EMERALD COAST UTILITIES AUTHORITY

# Engineering Manual

## September 1, 2016

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# Division 1 – Procedures

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# Procedure 1

## Engineering Manual User's Guide

### PART 1: ECUA Background

The Emerald Coast Utilities Authority (ECUA) was originally created under the name Escambia County Utilities Authority in 1981 by an Act of the Florida Legislature to own, manage, finance, promote, improve and expand the water and wastewater systems of Escambia County and the City of Pensacola. ECUA's name was officially changed to the Emerald Coast Utilities Authority on June 29, 2004.

ECUA is a local government body, existing under the laws of the State of Florida, separate and distinct from the City of Pensacola, Escambia County, and the State of Florida. The powers of the ECUA are exercised by a five-member Board. Each member of the Board is elected in one of the five County electoral districts. ECUA is a 100% rate-driven utility and does not receive any tax revenue.

Chapter 11 of the ECUA Code formally adopts this Engineering Manual (the Manual) in order to establish the engineering procedures, design standards, and technical specifications for the design and construction of ECUA water and wastewater systems.

### PART 2: Permitting Authority

Beginning on September 15, 1992, ECUA was granted permitting authority from the Florida Department of Environmental Protection (FDEP) for water distribution mains 12 inches or less in diameter, gravity sewage collection systems 12 inches or less in diameter, sewer force mains 12 inches or less in diameter, and associated pump stations which will be connected to water and sewerage plants owned by ECUA. In 2014, the FDEP also granted ECUA permitting authority for low pressure sewer systems.

Division 6 – Supporting Documents, contains documents related to ECUA's self-permitting authority.

### PART 3: Manual Stewardship

The ECUA Engineering Department is entrusted with the stewardship of the Manual with respect to organization, updates, and content. The Engineering Department strives to solicit input from all affected Manual users including but not limited to the consulting engineering community, the utility contracting industry, the utility suppliers industry, fellow regulatory agencies, multiple ECUA departments, and ECUA Engineering staff. While input is solicited and welcome, it is the Engineering Department's responsibility for the organization, updates, and final content of the Manual.

### PART 4: Manual Availability

This Manual is available online at ECUA's website: http://www.ecua.fl.gov/. It is not available from ECUA in printed format. Users are encouraged to print the Manual from the ECUA website, if desired. ECUA does not maintain a registry of Manual users. Users are advised to periodically review the Manual online in order to stay current with updates and/or other information.

## PART 5: Manual Updates

5.1 *Approval Authority* – Chapter 11 of the ECUA Code cites the ECUA Board's adoption of the Manual, as amended. At its December 18, 2016 meeting, the ECUA Board authorized the Executive Director to allow the ECUA Director of Engineering to amend the Manual when related to minor issues, with the Board retaining the authority to amend the Manual when related to major issues. The Executive Director will consult with the ECUA Board as needed on the distinction between minor and major issues. Modifications to any section of the Manual are strictly prohibited unless otherwise approved by ECUA's Director of Engineering or Board, as required. The following table summarizes the approval authorities.

| Issue | Scope | Examples | Public Comment Period Offered? | Authority to Approve Updates |
|---|---|---|---|---|
| Minor | Little or no financial and/or policy impacts | Re-formatting, re-titling, additions or deletions, and/or content change of documents; product/material changes; code changes; new construction details; etc. | No | ECUA Director of Engineering |
| Major | Substantial financial and/or policy impacts | Any design or construction changes that are considered to have major policy or cost impacts | Yes | ECUA Board |

5.2 *Update Listing* – A document containing a listing of recent updates will be maintained on the Manual website.

5.3 *Update Intervals* – Future changes will be grouped as much as practical into single updates. Updates will be made periodically on an as-needed basis and not necessarily on a semi-annual or annual basis.

5.4 *Update Notifications* – Individual notifications of proposed updates will not be made. Notice of future updates will be posted on the ECUA Engineering Manual website.

5.5 *Update Timing and Plan Approvals* – Submittal of design plans for Capital Improvement Projects, System Extensions, and Single Service Connections shall comply with the current Manual at time of submission as well as any updates made prior to the design plans being approved by ECUA.

## PART 6: Manual Contents

The Manual has six sections: Procedures, Design Standards, Technical Specifications, Detail Drawings, Forms, and Supporting Documents. The six sections are described as follows:

6.1 *Procedures* – Procedures are intended to assist commercial customers, developers, engineers, contractors and builders in their various interactions with the ECUA Engineering Department. The procedures identify what information is required to be provided to the Engineering

Department, how the Engineering Department will process the information, and the responses to be issued by the Engineering Department.

6.2 *Design Standards* – Standards are intended for use by engineers and others when designing system extensions and submitting plans for review by the ECUA Engineering Department.

6.3 *Technical Specifications* – Specifications are supplied for use in construction of all water and wastewater improvements which will become the property and responsibility of the ECUA. The Engineer's design shall conform to these specifications and the Contractor shall construct the improvements according to these specifications.

6.4 *Detail Drawings* – Details are drawings depicting industry/ECUA accepted standards related to the construction of typical water and sewer infrastructure. These details are intended to match the content of the technical specifications and are considered a supplement to the technical specifications.

6.5 *Forms* – Forms are documents used by various parties doing business with ECUA.

6.6 *Supporting Documents* – Supporting documents are listed in this section for reference purposes only.

## PART 7: <u>Responsible Charge of ECUA Standard Specifications and Detail Drawings</u>

ECUA develops and maintains standard technical specifications and detail drawings as found in this Manual to ensure uniformity in the design and construction of facilities to be owned by ECUA. The Engineer of Record (EOR) shall utilize and reference these standard technical specifications and detail drawings in the development of the engineering documents prepared under their responsible charge and thereby assumes responsibility for their use. Should the EOR discover that any part of these standards are inconsistent with current engineering practices, the inconsistency should be reported to ECUA immediately for review and possible corrective action.

## PART 8: <u>Commonly Used Terms</u>

8.1 *Applicant* – The Owner (or Developer) desiring to connect new services to ECUA's system (i.e. SSC) or desiring to extend ECUA's water or sewer system (Extension) to serve the Applicant's property or project.

8.2 *Commercial* – Any type of Applicant other than the owner of a single family home requesting service to said home.

8.3 *ECUA Engineering Manual (Manual)* – Document used by ECUA to provide procedural, design, and construction requirements for work involving ECUA water and sewer infrastructure.

8.4 *Engineer of Record (EOR)* – Applicant's Engineer tasked with the responsibility to design and submit reports and plans to and coordinate with ECUA on the approval of the Applicant's SSC or Extension request; the EOR shall be Professional Engineer licensed as such in the State of Florida.

8.5 *Force Main* – A pressurized pipe used to transport sewage flow, typically from lift stations to treatment facilities.

8.6 *Formal Submittal for Extension Projects* – **Mandatory** submittal of a formal engineering report, engineering plans, etc. that address the issues and design needs as determined from the Pre-appllication meeting; review time clock is started with complete submission.

8.7 *Lift Station* – An underground storage tank (wetwell) equipped with pumps and other electrical equipment that acts as a receiving point where sewage flow is collected and then pumped into a force main toward a treatment facility.

8.8 *Mains* – Water distribution piping, sewage collection piping, or sewage transmission piping; sometimes referred to as water and sewer lines, not including individual building service connections.

8.9 *Preliminary Engineering Report Submittal for Extension Projects* – **Mandatory** submittal of a Preliminary Engineering Report (PER) that highlights the project's background and water/sewer needs.

8.10 *Pre-application Meeting for Extension Projects* – **Mandatory** meeting following the PER Submittal for Extension Projects; meeting shall focus on the project's needs along with information regarding ECUA's water and sewer systems and applicable ECUA policies.

8.11 *Right-of-Way (ROW)* – A publicly owned corridor that contains public streets, drainage, and utilities.

8.12 *Service* – Typically smaller diameter water service lines connecting an ECUA water main to a water meter, fire service lines that connect an ECUA water main to a private fire line on private property, irrigation service lines that connect an ECUA water main to an irrigation meter, and sewer lines that connect an ECUA sewer main to a private sewer line on private property.

All service lines shall be located in the public ROW and shall be owned and maintained by ECUA with the exception of gravity sewer laterals (see ECUA Code for sewer lateral ownership and maintenance responsibilities) or as determined by ECUA.

8.13 *Single Service Connection (SSC)* – ECUA term used to describe a proposed connection of one commercial property or building to ECUA's water and/or sewer mains, with service lines being installed in a public ROW from the Applicant's property line to the ECUA main(s). Examples include gravity sewer laterals, fire lines, water services and meters, irrigation services and meters.

All water and sewer service lines installed on private property shall be privately owned and shall be reviewed, approved, and inspected by either City of Pensacola's or Escambia County's Building Inspections Department.

8.14 *SSC Application* – Application with sketch and/or plans showing the requested service connections to ECUA's water and/or sewer systems.

8.15 *System* – A utility's assemblage of water mains and/or sewer mains as a whole.

8.16 *System Extension (Extension)* – ECUA term used to describe any project that requires new ECUA water mains and/or gravity sewer mains and/or sewer force mains and/or low pressure sewer force mains to be constructed in public ROW or in a dedicated ECUA easement in order to serve the proposed project. Examples include:

8.16.1 Residential subdivisions.

8.16.2 Commercial subdivisions.

8.16.3 Project, which due to property location and lack of existing available ECUA infrastructure, can only be served by extensions to ECUA water/sewer mains.

8.16.4 Low-pressure sewage collection systems, typically designed for residential subdivisions.

8.16.5 Private lift stations for commercial customers, regardless of how connection to ECUA system is proposed.

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# Procedure 2

## Review and Approval of Water/Sewer System Extensions

### PART 1: Purpose

This procedure outlines the steps required to request ECUA's approval of a proposed extension to ECUA's existing water/sewer systems. See Procedure 1 – Engineering Manual User's Guide, Section 8.16 for definition and examples of System Extensions. ECUA's review and approval process is independent of other agencies. ECUA reserves the right to approve or deny proposed extensions based on the positive or negative impacts to ECUA's existing water/sewer systems and customer base.

### PART 2: Ownership Responsibility

2.1 *General* – Extensions to ECUA's water and sewer systems must be constructed in accordance with the approved plans. Prior to plan approval, ownership and maintenance responsibility of the completed facilities will be determined and outlined in Exhibit "C" of the Utility Service Agreement as executed by the developer and ECUA. ECUA typically accepts responsibility for all water and sewer extensions built within public rights-of-way and/or utility easements approved by ECUA.

2.2 *Water and Sewer System Extensions* – ECUA will accept all water and sewer system extensions within public rights-of-way and in easements dedicated for the use of public utilities such as in the case of newly platted subdivisions. Private water/sewer systems are not allowed in residential subdivisions. ECUA will accept water and sewer system extensions within easements on private property when those water and sewer system extensions are intended to either serve other properties or are required for ECUA system operational needs.

ECUA will not accept water or sewer system extensions intended to solely provide service to a single parcel or commercial entity, except for those portions entirely within the public right-of-way. Typically, ECUA does not accept water/sewer systems related to apartment complexes, strip shopping centers, malls, condominiums, office parks, industrial sites, etc. Metering of water service to those types of facilities shall be in accordance with current ECUA policies.

2.3 *Lift Stations* – ECUA will accept for ownership new lift stations constructed in accordance with the requirements of ECUA's Engineering Manual which provide service to multiple parcels such as in new subdivisions. ECUA will not approve the proposed construction of a new lift station to serve a new subdivision where the developer indicates his intention is for the station to remain privately owned. In the case of a lift station intended to serve traditional platted single-family residential subdivisions, the lift station must be designed and constructed in accordance with ECUA approved plans. Ownership of the completed lift station must be transferred to ECUA upon completion.

Lift stations intended to serve a single commercial entity will not be accepted for ownership by ECUA unless the lift station also will serve other parcels of land such that it is of benefit to the surrounding community. Examples of single commercial entities include: apartment complexes, strip shopping centers, malls, condominiums, office parks, industrial sites, etc.

2.4 *Determination* – ECUA solely reserves the right to determine the extent or limits of proposed ownership as a condition of plan approval for all water and sewer extensions. Those determinations will be outlined with the Utility Service Agreement, Exhibit “C”.

## PART 3: System Extension Submittal and Review Process

3.1 *Step 1: Preliminary Engineering Report (PER)* ***(mandatory)*** – Applicant’s Engineer of Record (EOR) shall prepare PER in pdf format (less than 10 MB) on 8.5” x 11” pages and email to the Engineering Department at ecuaeng.contact@ecua.fl.gov. The EOR may use their discretion on formatting the PER, however it shall contain the following items at a minimum:

3.1.1 Completed top half of ECUA’s *System Extensions – Project Information Form* located in the ECUA Engineering Manual, Division 5 Forms.

3.1.2 Vicinity map depicting location of project, to include limits of associated master development and/or other developments in close proximity to the project. The map shall also depict the project’s physical property address.

3.1.3 Narrative of requested extensions (i.e. water, irrigation, fire line, sewer).

3.1.4 Average daily flow (ADF) for water and/or sewer system.

3.1.5 Peak flows for potable water need, fire flow need, and peak hourly flow (PHF) for sewer system.

3.1.6 Preliminary estimate of main line sizes, lift station pump flows, and meter sizes as applicable.

3.1.7 Need for Applicant to provide and construct either a private lift station or an ECUA lift station (designed and built to ECUA standards and to be owned, operated, and maintained by ECUA)

3.1.8 For projects with proposed ECUA lift stations, proximity to available electrical power in area (3 phase 240V or 3 phase 480V)

3.1.9 Need for easements to be dedicated to ECUA and/or need for ECUA parcels

3.1.10 Unique topographic features (i.e. contours, wetlands, high water tables, etc.) that may impact design, construction, maintenance, and ECUA access.

3.1.11 Potential application of existing ECUA programs, etc.:

3.1.11.1 Septic tank abatement program

3.1.11.2 Fire hydrant cost-sharing program

3.1.11.3 Low-pressure sewer consideration

3.1.12 (Optional) Other pertinent information as EOR deems necessary. Examples include conceptual layout of proposed subdivisions, preliminary site plan showing possible connections to ECUA, set of conceptual construction plans, etc. Any construction plans provided at this stage are deemed preliminary and will require revisions based on ECUA review.

3.2 *Step 2: ECUA Project Establishment and Initial Review* – Upon receiving a complete PER, ECUA will assign an ECUA system extension project number, assign an ECUA reviewer, and forward the PER to various ECUA operational departments for preliminary review. Upon collection of ECUA internal comments, ECUA reviewer will schedule Pre-application Meeting with Applicant's EOR. This step typically takes 2-3 weeks to complete.

3.3 *Step 3: Pre-Application Meeting* ***(mandatory)*** – The pre-application meeting allows ECUA and Applicant to coordinate the following:

3.3.1 Meeting scheduling - Meetings are to be held at ECUA Engineering offices. ECUA reviewer may choose to hold pre-meeting with ECUA operations staff immediately prior to meeting with EOR. For projects with minimal complexity, ECUA reviewer may opt to perform meeting via tele-conference.

