specified in these Specifications. If a working pressure or pressure rating is not given, the following requirements shall apply:

Service	AWWA Pressure Rating
Low Pressure Air	25B
Wastewater or Sludge	150B
Potable or Plant Water	150B

Wafer type valves shall have a pressure rating of not less than 150 psi. Valves shall be drip-tight and bubble-tight at rated pressure differential across the valve in both directions.

- C. Valve body shall be one-piece, constructed of cast iron conforming to ASTM A126, Class B. The diameter of the opening shall be not less than the diameter of the corresponding pipe size. Unless otherwise specified, valve body shall be of the short-body style in accordance with Table 2 of AWWA C504. This requirement shall not apply to wafer type valves. No part of the valve internals shall extend beyond the valve ends when the valve is in the closed position. Short-body valves shall have 125-pound flanged ends per ANSI B16.1. Wafer type valves shall be designed to fit between 125-pound flanges per ANSI B16.1.
- D. Disc shall be cast bronze conforming to ASTM B143, Alloy 1A, cast iron conforming to ASTM A126, Class B, Ni-resist cast iron conforming to ASTM A436, Type 1 or 2, or Ni-resist ductile iron conforming to ASTM A439, Type D2. When used in wastewater or raw water, disc shall be streamlined with no exterior ribbing or openings.
- E. Shafts shall be polished stainless steel conforming to ASTM A276, Type 304 or Type 316. All keys and pins used in securing valve disc to shafts shall be stainless steel or monel.
- F. Valve seat shall be one-piece, molded synthetic rubber, Buna-N (Hycar) for wastewater and Buna-N or neoprene for air. Where temperatures exceed 180 F, EPT or Viton seats shall be used. Retaining rings, if used, shall be stainless steel. The method of mounting valve seat shall conform to the applicable requirements of AWWA C504, Section 3.5. Valve seats shall be field replaceable without necessity of chipping, burning, or cutting. Seats secured with retaining rings shall be fully adjustable. Metal seat mating surfaces shall be smoothly contoured and polished 18-8 stainless steel or monel. Alloy cast iron will not be acceptable as a seat mating surface. Sprayed or plated seat mating surfaces will not be acceptable.

- G. Shaft seals shall be O-ring or self-adjusting chevron packing of Buna-N or neoprene. Shaft seals shall conform to the requirements of AWWA C504, Section 3.7, and shall be of a design that allows replacement of the seal without removing the valve shaft. Alternately, pull-down packing is acceptable if the packing is adjustable and replaceable without removing valve operator.
 - H. Valve bearings shall be self-lubricating, sleeve-type bearings of corrosion resistant materials. Bearing load shall not exceed 2,500 psi. Provide valves 24 inches in size and larger with an adjustable, two-way thrust bearing to center the disc in the valve and allow the valve to be installed with the valve stem vertical. Bearing shall be easily accessible for adjustment.
 - I. Where the valve is installed adjacent to a fitting, flow meter, another valve, or similar items, furnish a spool piece or adaptor coupling as a spacer so that valve disc does not interfere with the operation of the adjacent meter or valve or contact cement linings on pipe or fittings.
 - J. Furnish valve with a lever operator, rotary manual operator, electric motor operator, or pneumatic cylinder operator as shown on the Drawings. Unless otherwise shown or specified, furnish a lever operator on valves 6 inches and smaller and a rotary manual operator on valves 8 inches and larger. Furnish extension stem and floorstand where shown or required.
 - K. Butterfly valves for drinking water service shall be coated interior and exterior with 10 mils, minimum, of TNEMEC Potapox 20, or equivalent NSF-61 compliant epoxy fully compliant with AWWA C550.
 - L. Butterfly valves shall be as manufactured by Val-Matic, Dezurik, Pratt, or equal.
- 2.4 AIR RELEASE VALVES
- A. Air release valves shall have cast iron body and cover, stainless steel float, stainless steel or bronze trim, and Buna-N seat. All other attaching parts or internal parts shall be stainless steel or bronze.
 - B. Valve shall be designed for a working pressure of 0 to 150 psi unless otherwise shown or specified and shall be equipped with an orifice appropriate to the venting needs of the pipeline.
 - C. Pressure water valves shall be installed in valve pit, complete with tapping saddle and connecting line to main, gate valve, etc., and at the location(s) shown on the Drawings. Clean, prime, and paint valve exterior with bituminous paint. Valves 2 inches and smaller shall have NP screwed inlet. Combination air vacuum/air release valve shall be Val-Matic Valve & Mfg. Corp. combination air valve, APCO Air Release Valve (Standard), Crispin Universal Air Valve, or equal.
- 2.5 BALL VALVES
- A. Ball valves shall be of the quarter turn type with full pipe size opening through the valve. Ball valves shall be suitable for a differential working pressure in either direction of not less than 400 psi.
 - B. Ball valves shall have a three-piece, bolted body designed to allow the interior portion of the valve to be removed without disturbing adjacent piping.

- C. Unless otherwise specified or required, ball valves shall have brass body, self-aligning brass ball, blowout-proof brass stem, reinforced Teflon seats and seals, plastic-coated plated steel handle, and threaded ends per ANSI B2.1. Ball valves shall be Powell "Star," Worcester "Miser," or equal.

2.6 FLEXIBLE DISK CHECK VALVES

- A. The check valve shall be of the full body type, with a domed access cover and only one moving part, the flexible disc.
- B. The valves shall be designed, manufactured and tested in accordance with AWWA Standard ANSI/AWWA C508. The valves used in potable water service shall be certified to NSF/ANSI 61, and certified to be Lead-Free in accordance with NSF/ANSI 61, Annex G. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.
- C. The Valves shall be provided with flanges in accordance with ANSI B16.1, Class 125.
- D. The valve body shall be full flow equal to nominal pipe diameter at all points through the valve. The 4 in. (100mm) valve shall be capable of passing a 3 in. (75mm) sphere. The seating surface shall be on a 45 degree angle to minimize disc travel. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator or oil cushion without special tools or removing the valve from the line. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator. The disc shall be of one-piece construction, precision molded with an integral o-ring type sealing surface, and contain alloy steel and nylon reinforcement in the flexible hinge area. The flex portion of the disc shall be warranted for twenty-five years. Non-Slam closing characteristics shall be provided through a short disc stroke and a memory disc return action to provide a cracking pressure of 0.25 psig. The valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508 and show no signs of wear, cracking, or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures.
- E. The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron or ASTM A126 class B for 30 in. (800mm) and larger. Optional body materials include ASTM A-351 Grade CF8M, stainless steel (sizes 3" (80 mm) through 12" (300 mm)). The disc shall be precision molded Buna-N (NBR), ASTM D2000-BG. Optional disc material includes Viton.
- F. Options: A screw-type backflow actuator shall be provided (when specified) to allow opening of the valve during no-flow conditions. Buna-N seals shall be used to seal the stainless steel stem in a Lead-Free bronze bushing. The backflow device shall be of the rising-stem type to indicate position. A stainless steel T-handle shall be provided for ease of operation.
- G. Options: A mechanical indicator shall be provided (when specified) to provide disc position indication on valves 3" (80 mm) and larger. The indicator shall have continuous contact with the disc under all operating conditions to assure accurate disc position indication.

- H. Options: A pre-wired limit switch will be provided (when specified) to indicate open/closed position to a remote location. The external position indicator shall be capable of actuating a mechanical type limit switch (if specified). The switch shall be rated for NEMA 4, 6, or 6P and shall have U.L. rated 5 amp, 12 or 250 VAC contacts (if required).
- I. Options: A bottom mounted oil dashpot (oil cushion) shall be provided when specified to provide hydraulic control of the final 10% of valve closure and reduce valve slam and water hammer normally associated with rapid flow reversal conditions on pump shut down. The dashpot shall consist of a high pressure hydraulic cylinder, adjustable external flow control valve, oil reservoir, pressure gauge, stainless steel air inlet valve, and piping designed to control the closing speed of the last 10% of travel in 1-5 seconds. A threaded brass dashpot bushing unit with a grease fitting for lubrication shall connect the cylinder to the valve and shall have an air gap to prevent hydraulic fluid from entering the valve and contaminating the water system. A snubber rod fitted with O-ring seals and rod wiper scrapers shall make contact with the lower portion of the disc's stainless steel strike plate.
- J. Manufacturer shall demonstrate a minimum of five (5) years experience in the manufacture of resilient, flexible disc check valves with air and hydraulic cushions. All valves shall be hydrostatically tested and seat tested to demonstrate zero leakage. When requested, the manufacturer shall provide test certificates, dimensional drawings, parts list drawings, and operation and maintenance manuals. The exterior and interior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy coating.
- K. Flexible Disk Check Valves shall be: Swing-Flex Series #500 by Val-Matic Valve & Mfg. Corp.; KenFlex Resilient Hinged Check Valve by Clow Valve Co; Mueller Figure 13.12 Flexible Disk Check Valve, or approved equivalent.

2.7 HOSE BIBBS

- A. Hose bibbs shall be angle hose valves of bronze construction suitable for 125 psi minimum working pressure. Valves shall have a renewable Teflon or resilient disc and shall be furnished with a ¾-inch male hose outlet connection. Body and bonnet shall be ASTM B62 bronze. Valves shall be furnished with a suitable cap and chain. Inlet connection shall be threaded per ANSI B2.1.

2.8 MANUAL VALVE OPERATORS

- A. All gate valves shall be furnished with manual operators as follows, unless otherwise shown or specified:

1.	Buried	Extension stem and valve box with standard operating nut
2.	Submerged or Located In Deep Vault operator	Extension stem with floor stand and handwheel
- B. Operating nuts for buried or submerged valves shall be standard 2-inch-square nuts and shall conform to AWWA C500, Section 19. Extension stems, valve boxes, and stem guides shall be furnished where shown, specified, or required for proper operation.
- C. Manual rotary operators for buried or submerged service shall be totally enclosed and completely sealed to prevent the entrance of water and dirt. Buried or submerged

operators shall be finished on the outside with a bituminous or other approved coating. Rotary operators for buried or submerged service shall be capable of withstanding 300 foot-pounds of torque on the operating nut or handwheel. A corrosion-resistant, dial type valve position indicator shall be provided at the operating nut on the extension stem of buried operators to provide a remote indication of valve position.

- D. All manual rotary and lever operators shall be capable of seating or unseating the valve disc under the most adverse conditions in the particular application with not more than an 80-pound pull on the handwheel or lever. Valve operators shall be capable of holding the valve in any position between fully open and fully closed without creeping or fluttering. Operators shall be provided with adjustable, mechanical, stop-limiting devices to prevent over-travel of the valve disc in the open and closed positions. Manual rotary and lever operators shall comply with all applicable requirements of AWWA C540, Sections 11.1, 11.2, and 11.3.

2.9 VALVE BOXES

- A. All buried valves shall be provided with three-piece, cast iron, extension sleeve type valve boxes suitable for the depth of cover shown on the Drawings.
- B. Valve boxes shall not be less than 5 inches in diameter, shall have a minimum thickness of 3/16 inch at any point, and shall be provided with suitable cast iron bases and covers. Covers shall have cast thereon an appropriate name designating the service for which the valve is intended ("W" for water, "S" for drain or waste lines). Covers in roadways shall be of the deep locking type.
- C. All parts of valve boxes, bases, and covers shall be heavily coated with a suitable bituminous finish.
- D. Valves and boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves with the top of the box flush with the finished grade.
- E. Valve box lids shall be provided with the word "Water" embossed in the lid surface.

PART 3 - EXECUTION

3.1 FACTORY TESTS

- A. Test all valves at the point of manufacture for proper and unobstructed operation and for leakage and adequacy of design.
- B. Test iron body gate valves in accordance with AWWA C500, Section 5.
- C. Test butterfly and plug valves in accordance with AWWA C504, Section 5.
- D. Test iron body check valves in accordance with AWWA C508, Section 5.
- E. All other valves shall be given an operation test, a leakage test at rated pressure differential, and a hydrostatic test at two times rated pressure. During the hydrostatic test, there shall be no leakage through the metal, the end joints, or the shaft or stem seal, nor shall any part be permanently deformed. During the leakage test, leakage shall not exceed that permitted by ANSI B16.104, Class IV for metal seated valves and Class VI for resiliently seated valves.

3.2 INSTALLATION

- A. Install all valves in strict conformance with the Drawings and approved shop drawings and manufacturer's instructions.
- B. Install all underground valves using a concrete valve box with cast iron frame and cover or in a cast iron valve box as specified herein.
- C. Install valves in such a way that operators and packing are easily accessible. Valves with field replaceable seats shall be installed with sufficient clearance to permit removal of valve bonnet and stem without removing valve from the line.
- D. New valves shall be installed as part of all water main extensions, replacements, and system improvements as required to provide proper system isolation, maintenance access, and operational control, in accordance with CCUD standards and approved plans.
- E. Existing valves that are found to be inoperable, damaged, leaking, buried, or otherwise non-functional during construction activities shall be replaced with new valves meeting the requirements of these Specifications, as directed by CCUD.
- F. All valves shall be installed in accessible locations, set to proper grade, and provided with valve boxes or vaults as specified. Valves shall be fully operable at the time of project acceptance.
- G. Replacement of existing valves may be required where necessary to maintain system reliability, isolate new construction, or support future maintenance operations.
- H. Valves that cannot be exercised or located during construction shall be considered non-functional unless proven otherwise.
- I. Final determination of valve locations, spacing, and replacement requirements shall be made by CCUD or its Engineer.

3.3 FIELD TESTING

- A. Following installation, test all valves under the anticipated operating conditions. The ability of the valves to operate properly without leakage, binding, sticking, fluttering, or excessive operating torque shall be demonstrated to the satisfaction of the Engineer. At Developer or contractor's expense, adjust and/or replace any valve as necessary to ensure satisfactory operation.

END OF SECTION

SECTION 33 12 19

HYDRANTS

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all materials, labor, and equipment required to furnish, install, and test fire hydrants and yard hydrants and accessories as specified herein and/or shown on the Drawings.

1.2 QUALITY ASSURANCE

- A. The manufacturer of the fire hydrants shall furnish a written certification to the Engineer that all hydrants furnished comply with all applicable requirements of AWWA C502, latest edition.

PART 2 - PRODUCTS

2.1 FIRE HYDRANTS

- A. Fire hydrants shall be of M & H dry-barrel, compression type hydrants and shall conform to the applicable requirements of AWWA C502, latest edition. Fire hydrants shall be cast iron, bronze mounted, suitable for a working pressure of 150 psi. The name of the manufacturer and size of the main valve shall be cast upon the hydrant in raised letters.
- B. Hydrants shall be constructed in a manner that will permit withdrawal of internal working parts without disturbing the barrel or casing. Valve shall be compression type, opening against pressure and so constructed that the main valve will remain closed should the hydrant be broken off by traffic accident. Valve opening shall be at least 5¼ inches in diameter and shall have a net area of waterway at the smallest part of not less than 120 percent of the valve opening when the valve is wide open. There shall be no chattering or water hammer under any conditions of operation.
- C. Barrel shall be made in two pieces with flanged joint above the finished grade or ground line. Lower barrel shall be fluted for strength and tapered to prevent frost heave. Ground live flange shall be of the break-away type. Two positive acting, bronze fitted drain valves shall be provided in the hydrant shoe automatically to open and provide rapid and complete drainage of the hydrant barrel when the main valve is closed.
- D. Hydrant bonnet shall be designed to protect the operating head against rust, corrosion, and dirt. The stuffing box shall be bronze glands and O-ring seal. Suitable means shall be provided for lubricating the stem threads. O-ring, and bearing surfaces in the bonnet.
- E. The main valve rod shall be of steel and shall be bronze sheathed where it passes through the stuffing box. Stem shall be equipped with a two-piece safety or breakable stem coupling to prevent damage to the stem when hydrant is hit by a vehicle. A positive stop shall be provided to permit full opening of the valve and prevent overtravel of the stem.

- F. Direction of opening shall be counterclockwise and shall be cast on the head. Operating nut shall be National Standard, 1½-inch, pentagon shaped.
- G. Two 2½-inch hose nozzles and one 4½-inch pumper nozzle shall be provided on each hydrant. Hose and pumper nipples shall be of bronze or noncorrosive metal, and threads shall be National Standard in accordance with NFPA Standard No. 1963. Nipple caps shall be securely chained to the barrel with galvanized, non-kinking chains.
- H. Hydrants that are to be connected to ductile iron pipe shall be equipped with mechanical joint inlet with gland, gaskets, bolts, and nuts. Suitable ringtight or fluidtight inlets shall be provided on hydrants that are to be connected to cement asbestos pipe. Inlet bell shall have two lugs for harness restraint.
- I. After fabrication, all exterior above-ground ferrous surfaces shall be blast-cleaned and painted at the shop with one coat of zinc chromate primer conforming to Federal Specification TT-P-636 and one coat of compatible alkyd enamel. Color shall be fire hydrant red. All interior and below ground, nonmachined ferrous surfaces shall be blast-cleaned and painted at the shop with two coats of asphaltic varnish conforming to Federal Specification TT-V-51c.
- J. Fire hydrants shall be as manufactured by Mueller, M&H (Dresser), Kennedy, or equal.

2.2 YARD HYDRANTS

- A. Yard hydrants shall be nonfreezing, compression, post type hydrant with self-draining barrel suitable for 150 psi working pressure.
- B. Yard hydrants shall have a cast iron bonnet and base, bronze seats, resilient-faced disc, O-ring stem seal, bronze or stainless steel stem, and galvanized steel barrel.
- C. Furnish yard hydrants with 1-inch threaded inlet connection per ANSI B2.1 and threaded 1-inch male outlet hose connection with suitable cap and chain. Furnish a ball-wheel handle to operate the valve.
- D. All internal working parts shall be readily accessible and removable through the top for ease of maintenance.
- E. Shop prime and paint hydrant in accordance with Part 2.1 I. of this section.

2.3 BLOW-OFF HYDRANTS

- A. Blow-off hydrants shall be full draining and shall have a 2-inch inlet, 2½-inch nozzle with cap, locking valve, and brass working parts.
- B. Hydrants shall be designed for underground installation in a meter box. Internal working parts shall be accessible through the top for ease of maintenance.
- C. Hydrant shall be Kupferle Main Guard No. 78, or approved equal.

PART 3 - EXECUTION

3.1 FACTORY TESTING

- A. Each hydrant shall be tested at the factory at a hydrostatic pressure of 300 psig in accordance with AWWA C502, Section 5. Hydrants shall be tested in both the open and closed positions. Hydrants shall be completely drained and closed before shipment.

3.2 INSTALLATION

- A. Hydrants shall be installed at the locations and in the manner shown on the Drawings. Hydrants shall be inspected, cleaned, and tested for operation prior to installation.
- B. Fire hydrants shall be isolated from the water supply main with a buried gate valve not less than 6 inches in size. Hydrants shall be installed in a suitable rock drain and anchored against thrust as shown on the Drawings. Upper barrel joint shall be located approximately 2 inches above ground level. Barrel extensions shall be furnished as necessary.
- C. Isolate each yard hydrant from the water supply by a 1-inch curb stop as shown on the Drawings.
- D. After installation, each valve shall be tested in the presence of the Engineer for proper operation and leaktightness. Any leaks shall be corrected.
- E. Following installation and testing, exposed ferrous surfaces of hydrants shall be field painted in accordance with CCUD's standard hydrant color scheme. Flow-based color coding shall not be required unless specifically directed by CCUD.

END OF SECTION

SECTION 33 13 00

DISINFECTION OF POTABLE WATER LINES AND WATER STORAGE TANKS

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, materials, and chemicals required to disinfect all potable water lines and water storage tanks in accordance with the procedures specified herein.
- B. Disinfect all distribution system piping and any surfaces that shall be in contact with potable water, upon completion of the construction and installation of equipment.
- C. No portion of new work shall be placed in service until disinfection has been completed and approved by the Engineer. Should the initial treatment fail to result in acceptable water, the chlorination procedure shall be repeated until satisfactory results are obtained.

1.2 STANDARDS

- A. Procedures for disinfecting potable water lines, unless otherwise modified herein, shall conform to the requirements of AWWA C651-23.
- B. Procedures for disinfecting water storage facilities, unless otherwise modified herein, shall conform to the requirements of AWWA C652.

PART 2 - PRODUCTS

2.1 DISINFECTION AGENT

- A. The disinfection agent shall be liquid chlorine, calcium hypochlorite, or sodium hypochlorite. The agent shall not be introduced into the line in a dry solid state.

PART 3 - EXECUTION

3.1 DISINFECTION PROCEDURE

- A. Disinfect all pipelines which will carry potable water, non-potable water, or hot water. Before acceptance of piping system operation, each section of completed pipeline shall be disinfected in accordance with ANSI/AWWA C651-23. Acceptable methods include: Tablet/Granule Method of Chlorination, Continuous-Feed Method of Chlorination, Slug Method of Chlorination, and Spray Disinfection for Large Transmission Lines. The method of application and type of disinfecting agent shall be acceptable Engineer.
- B. After pressure tests have been made, the piping section to be disinfected shall be thoroughly flushed at a minimum of 3.0 ft/s with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be liquid chlorine, calcium hypochlorite, or sodium hypochlorite. The

treated water shall be retained in the pipe long enough to destroy all non-spore-forming bacteria. Except where a shorter period is approved by the Engineer, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. All valves on the lines being disinfected shall be opened and closed several times during the contact period. The main should be flushed as soon as possible with clean water until the residual chlorine is reduced to less than 1.0 ppm, because prolonged exposure to high concentrations of chlorine might damage the asphaltic seal coating. During the flushing period, each outlet on the line shall be opened and closed several times.

- C. Bacteriological Test: The contractor is responsible for obtaining a clean bacteriological test from an approved laboratory. The report must be sent to the Engineer for review and documentation.

3.2 BACTERIOLOGICAL SAMPLING

- A. For new mains, the purchaser shall perform bacteriological testing for total coliform analysis by the following method:
 - 1. Before approving a main for release, collect two consecutive sets of samples from each location, taken at least 16 hours apart, as required by AWWA C651-23, Section 6.1. Both sets of samples must pass for the main to be approved for release.
- B. For new mains, sets of samples shall be collected every 1,200 ft (370 m) of the new water main, plus one set from the end of the line and at least one from each branch greater than one pipe length. Chlorine residual and bacteriological sample requirements must be met at all designated sample locations. Samples shall be collected in sterilized containers and have a bacterial examination performed by a commercial laboratory in accordance with the state approved methods. The commercial laboratory must be certified by the state's approving authority for examination of potable water. The disinfection shall be repeated until the piping system passes the bacterial examination for 2 consecutive days. The piping system will not be accepted until satisfactory bacteriological results have been obtained.
- C. If trench water has entered the main or if, in the opinion of the purchaser or engineer, excessive quantities of dirt or debris have entered the main, the section shall be flushed and then chlorinated by the continuous-feed or slug method of chlorination. The Tablet Method is prohibited if trench water or debris has entered the pipe.
- D. In the process of chlorinating newly constructed units and newly installed pipe, all valves or other appurtenances shall be operated at least five times while the units and pipelines are filled with the chlorinating agent.
- E. A standard heterotrophic plate count (HPC) test may be required at the option of the purchaser because new mains do not typically contain coliform bacteria but often contain HPC bacteria. If sample results show HPC greater than 500 colony-forming units (CFU)/mL (or 500 most probable number [MPN]/mL), flushing should resume (and re-disinfection if required by the purchaser) and another set of HPC and coliform samples collected until no coliform are present and the HPC is less than 500 CFU/mL (or 500 MPN/mL).

3.3 SAMPLING PROCEDURE

- A. Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate, in accordance with Section 9060—Samples of Standard Methods for the Examination of Water and Wastewater. Hydrants shall not be used for bacteriological sampling unless explicitly approved by the Engineer and only if no sampling tap is available. When used, the hydrant shall be thoroughly cleaned, flushed, and free of standing water. Preference shall be given to dedicated, sanitized sample taps installed for this purpose. A suggested combination blowoff and sampling tap used for mains up to and including 8-in. (200-mm) diameter. There should be no water in the trench up to the connection for sampling. The sampling pipe must be dedicated and clean and disinfected and flushed prior to sampling. A corporation cock may be installed in the main with a copper-tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use and the corporation cock should be capped or taped for future reuse. If corporation cocks are placed at the 12 o'clock position, they may be struck more easily during future excavations.
- B. Samples shall be tested for bacteriological quality in accordance with Standard Methods for the Examination of Water and Wastewater and shall show the absence of total coliform bacteria and *Escherichia coli*.
- C. In addition, it is recommended that samples be tested for acceptable aesthetic quality (e.g., chlorine residual [free and/or total], pH, temperature, alkalinity, specific conductance, turbidity). Levels should be as expected or typical for the water system. For new mains, a standard HPC test may be required as referenced in Sec. 3.2(F).

3.4 RECORD OF COMPLIANCE

- A. The record of compliance shall be the bacteriological test results certifying that the water sampled is free of coliform bacteria contamination.

3.5 REDISINFECTION.

- A. If the initial disinfection fails to produce satisfactory bacteriological results or if other results indicate unacceptable water quality, the main may be reflushed and then shall be resampled. If samples collected after reflush fail to produce acceptable results, the main shall be rechlorinated by the continuous-feed or slug method until satisfactory results are obtained—that being acceptable samples taken as described in Sec. 3.2(A).
- B. In the case of new mains, high velocities in the adjacent existing system, resulting from flushing the new main, may disturb sediment that has accumulated in the existing mains. When check samples are taken, it is advisable to sample water entering the new main to determine if excessive turbidity is present that could be interfering with results.

3.6 OPTIONAL SAMPLING AND TESTING

- A. If a pipeline is not promptly returned to service, the situation should be evaluated to determine if the water quality may have been impacted and if additional testing and further action, such as but not limited to flushing and disinfection, is warranted. Test results should confirm that the water quality is appropriate for distribution. Although

this assessment is unique for each system, parameters considered for testing include disinfectant residual, total coliform bacteria, E. coli, HPC, turbidity, pH, alkalinity, total chlorine, odor, and specific conductance.

END OF SECTION

DIVISION 40

PROCESS INTEGRATION

SECTION 40 05 13.53

DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes furnishing all labor, equipment, and materials required to furnish, install, and test ductile iron piping, including all fittings, wall pipe and sleeves, couplings, tappings, anchor blocks, and accessories, as specified herein and/or shown on the Drawings.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

- B. American National Standards Institute/American Water Works Association (ANSI/AWWA) Publications

- | | |
|--------------------------|--|
| 1. ANSI/AWWA C104/A21.4 | Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water |
| 2. ANSI/AWWA C105/A21.5 | Polyethylene Encasement for Ductile-Iron Pipe Systems |
| 3. ANSI/AWWA C110/A21.10 | Ductile Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids |
| 4. ANSI/AWWA C111/A21.11 | Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |
| 5. ANSI/AWWA C115/A21.15 | Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges |
| 6. ANSI/AWWA C116/A21.16 | Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service |
| 7. ANSI/AWWA C150/A21.50 | Thickness Design of Ductile-Iron Pipe |
| 8. ANSI/AWWA C151/A21.51 | Ductile-Iron Pipe, Centrifugally Cast, for Water |
| 9. ANSI/AWWA C153/A21.53 | Ductile-Iron Compact Fittings, 3-inch through 24-inch and 54-inch through 64-inch, for Water Service |
| 10. ANSI/AWWA C600 | Installation of Ductile-Iron Water Mains and Their Appurtenances |

- C. American Society of Mechanical Engineers/ American National Standards Institute (ASME/ANSI) Publications

1. ASME/ANSI B16.1-98

Cast Iron Flanges and Flanged Fittings

D. National Association of Pipe Fabricators (NAPF) Publications

1. NAPF 500-03-01

Solvent Cleaning

2. NAPF 500-03-04

Abrasive Blast Cleaning of Ductile Iron Pipe

1.3 QUALITY ASSURANCE

- A. Submit to the Engineer written evidence that the pipe furnished under this Specification is in conformance with the material and mechanical requirements specified herein. Certified copies of independent laboratory test results or mill test results from the pipe supplier may be considered evidence of compliance provided such tests are performed in accordance with the appropriate ASTM or AWWA testing standards by experienced, competent personnel. In case of doubt as to the accuracy or adequacy of mill tests, the Engineer may require that the Contractor furnish test reports from an independent testing laboratory on samples of pipe materials.
- B. Clearly mark each ductile iron pipe length and fitting with the pressure rating, metal thickness class, heat mark, net weight (excluding lining or coating), and name of the manufacturer. In addition, each item of piping shall be marked with an identifying mark corresponding to the appropriate mark on the shop drawings for that particular item of piping.