3.3.2 Meeting scope – This meeting allows for the mutually beneficial exchange of information related to ECUA's existing infrastructure and the project's water/sewer needs. Should the project be of such magnitude that it requires improvements to ECUA's infrastructure, then Applicant shall be responsible for those costs. This meeting also allows the opportunity to discuss property issues, ECUA policies and programs, compatibility with future capital projects, etc.

3.3.3 Oversizing – Should the ECUA feel it is in its best interest, then ECUA may require the Applicant to oversize portions of the project design (i.e. ECUA pays for incremental cost difference between a project requiring a 6" water main and ECUA requested 8" water main). The ECUA review engineer can brief the Applicant regarding the oversizing policies and procedures. See Engineering Manual, Procedure 6 – Oversizing.

3.3.4 Meeting results – The meeting results shall be captured by the ECUA reviewer on the bottom half of the *System Extensions - Project Information Form*, as well as incorporated into the project design and associated documents.

3.4 *Step 4: ECUA Reviewer Recommendation for Formal Submittal* ***(mandatory)*** – Once the prel-application meeting is completed to the satisfaction of the ECUA reviewer, the reviewer will sign the *System Extensions – Project Information Form* and give copy to Applicant's EOR, thus clearing the project for formal submittal to ECUA. The Applicant's EOR shall then incorporate the information and results from the preliminary submittal meeting into the formal submittal per Step 5 below.

3.5 *Step 5: Formal Submittal Contents*– Applicant's EOR shall prepare formal submittal package as follows and submit to the ECUA Engineering Department:

3.5.1 Cover letter with table of contents listing the submitted items.

3.5.2 ECUA signed *System Extensions – Project Information Form*.

3.5.3 $500 review fee, in the form of a check made payable to the ECUA.

3.5.4 One signed and sealed copy of the *Notice of Intent to Construct an Extension to ECUA's Water/Sewer Systems*. See Engineering Manual, Division 5 – Forms.

3.5.5 One draft, unsigned copy of the *Utility Service Agreement* with completed Exhibits A, B, C, and D attached. See ECUA Engineering Manual, Division 5 – Forms. Once form has been properly completed based on project specifics, then ECUA reviewer will request two signed originals.

3.5.6 Construction Plans: Depending on the complexity of the project, the ECUA reviewer may request 3 check sets, size 22” x 34” or 24” x 36”, of construction plans that are not signed and sealed at this stage in the process. Once the ECUA reviewer is satisfied that comments and requested revisions (generated in step 6) have been sufficiently incorporated into the plans, the ECUA reviewer will require six sets of construction plans, size 22” x 34” or 24” x 36”, signed and sealed by a Professional Engineer registered in the State of Florida. The upper right hand corner of each title sheet shall include the *ECUA Engineering Manual Reference Note*. See ECUA Engineering Manual, Division 5 – Forms, on ECUA website for note.

3.5.7 One copy of the plan review checklist (Future).

3.5.8 Two sets of lift station calculations, if applicable, signed and sealed by EOR, along with two copies of the following:

3.5.8.1 For privately owned lift stations – include completed *ECUA Review of Privately Owned Lift Stations*. See ECUA Engineering Manual, Division 5 – Forms, for document. See instructions on top of page one for simplex vs duplex pump requirements.

3.5.8.2 For ECUA owned lift stations – include completed *Lift Station Design Worksheet* and *Lift Station Pump Selection Worksheet*. See ECUA Engineering Manual, Division 5 – Forms, for worksheets.

3.5.9 Submit the following, if applicable, regarding property requirements:

3.5.9.1 For subdivision projects – include preliminary plat showing all existing and proposed public ROW, private road ROW, easements, and all easements and parcels for ECUA facilities, etc.

3.5.9.2 For other projects – include plans showing all existing and proposed public ROW, private road ROW, easements, and all easements and parcels for ECUA facilities, etc. The EOR is responsible for creating legal descriptions and sketches for all proposed easements and parcels, and shall coordinate with ECUA ROW Agent for proper documents to be used in the acquisition process.

3.5.10 Cost estimate information, if applicable, for oversizing requests.

3.6 *Step 6: ECUA Review and Approval of Formal Submittal* – The Formal Submittal review process will generally follow the steps outlined below:

3.6.1 Submittal will be logged in by ECUA Reviewer and reviewed for completeness. If complete, package will be routed to the appropriate ECUA departments for their formal reviews.

3.6.2 The ECUA Reviewer will begin review of plans and associated documents for compliance with ECUA and/or FDEP requirements, as appropriate.

3.6.3 Comments from ECUA departments will be collected and reviewed.

3.6.4 Additional meetings, requests for additional information, and/or changes to the design may be required. ECUA reserves the right to make changes and/or modify requirements during formal review process that were or were not addressed in the pre-application meeting.

3.6.5 Once submittals are deemed complete, accurate, and suitable to ECUA, then ECUA reviewer shall have executed the *Notice of Intent* (permit) and the two *Utility Service Agreements* and shall stamp all six sets of plans either “Approved” or “Approved with Comments”.

3.6.6 ECUA Engineering Department will contact EOR and quote the ECUA inspection fees required. Applicant or EOR shall deliver check for inspection fees to Engineering Department, at which time System Extension Plan Approval letter/package will be available for pickup.

3.6.7 Documents shall be distributed by ECUA as follows:

| | **Plan Approval Letter** | **Stamped Approved Plans** | **NOI** (original to ECUA binder) | **USA** (original to ECUA Board) |
|---|---|---|---|---|
| ECUA reviewer/file | 1 copy | 1 set | 1 copy | 1 copy |
| ECUA inspector | 1 copy | 1 set | 1 copy | - |
| ECUA operations | 1 copy | 2 sets | - | - |
| Owner/Applicant | 1 original [(i)] | 1 set [(i)(ii)] | - | 1 original [(i)] |
| EOR | 1 copy [(i)] | 1 set [(i)] | 1 copy [(i)] | - |

(i) Included with Plan Approval letter/package sent to EOR
(ii) Owner shall insure its Contractor has a set of the stamped approved plans on the project site for use in construction

3.6.8 Review time: 60 days of ECUA review time with clock starting on the date of a complete formal submittal package. Clock stops for periods of time when ECUA is awaiting information, re-submittals, forms, etc. from the EOR and/or Applicant. Time extensions may be required depending on the project’s complexity.

3.6.9 Nothing is stated or implied whereas an Applicant can receive ECUA approval by any means other than ECUA issuing a Plan Approval letter.

3.6.10 Expiration of System Extension Plan Approval Letter: Extensions shall be completed by Applicant and accepted by ECUA (per date of ECUA Final Acceptance letter) within three years of the date of the system extension Plan Approval letter, otherwise the extension Plan Approval will expire and Applicant will be required to resubmit, to include meeting current fees, ECUA standards, and other applicable codes at time of re-submittal.

3.7 *Step 7: Pre-Construction Coordination* – The following pre-construction activities shall take place based on project scope:

3.7.1 Material Submittals Review and Approval – For complex projects (i.e. subdivisions) as determined by ECUA reviewer, the EOR or the Applicant's Contractor shall provide ECUA with material submittals and shall order and utilize materials based on ECUA approved submittals. For less complex projects (i.e. private grinder station connection to ECUA force main) as determined by ECUA reviewer, material submittals will not be required.

3.7.2 Pre-Construction Meeting - For complex projects (i.e. subdivisions) as determined by ECUA reviewer, the EOR or the Applicant's Contractor shall schedule a pre-construction meeting with ECUA at least two weeks prior to commencing construction. For less complex projects (i.e. private grinder station connection to ECUA force main) as determined by ECUA reviewer, pre-construction meetings will not be required.

3.8 *Step 8: Construction* – Once the Applicant receives the system extension Plan Approval letter, has paid all applicable fees (impact, etc.), and has complied with the pre-construction coordination as mentioned above, then the construction phase of the project may proceed. Other permits may be required from other agencies. The approval of ECUA's Engineering Department does not constitute approval from other regulatory agencies. Additional construction-related items are as follows:

3.8.1 The Applicant's Contractor shall provide notice to ECUA's Inspector at least three full business days prior to beginning water or wastewater utility construction or connection activities.

3.8.2 Applicant shall give its Contractor a set of the ECUA stamped approved plans prior to commencing construction. The Contractor shall have, on the job site, one set of the ECUA "Approved" or "Approved with Comments" stamp-approved plans. A current set of As-Built plans shall also be kept on the job site. Contractor shall have printed version of ECUA Engineering Manual on site, or shall have access to manual via ECUA website while on site.

3.8.3 The ECUA Inspector will only inspect construction that is shown on the ECUA stamped approved plans. Work installed that does not conform to the ECUA stamped approved plans and/or the ECUA Engineering Manual will be rejected and will be assessed re-inspection fees.

3.8.4 Minor changes (i.e. service locations, valve locations, etc.) to the stamped approved plans may be made by the ECUA inspector. Major changes (i.e. additions or deletions of mains, changes in pumps, etc.) to the stamped approved plans must be requested by the Contractor, reviewed by the EOR, and then submitted to the ECUA reviewer by the EOR. The ECUA reviewer must provide approval, prior to construction of major changes.

3.8.5 All questions and comments regarding the construction plans shall be directed to the Applicant's EOR and shall be approved by ECUA reviewer.

3.8.6 Changes to the ECUA stamped approved plans may be required if various codes and standards (i.e. National Fire Protection Agency – NFPA, or National Electric Code – NEC) or other safety related needs dictate. Associated costs to change construction means, methods, equipment, etc. shall be borne by the Applicant and not ECUA.

3.9 *Step 9: Final Inspection/Walk-Thru* – Upon completion of construction and successful testing, the EOR shall notify the ECUA reviewer stating the project was completed according to the ECUA stamped approved plans, and request a final inspection/walk-thru. ECUA will schedule the final inspection/walk-thru. Attendees shall include at a minimum the EOR, Contractor's project manager, and ECUA inspector. Optional attendees will include the ECUA reviewer, ECUA regional supervisor, and other ECUA operations staff.

3.10 *Step 10: Closeout Paperwork Requirements* – The following items shall be submitted to the ECUA Inspector only after successful completion of the final inspection/walk-thru:

3.10.1 *Certification of Completion of Construction for an Extension to ECUA's Drinking Water Distribution System* and/or *Certificate of Completion of Construction for an Extension to ECUA's Wastewater Collection/Transmission System* (see ECUA Engineering Manual for forms). This certification also requires the submission of these additional documents:

3.10.1.1 (Water mains only) One copy of bacteriological test results. Certificate of Completion of Construction shall be received by ECUA no later than 60 days from date of samples. Include map of sampling points.

3.10.1.2 Letter from ECUA inspector stating all punch-list deficiencies have been corrected.

3.10.1.3 Record Drawings per ECUA specification section 4000.

3.10.1.4 *Certification of Developer* form with an itemized statement of improvement values or cost, one for water and one for sewer. See ECUA Engineering Manual, Division 5 – Forms, on ECUA website for *SD-3, Certification of Developer* form.

3.10.1.5 Recorded plat, if available (subdivision projects). Copies of all recorded easements pertinent to ECUA facilities (all projects).

3.10.1.6 One copy of all pressure tests for force mains and water mains.

3.10.1.7 One copy of all video inspection and air testing of gravity sewer collection systems, to include manhole vacuum test results.

3.10.2 (ECUA lift stations only) Operation and Maintenance manuals per ECUA Engineering Manual.

3.11 *Step 11: Final Acceptance by ECUA* – Upon successful completion of all closeout paperwork, the ECUA Engineering Department will issue a Certification of Final Acceptance Notice to the Applicant. Failure to obtain the Certification of Final Acceptance Notice from ECUA may result in the removal of water meter and termination of water service per the Utility Service Agreement.

3.12 *Step 12: Post-Construction Coordination* – The following post-construction activities shall take place:

3.12.1 Warranty – All projects and all work that is accepted by ECUA for ownership and maintenance shall be covered by a two year warranty per the Utility Service Agreement.

3.12.2 Final recorded plat – For subdivision projects, the EOR shall submit to the ECUA reviewer the final recorded subdivision plat within 10 days of its recording, if not already submitted.

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# Procedure 3

## Review and Approval of Single Service Connections

### PART 1: Purpose

This procedure outlines the steps required to request ECUA's approval of a proposed commercial service connection to ECUA. Service line connections to ECUA's water and/or sewer mains are called Single Service Connections (SSC). ECUA's review and approval process is independent of other agencies.

### PART 2: Single Service Connection Submittal and Review Process

2.1 *Step 1: Submittal* – Submit to the Engineering Department the required form "Request for Single Service Connection", found in Division 5 – Forms, along with a vicinity map and drawing depicting how and where the property is located and what services (water, irrigation, fire line, sewer) are proposed to be connected to ECUA's system.

2.2 *Step 2: Review* – Provided the initial submittal is complete, ECUA will assign a Reviewer and forward the information to the appropriate operations department for their review. Both the Reviewer and the operations department will provide comments and the Reviewer will coordinate with Applicant as required if changes are needed. This process typically takes approximately 1-2 weeks for review and initial response.

2.3 *Step 3: Approval* – ECUA will issue a SSC Approval Letter to the Applicant, along with any special instructions pertaining to the connections. The Applicant shall give these instructions to its Contractor. Failing to perform connections based on the contents of the Approval Letter will void the SSC approval.

2.4 *Step 4: Pay Fees* – Applicant shall go to ECUA's Customer Service Department to pay all applicable fees (i.e. impact, meter, deposit, SSC review fee of $60, etc.). Customer Service will then notify ECUA operations department via a work order that all payments have been made and connections are cleared for installation.

2.5 *Step 5: Installation* – ECUA does not perform connections for SSC's. Applicant's Contractor shall call ECUA contact person listed in SSC Approval Letter at least three full business days prior to making connection(s) so ECUA can witness all connections. Connections shall not be made unless ECUA is present. ECUA typically provides meters and coordinates and/or assists with the installation.

2.6 *Step 6: Field Measurements* – Contractor shall coordinate with ECUA contact on the required submittal of field measurements to meters, valves, etc.

2.7 *Step 7: Closeout* – ECUA contact closes out work order and Applicant's (now customer's) account is activated. SSC's shall be completed within one year of the date of the SSC Approval Letter, otherwise the SSC Approval will expire and Applicant will be required to resubmit, to include meeting current fees and standards at time of re-submittal.

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# Procedure 4

## Contract Administration for CIP Projects

# RESERVED

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# Procedure 5

## Septic Tank Abatement Policy

### PART 1: Summary

This policy allows ECUA to consider cost participation, when feasible, to assist a developer with the installation of a conventional ECUA approved and owned sewer collection system in lieu of an originally planned development with onsite septic tank systems.

Simply stated, if a developer can install a conventional ECUA wastewater collection system for less money than onsite septic tank systems, then the project must connect to the ECUA wastewater system with a conventional ECUA sewer system, with the developer being responsible for all costs. ECUA uses an annually updated figure (see ECUA Code Section 27-2.B.4) for the assumed cost of an onsite septic tank system. This figure is also referred to as a cost participation threshold.