1.4 SHOP DRAWINGS AND ENGINEERING DATA

- A. Submit complete shop drawings and engineering data on all piping and accessories to the Engineer in accordance with the requirements of Section 01 33 23 - Shop Drawings, Product Data, and Samples.
- B. Shop drawings shall indicate piping layout in plan and elevations as may be required and shall be completely dimensioned. The Drawings shall include a complete schedule of all pipe, fittings, specials, hangers, and supports. Special castings shall be clearly detailed showing all pertinent dimensions.
- C. Furnish the Engineer with lists, in duplicate, of all pieces of pipe and fittings in each shipment received. These lists shall give the serial or mark number, weight, class, size, and description of each item received.

1.5 STORAGE AND PROTECTION

- A. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports. Items such as pipe, structural steel, and sheet construction products shall be stored with one end elevated to facilitate drainage.

1.6 SHOP PAINTING

- A. All ductile iron pipe and fittings shall be cleaned and provided with a bituminous coating and cement lining applied at the factory, unless otherwise specified herein.

1.7 GUARANTEE

- A. Provide a guarantee against defective materials and workmanship in accordance with the requirements of Section 01 78 36, Warranties and Bonds.

1.8 ACCEPTABLE MANUFACTURERS

- A. Ductile iron pipe and fittings must be the products of member companies of the Ductile Iron Pipe Research Association (DIPRA). Products from manufacturers who are not DIPRA member companies shall not be utilized in the work covered by these Specifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. No broken, cracked, deformed, misshapen, imperfectly coated, or otherwise damaged or defective pipe or fittings shall be used. All such material shall be removed from the site of the work.
- B. Minimum pipe wall thickness and pressure class of pipe shall be as follows, unless otherwise shown on the Drawings or directed by the Engineer:

<u>Pipe Size</u>	<u>Pressure Class (psi)</u>	<u>Metal Wall Thickness in Inches</u>
3-Inch Ductile Iron	350	0.25
4-Inch Ductile Iron	350	0.25
6-Inch Ductile Iron	350	0.25
8-Inch Ductile Iron	350	0.25
10-Inch Ductile Iron	350	0.26
12-Inch Ductile Iron	350	0.28
14-Inch Ductile Iron	350	0.31
16-Inch Ductile Iron	350	0.34
18-Inch Ductile Iron	300	0.34
20-Inch Ductile Iron	300	0.36
24-Inch Ductile Iron	250	0.37
30-Inch Ductile Iron	250	0.42
36-Inch Ductile Iron	250	0.47
42-Inch Ductile Iron	250	0.52
48-Inch Ductile Iron	250	0.58
54-Inch Ductile Iron	250	0.65
60-Inch Ductile Iron	250	0.68
64-Inch Ductile Iron	250	0.72

2.2 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be designed in accordance with ANSI/AWWA C150/A21.50, using 60,000-psi tensile strength, 42,000-psi yield strength, and 10 percent elongation. Additionally, ring bending stress is limited to 48,000 psi to provide a 2.0 safety factor based upon ultimate bending stress.
- B. Ductile iron pipe shall be manufactured in accordance with ANSI/AWWA C151/A21.51, and shall be made of ductile iron having a minimum tensile strength of 60,000 psi, a minimum yield strength of 42,000 psi, and 10 percent minimum elongation.

2.3 DUCTILE IRON FITTINGS

- A. All fittings shall conform in every respect to ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53.
- B. All fittings shall be for pressure rating of 250 psi, unless otherwise shown on the Drawings, directed, or specified.
- C. Flanged fittings, in general, shall be ANSI pattern using long radius elbows except where space limitations prohibit the use of same. Design of all fittings, whether long or short pattern, shall be as indicated or dimensioned on the Drawings. Special fittings, wall pipes, and sleeves shall conform to the dimensions and details shown on the Drawings.

2.4 JOINTS FOR DUCTILE IRON PIPE AND FITTINGS

A. General

- 1. Joints for ductile iron pipe and fittings shall be mechanical joints, flanged joints, push-on joints, or bell and spigot joints, as shown on the Drawings or specified herein.
- 2. All ductile iron pipe laid underground shall be joined using mechanical joints or push-on type joints, unless otherwise shown on the Drawings, specified, or directed.
- 3. Joints for ductile iron pipe used for horizontal directional drilling (HDD) shall be flexible restrained joints, as shown on the Drawings or specified herein.
- 4. All mechanical and push-on joints in underground piping shall be restrained against thrust using external joint restraint, such as the EBAA MEGALUG Series, Sigma One-Lok, or approved equal. Alternately, the Contractor may use restrained joint pipe such as US Pipe TR-Flex or American Flex-Ring pipe in lieu of external joint restraint.

B. Mechanical Joints

- 1. Mechanical joints shall consist of a bolt joint of the stuffing box type as detailed in ANSI/AWWA C110/ A21.10 and described in ANSI/AWWA C111/A21.11.
- 2. Mechanical joints shall be thoroughly bolted in accordance with the manufacturer's recommendations with Tee Head Bolts and bolts of high strength, low-alloy steel having a minimum yield point strength of 40,000 psi and an ultimate tensile strength of 70,000 psi.
- 3. Gaskets, bolts, and nuts shall conform to ANSI/AWWA C111/A21.11. Gaskets shall be of neoprene or rubber of such quality that they will not be damaged by the liquid or gases with which they will come into contact.
- 4. Glands shall be of high strength ductile iron.

C. Flanged Joints

- 1. Flanged joints shall conform to ANSI/AWWA C115/A21.15, 250 psi for water service.

2. Special flanged joints shall conform to ASME/ANSI B16.1, Class 250, in accordance with Table 10.23 of ANSI/AWWA C110/A21.10.
3. Flanged joints shall be bolted with through stud or tap bolts of required size as directed. Bolts and nuts shall conform in dimensions to the American Standard heavy series. Nuts shall be hexagonal, cold pressed. Bolts and nuts shall be cadmium plated, cold pressed, steel machine bolts, conforming to ASTM A 307, Grade B. Cadmium plating shall be by an approved process and shall be between 0.003 and 0.0005 inch thick.
4. Gaskets shall be full face type, 1/8 inch thick, conforming to the requirements of ANSI/AWWA C111/A21.11. Gaskets in air piping shall be suitable for operating temperatures of up to 250° F.
5. Flanges on ductile iron pipe shall be screw type. Pipe threads shall be of such length that with flanges screwed home, the end of the pipe shall project beyond the face line of the flange. Flange and pipe shall then be machined to give a flush finish to the pipe and the flange and surface shall be normal to the axis of the pipe. Ductile iron flanges shall be of such design that the flange neck completely covers the threaded portion of the pipe to protect same against corrosion. All pipe with screw type flanges shall be assembled, faced, and drilled at the point of manufacture, unless otherwise approved by the Engineer.
6. Where tap or stud bolts are required, flanges shall be drilled and tapped accordingly.

D. Push-On Joints

1. Push-on joints shall conform to ANSI/AWWA C111/A21.11. Details of the joint design shall be in accordance with the manufacturer's standard practice.
2. Gaskets shall be in accordance with ANSI/AWWA C111/A21.11 and shall be of such quality that they will not be damaged by the liquid or gases with which they will come into contact.

E. Flexible Restrained Joints (for Horizontal Directional Drilling (HDD))

1. Joints used for HDD shall be boltless, flexible restrained, with smooth contoured bells. Joints with bulky glands or flanges that may prevent the smooth flow of drilling fluid/soil slurry over the joint are not acceptable.
2. Joint seals and joint used for HDD, when properly assembled and installed, shall be capable of dependably handling the specified internal pressure and pulling loads, in straight alignment or at maximum rated joint deflection, required for the project.

2.5 PIPE COATING AND LINING

- A. All ductile iron pipe and fittings buried underground shall have a standard bituminous outside coating conforming to ANSI/AWWA C151/A21.51. All exposed or immersed ductile iron pipe and fittings shall have an outside shop prime coat of epoxy coating, Tnemec Series 20 Pota-Pox (or approved equal) at 4 to 6 mils DFT and two additional coats of Tnemec Series 20 at 4 to 6 mils DFT per coat. Total minimum DFT of coating system shall be 12 mils. Total maximum DFT shall not exceed 18 mils.

- B. All ductile pipe used for water shall have cement mortar lining of standard thickness in accordance with ANSI/WWA C104/A21.4. Cement mortar lining for ductile iron fittings shall be double the standard thickness under ANSI/WWA C104/A21.4
- C. Surface preparation of ductile and/or cast iron prior to coating application shall be in accordance with the following:
 - 1. Immersion, Interior and Exterior Exposed: Solvent cleaning and abrasive blast cleaning in accordance with NAPF 500-03-01 and -04, respectively. Abrasive blasting shall achieve an anchor pattern or blast profile as recommended by the coatings manufacturer.
 - 2. Field Preparation of Shop Primed Surfaces: Solvent cleaning in accordance with NAPF 500-04-01. Shop primed iron surfaces which have been damaged or which show signs of corrosion shall be abrasive blasted and/or cleaned in accordance with the specifications given above for both asphaltic and non-asphaltic coating systems.

2.6 SPECIAL PIPE PROTECTION

- A. Provide polyethylene wrap protection of ductile iron piping and fittings installed underground where aggressive soils exist or where possible stray currents from cathodic protected piping or structures exist or could exist in the future.
- B. Ductile iron piping and fittings shall be continuously wrapped with a single layer (wrap) of 4-mil, high density, cross-laminated (HDCL) or 8-mil, linear low-density (LLD) polyethylene film or V-BIO Enhanced Polyethylene Encasement whenever piping system is within 10 feet of direct current protected piping or structure. Provide continuous double wrap when piping system is within 5 feet of direct current protected piping or structure.
- C. Install protective wrap in accordance with AWWA C105/A21.5-05 or manufacturer's recommendations.

2.7 PIPE COUPLINGS

- A. Pipe couplings shall be installed where shown on the Drawings, required for installation, or directed by the Engineer.
- B. Pipe couplings shall conform to the requirements of 40 05 33, Pipe Couplings and Expansion Joints.

2.8 WALL PIPE AND WALL SLEEVES

- A. Furnish and install ductile iron wall pipe or wall sleeves where ductile iron piping connects with or passes through concrete walls or floors and in locations where small piping and electric wiring and conduits connect with or pass through concrete walls or floors.
- B. Where wall pipes or sleeves are to be installed flush with the wall or slab, the flange or bell shall be tapped for studs. Where the flange or bell will project beyond the wall, the projection shall be sufficient to allow for installation of connecting bolts.

2.9 LEAD CONTENT RESTRICTIONS

- A. All ductile iron piping and fittings shall meet applicable requirements for a low lead ("lead-free") product, with a weighted average lead content of less than 0.25%, and

piping and fittings for potable water service meet the requirements of NSF/ANSI 61 and NSF/ANSI 372.

2.10 NSF CERTIFICATION REQUIREMENTS

- A. All products or materials which will contact drinking water must have NSF/ANSI Standard 61 certification; and all chemicals which will contact drinking water shall have NSF/ANSI Standard 60 certification.

2.11 SPARE PARTS

- A. Furnish 4 spare gaskets for each size and type of joint requiring the use of a gasket. Furnish 8 bolts and nuts of each size and type used for ductile iron pipe joints.

PART 3 - EXECUTION

3.1 LAYING

- A. Proper and suitable tools and appliances for safe and convenient handling and laying of pipe and fittings shall be used. Great care shall be taken to prevent the pipe coating from being damaged, particularly cement linings on the inside of the pipes and fittings. Any damage shall be remedied as directed by the Engineer.
- B. Carefully examine all pipe and fittings for defects just before laying and no pipe or fitting shall be laid which is defective. If any defective pipe or fitting is discovered after having been laid, it shall be removed and replaced in a satisfactory manner with a sound pipe or fitting by the Contractor at his own expense.
- C. Thoroughly clean all pipes and fittings before they are laid and keep clean until they are used in the completed work. Open ends of pipe shall be kept plugged with a bulkhead during construction.
- D. Bedding and Backfill
 - 1. Ductile iron pipe shall be installed on a firm, stable, and uniform bedding. Bedding material shall consist of sand or crushed stone in accordance with Section 31 20 00 – Earthwork. Provide a minimum of 4 inches of compacted bedding beneath the pipe barrel unless otherwise shown on the approved plans.
 - 2. Initial backfill around the pipe shall be placed and compacted to provide uniform support and prevent displacement of the pipe. Backfill above the pipe springline shall comply with Section 31 20 00 – Earthwork.
- E. Pipe laid in trenches shall be laid true to line and grade on a firm and even bearing for its full length at depths and grades as shown on the Drawings. Adequate precautions shall be taken to prevent flotation of pipelines prior to backfilling. Installation of ductile iron pipe in underground pressure piping systems shall conform to the requirements of AWWA C600.
- F. All ductile iron piping laid underground shall have a minimum of 36 inches of cover above the top of the pipe unless otherwise shown on the Drawings.
- G. All elbows, tees, branches, crosses, and reducers in pressure piping systems shall be adequately restrained against thrust. Underground pressure piping shall be

restrained against thrust by mechanically restrained joints. Install restraints in accordance with manufacturer's recommendations. Install number of restraints recommended by manufacturer for size of pipe, type of fitting, and type of soil or as shown on the Drawings.

- H. All ductile iron pipes entering buildings or basins shall be adequately supported between the structure and undisturbed earth as shown on the Drawings to prevent breakage resulting from settlement of backfill around the structure.
- I. Wall pipe and wall sleeves shall be accurately located and securely fastened in place before concrete is poured. All wall pipe and wall sleeves shall have wall collars properly located to be in the center of the wall where the respective pipes are to be installed.
- J. Wall pipe and wall sleeves shall be installed when the wall or slab is constructed. Blocking out or breaking of the wall for later insertion shall not be permitted.
- K. Cutting or weakening of structural members to facilitate pipe installation shall not be permitted. All piping shall be installed in place without springing or forcing.
- L. Sufficient couplings and flanged joints shall be provided to facilitate equipment installation and removal.
- M. Exposed ductile iron piping shall be supported as shown on the Drawings.

3.2 CUTTING

- A. Whenever pipe requires cutting to fit the lines, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe. When a piece of pipe is cut to fit into the line, no payment will be made for the portion cut off and not used.
- B. Whenever existing pipe requires cutting to install new fittings, the work shall be done in such manner as to leave a smooth end at right angles to the axis of the pipe and special care shall be exercised to guard against breaking or splitting the existing piping.
- C. All cutting of ductile iron pipe shall be done with a cutting saw. All burrs shall be removed from the inside and outside edges of all cut pipe.

3.3 JOINING

A. Mechanical Joints

- 1. The successful operation of the mechanical joint specified requires that the spigot be centrally located in the bell and that adequate anchorage be provided where abrupt changes in direction and dead ends occur.
- 2. The surfaces with which the rubber gasket comes in contact shall be brushed thoroughly with a wire brush just prior to assembly to remove all loose rust or foreign material which may be present and to provide clean surfaces which shall be brushed with a liberal amount of soapy water or other approved lubricant just prior to slipping the gasket over the spigot end and into the bell. Lubricant shall be brushed over the gasket prior to installation to remove loose dirt and lubricate the gasket as it is forced into its retaining space.
- 3. Joint bolts shall be tightened by the use of approved wrenches and to a tension recommended by the pipe manufacturer. When tightening bolts, it is essential

that the gland be brought up toward the pipe flange evenly, maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This may be done by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, and last, the remaining bolts. This cycle shall be repeated until all bolts are within the range of acceptable torques. If effective sealing is not attained at the maximum torque indicated above, the joint shall be disassembled and reassembled after thorough cleaning. Overstressing of bolts to compensate for poor installation shall not be permitted.

4. After installation, bolts and nuts in buried piping shall be coated with 1 coat of Roskote Mastic A-51 by Royston or approved equal.

B. Flanged Joints

1. All flanges shall be true and perpendicular to the axis of the pipe. Flanges shall be cleaned of all burrs, deformations, or other imperfections before joining. Flanged joints shall be installed so as to ensure uniform gasket compression. All bolting shall be pulled up to the specified torque by crossover sequence. Where screwed flanges are used, the finished pipe edge shall not extend beyond the face of the flange, and the flange neck shall completely cover the threaded portion of the pipe.
2. Connections to equipment shall be made in such a way that no strain is placed on the equipment flanges. Connecting flanges must be in proper position and alignment and no external force may be used to bring them together properly.

C. Push-On Joints and Flexible Restrained Joints

1. The inside of the bell and the outside of the pipe from the plain end to the guide stripe must be wiped clean immediately before assembling the pipe joint. Then the rubber gasket shall be inserted into a groove or shaped recess in the bell. Both the bell and spigot ends to be joined shall be wiped again to ensure they are thoroughly clean. A liberal coating of special lubricant furnished by the pipe manufacturer shall be applied to the outside of the pipe from the plain end to the yellow guide stripe and to the inside of the gasket. The plain end shall be centered in the bell and the spigot pushed home. Wherever possible the pipe shall be socketed by hand; however, jacking may be required to push the spigot in place on the larger sizes of pipe. The completed joint shall be permanently sealed and watertight. For flexible restrained joints, follow manufacturer's instructions for joint assembly.
2. Whenever the pipe is cut in the field, the cut end shall be conditioned so it can be used in making up a joint by filing or grinding the cut end to remove burrs or sharp edges that might damage the gasket.

D. Permissible Deflection of Joints

1. Deflection of ductile iron pipe at joints for long radius curves or for avoiding obstacles shall be permitted only upon approval of the Engineer.
2. Where deflection of push-on or mechanical joints is permitted, such deflection shall be made in accordance with and shall not exceed 80 percent of the maximum deflection angle provided in Tables 3 and 4 of AWWA C600-05.

3. Where deflection of flexible restrained joints is permitted or necessary for pipe installation during horizontal directional drilling, such deflection shall not exceed 50 percent of the maximum deflection angle provided in Table 3 of AWWA C600.

- E. Joints of Dissimilar Metals. When a flanged joint consists of a ductile iron flange mated to a steel or alloy flange, the steel flanges shall be flat-faced and furnished with full-faced gaskets, insulating bushings, and stainless steel bolts.

3.4 SERVICE CONNECTIONS

- A. Small service lines and branches shall connect to larger ductile iron mains using ductile iron tapped tees and crosses, in general and unless otherwise shown.
- B. Tapped tees and crosses shall have minimum 2-inch NPT branch connections and shall be furnished with mechanical joint ends.

3.5 CUT-INS TO EXISTING PIPING

- A. Cut-ins to existing ductile iron piping for installation of new mechanical joint fittings and valves shall be made using ductile iron cutting-in sleeves, in general and unless otherwise shown.
- B. Cutting-in sleeves shall have a pressure rating not less than that of the existing pipeline and shall be furnished with a mechanical joint end on one end and a plain end on the other.

3.6 DRILLING AND TAPPING

- A. Wherever required, ductile iron pipe and fittings shall be drilled and tapped to receive drainage or any other piping. All holes shall be drilled accurately at right angles to the axis of any pipe or fitting. Where plugs are drilled, holes shall be at right angles to the face of the plug.
- B. Where the size of the pipe to be connected is such as to require bosses for connection and when the pipe wall thickness is too thin to permit the effective length of pipe threads to be utilized as necessary for the size pipe being connected by threads, furnish such pipe with cast-on bosses suitable for drilling, tapping, and connecting such pipe. Alternately, where shown or specified, a tapped saddle clamp may be used in lieu of a cast-on boss. Saddle clamp shall be of the heavy-duty type with O-ring gaskets and 2 heavy U-bolt clamps.
- C. All tapping shall be carefully and neatly done by skilled workmen with suitable tools.
- D. Where connections are made between new and old piping, the connections shall be made in a thorough and workmanlike manner using proper fittings and specials to suit actual conditions.
- E. Cut-ins to existing and operating pipelines shall be done at times agreeable to the Owner upon approval of the Engineer.
- F. Existing pipelines that may be cut or damaged during the performance of work under this item shall be repaired, reconnected, and returned to service in equal or better condition in which they were found and in accordance with the requirements of this Specification.

- G. No separate payment will be made for drilling, tapping, making connections, cut-ins, repairs to damaged existing pipelines, and reconnections in existing pipelines.

3.7 AIR RELIEF AND FLUSHING

- A. Expel all air from the pipe before applying the specified hydrostatic test. If hydrants, blow-offs, or air release valves are not available at the high points, make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- B. Thoroughly flush the lines after expelling all the air to remove foreign material in the pipe during installation. Flush the lines at hydrants and blow-offs to maintain a minimum velocity in the main of 2.5 fps.

3.8 HYDROSTATIC TESTING

- A. After all piping has been placed, backfilled, and flushed, each run of newly laid pipe, or any valved section thereof, shall be tested by the Contractor in the presence of the Engineer, and tests shall be continued until all leaks have been made tight to the satisfaction of the Engineer.
- B. All piping shall be subject to a hydrostatic gauge pressure equal to 150 percent of the maximum operating pressure of the pipe section under test or 150 psig, whichever is greater, based on the elevation of the lowest point of the section of pipe under test and corrected to the elevation of the test gauge. The test shall be maintained for a minimum of two consecutive hours. The test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed gate or butterfly valves.
- C. The specified test pressure shall be applied by means of a pump connected to the pipe.
- D. Allow the system to stabilize at the test pressure before conducting the test.
- E. The hydrostatic test (AWWA C600) shall be based upon leakage and pressure. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.
 - 1. Allowable leakage: No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133200}$$

Where: L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per Square inch (gauge)

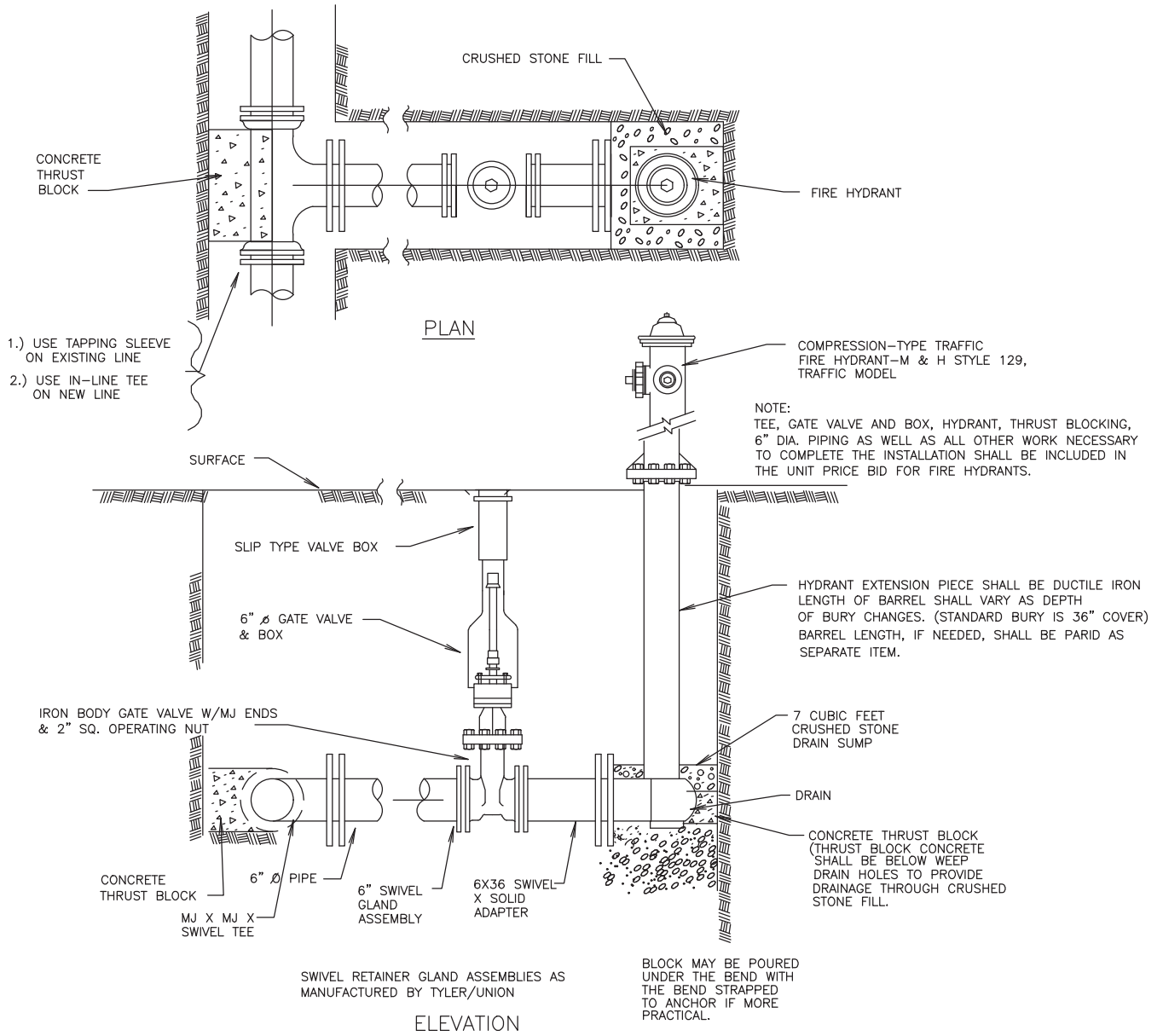
This formula is based on an allowable leakage of 11.65 gpd/mi/in. of nominal diameter at a pressure of 150 psi.

2. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/h/in. of nominal valve size shall be allowed.
 3. When hydrants are in the test section, the test shall be made against the main valve in the hydrant.
- F. Acceptance of Installation. Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified, repairs or replacements shall be corrected at the Contractor's expense by tightening, replacing packing or gaskets, or replacing defective portions of the piping system. Caulking will not be permitted. If the defective portion cannot be located, the Contractor, at his expense, shall remove and reconstruct as much of the original work as necessary to obtain an acceptable installation.
- G. All visible leaks are to be repaired regardless of the amount of leakage.
- H. The Contractor shall bear the complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, water, and any other materials required to conduct the tests.
- 3.9 DISINFECTION
- A. Potable water lines shall be disinfected in accordance with the requirements of Section 33 13 00, Disinfection of Potable Water Lines and Water Storage Tanks, following installation and testing.
- 3.10 DISCHARGE OF CHLORINATED WATER
- A. Water for testing or flushing must be dechlorinated or held in detention basins or otherwise discharged in such a manner that chlorinated water is not discharged into waters of the State.