If the cost per lot for a conventional ECUA wastewater collection system is greater than the cost participation threshold, then ECUA will analyze the differential amount and consider cost participation to pay the difference. If ECUA chooses not to reimburse the differential amount, then a developer may proceed based on using septic tanks.

### PART 2: Minimum Project Requirements

Although described in more detail in the "Procedure for Review, Approval, and Administration of Sewer Service for New Structures South of Well Line Road" which can be viewed in Division 6-"Supporting Documents", the following is a brief summary of the requirements to qualify for this Policy:

2.1 Project site must be south of Well Line road

2.2 Proposed development must be single family, multi-family, or non-residential

2.3 Proposed parcel sizes must be 1/4 acre (10,890 square feet) or larger

2.4 Parcel sizes cannot decrease to smaller than 1/4 acre if Policy is implemented

2.5 County Health Department confirms the parcel(s) are permittable for traditional septic tank or mound systems

2.6 Developer must request the application of the Policy at initial submittal

## PART 3: Background

In the late 1990's, the ECUA, Escambia County, and Health Department collaborated on a policy intended to better protect our community's water supplies by decreasing new septic tank installations south of Well Line Road. In 1999, the ECUA Board amended its Code to add a new septic tank abatement policy, and later in 2005, added language that would clarify how to update the annual reimbursement amounts. All together, these changes can be seen in the following excerpts from the ECUA Code:

> Chapter 27-2.B.4: "If a development is eligible for reimbursement under the ECUA "*Procedure for Review, Approval, and Administration of Sewer Service for New Structures South of Well Line Road"*, ECUA shall reimburse the developer for a portion of the cost of construction of wastewater collection facilities to serve the development. The amount of reimbursement shall initially be determined by subtracting the sum of $3,600 [2014 figure] from the average cost per lot or parcel of the cost of construction of wastewater collection facilities and multiplying the remainder by the number of lots or parcels in the development for which septic tanks are permittable. The initial $2,750 sum [reimbursement amount] shall be adjusted in January, 2006 and each January thereafter. This adjustment shall be computed by multiplying $2,750 by the first Cost Construction Index (CCI) published by *The Engineering News-Record* in the month of January of that year, and dividing the product by the CCI published in April, 2005 (i.e. 7,355). The result so obtained shall be rounded to the nearest $50. This adjustment shall be effective the date the CCI is first published each January."

> Chapter 27-2.B.6: "Prior to reimbursement the developer shall submit a certified statement of itemized construction cost, together with written evidence that all such cost has been paid, and shall submit all final documentation, including "as-built" drawings in accordance with the ECUA Engineering Manual."

The document "*Procedure for Review, Approval, and Administration of Sewer Service for New Structures South of Well Line Road"* also contains the resolutions that were passed in order to amend the ECUA Code as seen with the excerpts above.

## PART 4: Cost Participation Threshold

This figure is adjusted annually per the CCI per the following table:

| Year | CCI | Threshold Amount | |
|---|---|---|---|
| | | Calculated | Adopted |
| 2005 | 7,355 | | $2,750 |
| 2014 | | | $3,600 |
| 2015 | | | |
| 2016 | | | |
| 2017 | | | |

**PART 5: Examples**

Developer shall follow the "*Procedure for Review, Approval, and Administration of Sewer Service for New Structures South of Well Line Road".* The examples below are developed based on the content of said document.

| # | Sewer System Type (1) | # of Lots | Total Costs (2) | Cost per Lot | Cost Differential (Cost per Lot – Current Threshold) |
|---|---|---|---|---|---|
| | | | | | 2014 = $3,600 |
| 1 | Conventional Sewer System | 80 | $260,000 | $3,250 | (- $350) |
| 2 | Conventional Sewer System | 80 | $350,000 | $4,375 | $775 |
| 3 | Conventional Sewer System | 80 | $500,000 | $6,250 | $2,650 |
| N/A | Septic Tanks | 80 | $280,000 | $3,500 | |

(1) Conventional sewer system includes gravity sewer only or gravity sewer with master lift station and force main
(2)Includes surveying, engineering, and construction for on-site and required off-site infrastructure

Notes:

Example 1: Cost per lot is less than threshold amount, therefore project does not qualify for Policy. Developer continues with submittal and review process for conventional ECUA wastewater collection system.

Example 2: Cost differential is less than $1,000 per lot, and total project differential is less than $150,000, therefore project qualifies for Policy and can be approved by ECUA Staff. In this example, ECUA and Developer would calculate ECUA's cost participation and include in the Utility Service Agreement. ECUA's cost participation for this example is:

$775 x 80 lots = $62,000

Example 3: Cost differential is more than $1,000 per lot, therefore project is sent to Board for review and determination on application of Policy. If the Board qualifies the project for the Policy, then ECUA and Developer would calculate ECUA's cost participation and include in the Utility Service Agreement. ECUA's cost participation for this example is:

$2,650 x 80 lots = $212,000

The cost differential amount and subsequent decision on whether or not the Board approves a project for this Policy is made on a case by case basis and is weighed against several factors to include cost, future benefit to ECUA's infrastructure, etc.

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# Procedure 6

# Oversizing

## PART 1: Summary

Section 27-2 of the ECUA Code authorizes ECUA to require a developer to construct facilities of such size, length, and/or depth to not only serve the proposed development, but to also serve anticipated growth in the area should ECUA determine it to be beneficial. These additional requirements are generally termed "oversizing." The design and construction of said oversizing shall be incorporated into the development's water and sewer design.

ECUA shall reimburse the developer for the difference in the design and construction costs of the original designed development plan and the ECUA required oversize development plan. The reimbursement amount shall initially be estimated during the design phase based on estimates submitted by the Developer's Engineer and confirmed by ECUA. Final reimbursement shall be based on actual design and construction costs as submitted by developer and approved by ECUA.

## PART 2: Process

At the mandatory Pre-Application meeting, ECUA will evaluate the project area on the need for oversizing. Should ECUA require oversizing, the ECUA Engineer will work with the Developer's Engineer on scope and estimates. This cost estimate shall be included in the Utility Service Agreement, which requires approval from either the ECUA Executive Director or ECUA Board, depending on the dollar amount. At the end of the project, the developer will submit copies of paid invoices to ECUA for reimbursement, along with statement of itemized construction costs, record drawings, and certification that all material suppliers and contractors have been paid.

*Examples -*

2.1 Developer proposes a new subdivision that requires a new gravity sewer main to be built from the subdivision entrance to the nearest gravity sewer about 1,000 feet away. Along that 1,000 feet of roadway/proposed sewer, are 10 properties that would benefit from connecting to the proposed sewer via having new sewer laterals installed. In this example, the gravity sewer main is the responsibility of the developer, while the new laterals would be the responsibility of the ECUA. After estimating, the Developer's Engineer and the ECUA Engineer agreed that the 10 laterals would cost on the order of $3,000 each. ECUA confirms the total estimate of $30,000 is a cost-effective application of the oversizing policy, and directs the Developer's Engineer to put the new laterals in the developer's construction plans. The Utility Service Agreement is prepared such that ECUA will contribute up to $30,000 for the new sewer laterals. ECUA staff requests approval of the Utility Service Agreement and therefore $30,000 of oversizing. At the end of the project, the developer supplies the appropriate information, along with an invoice for the actual costs of $24,000, of which ECUA reimburses the developer the $24,000.

2.2 Developer proposes a new commercial property that is located such that ECUA has water main on both the north and south side of the property. ECUA desires to have a new north-south connector water main installed on the property that would connect the mains on the north and south sides of the property thereby helping with water system pressures and supply. ECUA would be responsible for the new water main design and construction costs, with the developer being required to provide an easement for the new connector main (see Procedure 9-“Property Acquisition and Easements”). The remaining coordination and procedures would be similar to those listed in example #1.

2.3 Customer is building a new business in an area where the closest ECUA water main is about 500 feet away. A 6-inch water main extension to ECUA’s water system is proposed by the Customer’s Engineer in order to serve the new business with a potable water meter, irrigation meter, and fire line. Upon review and based on future water system planning, ECUA believes it is in the best interest of ECUA to require an 8-inch main in lieu of a 6-inch main. After estimating, the Developer’s Engineer and the ECUA Engineer agreed that the cost for 500’ of 6” main would be on the order of $10,000, while the cost for 500 feet of 8-inch main would be on the order of $12,000. ECUA confirms the differential increase of $2,000 is a cost-effective application of the oversizing policy, and directs the Developers Engineer to put the larger main in the construction plans. The remaining coordination and procedures would be similar to those listed in example #1.

# Procedure 7

## Review and Approval of Grinder Pump Reimbursement Requests

**PART 1: Purpose**

This procedure outlines the steps required to submit documents and to receive ECUA approval of reimbursement for residential or commercial grinder pump installations to replace a septic tank system.

**PART 2: Definitions**

2.1 *Grinder Pump Reimbursement Application* – application with sketch, paid invoices with detailed breakdown of expenses, and/or plans showing the details of the installation (see attached forms).

2.2 *General Description of Work* – The Contractor shall furnish and install all pipes, fittings, structures and accessories required for grinder pump installation, and shall install grinder pump in accordance with manufacturer recommendations and all applicable codes and standards.

**PART 3: Grinder Pump Reimbursement Request Submittal and Review Process**

3.1 *Submittal* – Submit the required Grinder Pump Application forms listed below (see Division 5 – "Forms") along with a detailed invoice with cost breakdown as evidence of the actual cost paid for the grinder pump installation.

- Application for Reimbursement of Grinder Pump Station
- Agreement for Residential or Commercial Grinder Pump Station

3.2 *Review* – Provided the initial submittal is complete, the ECUA staff will review the submittal and coordinate with Applicant as required if changes are needed. This process typically takes approximately 1-2 weeks for review and approval.

3.3 *Approval and Payment* – ECUA will issue an Approval Letter to the Applicant. Upon receipt, the applicant shall then contact the ECUA Customer Service Department to pay all applicable fees (i.e. impact, deposit, etc.). Customer service will then issue a check for the reimbursement amount (not to exceed $1,500).

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# Procedure 8

## New Product Review and Approval

### PART 1: Summary

ECUA lists approved manufacturers and/or materials in individual technical specification sections of the ECUA Engineering Manual. Should a manufacturer desire to have a product reviewed for possible inclusion in the Engineering Manual, then they should follow the review process outlined in this procedure.

ECUA evaluates new and existing products for efficient and economical utilization within its system. ECUA is charged with the development of a fair and reasonable methodology to systematically evaluate utility products for use through research and/or field evaluation. It is the intent of ECUA to review and update its compilation of approved materials from time to time, as appropriate, to ensure efficient operation of its systems.

The person making the product review request shall be considered the “product representative”, with such term being used for the remainder of this procedure. This person is typically assumed to be a product sales representative, but at times may be a manufacturer’s representative.

### PART 2: Procedures To Request Product Review

Product representative shall follow the following submittal process for product review and potential inclusion in the ECUA Engineering Manual:

2.1 *Initial Contact* – Contact ECUA’s Engineering Department at 850-969-3310 and request an ECUA Engineer be assigned to coordinate and review the product review approval process. The ECUA Engineer will request an ECUA operations staff member assistance from an operations standpoint. Engineer will contact product representative to exchange appropriate contact information.

2.2 *Initial Submittal* – Submit the following to the ECUA Engineer:

2.2.1 *Request Letter* – Formal letter with the company names, phone numbers, and email addresses of both the manufacturer and the sales representative firm and corresponding point of contacts, and designate which contact will be the “product representative” during the review process. Letter shall request a formal review of one specific product, indicating the applicable technical specification section(s).

2.2.2 *Technical Content* – The subsequent content shall include a copy of the product’s sales brochure, technical cut sheets to include product description, technical specifications, drawings, installation instructions / procedures, catalog information (including part numbers, series numbers, size ranges, quality control procedures, all applicable product standards (NSF, AWWA, ASTM, ANSI, NFPA, UL/FM, Uni-Bell, DIPRA, ISO, etc.) as appropriate for the product, internal/external test results showing compliance with applicable standards, including independent laboratory test results, as appropriate.

2.2.3 *Product Sourcing and Availability* – Provide statements and timeframes as to the product's availability, delivery times, locations of manufacturing facilities, local distribution locations. State if the manufacturing facilities are owned by the company/brand whose name appears on the product or if the product's manufacturing is outsourced.

2.2.4 *Special Installation/Operation/Maintenance Requirements* – List any special requirements, good or bad, of the product as compared to the products typically used in the industry today. A detailed side-by-side comparison of the proposed product to a comparably accepted and used product is recommended. Also list recommended maintenance schedules.

2.2.5 *Warranty Information* – Summarize the normal warranty durations, repair/replacement procedures, parts/materials included or excluded per the warranty.

2.2.6 *Product References* – Provide reference sheet with multiple utility agency references from Florida. Out of state references may be used as well, however in-state is preferred. For each utility, provide utility name, name of contact person, street address, e-mail address, and telephone number. Also include product application (quantity, size, specific model number, number of years in service)

2.2.7 *Overall Justification* – Explain how the product benefits ECUA in terms of prolonged service life, reduced maintenance, reduced life-cycle cost and other relevant aspects. Provide additional justification deemed necessary such as samples, video, or PowerPoint presentations.

2.2.8 *Other Information* – Any additional information deemed essential by ECUA. If this information is not presented in a timely manner, the product may be removed from consideration.

2.3 *Initial Review* – Upon complete submittal of the information from step 2 above, ECUA Engineer will perform an initial review by consulting with the appropriate ECUA operational personnel.

2.4 *Final Review* – The final review will be completed per one of the following two methods:

2.4.1 *Desk Review Process Only* – Should the initial review reveal minimal or no concerns, the product is compliant with the industry norms, meets ECUA specifications, has a proven and reliable history, is not new to the industry, has minimal if any operational risks (i.e. tracer wire), then the ECUA Engineer will typically determine that a desk review of the product will be sufficient enough to complete the review process. A presentation by the manufacturer would typically not be required, but may still be requested should ECUA desire.

2.4.2 *Field Testing Process* – Should the initial review reveal concerns or questions, and/or the product not meet any of the objectives identified in the desk review process above, then a mandatory presentation will be required. ECUA will choose to either continue or discontinue product evaluation after the presentation. Should ECUA desire to further evaluate the product, then the manufacturer shall be required to provide and/or install, most times free of charge, a sample of the product in the ECUA system, and shall coordinate with ECUA operational staff on the best location for installation and/or monitoring. Product sample shall be installed for a minimum of one year for testing and evaluation purposes. It is the product representative's responsibility to revisit with ECUA after the one year period to finish the evaluation and review process.

2.5 *Rendered Decision* – Approval or denial status shall be rendered by the ECUA Engineer. In rare instances, the decision may be tabled until such time that additional information and/or testing has become available. Said result shall be indicated in a letter sent to product representative, and copies sent to the Engineering Department staff, appropriate ECUA operational staff, ECUA purchasing department, ECUA warehouse, and the three local utility suppliers in the ECUA area. Letter shall include the reasoning for approval or denial as the case may be. If approved, ECUA Engineer will add the product to the ECUA Engineering Manual upon the next available Manual update. Product will not be available for use in ECUA's system until the Manual is updated with the product's information.