END OF SECTION

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CALHOUN-CHARLESTON



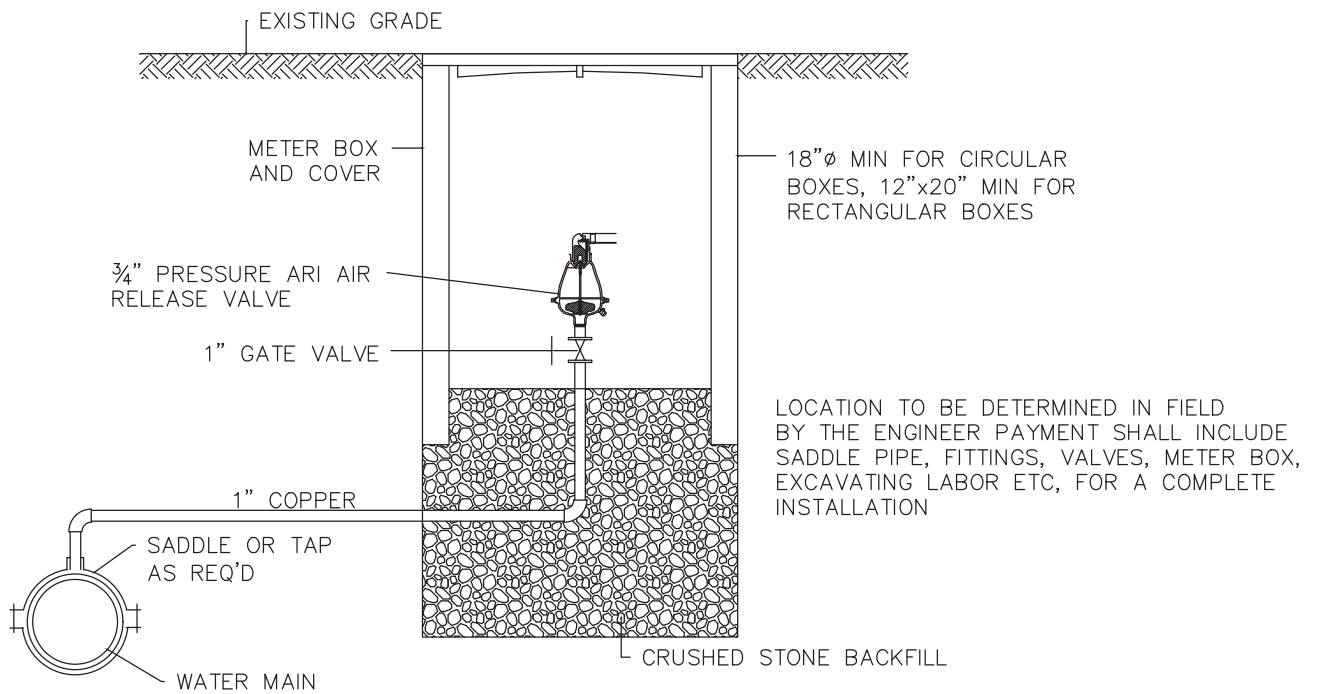
UTILITY DISTRICT

STANDARD WATER DETAIL

**FIRE HYDRANT
INSTALLATION DETAIL**
NOT TO SCALE



**CALHOUN-CHARLESTON
UTILITY DISTRICT**



CALHOUN-CHARLESTON



UTILITY DISTRICT

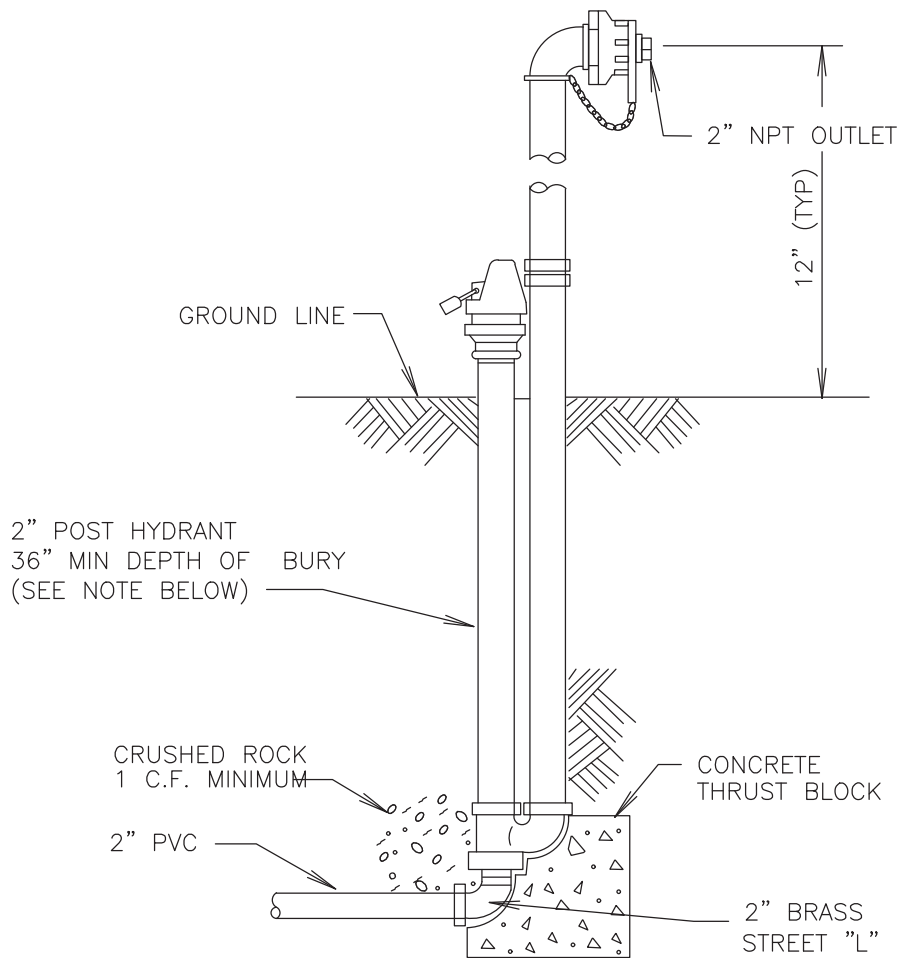
STANDARD WATER DETAIL

ARI AIR RELEASE VALVE DETAIL

NOT TO SCALE



CALHOUN-CHARLESTON
UTILITY DISTRICT



2" BLOW-OFF DETAIL

NOT TO SCALE

NOTE: HYDRANTS SHALL BE NON-FREEZING, SELF-DRAINING TYPE WITH A 36" BURY. PROVIDE WITH 2" FIP INLET, NON-TURNING OPERATING ROD. HYDRANT SHALL OPEN TO THE LEFT. ALL WORKING PARTS SHALL BE OF BRONZE-TO BRONZE DESIGN, AND BE SERVICEABLE FROM ABOVE GRADE WITH NO DIGGING. THE OUTLET SHALL ALSO BE BRONZE AND BE 2-1/2" NST. HYDRANTS SHALL BE LOCKABLE TO PREVENT UNAUTHORIZED USE. POST HYDRANT SHALL BE MODEL NO. 77 AS MANUFACTURED BY KUPFERLE FOUNDRY CO., ST. LOUIS, MO., OR APPROVED EQUAL..

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UTILITY DISTRICT

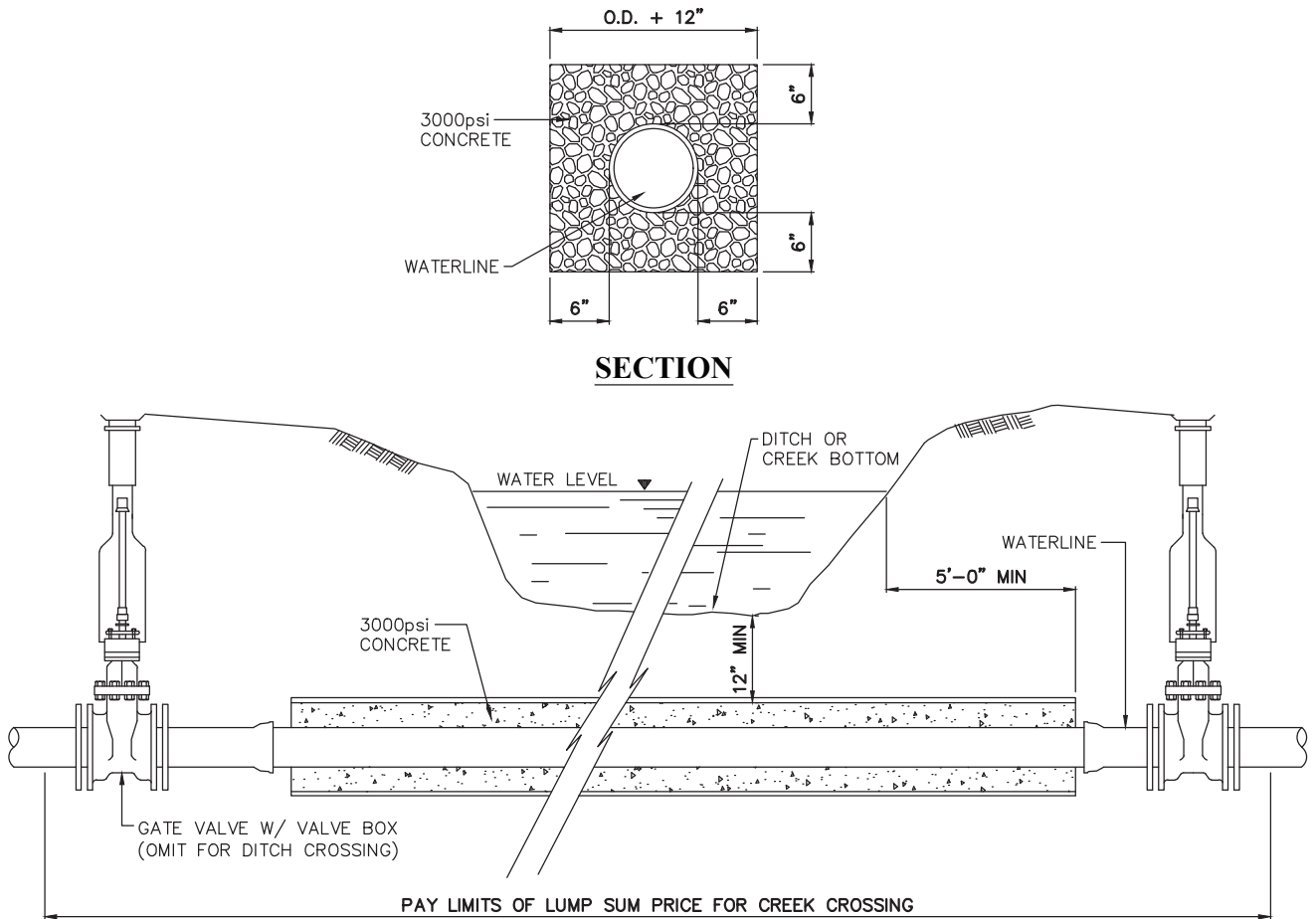
STANDARD WATER DETAIL

2" BLOW-OFF DETAIL

NOT TO SCALE



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UTILITY DISTRICT



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UTILITY DISTRICT

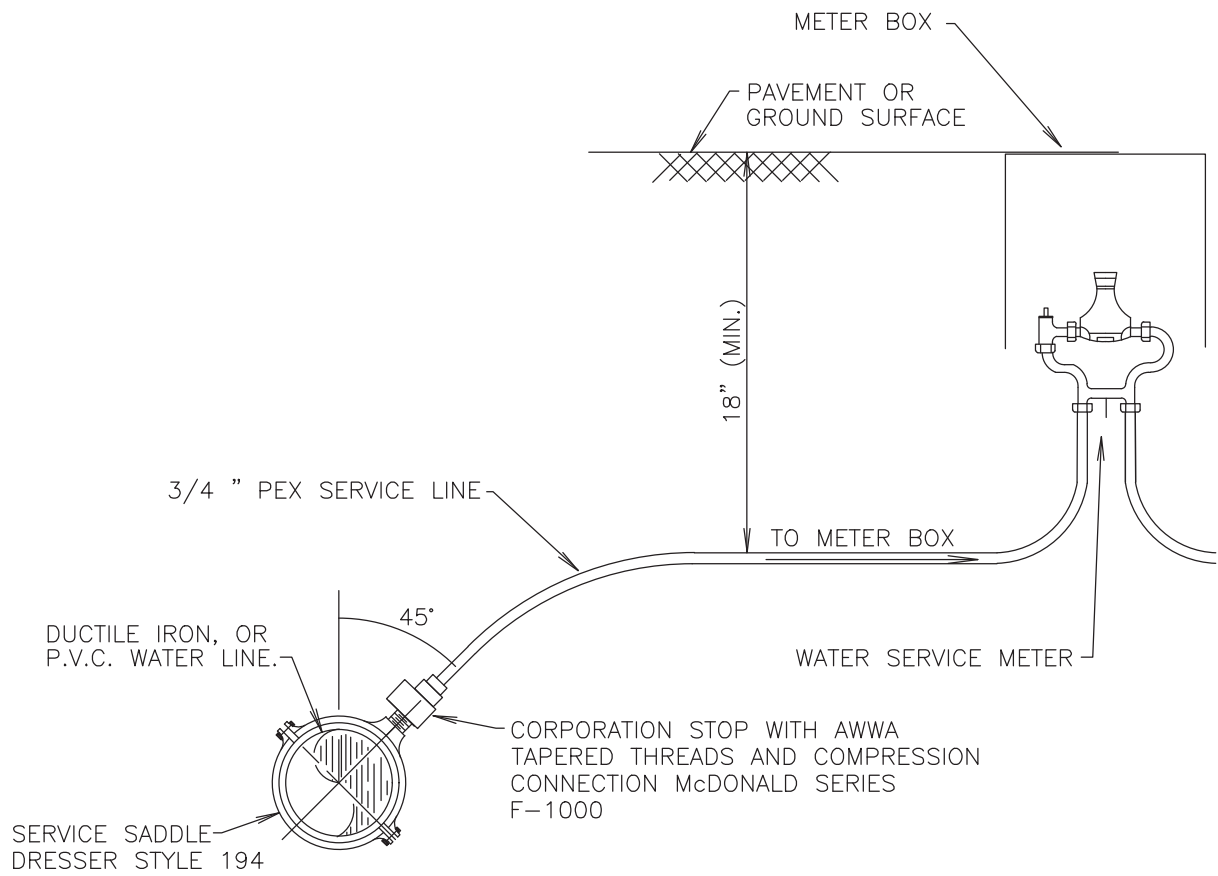
STANDARD WATER DETAIL

**CREEK OR DITCH
CROSSING DETAIL**

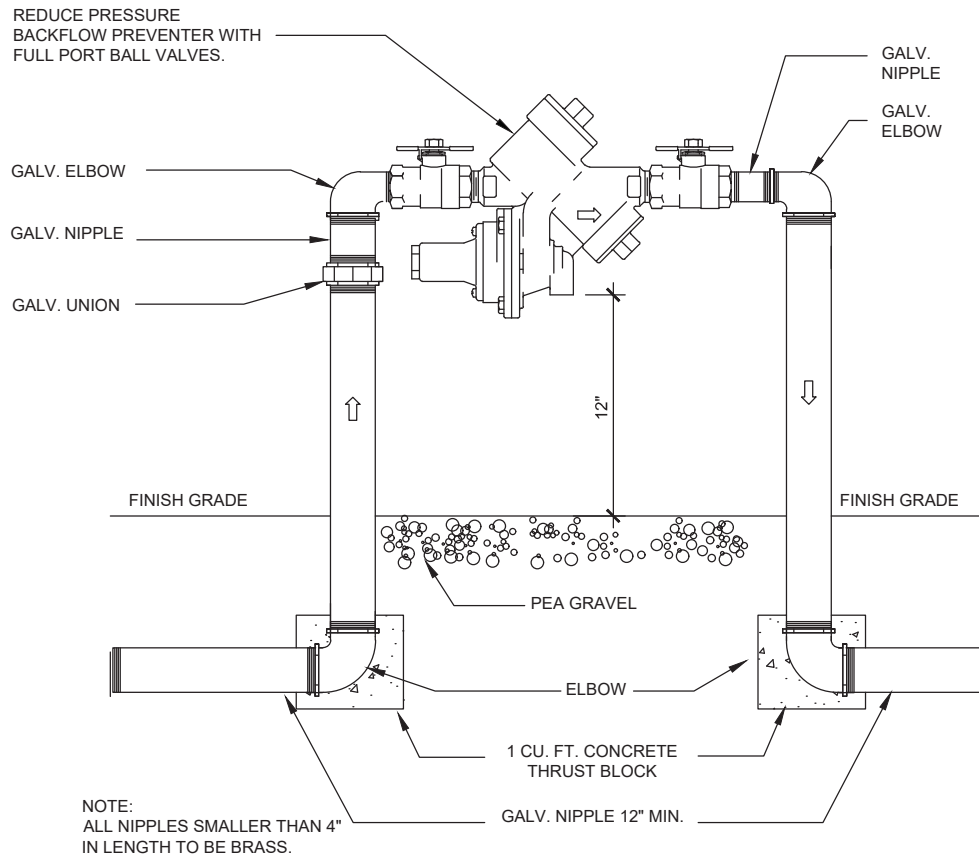
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**CALHOUN-CHARLESTON
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(METERS 1" AND SMALLER)