## PART 3: General

ECUA reserves the right to limit the number of approved manufacturers for any specific type of product for the purpose of minimizing inventory of parts, replacement components, and training requirements.

ECUA may, with cause, disapprove and remove from the Manual any previously approved product. Cause may include, but is not limited to, the unavailability of a product or its replacement parts, failure of a product, unresponsiveness on the part of the manufacturer or their representative to resolve product issues, a decline in the quality or performance of a product, or functional obsolescence.

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# Procedure 9

## Property Acquisition, Easements, Railroad Coordination

### PART 1: Background

This procedure describes the various requirements and methods for ECUA to acquire real property and utility easements, as well as perform coordination with railroad companies related to new utility construction in or crossing railroad rights-of-way.

The process of acquiring real property and utility easements as well as railroad coordination shall be coordinated through the assigned ECUA Project Engineer, ECUA ROW Agent, ECUA legal counsel, with assistance from the Engineer of Record as applicable. ECUA Board action may also be required.

### PART 2: Real Property Acquisition

2.1 *Property Acquisition via Recorded Plats* – Residential and commercial subdivisions typically require plats to be recorded as part of the County's approval process. Subdivisions are typically categorized by ECUA as a System Extension as part of ECUA's review process. The most common ECUA property acquisition need in subdivisions would be for parcels involving sewer lift station sites and/or access to said sites.

As part of the required pre-application meeting for System Extensions, the subdivision developer and/or their Engineer of Record (EOR) shall state if the project requires transfer of property to the ECUA. ECUA will notify developer if ECUA agrees in principle to the proposed property's location and size and subsequent transfer based on ECUA requirements and needs.

A preliminary subdivision plat correctly showing proposed parcel(s) locations, sizes, and dedications as agreed to by ECUA shall be submitted to and approved by ECUA prior to ECUA granting Plan Approval status for the System Extension.

A draft of the final subdivision plat that still correctly shows final parcel locations, sizes, and dedications is required prior to ECUA issuing the Final Acceptance.

A copy of the final recorded subdivision plat with book and page number shall be delivered to ECUA as soon as it becomes available.

2.2 *Property Acquisition via ECUA CIP Projects* – Many of ECUA's CIP projects require property acquisitions for facilities such as sewer lift stations, water wells, etc. As part of the initial design stages of the project, the Engineer of Record (EOR) shall notify the ECUA Project Engineer and the ECUA ROW Agent about the project's property acquisition needs.

Once the proposed property's location and size has been confirmed by the ECUA Project Engineer and ECUA ROW Agent, the EOR shall have a Professional Land Surveyor licensed in Florida prepare a legal description and scaled drawing of the proposed parcel, and shall then forward to the ECUA ROW Agent. The ROW Agent will review and shall then forward said documents to ECUA legal counsel such that property acquisition process can begin via contact with the property owner, making of initial offer, obtaining Board approval, assemblage of a sales contract, closing of the property, and recording of appropriate documents in public record.

The property acquisition process, to include closing, shall be completed prior to the CIP project being advertised. The ECUA Director of Engineering may relax this requirement should the project conditions warrant and based on a high probability of closing within a reasonable timeframe following project advertisement.

## PART 3: Utility Easement Acquisition

3.1 *Easement Acquisition via Recorded Plats* – Residential and commercial subdivisions typically require plats to be recorded as part of the County's approval process. Subdivisions are typically categorized by ECUA as a System Extension as part of ECUA's review process. The most common ECUA easement acquisition need in subdivisions would be for easements involving water and/or sewer mains.

As part of the required pre-application meeting for System Extensions, the subdivision developer and/or their Engineer of Record (EOR) shall state if the project requires easements for ECUA facilities. ECUA will notify developer if ECUA agrees in principle to the proposed easement's location and size and subsequent transfer based on ECUA requirements and needs.

A preliminary subdivision plat correctly showing proposed easement(s) locations, sizes, and dedications as agreed to by ECUA shall be submitted to and approved by ECUA prior to ECUA granting Plan Approval status for the System Extension. Dedications shall state the easement area is either a public utility easement (if other utilities are present) or an ECUA utility easement (if only ECUA utilities are present).

A draft of the final subdivision plat that still correctly shows final easement locations, sizes, and dedications is required prior to ECUA issuing the Final Acceptance.

A copy of the final recorded subdivision plat with book and page number shall be delivered to ECUA as soon as it becomes available.

3.2 *Easement Acquisition via ECUA CIP Projects* – Many of ECUA's CIP projects require easements for facilities such as underground water and sewer mains. As part of the initial design stages of the project, the Engineer of Record (EOR) shall notify the ECUA Project Engineer and the ECUA ROW Agent about the project's easement needs.

Once the proposed easement's location and size has been confirmed by the ECUA Project Engineer and ECUA ROW Agent, the EOR shall prepare a legal description and scaled drawing of the proposed easement, preferably prepared by a Professional Land Surveyor licensed in Florida, and shall then forward to the ECUA ROW Agent. The ROW Agent will review and shall then forward said documents to ECUA legal counsel such that easement acquisition process can begin via contact with the property owner, assemblage of easement forms/documents, execution of the easement, and recording of appropriate documents in public record.

The easement acquisition process, to include closing, shall be completed prior to the CIP project being advertised. The ECUA Director of Engineering may relax this requirement should the project conditions warrant and based on a high probability of easement acquisition within a reasonable timeframe following project advertisement.

3.3 *General Easement Requirements* – Utilities installed in easements are not as desirable as utilities installed in public ROW, therefore utilities shall not be located in easements unless approved by ECUA. An easement is required for any water or sewer main to be owned and operated by ECUA if said main is not located in public ROW.

ECUA owned and operated lift stations require fee simple title. On rare occasions ECUA may allow lift stations to be located in an easement shown a publicly recorded plat with easement dedication language stating easement is perpetual with exclusionary rights given to ECUA.

Easements and the utilities installed in them generally must serve more than one parcel. Examples of developments that typically serve more than one parcel include residential subdivisions, commercial subdivisions, and some townhome developments.

ECUA generally will not accept ownership of mains installed on private property for projects that serve only one parcel. These mains on private property will be considered to be privately owned and maintained by the parcel owner. Examples of developments that typically serve only one parcel include mobile home parks, apartment complexes, and shopping center strip malls.

Notwithstanding these guidelines, ECUA maintains the right to accept an easement on any type of property provided the utilities and easement provide a substantial benefit to the ECUA in the form of needed system interconnections and/or future extensions to ECUA's system.

3.4 *Design Requirement of Easements* –

3.4.1 *Width* – Twenty feet is the minimum width for easements located on private property. Where easements are adjacent to an open ten foot strip of public right-of-way with minimal conflicts (i.e. other utilities, trees, drainage, etc.), a minimum width of ten feet on private property is allowed. Minimum widths may increase based on the following table:

| **Pipe Depth of Deepest Utility [ft.]** | **Easement Width [ft.]** | | |
|---|---|---|---|
| | **One Utility** | **Two Utilities** | **Three Utilities** |
| 0 to <6 | 20 | 25 | 30 |
| 6 to <8 | 25 | 30 | 35 |
| 8 to <10 | 30 | 35 | 40 |
| 10 to 12 | 35 | 40 | 50 |
| > 12 | Per design | Per design | Per design |

Depths are as measured from final grade to bottom of pipe at deepest portion of a pipe run. Easement alignments shall minimize corners, curves, and other irregularities.

3.4.2 *Utility Positions in Easement* – For single utility installations, mains shall be centered in easement unless otherwise directed by ECUA Engineering. For multiple main installations, mains of normal depth (30 inches) shall be placed at least 5 feet from the edge of easement and have at least 5 foot separation from other mains. Mains deeper than 30 inches shall be located at a distance from edge of easement equivalent to at least two times the depth of the main. Water and sewer mains shall be positioned at least 20 feet away from any building, foundation, balcony, roof overhang, shed, or other structures, therefore easement should be positioned accordingly.

3.4.3 *Minimum Access Requirements* – Easements along common side property lines in subdivisions are not preferable, but will be considered by ECUA on a case-by-case basis. Easements along rear property lines in subdivisions are strongly discouraged and generally not allowed.

Easements through undeveloped areas and other areas not adjacent to roadways still require ECUA's access on a routine basis and must meet minimum access requirements. In steep, wet, sandy, or other problematic terrain, an improved road surface will be required. This surface will require a minimum 6 inches of compacted graded aggregate over 12 inches of compacted sub grade, ten feet in width, with slopes not to exceed 10 percent. Additional surfaces such as 1 1/2-inch asphalt may be required if deemed necessary by ECUA Engineering. The site specific requirements will be made by ECUA Engineering. ECUA will not accept easements through jurisdictional wetlands.

3.4.4 *Obstructions Not Allowed in Easements* – Due to access, operation, maintenance, and repair needs, obstructions cannot be allowed in ECUA easements in undeveloped areas. Examples of obstructions in undeveloped areas include but are not limited to: trees, large shrubs/landscaping, buildings, signs, fences, or any other item that would preclude ECUA from driving the entire length and width of easement with construction equipment. Owner of property is assumed to keep easement free of obstructions and in an accessible condition at all times. Private gates blocking access to ECUA easements are not allowed.

ECUA will typically repair roadways/drives and replace grass damaged by utility access, maintenance, repair, and replacement. Damage to or removal of other features such as buildings or permanent structures during ECUA's utility access, maintenance, repair, and replacement may require repair or replacement of said buildings and structures by the Property Owner.

3.4.5 *Pipe and Manhole Materials* - All water mains will be ductile iron and all water services will be copper. Gravity and sewer force mains will be ductile iron, epoxy-lined on the inside. All manholes shall be epoxy coated and equipped with rain guard devices and shall have locking lids.

3.4.6 *Easement Requirements in Townhome and Similar Developments* – ECUA will only consider accepting water and sanitary sewer facilities in townhome projects with single story units on individual parcels. The following are minimum requirements for ECUA to consider acceptance of the onsite potable water and sanitary sewer systems for operation and maintenance.

3.4.6.1 ECUA must be willing to accept both water and sewer systems; separation of systems (i.e. water belongs to ECUA and sewer remains private) is not allowed.

3.4.6.2 Development must have two connections to ECUA water system.

3.4.6.3 Valves shall be installed so that in the event of a main break no more than one building will be without water when the water main is shut down for repairs. If a main break occurs under parked vehicles, ECUA will valve off the mains until the Homeowner Association has vehicles moved in order for ECUA to access the main and make repairs.

3.4.6.4 See chart in section 3.4.1 for minimum easement widths.

3.4.6.5 See section 3.4.2 for locations of mains within easements.

3.5 *Other Easement Needs* –Listed below are summaries of other easement types and needs:

3.5.1 *Temporary Construction Easement Form* – Included in Division 5-"Forms", is a sample Temporary Construction Easement form. Contractors are solely responsible for whatever temporary construction easement form they utilize on a project.

3.5.2 *Water Meter Vault Access Agreement Form* – Due to issues such as limited ROW, conflicts with other utilities and/or drainage, and in an effort to avoid future conflicts on roadway projects, ECUA generally requires that large meter vaults be placed on private property, just inside the property line near the ROW. The Water Meter Access Agreement, in Division 5, requires signature by the Property Owner prior to ECUA approving a requested meter service with a large meter vault.

3.6 *Retaining Easements from Public Right-of-Way Vacations or Abandonment* –

3.6.1 *Background* – Occasionally public agencies, such as the State, County or local municipality will vacate or abandon certain segments of their street or road rights of way to other interested parties. The ECUA will often have existing utilities in that ROW that cannot be abandoned or relocated. In these cases ECUA Right-of-Way Agent will coordinate with the respective agency to insure that a utility easement interest is retained during the vacation process.

3.6.2 *Vacation Requests* – All right of way vacation requests shall be forwarded to the ECUA Right of Way Agent for coordination of the review and monitoring of the progress of the vacation process. Input will be sought from ECUA Project Engineers/Managers, Regional Supervisors, Department Heads and others as to any known utilities that may be in the subject ROW or any known future needs.

3.6.3 *Information Recording* – If there are ECUA utilities, or future interests, in the subject ROW, an easement will be requested to be retained by the vacating agency in the Final Ordinance. A copy of the Final Ordinance with Official Record Book and Page recording information will also be requested. The ROW Agent will work with the County Property Appraisers office and ECUA GIS to ensure facility mapping remains as accurate and as current as possible. If no utility or future interests are indicated, the vacating agency will be notified.

## PART 4: <u>Railroad Coordination</u>

4.1 *Background* – ECUA has a long working history with various railroad companies as it relates to planning and installing mains perpendicularly across or longitudinally within railroad ROWs. This knowledge base is vital when coordinating with railroad companies on future installations of utilities within railroad ROW.

ECUA's research indicates the majority of railroad deeds only grant the railroads rights-of-way and not ownership, and that ownership, not just rights-of-way, is required in order for a railroad or any other entity to require permits, fees, or agreements. Deeds granting full ownership, as in fee simple title, are deemed by ECUA to convey ownership.

On ECUA sponsored CIP projects as well as Developer sponsored System Extension projects, should a utility installation within a railroad ROW railroad installation be proposed, then the project's EOR shall coordinate with ECUA's ROW Agent prior to any contact with railroad companies.

4.2 *Procedures to Install ECUA Facilities within Railroad Rights-of-Way –*

4.2.1 *Determination of the Nature of Railroad Property Interests* – Due to the variety of railroad property interests, an initial request letter shall be sent to the railroad requesting the railroad present proof of fee simple title to the affected portion of railroad ROW as early as is practicable to allow time to establish the nature of their property interests. Indicate that response along with supporting documents should be received within thirty days from the date of the initial request.

4.2.2 *A Fee Simple Property Interest Is Not Established* – If the railroad company does not respond within the allotted time, or cannot establish fee simple property interests in their ROW, a construction notification letter shall be sent to the railroad stating that ECUA has not received sufficient proof that the railroad has ownership of the ROW. The letter shall also state that ECUA still desires to coordinate the proposed utility installation with the railroad, although ECUA will not be applying for a permit nor entering into a lease agreement nor paying lease fees. Proposed construction plans shall accompany the letter.

This letter shall continue by stating that coordination between the ECUA Project Engineer, ECUA Right-of-Way Agent, ECUA Risk Management and the railroad company will be needed to review and incorporate as needed railroad and utility industry standards for the location of ECUA facilities, means and methods of construction, construction equipment used, construction materials, and other information related to the protection of the railroad facilities, along with additional safety or insurance requirements that are deemed reasonable by ECUA Engineering and Risk Management. This coordination process should be completed within thirty to sixty days from the date of the construction notification letter. Only the reasonable expenses of the railroad company related to the review of the construction plans will be reimbursed.