1/2"=1'-0"
BACKFLOW PREVENTER ASSEMBLY

CALHOUN-CHARLESTON



UTILITY DISTRICT

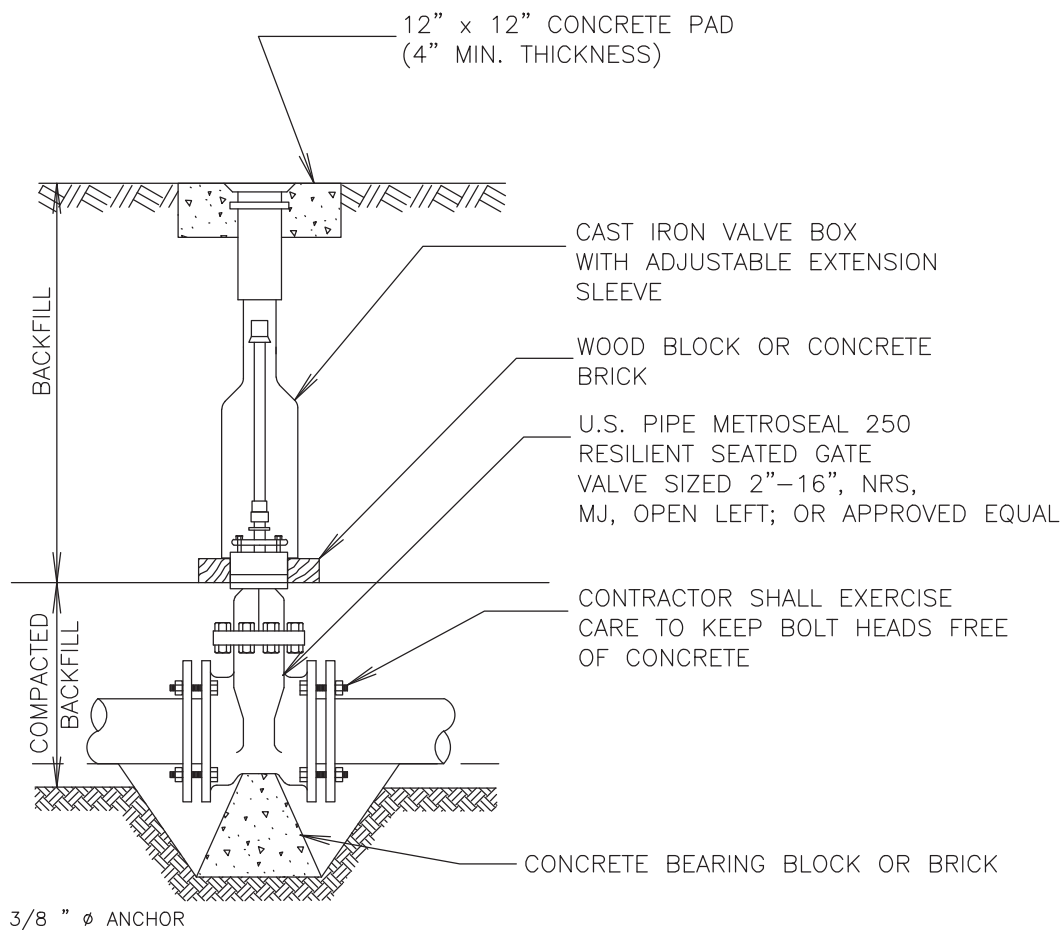
STANDARD WATER DETAIL

BACKFLOW PREVENTION DETAIL

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UTILITY DISTRICT



CALHOUN-CHARLESTON



UTILITY DISTRICT

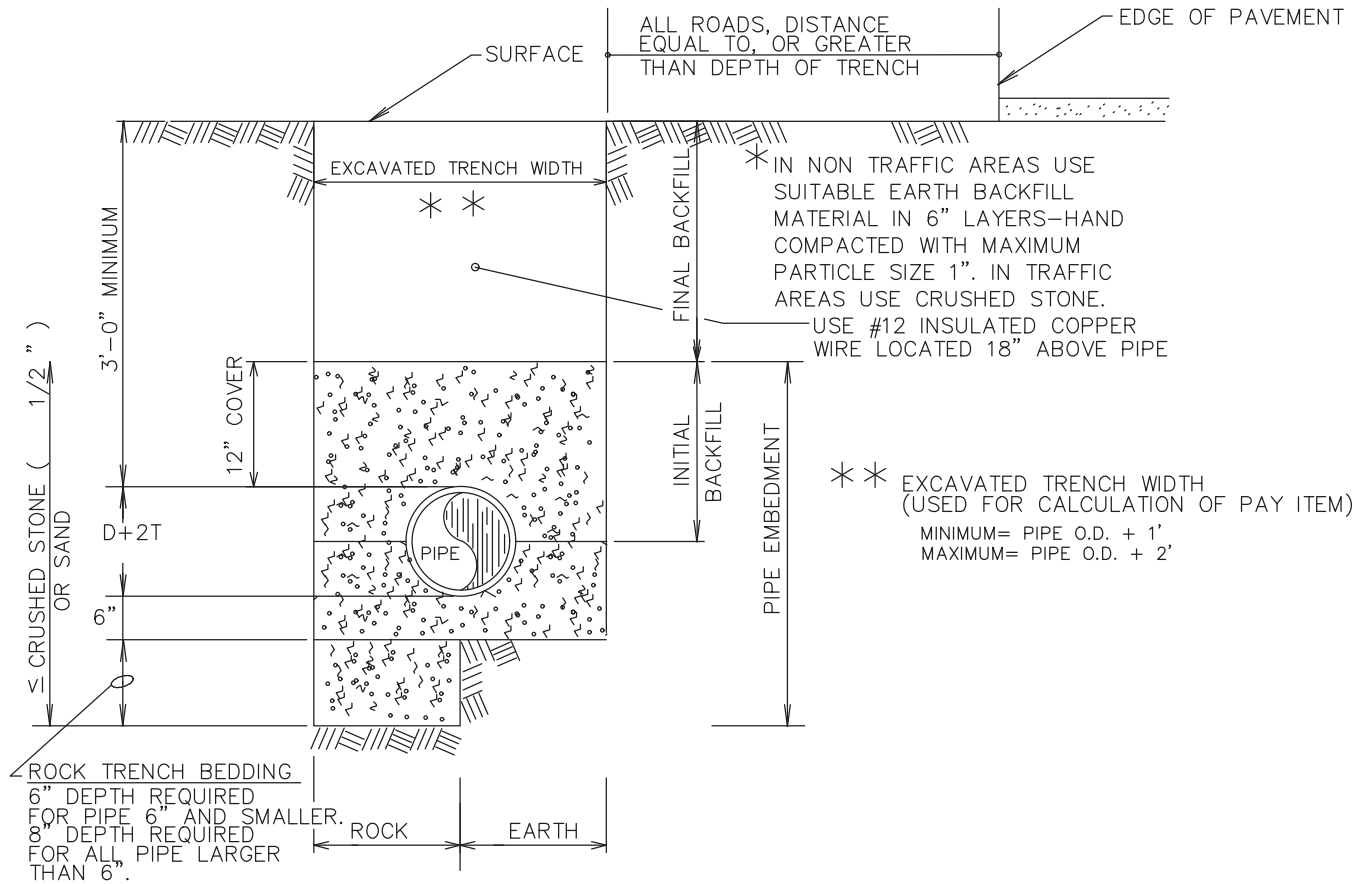
STANDARD WATER DETAIL

**GATE VALVE
INSTALLATION DETAIL**

NOT TO SCALE



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UTILITY DISTRICT

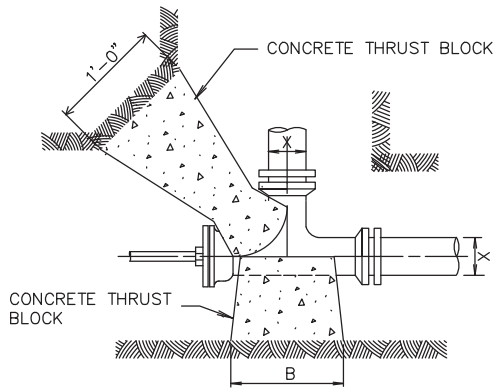
STANDARD WATER DETAIL

PVC PIPE INSTALLATION DETAIL

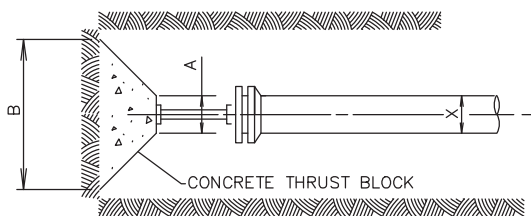
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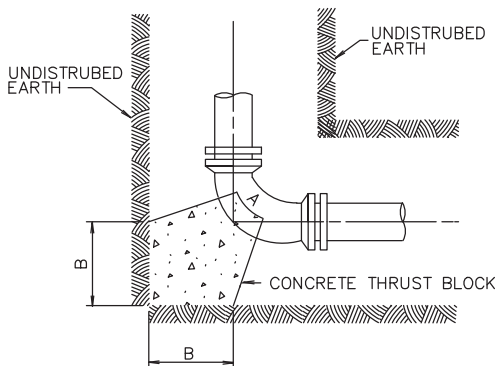
CALHOUN-CHARLESTON
UTILITY DISTRICT



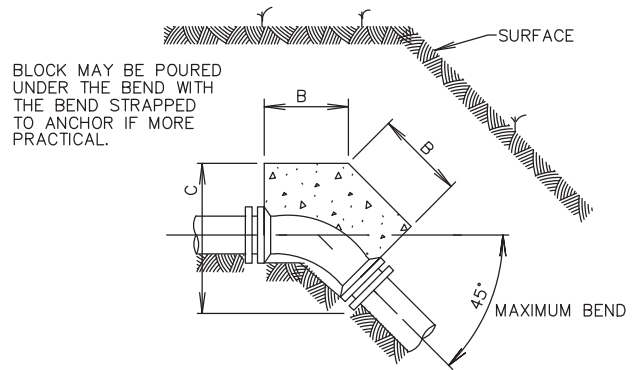
PLAN-UNBALANCED TEE
NOT TO SCALE



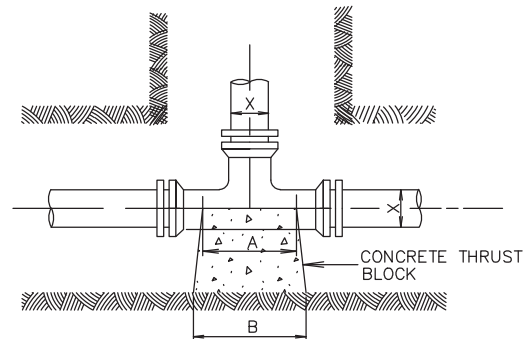
PLAN-TYPICAL PLUG
NOT TO SCALE



PLAN-TYPICAL HORIZONTAL BEND
NOT TO SCALE



PLAN-TYPICAL VERTICAL BEND
NOT TO SCALE



PLAN-TYPICAL TEE
NOT TO SCALE

TABLE OF DIMENSIONS FOR HORIZONTAL & VERTICAL BENDS

PLUG & TEE			
16"	3'-0"	3'-6"	
12"	2'-0"	4'-9"	2'-9"
10"	1'-9"	4'-0"	2'-3"
8"	1'-6"	3'-0"	2'-0"
6"	1'-0"	2'-8"	1'-6"
4"	1'-0"	2'-0"	1'-0"

PIPE SIZE X	A	B	DEPTH C
90° BEND & UNBALANCED TEE			
16"	1'-9"	4'-0"	4'-0"
12"	1'-6"	3'-0"	3'-0"
10"	1'-4"	2'-2"	3'-0"
8"	1'-0"	2'-0"	2'-0"
6"	1'-0"	1'-3"	2'-0"
4"	0'-9"	1'-0"	1'-0"
45° BEND			
16"	1'-0"	4'-4"	2'-0"
12"	1'-0"	2'-6"	2'-0"
10"	0'-9"	2'-0"	1'-9"
8"	0'-9"	1'-6"	1'-8"
6"	0'-9"	1'-0"	1'-6"
4"	0'-9"	1'-0"	1'-0"
22 1/2° BEND			
16"	1'-0"	2'-4"	2'-0"
12"	1'-0"	1'-6"	1'-9"
10"	0'-9"	1'-3"	1'-6"
8"	0'-9"	1'-0"	1'-4"
6"	0'-9"	0'-10"	1'-0"
4"	0'-9"	0'-7"	1'-0"

NOTE : ALL CONCRETE FOR THRUST BLOCKS SHALL BE READY-MIXED 3000 psi (MINIMUM) CLASS "B". MIX DESIGN SHALL BE SUBMITTED TO ENGINEER FOR APPROVAL PRIOR TO USE. THRUST BLOCKS BASED ON 225 psi & 2000lb/ft² SOIL RESISTANCE TYPICAL FOR UNDISTURBED SAND AND GRAVEL CEMENTED WITH CLAY. FOR OTHER SOILS THE BEARING OF THE THRUST BLOCKS SHOULD BE INCREASED BY THE FOLLOWING FACTORS.

SAND	1.33	2
SAND & GRAVEL		
SHALE	0.4	

SOFT CLAY, MUCK AND PEAT SHALL USE RESTRAINED JOINTS IN LIEU OF THRUST BLOCKS.