4.2.3 *A Fee Simple Property Interest Is Established* – Contact the ECUA ROW Agent to proceed. A review of factors such as if the railroad is listed as a public crossing, listed for public use in federal commerce records, tax records and property valuations, etc. will be performed to determine if the railroad has in essence relinquished its ownership rights in the ROW.

Should ECUA believe that fee simple ownership has been retained by the railroad, then continue negotiations based on the railroad's permitting process. ECUA will consider payment of reasonable review fees, and if needed loss of property value based on diminution of value calculations performed by an ECUA hired USPAP certified appraiser. This reimbursement will be paid with a one-time lump-sum payment. However, ECUA will not enter into lease agreements due to the typical, highly unfavorable terms and conditions, nor will ECUA pay lease fees due to ECUA's non-profit public utility status.

Should the permitting process stall due to these factors, then consideration should be given to the use of condemnation.

# Procedure 10

## Miscellaneous Information

**PART 1: Letters of Capacity Reservation**

If requested, ECUA can provide a letter of capacity reservation for use with Escambia County development review. Submit ECUA's "Capacity Reservation Form" and provide the required information. ECUA will review and return form stating whether or not ECUA has water well and/or wastewater treatment plant capacity to serve the project. Please note that this form does not constitute approval to connect to ECUA's system nor does it guarantee that ECUA's system infrastructure (water/sewer mains, lift stations, etc.) is adequate to serve the project.

**PART 2: Requesting Fire Hydrant Flow Data**

Contact the ECUA Engineering Map Room at 969-3311 to request fire hydrant flow data from prior flow tests. ECUA will review flow records and record data on ECUA standard form and email to requestor.

ECUA does not perform flow tests on request. Should more current flow data be needed, then requestor can contact ECUA Regional Services at 969-6666 in order for ECUA to coordinate/oversee the requestor's private flow test company as they perform the tests.

**PART 3: Dumpster Drains**

Dumpster drains should be avoided if at all possible due to:

- They are not required by Florida's State Plumbing Code.
- Dumpsters are required to be watertight, thereby eliminating need for drains.
- Can washing and similar operations should not be conducted near dumpster areas but should be conducted at a provided can washing station next to the building.

Should a dumpster drain be provided, then it and any can washing station shall be:

- Designed such that rainfall will not enter drain.
- Designed with elevation or curbing such that stormwater runoff will not enter drain.
- Connected to building's oil/water separator unit upstream of connection to ECUA's sewer system.

**PART 4: Swimming Pools and Other Unpolluted Water Discharge**

To avoid interference with the operations and performance of ECUA Wastewater Treatment Facilities users of ECUA's wastewater collection system shall **not** discharge water from the following sources into the sanitary sewer system: swimming pools, stormwater runoff, condensate, noncontact cooling water, and other unpolluted drainage.

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# Division 2 – Design Standards

Section 101 – Plan Preparation

Section 556 – Water Distribution Systems

Section 570 – Gravity Sewer Collection Systems

Section 575 – Wastewater Lift Stations

Section 576 – Wastewater Force Main Systems

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# Section 101

# Plan Preparation

## PART 1: General

1.1 *General Description of Work* – All plans submitted to ECUA for review shall comply with these standards for preparation. The plans shall include sufficient detail to clearly and accurately communicate the design intent. The plans should reflect the anticipation of foreseeable problems with corresponding design solutions. All work shall be planned, designed, and constructed in accordance with the latest edition of ECUA's Engineering Manual.

## PART 2: Plan Makeup

2.1 *General* – The plans shall be clean and legible. Any plans which lack sufficient clarity in content or presentation to facilitate their review will be rejected. All gravity sewer and sanitary sewer force main design shall be shown in both plan and profile view.

2.1.1 *Sheet Size* –

2.1.1.1 ECUA Capital Improvement Projects. Standard Sheet size shall be 22 inch by 34 inch. Alternate sheet sizes including 11 inch by 17 inch, 24 inch by 36 inch, or 30 inch by 42 inch may be allowed with ECUA Project Engineer approval.

2.1.1.2 Developer Sponsored Projects, Standard Sheet size shall be 24 inch by 36 inch, 22 inch by 34 inch, 11 inch by 17 inch with title block. Plan sheets of 30 inch by 42 inch may also be accepted if necessary for coordination of utility plans with other design disciplines.

2.1.2 *Text Height* – Text Height shall be of appropriate size but in no case less than 1/8".

2.1.3 *Required Documents* – Plan sets shall consist of:

2.1.3.1 Cover Sheet

2.1.3.2 Location Map

2.1.3.3 Project Map

2.1.3.4 Design Sheets

2.1.3.5 Detail Sheets

2.1.4 *Required Note* – All design and detail sheets shall have the following note in the upper right hand corner: "All work shall be constructed in accordance with the most recent edition of ECUA's Engineering Manual".

2.1.5 *Title Block* – The title block is to be shown on all sheets except cover sheet, and shall include:

2.1.5.1 Project Name

2.1.5.2 Sheet Title

2.1.5.3 Engineer

2.1.5.4 Date Prepared

2.1.5.5 Date Revised

2.1.5.6 Sheet Number (sequential)

2.2 *Cover Sheet* – The cover sheet shall include the following items:

2.2.1 Project Title

2.2.2 Identified ECUA and Board Members at Time of Bidding. (ECUA Capital Improvement Projects only)

2.2.3 Developer and Engineer or Engineer

2.2.4 Project Number or Identification

2.2.5 Type of Project (if not clear in title)

2.2.6 Date(s) of Design or Submittal and Subsequent Revisions

2.3 *Location Map* – The location map shall include the following items:

2.3.1 Map of Project Area and Area Surrounding in order to easily identify location of project (minimum of ½ mile radius) at a minimum scale of 1 inch = 1000 ft. (min.). Include graphical bar scale.

2.3.2 North Arrow (pointing to the top of page or to the right of page)

2.3.3 Title Block

2.4 *Project Map* – NOTE: Location map and Project map may be combined on single sheet if project size permits.

2.4.1 Project Map shall be at 1 inch = 200 feet or other appropriate scale as approved by ECUA Project Engineer. Include graphical bar scale.

2.4.2 Index of Design Sheets

2.4.3 North Arrow (pointing to the top of page or to the right of page)

2.4.4 General Notes

2.4.5 Title Block

2.5 *Design Sheets* – The following items shall be included on each design sheet where applicable

2.5.1 North Arrow (pointing to the top of page or to the right of page)

2.5.2 Scale shown numerically and graphically.

2.5.2.1 Standard horizontal scales shall be one inch = twenty feet, one inch = thirty feet, or one inch = fifty feet. Alternate scales may be used with the approval of the ECUA Project Engineer.

2.5.2.2 Standard vertical scales shall be one inch = two feet, one inch = three feet, or one inch = five feet. Alternate scales may be used with the approval of the ECUA Project Engineer.

2.5.3 Title Block

2.5.4 To be shown on both plan and profile:

2.5.4.1 Pipe with size and material, to be installed.

2.5.4.2 All appurtenances, shown and located (bends, T's, X's, valves, hydrants, manholes, services, etc.)

2.5.4.3 At all road or paving crossing show method of crossing, i.e. open cut, jack and bore, or directional drill.

2.5.4.3.1 For all jack and bored or directionally drilled crossings, provide both horizontal and vertical detail of the proposed crossing including material type, length, depth and size of carrier pipe and casing (if applicable).

2.5.4.3.2 Depict horizontal and vertical location of existing utilities along the crossing path. (Note the method by which the existing utility location was determined).

2.5.4.3.3 Depict anticipated temporary construction easements as necessary for completion of the planned crossing.

2.5.4.4 Special notes for construction that are specific to each sheet.

2.5.4.5 Circle and reference items for which a detail is provided. Show on same sheet if possible; otherwise, show on specially designated and appropriately referenced detail sheet.

2.5.4.6 Minimum of one Bench mark per sheet.

2.5.4.7 Match line with station for continued sheets.

2.5.4.8 Boring location and results (if available).

2.5.4.9 Stationing along centerline at 100-foot increments. (May use survey baseline stationing if very close to pipeline. Restrict use of station equations.)

2.5.4.10 Location of other utilities within 20 feet of project or that may otherwise conflict with project.

2.5.4.11 Poles, trees, structures, roads, etc. that may conflict with project.

2.5.4.12 Property lines, ROW lines, easements (both temporary and permanent), which are existing and proposed.

2.5.4.13 Topographical features, such as ditches, embankments, etc.

2.5.5 *Other Required Considerations* –

2.5.5.1 Water distribution plans shall also clearly identify the intended depth of cover at least twice on each sheet.

2.5.5.2 Wastewater Plans shall also clearly identify:

2.5.5.2.1 The invert of each pipe in each manhole.

2.5.5.2.2 The calculated slope of each section.

2.5.5.2.3 The final rim elevation of each manhole and the type rim if other than standard (locking, waterproof, etc.).

2.5.5.2.4 The size (inside diameter) of each manhole and anything special, such as drop (inside or outside), shallow (flat top), etc., if different than standard size.

2.5.5.2.5 Profile Sheets should also include:

2.5.5.2.5.1 Ground surface elevation at intervals of no less than one hundred feet. These should be depicted for existing conditions and as final if different.

2.5.5.2.5.2 Type and depth of underground utilities and other features that will be crossed or that might otherwise cause a problem. Provide Subsurface Utility Engineering (SUE) data, aka potholing, vertical verification, etc. via the use of a SUE contractor.

2.5.5.2.5.3 Ground water elevations if known.

2.5.5.2.5.4 Stream or water crossings with stream bed elevations and the normal and extreme high and low water levels.

2.6 *Detail Sheets* – Detail sheets shall be used when necessary for clarity of work and will include:

2.6.1 Appropriate Scale

2.6.2 Label

2.6.3 Elevations

2.6.4 Dimensions

2.6.5 Other Information as Appropriate

2.6.6 Title Block

# Section 556

## Water Distribution Systems

### PART 1: General

1.1 *General Description of Work* – All potable water distribution systems which are to be extensions to the ECUA system shall be designed and constructed in accordance with these Standards. Potable water distribution systems include transmission and distribution mains, service lines, valves, fire hydrants, meters and other appurtenances. Water system materials, installation, and construction methods and procedures shall be in accordance with current ECUA Specifications. Technical Specifications for Water Transmission, Distribution and Service Lines are included in Section 2556 of this Manual.

1.1.1 *Minimum Requirements* – Design standards indicated herein shall be considered minimum requirements unless otherwise noted. The Design Standards outlined in this Manual are intended to provide an adequate supply of potable water to consumers, and fire protection at all times, at pressures and flows as required by the Florida Administrative Code – F.A.C. All proposed system expansions shall be compatible with the Water Master Plan as maintained and amended by ECUA.

1.1.2 *Deviations* – Deviations from these standards may be allowed by ECUA upon a finding by ECUA that, in accordance with sound engineering principles, the granting of the deviation will not result in an increase in the likelihood of a system failure or additional maintenance requirements. Proposed deviations shall be clearly noted on the Construction Plans and explained in an Engineering Report signed and sealed by the Engineer-of-Record and approved in writing by ECUA. Approval of proposed deviations from these Standards is at ECUA's sole discretion.

### PART 2: Other Standards

2.1 *General* – ECUA's Potable Water System Design Standards may differ from the requirements of other local, state and federal agencies having jurisdiction. The more stringent requirement, as determined by ECUA, shall apply.

### PART 3: Water Distribution System Design Standards

3.1 *Flow Requirements* – In sizing extensions to the water distribution system, the minimum required design flow shall be the sum of the required fire flow plus two-thirds (2/3) of the required domestic flow.

3.1.1 *Required Domestic Flow* – Required flow for domestic use in residential areas shall be in accordance with sound engineering practice based upon the Design Engineer's knowledge of water demand characteristics for the specific development, but in no case shall the design be based upon flows less than those presented in the following table:

| REQUIRED DOMESTIC WATER SUPPLY | | | | | | |
|---|---|---|---|---|---|---|
| Max. No. Dwelling Units | Minimum Supply, GPM Dwelling Unit | | | | | |
| | Single Family Detached | Multi-Family | | Mobile Homes | | Retirement Single Family |
| | | 2 BDRM | 1 BDRM | 2 BDRM | 1 BDRM | 2 BDRM (MAX) |
| 50 | 4.0 | 3.6 | 3.4 | 3.2 | 3.0 | 2.6 |
| 100 | 3.0 | 2.7 | 2.6 | 2.4 | 2.3 | 2.0 |
| 200 | 2.0 | 1.8 | 1.7 | 1.6 | 1.5 | 1.3 |
| 200+ | 1.5 | 1.4 | 1.3 | 1.2 | 1.1 | 1.0 |

Note: Multi-family, mobile home, or retirement units consisting of more than 2 bedrooms shall be considered as single-family detached.

3.1.2 *Required Commercial Flow* – The required flow for commercial, industrial or other nonresidential areas shall be as determined by the Engineer-of-Record and approved by the ECUA for each specific instance.

NOTE: Acceptable technical guidance for establishing required flow values may include, but is not necessarily limited to: a) Metcalf & Eddy “Wastewater Engineering”, b) State of Florida Department of Health, Chapter 64E-6, c) Fixture Values as contained in the Florida Building Code, Plumbing, Appendix E. Historical consumption data as documented by utility billing records from approved comparable uses may also be accepted.

3.1.3 *Required Fire Flow* –

3.1.3.1 The minimum required design fire flow shall be 600 gpm with a minimum residual pressure of 20 psig.

3.1.3.2 ECUA will, on request, provide the designer with available system data. ECUA-provided data may be used for preliminary planning purposes only. Engineer-of-Record shall conduct flow testing, in the presence of ECUA Regional Services personnel to support final design.

3.2 *Water System Layout* –

3.2.1 *Grid System* – Where technically feasible and economically sensible, all mains shall be interconnected to form a grid or “looped” system. Six-inch mains shall be placed to form grids of 1,000 feet or less. In no case should 6-inch mains be installed such that there is more than 1,320 feet of line between grid interconnections unless authorized by the ECUA. Eight-inch mains shall form grids no greater than 4,000 feet x 8,000 feet. When larger grids are necessary, larger diameter pipes shall be used unless authorized by ECUA for water quality considerations. Four-inch mains may also be used to form localized grid interconnections where appropriate.

3.2.2 *Subdivision Layout* – A development designed for more than 25 single family dwellings shall have 2 or more connections to the existing distribution system

3.2.3 *Dead-Ends* – All mains shall be looped where possible. Where not possible, provisions shall be made (for example provision of easements) to facilitate future interconnections.

3.2.4 *Future Interconnections* – Provisions for future connecting mains shall be made by extending construction of all water mains to the exterior boundaries of the development wherever future connections to adjacent properties are anticipated or are required to form a looped system.

3.3 *Water Line Sizing* – Distribution mains shall be of sufficient size to furnish the required flow at pressures and velocities as herein provided. Mains shall be located to provide service to each unit within a development and to form a looped network as provided above.

3.3.1 *Required Pressure* – Extensions to the water system shall be designed such that the water pressure at all points in the distribution system shall not be less than 40 psi with no fire hydrant in use. Water pressure in the main at ground level shall not be less than 20 pounds per square inch under all conditions, inclusive of fire flows.