CALHOUN-CHARLESTON



UTILITY DISTRICT

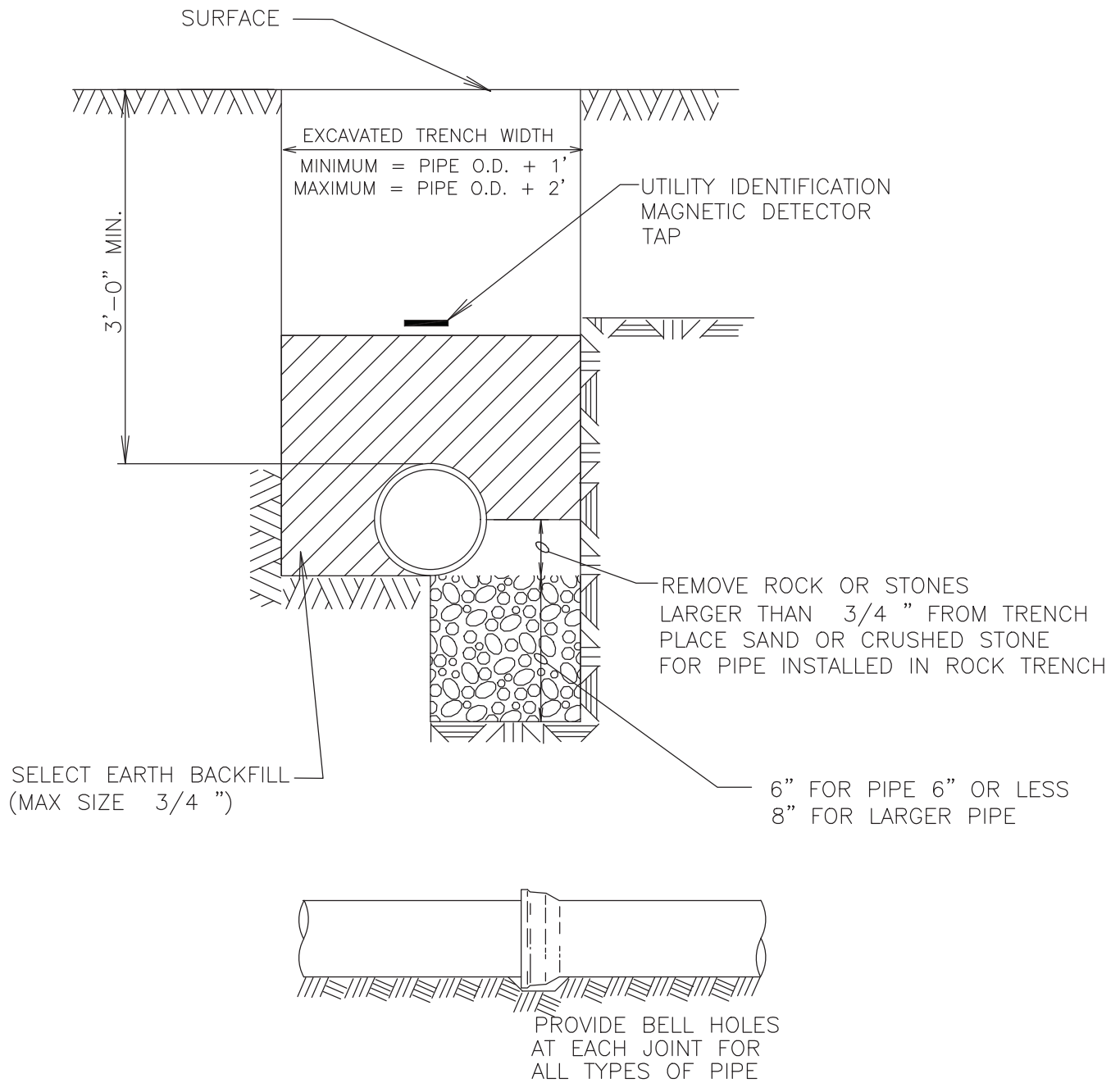
STANDARD WATER DETAIL

THRUST BLOCK DETAIL

NOT TO SCALE



CALHOUN-CHARLESTON
UTILITY DISTRICT



CALHOUN-CHARLESTON



UTILITY DISTRICT

STANDARD WATER DETAIL

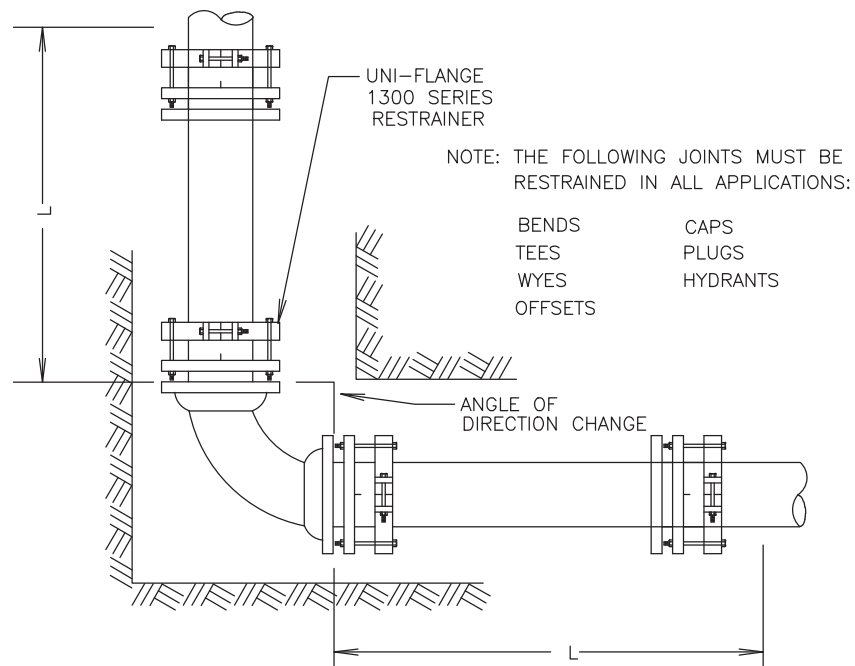
**DUCTILE IRON PIPE
 INSTALLATION DETAIL**

NOT TO SCALE



**CALHOUN-CHARLESTON
 UTILITY DISTRICT**

10



PLAN

NOM. PIPE SIZE	L= MINIMUM LENGTH TO BE RESTRAINED ON EACH SIDE OF FITTING (FT.) *																			
	CLAY					COHESIVE GRANULAR MAT.					SAND					SILT, MUCK, PEAT				
	ELBOWS (DEG.)				VALVES TEES DEAD ENDS	ELBOWS (DEG.)				VALVES TEES DEAD ENDS	ELBOWS (DEG.)				VALVES TEES DEAD ENDS	ELBOWS (DEG.)				VALVES TEES DEAD ENDS
	11 1/2	22	1/4	45 90		11 1/2	22	1/4	45 90		11 1/2	22	1/4	45 90		11 1/2	22	1/4	45 90	
2	1	2	3	5	4	2	3	4	7	6	2	3	5	8	6	2	4	6	11	9
3	2	2	4	7	5	3	4	5	9	7	3	4	7	10	8	3	5	8	13	10
4	2	3	5	8	6	3	5	7	11	8	3	5	8	12	9	4	6	11	17	13
6	3	4	6	9	7	4	6	9	14	10	4	6	10	15	11	4	6	10	15	11
8	3	5	7	10	8	4	7	11	19	13	4	7	13	20	14	5	10	16	26	18
10	4	6	9	13	11	5	10	15	22	15	5	9	15	25	18	6	11	20	32	22
12	4	8	11	15	13	6	11	17	26	18	6	10	17	29	21	7	14	24	39	27

* RESTRAIN JOINT BEYOND MINIMUM LENGTH.

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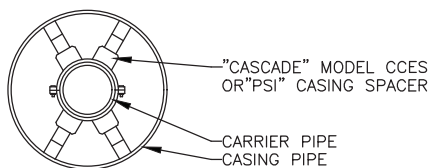
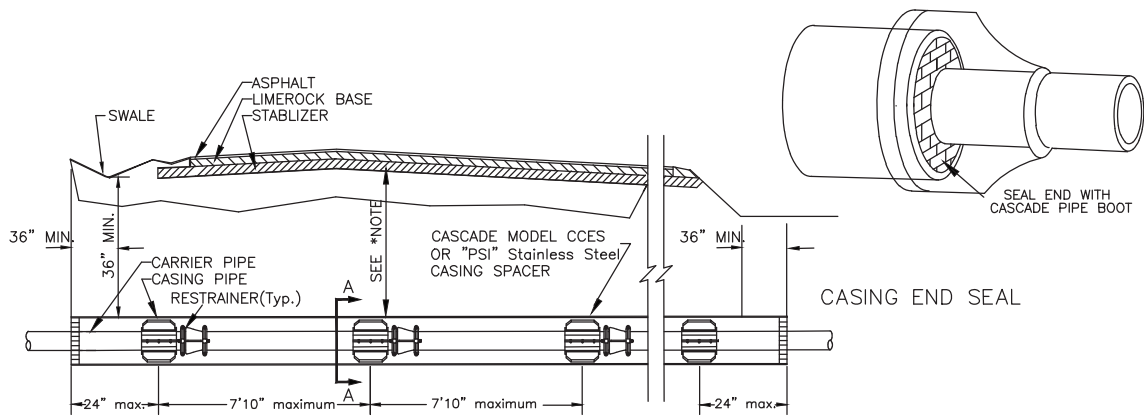
STANDARD WATER DETAIL

RESTRAINED JOINT DETAIL

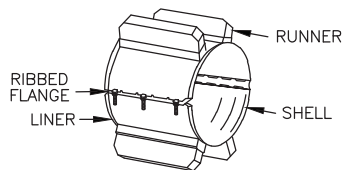
NOT TO SCALE



**CALHOUN-CHARLESTON
UTILITY DISTRICT**



SECTION "A-A"



SPACER

STANDARD NO. OF RUNNER REQ'D.

UP TO 14" CARRIER PIPE	- 4 REQ'D.
OVER 14" THROUGH 36" CARRIER PIPE	- 6 REQ'D.
OVER 36" THROUGH 48" CARRIER PIPE	- 7 REQ'D.

CARRIER PIPE DIA. (IN.)	CASING (IN.)	MIN. STDS. HIGHWAY THICKNESS (IN.)	INTERSTATE & RAILWAY THICKNESS (IN.)
2	4	3/16"	1/4"
4	10	1/4"	1/4"
6	12	1/4"	1/4"
8	14	1/4"	5/16"
10	16	1/4"	5/16"
12	20	1/4"	3/8"
14	24	1/4"	7/16"
16	24	1/4"	7/16"
18	30	5/16"	1/2"
20	30	5/16"	1/2"
24	36	3/8"	9/16"
30	42	1/2"	9/16"
36	48	1/2"	9/16"

*NOTE:

UNDERGROUND CROSSINGS REQUIRE A MINIMUM VERTICLE CLEARANCE OF 48" BELOW PAVEMENT SURFACE FOR FREEWAYS, 48" FOR OTHER HIGHWAYS OR 36" BELOW UNPAVED GROUND INCLUDING DITCH GRADE PER G.D.O.T.

STAINLESS STEEL SPACERS

SPACERS SHALL BE BOLT-ON STYLE WITH A TWO PIECE SOLID SHELL OR A MINIMUM 14 GA. MILD STEEL THICKNESS. THE SHELL SHALL BE LINED WITH A RIBBED PVC SHEET OF 0.090" THICKNESS THAT OVERLAPS THE EDGES. RUNNERS MADE FROM UHMW POLYMER, SHALL BE ATTACHED TO RISERS AT APPROPRIATE POSITIONS TO PROPERLY LOCATE THE CARRIER WITHIN THE CASING AND TO EASE INSTALLATION. RISERS SHALL BE MADE FROM A MINIMUM 14GA MILD STEEL THICKNESS AND SHALL BE ATTACHED TO THE SHELL BY ELECT. WELDING. ALL WELDS SHALL BE FULLY PASSIVATED. ALL FASTENERS SHALL BE MADE FROM A MINIMUM 14GA. MILD STEEL. CASING SPACERS SHALL BE MODEL CCS AS MANUFACTURED BY "CASCADE" (Cascade Water Works Mfg. Company of Yorkville Ill.), or "PSI" (Pipeline Seal & Insulator, Inc., Houston, Texas.)

PLACEMENT OF SPACERS ON CARRIER PIPE

- 1) GENERAL- ONE SPACER SHALL BE PLACED NOT MORE THAN TWO FEET FROM EACH END OF CASING. SUBSEQUENT SPACERS SHALL BE PLACED AT 6'-10" INTERVALS WITHIN THE CASING, OR IN ACCORDANCE WITH PIPE MANUFACTURER'S RECOMMENDATIONS.
- 2) PVC CARRIER- ONE SPACER SHALL BE PLACED ON THE SPIGOT END OF EACH SEGMENT AT THE LINE MARKING THE LIMIT OF INSERTION INTO THE BELL. WHEN THE JOINT IS COMPLETE, THE SPACER SHALL BE IN CONTACT WITH THE BELL OF THE JOINT SO THAT THE SPACER PUSHES THE JOINT AND RELIEVES COMPRESSION WITHIN THE JOINT. SUBSEQUENT SPACERS SHALL BE PLACED AT 6'-0" INTERVALS, OR IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

CARRIER PIPE

CARRIER PIPE SHALL BE CENTERED WITHIN CASING BY USE OF MODEL CCS STAINLESS STEEL CASING SPACERS AS MANUFACTURED BY CASCADE WATER WORKS MFG. COMPANY OR APPROVED EQUAL. SPACERS FOR PIPES OVER 48" MAY REQUIRE THREE PIECE SHELLS. SHELL CONNECTORS ABOVE 48" WILL BE RECEIVER BAR/ WASHER PLATE TYPE.