NOTE: When the water pressure exceeds 80 psi, there shall be installed and maintained by the customer, on the property side of the water meter, an approved pressure regulator in conformance with applicable state and local codes.

3.3.2 *Standard Sizes* – Distribution mains used shall have nominal diameters of 2, 3, 4, 6, 8, 12 and 16 inches.

3.3.3 *Minimum Main Size* – Minimum distribution main diameter shall be 4 inches in single family residential areas where fire hydrants are not required, and 6 inches in all other areas. For cul-de-sacs, 3-inch water mains may be used when serving no more than 10 residences. 2-inch water mains may be used around cul-de-sacs serving 4 or less residences. Fittings shall be used as necessary for installation of the pipe around the cul-de-sac.

3.3.4 *Velocity* – Velocities of water for the non-fire flow conditions in the distribution mains shall not exceed 6 feet per second. The velocity under any flow condition shall not exceed 15 fps.

| **Approximate Capacities and Head Loss of Pipes @ Maximum Design Velocity (Non-Fire Flow Conditions)** | | | |
|---|---|---|---|
| **Size** | **Flow (gpm) at 6 fps** | **Head Loss C900 Pipe (c=130) ft./1000ft** | **Head Loss C900 Pipe (c=130) psi/1000ft** |
| 4" | 235 | 39 | 17 |
| 6" | 530 | 22 | 10 |
| 8" | 950 | 15 | 6.5 |
| 12" | 2100 | 10 | 4 |
| 16" | 3700 | 7 | 3 |

3.4 *Water Line Placement* –

3.4.1 *Location* – All mains to be accepted by ECUA shall be installed only in public rights-of-way, utility easements, or on land owned by ECUA.

3.4.2 *Alignment* – Water mains shall be designed to be parallel to the adjoining pavement and/or right-of-way line to the extent practical. In order to keep the main within its desired alignment within the right-of-way or easement, may be required. Standard fittings are available as 11 ¼-degree, 22 ½-degree or 45-degree bends.

If unavoidable, pipe deflections shall adhere to the Manufacturer's recommendations.

3.4.3 *Depth* –

3.4.3.1 *General* – Water lines shall be designed to provide a minimum of 30 inches or a maximum of 36 inches of cover below the proposed finished grade. Deviations from the required minimum or maximum cover may be allowed where conditions require, subject to prior approval of ECUA.

3.4.3.2 *Roadway Crossings* – When crossing roadways, refer to the following guidelines:

3.4.3.2.1 Water line installation in public rights-of-way shall conform to all applicable requirements of the governing agency responsible for the maintenance and operation of the roadway.

3.4.3.2.2 In cases where open-trench construction of roadway crossings is allowed, water lines may be installed as ductile iron or with steel casing in accordance with ECUA's Technical Specifications.

3.4.3.2.3 In cases where open trench construction of roadway crossings is not allowed, water lines shall be installed in a casing in accordance with Section 2310-"Jack and Bore" of ECUA's Technical Specifications. In circumstances where conditions warrant, valves may be required on both sides of the casing.

3.4.3.3 *Water Crossings* – When crossing water, refer to the following guidelines:

3.4.3.3.1 Water line installation involving construction under or across waters of the state shall conform to all applicable requirements of the governing agency, or agencies, having jurisdiction for such activities.

3.4.3.3.2 Where open trenching is permitted, waterline shall be constructed using ductile iron river crossing pipe (or other approved equal) at a depth not less than 36 inches below the bottom surface of the crossing. The ductile iron pipe shall extend at least 20 feet beyond either side of the maximum width of the crossing, and no less than to the jurisdictional line of state waters. Valves shall be placed on each side beyond the jurisdictional line defining the boundaries of the waters of the state.

3.4.3.3.3 Water lines installed under crossings where open trenching is not permitted shall be installed per Section 2300-"Horizontal Directional Drilling" of ECUA's Technical Specifications.

3.4.3.3.4 In circumstances where conditions do not allow trenchless installation, and an existing or proposed bridge crosses the waterway at the same location as the proposed water line, provision may be made to attach the water line to the bridge structure. Prior consent must be obtained from the agency responsible for the maintenance and operation of the bridge. Design of pipe restraints for the bridge attachment shall allow for limited movement of the pipe as a result of expansion and contraction.

3.4.3.3.5 Valves are to be installed on both sides of all water crossings.

3.4.3.4 *Railroad Crossings* – When crossing railroads, refer to the following guidelines:

3.4.3.4.1 Water line installation involving construction under railroads shall conform to all applicable requirements of the governing agency, or agencies, having jurisdiction for such activities.

3.4.3.4.2 Railroad crossings of any length shall be installed in a casing in accordance with Section 2310-"Jack and Bore" of ECUA's Technical Specifications, or in accordance with any special requirements of the railroad company, whichever is more strict.

3.4.3.5 *Other Crossings* – Refer to the following guidelines for other crossings:

3.4.3.5.1 Water lines that must be installed under existing obstructions, such as pipes or conduits, shall maintain a vertical separation of at least 6 inches. In cases where a minimum separation of at least 6 inches cannot be maintained, or in any case where there is a potential threat to the integrity of the water line as a result of an existing obstruction, the pipe shall be installed in a steel casing in accordance with Section 2310-"Jack and Bore" of ECUA's Technical Specifications. Alternatively, Ductile Iron pipe may be used. These special provisions shall extend at least 10 feet on either side of the pipe or obstruction being crossed.

3.4.3.5.2 Water lines installed within easements shall be constructed with Ductile Iron pipe through the entire length of the easement. Valves shall be installed at both ends of the line, unless otherwise approved by ECUA.

3.4.4 *Separation of Potable Water Lines From Sanitary Sewer Lines* – For the purpose of this section, the phrase "water mains" shall mean mains, including treatment plant process piping, conveying either raw, partially treated, or finished drinking water; fire hydrant leads; and service lines that are under the control of a public water system and that have an inside diameter of three inches or greater.

3.4.4.1 *Horizontal Separation* – Refer to the following guidelines regarding horizontal separation between underground water mains and sanitary or storm sewers, wastewater or storm water force mains, reclaimed water pipelines, and on-site sewage treatment and disposal systems:

3.4.4.1.1 New or relocated, underground water mains shall be laid to provide a horizontal distance of at least three feet between the outside of the water main and the outside of any existing or proposed storm sewer, or storm water force main.

3.4.4.1.2 New or relocated, underground water mains shall be laid to provide a horizontal distance of at least three feet, and preferably ten feet, between the outside of the water main and the outside of any existing or proposed vacuum-type sanitary sewer.

3.4.4.1.3 New or relocated, underground water mains shall be laid to provide a horizontal distance of at least six feet, and preferably ten feet, between the outside of the water main and the outside of any existing or proposed gravity- or pressure-type sanitary sewer, wastewater force main, or pipeline conveying reclaimed water. The minimum horizontal separation distance between water mains and gravity-type sanitary sewers shall be reduced to three feet where the bottom of the water main is laid at least six inches above the top of the sewer.

3.4.4.1.4 New or relocated, underground water mains shall be laid to provide a horizontal distance of at least ten feet between the outside of the water main and all parts of any existing or proposed “on-site sewage treatment and disposal system”.

3.4.4.2 *Vertical Separation* – Refer to the following guidelines regarding vertical separation between underground water mains and sanitary or storm sewers, wastewater or storm water force mains, and reclaimed water pipelines:

3.4.4.2.1 New or relocated, underground water mains crossing any existing or proposed gravity- or vacuum-type sanitary sewer or storm sewer shall be laid so the outside of the water main is at least six inches, and preferably 12 inches, above or at least 12 inches below the outside of the other pipeline. However, it is preferable to lay the water main above the other pipeline.

3.4.4.2.2 New or relocated, underground water mains crossing any existing or proposed pressure-type sanitary sewer, wastewater or storm water force main, or pipeline conveying reclaimed water shall be laid so the outside of the water main is at least 12 inches above or below the outside of the other pipeline. However, it is preferable to lay the water main above the other pipeline.

3.4.4.2.3 At the utility crossings described in paragraphs “a” and “b” above, one full length of water main pipe shall be centered above or below the other pipeline so the water main joints will be as far as possible from the other pipeline. Alternatively, at such crossings, the pipes shall be arranged so that all water main joints are at least three feet from all joints in vacuum-type sanitary sewers, storm sewers, storm water force mains and at least six feet from all joints in gravity- or pressure-type sanitary sewers, wastewater force mains, or pipelines conveying reclaimed water.

3.4.4.3 *Water Main and Manhole Separation* – Refer to the following guidelines regarding separation between water mains and sanitary or storm sewer manholes:

3.4.4.3.1 No water main shall pass through, or come into contact with, any part of a sanitary sewer manhole.

3.4.4.3.2 Water mains shall not be constructed or altered to pass through, or come into contact with, any part of a storm sewer manhole or inlet structure. Where it is not technically feasible or economically sensible to comply with this requirement (i.e., where there is a conflict in the routing of a water main and a storm sewer and where alternative routing of the water main or the storm sewer is not technically feasible or is not economically sensible), the ECUA may allow exceptions to this requirement (i.e., ECUA may allow construction of conflict manholes), but such exception shall be subject to written authorization from the Florida Department of Environmental Protection (FDEP). It shall be the responsibility of the Design Engineer to secure such authorization from the FDEP. The Design Engineer shall prepare and submit a preliminary design report to the FDEP including the following information:

3.4.4.3.2.1 Technical or economic justification for each conflict manhole.

3.4.4.3.2.2 A statement identifying the party responsible for maintaining each conflict manhole.

3.4.4.3.2.3 Assurance of compliance with the design and construction requirements in sub-subparagraphs (a) through (d) below.

3.4.4.3.2.3.1 Each water main passing through a conflict manhole shall have a flexible, watertight joint on each side of the manhole to accommodate differential settling between the main and the manhole.

3.4.4.3.2.3.2 Within each conflict manhole, the water main passing through the manhole shall be installed in a watertight casing pipe having high impact strength (i.e., having an impact strength at least equal to that of 0.25-inch-thick ductile iron pipe).

3.4.4.3.2.3.3 Each conflict manhole shall have an access opening, and shall be sized to allow for easy cleaning of the manhole.

3.4.4.3.2.3.4 Gratings shall be installed at all storm sewer inlets upstream of each conflict manhole to prevent large objects from entering the manhole.

3.4.4.4 *Other Separation Guidelines* – Refer to the following guidelines regarding separation between fire hydrant drains and sanitary or storm sewers, wastewater or storm water force mains, reclaimed water pipelines, and on-site sewage treatment and disposal systems.

3.4.4.4.1 New or relocated fire hydrants with underground drains shall be located so that the drains are at least three feet from any existing or proposed storm sewer, or storm water force main, and preferably ten feet, from any existing or proposed vacuum-type sanitary sewer; at least six feet, and preferably ten feet, from any existing or proposed gravity- or pressure-type sanitary sewer, wastewater force main, or pipeline conveying reclaimed water; and at least ten feet from any existing or proposed “on-site sewage treatment and disposal system.

3.4.4.5 *Exceptions* – Where it is not technically feasible or economically sensible to comply with the requirements in subsection “1” or “2” above, ECUA may allow exceptions to these requirements upon the condition that technical or economic justification for each exception is provided and that alternative construction features ensure similar level of reliability and public health protection. Acceptable alternative construction features include the following:

3.4.4.5.1 Where an underground water main is being laid less than the required minimum horizontal distance from another pipeline and where an underground water main is crossing another pipeline and joints in the water main are being located less than the required minimum distance from joints in the other pipeline:

3.4.4.5.1.1 Use of pressure-rated pipe conforming to the American Water Works Association standards incorporated into Rule 62-555.330, F.A.C., for the other pipeline if it is a gravity- or vacuum-type pipeline;

3.4.4.5.1.2 Use of welded, fused, or otherwise restrained joints for either the water main or the other pipeline; or

3.4.4.5.1.3 Use of watertight casing pipe for either the water main or the other pipeline.

3.4.4.5.2 Where an underground water main is being laid less than three feet horizontally from another pipeline and where an underground water main is crossing another pipeline and is being laid less than the required minimum vertical distance from the other pipeline:

3.4.4.5.2.1 Use of pipe, or casing pipe, having high impact strength (i.e., having an impact strength at least equal to that of 1/4-inch-thick ductile iron pipe); and

3.4.4.5.2.2 Use of pipe, or casing pipe, having high impact strength (i.e., having an impact strength at least equal to that of 1/4-inch-thick ductile iron pipe) for the other pipeline if it is new and is conveying wastewater or reclaimed water.

3.4.5 *Pipe Restraints* – All water line fittings and appurtenances shall be restrained. Joint restraints shall be provided in accordance with ECUA Detail D-62. See Section 2556-“Water Distribution Systems”, Paragraph 2.4.1.6 for further information.

3.5 *Appurtenances* –

3.5.1 *Valves* – In-line valves shall be spaced such that no more than 1,000 feet of pipe would be out of service with valves shut, and shall be located on every branch line, with at least one valve on the main line at the junction. The valve may be located on the opposite side of the street from the fittings, except in cases where a tapping sleeve and valve is used. ECUA may require the installation of air release valves on distribution mains. Valves shall be installed in accordance with ECUA Standard Details and Specification 2556-“Water Distribution Systems.”

3.5.2 *Fire Hydrants* –

3.5.2.1 Fire hydrants shall be on a 6-inch or larger main, and no more than 1,000 feet apart along rights-of-way or approved easements. Fire hydrants shall be located at intersections when practical, otherwise as close as practical to common property lines.

3.5.2.2 Fire hydrants shall be located in single family residential areas so that not more than 600 feet of fire hose, as laid along a public right-of-way, will be required to reach any proposed house.

3.5.2.3 Fire hydrants shall be located in multi-family residential or commercial areas, so that no more than 500 feet of hose, as laid across unobstructed terrain, will be required to reach the most remote part of any proposed building.

3.5.2.4 Fire hydrants may also be installed on private land supplied by a private dedicated fire line of at least 6 inches diameter, and protected with an appropriate detector-check assembly located at the property line. Operation and maintenance of hydrants on private property (excluding those in ECUA approved easements) is solely the responsibility of the private maintenance entity.

3.5.3 *Flushing Hydrants* –

3.5.3.1 Flushing hydrants shall be located within a right-of-way or easement near lot/property corners such that their location and use will not be hampered by improvements (driveways, fences, shrubbery).

3.5.3.2 All dead-end lines 4 inches and smaller shall have at least a 2-inch post hydrant assembly.

3.5.3.3 All dead-end lines 6 inches and larger shall have a standard fire hydrant with valve. See ECUA Standard Detail D-50.

3.5.4 *Backflow Preventers* – See Section 3.7 “Cross Connection Control and Backflow Prevention”

3.5.5 *Double Check Detector Assemblies* – An appropriate double check detector assembly shall be required in any private fire line.