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UTILITY DISTRICT

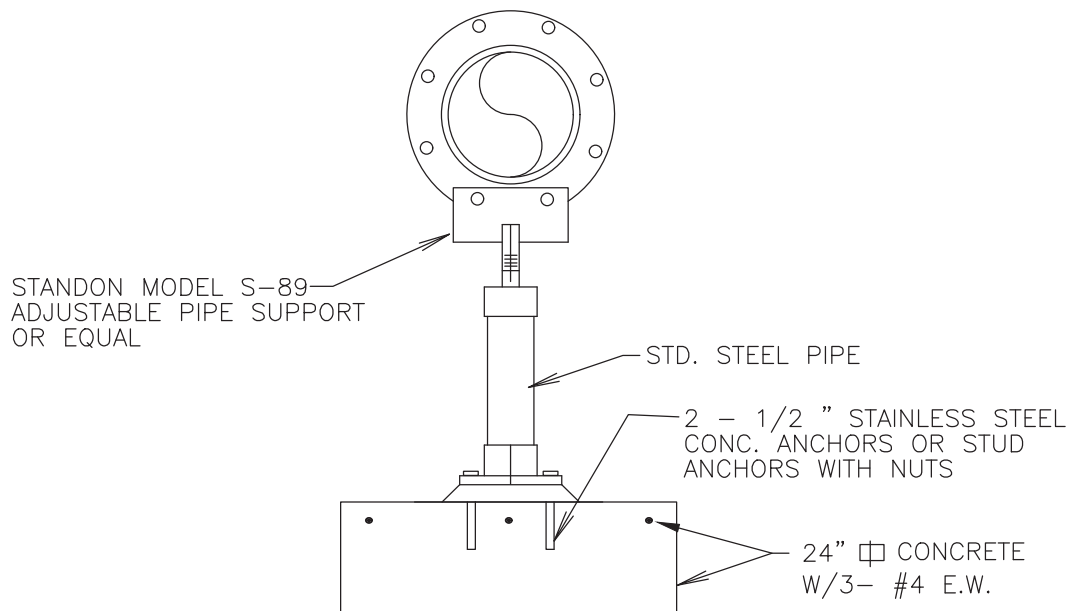
STANDARD WATER DETAIL

JACK AND BORE DETAIL

NOT TO SCALE



CALHOUN-CHARLESTON
UTILITY DISTRICT



ADJUSTABLE FLANGE PIPE SUPPORT DETAIL

NOT TO SCALE

CALHOUN-CHARLESTON



UTILITY DISTRICT

STANDARD WATER DETAIL

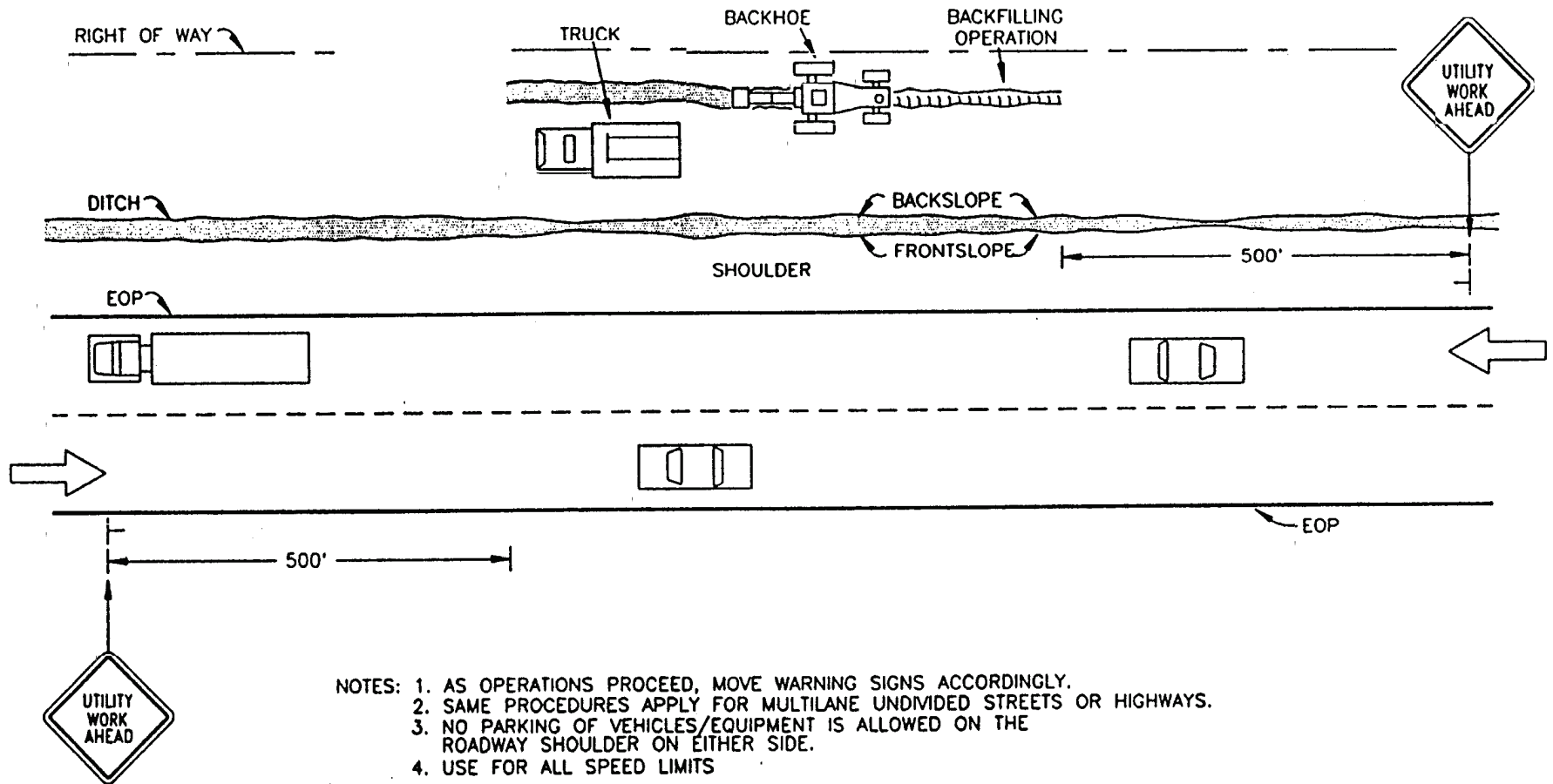
**ADJUSTABLE FLANGE
PIPE SUPPORT DETAIL**

NOT TO SCALE



CALHOUN-CHARLESTON
UTILITY DISTRICT

TWO-LANE STREET OR HIGHWAY TRAFFIC CONTROL DEVICE PLACEMENT WORK AREA BETWEEN DITCH AND BACK OF RIGHT-OF-WAY



CALHOUN-CHARLESTON



UTILITY DISTRICT

MISCELLANEOUS STANDARD DETAIL

TRAFFIC CONTROL DETAILS

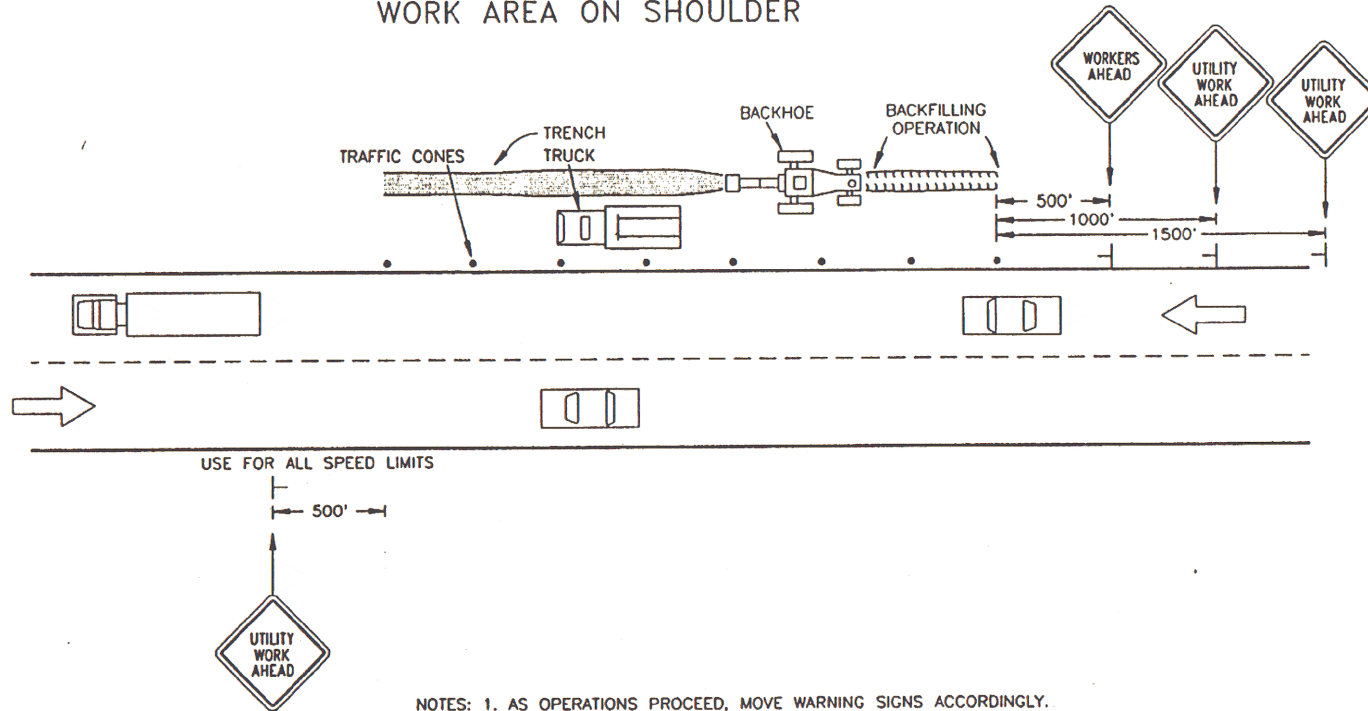
1 OF 3

NOT TO SCALE



CALHOUN-CHARLESTON
UTILITY DISTRICT

TWO-LANE STREET OR HIGHWAY TRAFFIC CONTROL DEVICE PLACEMENT WORK AREA ON SHOULDER



- NOTES: 1. AS OPERATIONS PROCEED, MOVE WARNING SIGNS ACCORDINGLY.
2. NO PARKING OF VEHICLES/EQUIPMENT IS ALLOWED ON THE ROADWAY SHOULDER OPPOSITE OF THE WORK AREA.
3. DIAGRAM SHOWN FOR SPEED LIMIT OF 55 MPH; FOR OTHER SPEED LIMITS, SEE CHART.

CONE AND WARNING SIGN SPACING AND TAPER LENGTHS					
Speed limit (mph)	Cone Spacing (ft)	Taper Length (ft)	Number of Cones Req'd	Warning Sign Spacing (ft)	Minimum Sign Size
25	25	125	6	250	36" X 36"
35	35	245	8	250	36" X 36"
45	45	540	13	500	48" X 48"
55	55	660	13	500	48" X 48"
Interstate, Expressway and Limited-Access Roadways				1000	48" X 48"
				2640	48" X 48"
				5280	48" X 48"

CALHOUN-CHARLESTON



UTILITY DISTRICT

MISCELLANEOUS STANDARD DETAIL

TRAFFIC CONTROL DETAILS

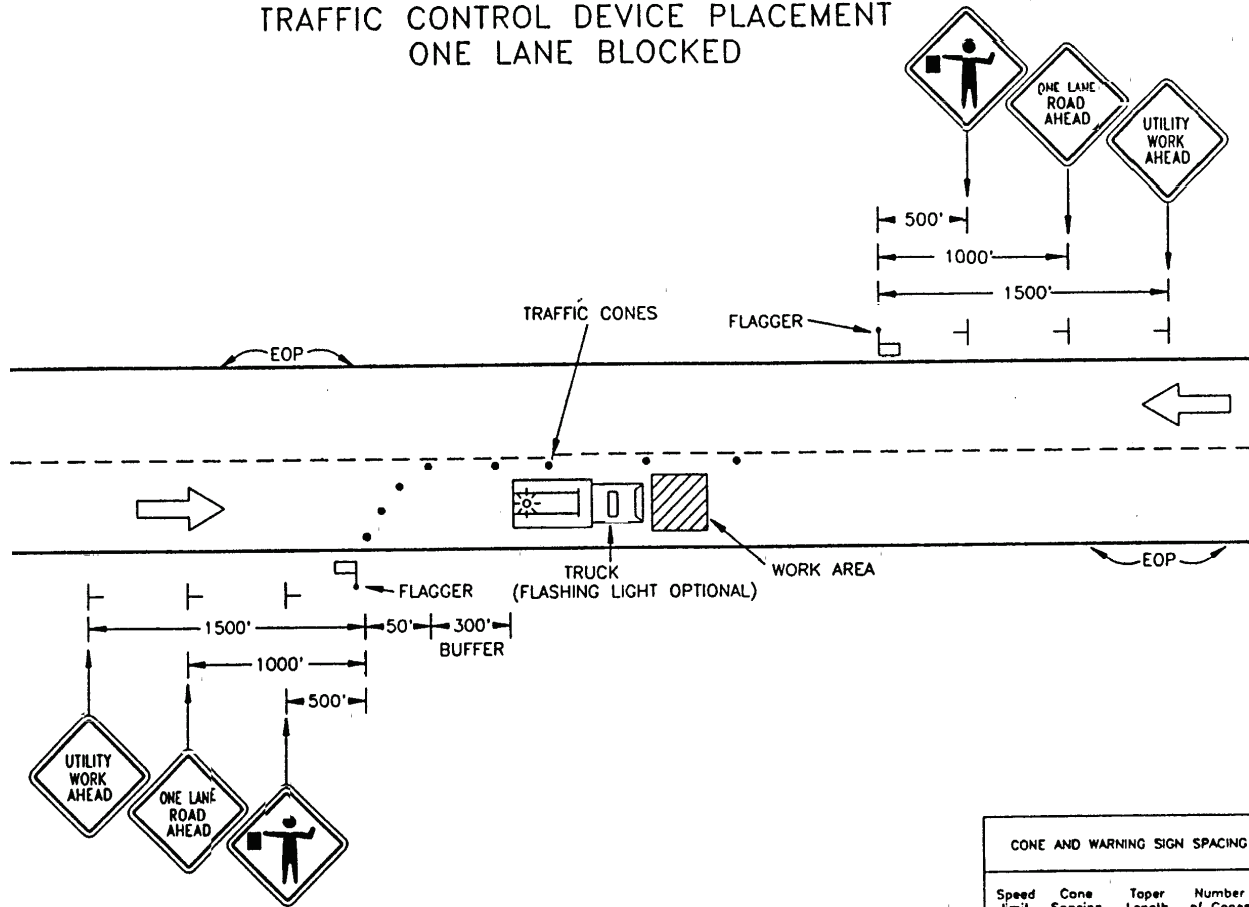
2 OF 3

NOT TO SCALE



**CALHOUN-CHARLESTON
UTILITY DISTRICT**

TWO-LANE STREET OR HIGHWAY TRAFFIC CONTROL DEVICE PLACEMENT ONE LANE BLOCKED



- NOTES:
1. NO PARKING OF VEHICLES/EQUIPMENT IS ALLOWED ON THE ROADWAY SHOULDER OPPOSITE OF THE WORK AREA.
 2. A DAYTIME OPERATION WITH GOOD VISIBILITY AND LOW-VOLUME STREET MAY USE A SINGLE FLAGGER
 3. DIAGRAM SHOWN FOR SPEED LIMIT OF 55 MPH; FOR OTHER SPEED LIMITS, SEE CHART.

CONE AND WARNING SIGN SPACING AND TAPER LENGTHS					
Speed limit (mph)	Cone Spacing (ft)	Taper Length (ft)	Number of Cones Req'd	Warning Sign Spacing (ft)	Minimum Sign Size
25	25	125	6	250	36" X 36"
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Interstate, Expressway and Limited-Access Roadways				1000	48" X 48"
				2640	48" X 48"
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CALHOUN-CHARLESTON



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MISCELLANEOUS STANDARD DETAIL

TRAFFIC CONTROL DETAILS

3 OF 3

NOT TO SCALE



CALHOUN-CHARLESTON
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