3.5.6 *Meters* – Residential and commercial boxes for meters up to 1 ½ inches in size are typically provided by ECUA. Residential and commercial water meters are typically provided by ECUA for all sizes. For water meters 2 inches and larger, the developer is required to install the meter vault in accordance with ECUA Standard Detail D-44 or D-45 as applicable.

3.6 *Service Lines* –

3.6.1 *Potable Water Services* –

3.6.1.1 *General* – Line size must be selected with due consideration for length, peak demand, elevation and pressure loss, including loss across backflow preventer, for the anticipated end use(s). A water meter of the size requested by the customer will be supplied and installed by the ECUA at each connection point. The meter size should be shown on the plans for all commercial developments. Refer to the table below for tubing size.

All residential meters shall be installed in boxes immediately adjacent to the property line in the public right-of-way or easement and readily accessible to ECUA meter readers. Meter boxes shall not be located in driveways or where they might be obstructed by landscaping or other structures, or closer than six feet to the sanitary sewer service lateral. For residential subdivisions, the owner/developer shall coordinate the location of the water meter with the power company prior to installation.

In cases where there is insufficient space to locate a commercial meter box in the right-of-way, an easement of sufficient size to access, operate and maintain the meter, box and bypass lines shall be provided.

For water meters 2-inches or greater, a meter vault shall be installed. The meter vault is to be installed on private property. An easement of sufficient size shall be granted to provide access, to operate and maintain the meter, vault and bypass lines.

| Recommended Tubing Size For Water Services | | | | |
|---|---|---|---|---|
| **Size of Meter** | **Max. Flow (gpm)** | **Max. Pressure Loss (psi)** | **Max. Length of Tubing For Size Indicated** | |
| | | | **1"** | **2"** |
| 5/8" | 20 | 10 | 92 | 2679 |
| 1" | 50 | 10 | 17 | 492 |
| 1-1/2" | 100 | 10 | - | 136 |
| 2" | 160 | 10 | - | 57 |

Any water service serving two or more buildings shall be designed, reviewed and permitted as a distribution system.

3.6.1.2 *Residential* – Water service installation in accordance with ECUA Standard Detail D-40 shall be provided for individual service lines to each lot within all residential developments.

3.6.1.3 *Commercial* – Service Connections to industrial or commercial lots may be omitted if the service size cannot be predetermined, provided approval is obtained. Provisions shall be made so that it is not necessary to cut the public roadway to install the service in the future.

Master meters are required for shopping centers, malls and similar developments. Exceptions may be made when a beneficial part of the Distribution System runs through the development within an ECUA approved easement.

A master meter is required for a wholesale customer, where water is to be distributed to individual units through private lines.

Master meters shall be used for apartment, condominium and other such complexes. ECUA does not accept water and sewer facilities, located outside of the right-of-way which serve Condominium projects subject to the exceptions as described in the document entitled “ECUA Requirements for Acceptance of Potable Water and Sanitary Sewer Mains and Facilities in Condominium Projects”. (See Appendix A).

3.6.2 *Fire Service Lines* –

3.6.2.1 Fire service lines may be installed at the customer's expense, provided that there is adequate existing capacity. Verification of capacity shall be the sole responsibility of the Customer and his design professional.

3.6.2.2 An approved backflow preventer shall be installed by the customer at his expense immediately adjacent to the property line. (See Section 3.7 below.)

3.6.2.3 All fire line services shall be pressure-tested and chlorinated up to the backflow preventer in the same manner as other line extensions.

3.6.3 *Irrigation Service Lines* – Provision shall be made for separate irrigation services and meters to be installed at customer's expense, if required. These should adhere to the requirements for potable water services, per paragraph 3.6.1.

3.7 *Cross Connection Control and Backflow Prevention* – Backflow prevention assemblies shall be installed, in accordance with requirements contained in ECUA's Code, Chapter 5, "Cross Connection Control" and ECUA's Cross Connection Control Program, by the owner/developer, to protect the water distribution system from potential contamination.

3.7.1 *Water Services Requiring Backflow Prevention Assemblies* –

3.7.1.1 *Single Family Residences* – A Backflow Prevention Assembly is required for certain types of residential services. These services are dedicated irrigation services, dedicated fire suppression services and in situations where there is an auxiliary water source on the property.

3.7.1.2 Commercial and Multi-Family – A Backflow Prevention Assembly is required on every commercial and multi-family service.

3.7.2 *Types of Backflow Prevention Assemblies Required* – The type of backflow prevention assembly required for each individual establishment will be based on the degree of hazard involved. ECUA shall make the final decision based on the proposed land use activities. Refer to ECUA Code, Chapter 5, "Cross-Connection Control" and ECUA's Cross Connection Control Program. All assemblies must be approved for use in potable water service by one or more of the following: NSF, ANSI, ASSE, and UL.

3.7.2.1 *Backflow Prevention Assembly Types* –

3.7.2.1.1 Air-Gap Separation Backflow Prevention Assembly will be used in any high risk installation, but is acceptable in all situations described in this section.

3.7.2.1.2 Reduced Pressure Principle Backflow Prevention Assembly will be used in any moderate to high-risk installation.

3.7.2.1.3 Double Check Valve Backflow Prevention Assembly will be used in any moderate-risk installation, which will include most private fire lines, and private hydrants.

3.7.2.1.4 Pressure Vacuum Breaker Backflow Prevention Assembly will be used for irrigation systems only.

3.7.2.2 *Additional Requirements –*

3.7.2.2.1 The type of backflow prevention assembly shall be shown on the Construction Plans.

3.7.2.2.2 An unmetered water line with a backflow prevention assembly may also be required to have a low flow detector meter.

3.7.3 *Bypass* – Any piping arrangement that bypasses the backflow prevention assembly is strictly prohibited.

3.7.4 *Location –*

3.7.4.1 All backflow prevention assemblies are to be located immediately after the meter or immediately inside the property line at the right-of-way line, and shall be readily accessible for inspection and visible from the public right-of-way.

3.7.4.2 Any deviation from 3.7.4.1 above must be individually approved by the ECUA in writing.

3.7.4.3 The location of the backflow prevention assembly is to be shown on the Construction Plans for all developments with the exception of single family dwellings.

3.7.5 *Inspection and Testing* – Inspection and testing of the backflow prevention assembly is the responsibility of the owner. Upon the completion of the initial installation of the backflow prevention assembly, the assembly shall be tested. Additional tests are required biennially for Single Family and annually for Commercial/Multi-Family. All backflow assembly tests shall be conducted by a certified backflow prevention tester and the test results submitted to ECUA's Cross Connection Control Division.

# Section 570

## Gravity Sewer Collection Systems

**PART 1: General**

1.1 *General Description of Work* –

1.1.1 *Minimum Requirements and Deviations* – The following minimum requirements are considered acceptable to the ECUA in the design of collection systems for wastewater from domestic and commercial customers. Deviations from these standards may be allowed by ECUA only upon a finding by the ECUA that, in accordance with sound engineering standards, the granting of the deviation will not cause or exacerbate operational or maintenance difficulties. No deviation will be allowed unless it is approved in writing by ECUA and is clearly noted on the approved construction plans.

1.1.2 *Expansion* – All expansion shall conform to the "Master Plan for Wastewater" as maintained and amended by the ECUA.

1.1.3 *Differences with State/Federal Requirements* – When these standards differ from state and/or federal requirements, the more stringent requirement shall apply.

1.1.4 *Applicable Appurtenances* – The collection system for wastewater includes the gravity mains, manholes, customer service pipes, lift stations, force mains, and other appurtenances. The system should be designed to provide for the collection of wastewater from the customer and its safe and economical transport to ECUA's Wastewater Reclamation Facilities.

**PART 2: Standards**

2.1 *U.S. Environmental Protection Agency and U.S. Public Health Service* – The governing standards of these agencies will be followed when applicable.

2.2 *State of Florida Department of Environmental Protection* – The wastewater collection system shall conform to the applicable State of Florida Department of Environmental Protection (FDEP) laws, policies, standards, rules, and regulations for public wastewater collection systems.

2.3 *Plumbing Codes* – The provisions of the Plumbing Code of the City of Pensacola or Escambia County as it pertains to sanitary wastewater collection, service line locations and materials, and onsite plumbing, except as provided for elsewhere in these criteria, shall apply. It is the intent of this standard that the applicable Plumbing Code(s) apply to sewer collection infrastructure constructed beyond the public right-of-way or public utility easements, which does not meet the definition of a "collection system" as defined by the FDEP.

2.4 *Recommended Standards for Wastewater Facilities* – Policies for the Design, Review, and Approval of Plans and Specifications for Wastewater Collection and Treatment Facilities; Great Lakes—Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers; 2004 Edition.

2.5 *Emerald Coast Utilities Authority* – All wastewater collection systems that are connected to, or to become a part of the ECUA system shall be designed and constructed in accordance with these standards. Materials, installation of materials, and construction methods and procedures shall be in accordance with the current ECUA material and installation specifications. Refer to the Technical Specifications of the ECUA Engineering Manual. All discharges into the ECUA sewer system shall meet the requirements of the ECUA Code.

## PART 3: Design Standards For Gravity Sewer Collection Systems

3.1 *Flow Requirements* – In sizing the collection system gravity mains, the required design flow shall be the sum of the required sanitary flow as contained below, plus an allowance for infiltration and inflow.

3.1.1 *Required Sanitary Flow (Residential)* – Required average daily flow for sanitary use in residential areas shall be based on 300 gallons per day per unit or as approved by the ECUA.

3.1.2 *Required Sanitary Flow (Nonresidential)* – The required flow for commercial, industrial, or other nonresidential areas shall be as determined by the Engineer and approved by the ECUA for each specific instance. Refer to State of Florida Department of Health Chapter 64E-6 Florida Administrative Code Table 1.

3.1.3 *Required Allowance for Inflow and Infiltration* – The maximum required allowance for infiltration and inflow for developed areas shall be in accordance with the following table: (Based on 25 gpd/inch dia./mile for new construction)

| **Inflow and Infiltration Allowance** | |
|---|---|
| **Pipe Diameter (inches)** | **Max. Allowance I & I Flow (GPD/1000 ft.)** |
| 8 | 38 |
| 10 | 47 |
| 12 | 57 |
| 24 | 114 |
| 30 | 142 |
| 36 | 170 |

3.1.4 *Peak Flow* – Peak factors shall be applied to the calculated flow in accordance with Figure. 1, "Ratio of Peak Hourly Flow to Design Average Flow" as taken from the Recommended Standards for Wastewater Facilities, Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, most recent edition.

3.2 *Future Interconnections* – Provisions for future connecting mains shall be made by providing appropriate easements and/or extending construction of all wastewater mains to the exterior boundaries of the subdivision or development wherever future connections to adjacent subdivisions or lots are anticipated.

3.3 *Gravity Collection Mains* – Gravity mains shall be of sufficient size to carry the required flow at velocities as herein provided. Mains shall be located to provide service to each lot within a development as herein provided. All mains shall be installed only in public rights-of-way or utility easements, in favor of the ECUA for the use and benefit of the ECUA. All main locations and sizes shall be in accordance with the ECUA's current "Master Plan for Wastewater" and the ECUA-approved development plan and utility layout.

3.3.1 *Minimum and Standard Main Size* – Minimum gravity main diameter shall be 8 inches in all areas. Standard sizes of gravity mains used shall have nominal diameters of 8, 10, 12, 15, 18, 24, 30, and 36 inches.

3.3.2 *Minimum Allowable Slope* – Slopes shall be designed with a hydraulic gradient sufficient to prevent deposition of solids, by developing a minimum velocity of 2.0 feet per second as computed using Manning's formula and a "n" value of not less than .013 while flowing full. The following table establishes the minimum allowable slopes for various size pipe.

| **Minimum Allowable Slope for Sewer Mains** | |
|---|---|
| **Pipe Size (inches)** | **Minimum Slope (%)** |
| 8 | 0.4 |
| 10 | 0.28 |
| 12 | 0.22 |
| 15 | 0.15 |
| 18 | 0.12 |
| 24 | 0.08 |
| 30 | 0.06 |
| 36 | 0.05 |

Under special conditions, if full and justifiable reasons are given, slopes slightly less than those required for the 2 feet per second velocity when flowing full may be permitted. Such decreased slopes will only be considered where the depth of flow will be 0.3 of the diameter or greater for design average flow. Whenever such decreased slopes are selected the Engineer must furnish with his report his computations of the depths of flow in such pipes at minimum, average and peak rates of flow. It is recognized that such flatter grades may cause additional sewer maintenance expense and odor nuisance. The selection of the size of pipe shall be determined on the basis of the most desirable flow characteristics obtainable. The Owner of any privately maintained sewer system will give written assurance to the appropriate reviewing agency that any additional sewer maintenance required by reduced slopes will be provided.

3.3.2.1 In the case of sewers where the slope and volume are such that velocities will exceed 10 feet per second at average flow, special provision shall be made to protect against erosion. This protection may be secured utilizing C900 PVC, ductile iron, steel pipe or equivalent, when approved in writing by the ECUA.

3.3.2.2 Where velocities greater than 15 feet per second are anticipated, special provision shall be made to protect against displacement by erosion and shock.

3.3.2.3 Sewers on 20 percent slopes or greater shall be anchored securely with concrete anchors or equal, spaced as follows:

3.3.2.3.1 Not over 36 feet center to center on grades 20 percent and up to 35 percent,

3.3.2.3.2 Not over 24 feet center to center on grades 35 percent and up to 50 percent; and

3.3.2.3.3 Not over 16 feet center to center on grades 50 percent and over.

3.3.2.4 Full advantage of suitable topography and paralleling of ground slopes shall be made. Minimum slopes should only be used when necessary, particularly with 8-inch pipe. When depth exceeds 10 feet, check pipe class for strength, and/or specify stricter bedding requirements.

3.3.2.5 Sewers shall be designed and laid with a uniform slope between manholes.

3.3.3 *Pipe Size Between Manholes* – Change in pipe size shall not occur between manholes.

3.3.3.1 *Increasing Size* – When a smaller sewer joins a larger one, the invert of the larger sewer shall be lowered sufficiently to maintain the same hydraulic gradient. The crowns of pipes shall be at the same elevation within the manhole.

3.3.3.2 *Decreasing Size* – At times, due to increasing sewer slopes, a reduction in the size of the outgoing sewer from a manhole may be justified. Such a reduction shall not be permitted on sewers 24-inch in diameter or under, but may be permitted on sewers larger than 24-inch in diameter. Inverts of the pipes shall be matched in the manhole.

3.3.4 *Crossing Other Utilities* – When crossing other utilities, vertical separation shall be shown.

3.3.5 *Change in Horizontal Alignment* – There shall be a drop of 0.1 foot across each manhole.

3.3.6 *Crossing Existing Roads* – When crossing under existing paved streets or roads, it must be determined if open cut will be permitted. If jack and boring will be required complete details must be shown. Extra effort should be expended to locate any possible conflict with existing utilities. Allow extra slope through bore and specify minimum and maximum allowable deviations.

3.3.7 *Collection System Depth* – The depth of the collection system shall be sufficient to receive flows by gravity from all buildings and lots to be served. The service lines shall be installed in accordance with plumbing code(s) specifications and slopes. A 30-inch minimum cover shall be required. Less cover may be considered with special provisions for protection of the pipe.

3.3.8 *Privately Maintained Stations* – Connections of individual properties and buildings to the ECUA wastewater collection system shall be accomplished by gravity flow to the maximum extent practicable. When no reasonable alternative exists, privately maintained lift stations may be employed, with ECUA consent, for connection to the collection system. All such systems necessary for connection to the ECUA collection system shall be privately maintained.

3.3.9 *Alignment* –

3.3.9.1 Sewers shall be laid with straight alignment between manholes.

3.3.9.2 Horizontal separation from other utilities shall be maintained.

3.3.9.3 Sewers 48-inch and larger may be laid on a curve. Refer to pipe manufacturer for allowable curvature.

3.3.9.4 Changes in horizontal alignment of greater than 90º are to be avoided.

3.3.10 *Pipe Material* – PVC pipe SDR26 shall be utilized for gravity lines. C900 PVC or DI pipe may be substituted where extra strength or joint integrity is required.

3.3.10.1 Pipe material will not be changed between manholes (except where additional structural protection is required).

3.3.10.2 Where ductile-iron pipe is to be installed, external pipe corrosion protection will be specified if soil resistivity is less than 1,000 ohms per square centimeter per centimeter. (Polyethylene sleeves or an anticorrosion embedment as directed by the ECUA.) Internal pipe corrosion protection shall be provided by proven Hydrogen Sulfide and abrasion resistant coatings. Fused Epoxy coating is recommended, others shall be approved by ECUA Engineering Department.

3.3.11 *Cover* –

3.3.11.1 A minimum cover of 30 inches must be provided where conditions permit.

3.3.11.2 At road crossings, a minimum separation distance of 24 inches shall be maintained from the bottom of the roadway base to the top of the pipe or the top of the casing when provided.

3.3.11.3 At buried stream crossings, a minimum cover of 36 inches is required.

3.3.12 *Crossings* –

3.3.12.1 Major road crossings shall be encased per Section 2310-“Jack and Bore” of Standard Specifications or made using ductile iron pipe. Additional requirements of the regulatory agency responsible for the road shall be met.

3.3.12.2 Buried stream crossing shall be encased in steel casing or made with ductile iron pipe. This protection shall extend 10 feet beyond the bank and the pipe or casing shall be anchored to prevent shifting.

3.3.12.3 Aerial stream crossing shall be encased in steel casing or made with ductile iron pipe. This protection shall extend until 30 inches of cover is provided.

3.3.12.4 When crossing under pipes, conduits or other structures greater than 24 inches in diameter, and a 6-inch separation distance cannot be maintained, the pipe shall be encased in steel casing or made with ductile iron pipe for a minimum of 10 feet distance on either side of the crossed pipe.

3.3.13 *Manholes* – Manholes shall be installed at the end of each sewer line, at all junctions, at all changes in grade, size, or alignment; with the following added considerations:

3.3.13.1 Maximum spacing shall be 400 feet up to and including 36-inch pipe, controlled by available ECUA cleaning equipment. Spacing for pipes larger than 36-inch may be increased up to, but not to exceed 500 feet, controlled by cleaning requirement.

3.3.13.2 Lampholes shall not be used on any gravity sewer line. Manholes shall be provided at the end of every sewer line.

3.3.13.3 Manholes located in the roadway shall be placed in the center of the roadway or travel lane if possible to avoid wheel traffic.

3.3.13.4 A drop manhole shall be provided when a sewer invert enters a manhole at an elevation of 2 feet or more above the manhole invert. Where the difference in elevation is less than 2 feet, the invert shall be formed to a half-round concrete channel of equivalent diameter of the outlet pipe to prevent solids deposition. Drop manholes shall use an outside drop connection, except inside drops may be approved for building services and laterals. Inside drops shall be securely fastened to the interior wall of the manhole with stainless steel clamps or pipe hangers. Inside drops shall be extended to the invert of the manhole on a 45-degree bend installed to direct flow correctly. The drop shall be installed so it does not block manhole access or inhibit maintenance. See ECUA Detail D-13, "Drop Manhole Connections."

3.3.13.5 The inside diameter of manholes shall be a minimum of 48 inches up to and including 24-inch pipe. For pipe larger than 24 inches, the inside diameter of the manhole shall be increased so as to provide at least a 12-inch shelf on each side of the pipe.

3.3.13.6 Manholes shall be precast reinforced concrete unless special conditions would dictate a cast in place or other type.

3.3.13.7 The manhole flow channel shall ensure a smooth flow line from all incoming lines to the outgoing. All channels must provide a smooth transition to the outgoing line with the maximum possible radius on all curves. Precast manhole channels or inverts may be approved, but only if they meet the above requirements. Channels shall have the equivalent diameter of the manhole effluent pipe.

3.3.13.8 Ventilated manholes may be required by the ECUA Engineering Department as conditions dictate. Ventilation methods shall be approved by the ECUA Engineering Department in writing before installed.

3.4 *Wastewater Services* –

3.4.1 *Service Laterals* – Service laterals shall be provided to all lots within a subdivision in accordance with the ECUA regulations. All residential service laterals shall be located in the center of the property line nearest to the collection system. Customer service connections to industrial or commercial lots may be omitted provided approval of the ECUA is obtained prior to approval of plans and specifications.

3.4.2 *Flow Measurement* – The ECUA may require flow measuring devices where flows in excess of 50,000 gpd can be expected. This includes apartment complexes, trailer parks, shopping centers, etc. The ECUA must approve the method and location of flow measurements. Acceptable methods will include pre-approved open channel flow devices with meter/totalizer, pipe meters and hour meters on private lift stations.

3.4.3 *Cleanouts* – A two-way cleanout shall be installed at the property line or otherwise approved by the ECUA Engineering Department.

# Section 575

# Wastewater Lift Stations

## PART 1: General

1.1 *Overall Design* – All lift station components, including fiberglass wetwell, shall be designed (signed and sealed) by a Florida Professional Engineer.

1.2 *Purpose* – Lift stations shall be provided at any point in a proposed sewage collection system where the upstream gravity collection system cannot be physically connected to the existing collection system in a manner to permit gravity flow. System extensions shall be designed to avoid lift stations as much as possible.

1.2.1 In general, lift stations may lift flows to a higher elevation, transport flow horizontally or combine lifting and horizontal transport.

1.2.2 In general, lift stations shall utilize submersible pumps placed in a below-ground wet well, unless otherwise noted.

1.3 *Oversizing* – Lift stations often offer oversizing opportunities due to ECUA system growth patterns and the need to accommodate such growth with efficient planning and design of proposed stations. Oversizing options for lift stations include but are not limited to parcel size, pumping rate, wetwell size, force main size, etc. All oversizing decisions should be made by ECUA during the design process in accordance with Procedure 6 – Oversizing, and shall be documented in the Utility Service Agreement for the applicable project.

1.4 *Future Need* – When the wet well and force main are oversized for future requirements, the station piping, electrical service, and controls shall be sized accordingly. When it is anticipated that a third pump is to be installed in the future, the station shall be designed to accommodate through-wall piping in the wet well top, a manifold into the discharge force main, and appropriate equipment in the control panel.

1.5 *Location and Design* – Lift station location and design capacity shall be compatible with the ECUA Collection System Master Plan. Lift stations shall be designed to operate effectively at initial flows as well as at ultimate design flows. To that end, each lift station design must address several interrelated elements including, but not limited to:

1.5.1 Wet well size (diameter and depth)

1.5.2 Force main size and lift station piping

1.5.3 Pump and control selection

1.5.4 Flow quantity and lift station appurtenances

1.6 *Calculations* – Lift station calculations shall be performed, signed, and sealed by a Florida Professional Engineer, and shall be done in accordance with this procedure and the rest of the ECUA Engineering Manual, as well as include design considerations and variables as offered by ECUA staff.

1.7 *Lift Station Pump Overview Chart* – The Engineer-of-Record (EOR) shall review ECUA's Lift Station Pump Overview Chart and all applicable sections of the ECUA Engineering Manual prior to initiating design.

1.8 *Lift Station Manufacturer's Contact List* – ECUA has compiled a list of ECUA approved lift station component manufacturers, along with contact information. This information is contained in ECUA's Lift Station Approved Manufacturers and Sales Contacts List.

1.9 *Pump Selection Worksheet* – Once the initial pump coordination with ECUA has been completed, the system design has been performed, and the pump requirements have been determined, the EOR shall contact each of ECUA's approved pump manufacturers and request them submit their best pump for the application. The EOR shall then utilize ECUA's Pump Selection Worksheet in order to determine a group of pumps that are acceptable to the ECUA. In determining the appropriate group of pumps, the EOR shall analyze the technical, performance, efficiency, cost, future flow capacity, future head capacity, future impeller upgrades and other related data such that the selected pumps are deemed equivalent to each other within the group and as a group better suited to the project application than non-selected pumps. The EOR should strive to create a manageable list of at least two acceptable pumps, preferably three. Said document shall be signed by the EOR, ECUA Project Engineer, and ECUA Lift Station Representative thus certifying the pumps on the worksheet are acceptable for use on project. Said pump selection information shall then be recorded in the pump chart on the lift station detail sheet thus making any of the pumps available for use on the project.

## PART 2: <u>Design Criteria</u>

2.1 *Lift Station Siting* – Lift station shall be located to allow sewage collection by means of gravity flow from the largest feasible drainage area. Consideration may be given to locating lift stations to permit continuing future downstream gravity sewer system development where possible and consistent with ECUA's Collection System Master Plan.

2.1.1 *General Location* – Lift station wetwell top elevation shall be at least three feet above the 100 year flood level as designated by FEMA Flood Maps, and at least three feet above the highest berm elevation of any nearby stormwater pond. In no case should the lift station be placed in an area subject to prolonged periods of flooding. Wetwell shall be higher than surrounding area to prevent over-wash of station. The parcel and any associated access driveways shall be designed to permit proper drainage away from the lift station.

2.1.2 *Access* – Lift station parcels shall be located to provide sufficient accessibility for maintenance vehicles at all times. Accessibility includes, but is not limited to, adequate space for ECUA service vehicles to perform turn-around maneuvers if needed, gate access, etc. Parcels shall be located adjacent to roadway right-of-way as much as possible. Parcels not adjacent to roadway right-of-way shall be provided with a 20 foot wide access parcel that connects the lift station parcel to the roadway right-of-way. Driveways shall be 12 feet wide minimum (may be wider per ECUA access needs) and may be either paved (2-inch asphalt, 6-inch graded aggregate base, 12-inch sub-grade stabilization) or rock surface (8-inch graded aggregate base, 12-inch sub-grade stabilization) capable of supporting H-20 traffic loading.

2.1.3 *Parcel Requirements* – The lift station parcel shall be 50 feet in width and 50 feet in depth. Any reduction will require written justification from the EOR and written approval of the

Director of Engineering and the Director of Maintenance. Depending on the lift station and its needs, parcels larger than 50 feet x 50 feet may be required if necessary to accommodate additional equipment or access. Title to the lift station site, access drive, and easements shall be conveyed to ECUA in accordance with ECUA policy. The site shall be fenced in accordance with the plans unless specifically exempted.. Access driveways shall not be shared with private entities, such as home owners or homeowner associations.

2.1.4 *Electrical Service* – The lift station site shall have access to three phase power (minimum ECA requirement) installed in accordance with Gulf Power and the station's voltage needs.

2.2 *Design Criteria* –

2.2.1 *Redundancy* – Lift stations shall contain a minimum of 2 pumps. Additional pumps may be required based on coordination with ECUA.

2.2.2 *Minimum Pumping Rate* – The Average Daily Flow for lift station collection areas shall be developed in accordance with Section 570-"Gravity Sewer Collection Systems". Peak hourly flow (PHF) shall be determined using the *Ten States Standards* peaking formula. The minimum PHF for each pump shall be 125 gallons per minute (GPM). On ECUA Capital Improvement Projects (CIP), ECUA will typically select 250 GPM as the minimum PHF for each pump. On System Extension Projects (aka Developer), ECUA may elect to increase design pumping rates based on future system needs and cost effectiveness, via ECUA cost sharing and oversizing program.

2.2.3 *System Head* – Calculate system heads based on pumping rates above. Include minimum, average, and maximum static head conditions to insure pump selection can perform adequately for each head condition.

2.2.4 *Pump Curves with System Head Curves* - Submit factory pump curves showing efficiencies, horsepower, and all available impellor sizes, superimposed with system head curves generated by EOR. **Excel generated curves will not be allowed.**

2.2.5 *Velocities* – The lift station discharge force main (riser piping) minimum velocity shall be 2.5 fps, although 5 fps is preferred, and in no case shall it exceed 10 fps. If flow monitoring is required, the riser piping velocity shall be maintained through the flow meter. The force main velocity in the remaining parts of the proposed transmission system (downstream of the above-grade plug valves or flow meter) shall not be less than 2.5 fps.

2.2.6 *Pump Efficiencies* – Pump efficiency is just one of the criteria used in determining the list of acceptable pumps for each station. Smaller stations by nature are not as efficient as larger stations, therefore it is un-realistic for ECUA to set high goals for minimum efficiencies of said small stations. For small stations, the EOR shall balance efficiencies with other functional criteria as part of the analysis and selection of acceptable pumps. For larger lift stations, as determined by ECUA, or those stations that are anticipated to have a total daily runtime greater than 5 hours, the EOR shall utilize either a minimum efficiency approach or specify pumps that operate at a certain percentage of BEP as part of the analysis and selection of allowable pumps.

2.2.7 *Downstream Impacts* – The EOR shall coordinate with ECUA Engineering staff to analyze downstream capacities. ECUA staff will assist the EOR to the extent possible with the analyses noted below.

2.2.7.1 When the force main will manifold into an existing force main, the impact on that line and all existing lift stations that utilize that line must be evaluated by the EOR and ECUA staff.

2.2.7.2 When the force main could either discharge to an existing lift station or manifold into that station's force main, an analysis shall be made to determine which alternative is in the best long-term interest of ECUA.

2.2.8 *Wet Well Sizing* – The minimum wet well size shall be 8-feet in diameter. The wet well shall be sized by determining the combination of diameter and depth most suitable to handle the intended maximum design capacity with adequate provision for emergency storage.

2.2.8.1 *Anti-flotation* – Anti-flotation design shall incorporate the following:

2.2.8.1.1 Wet well empty weight and soil pressure on concrete base collar may be used to calculate down forces, but pump and piping weights shall not be used. Assume groundwater is at grade. A factor of safety of 1.2, minimum, must be used in anti-flotation calculations.

2.2.8.1.2 Delegated Engineer shall design anti-floatation base as part of Delegated Engineering Documents requirements with minimum sizing per ECUA Design Standard Drawings.

2.2.8.2 *Liquid Level Control Elevations* – See Appendix for design guidance requirements.

2.2.8.3 *Concrete Cover* – Delegate Engineer shall design concrete cover as part of Delegated Engineering Documents requirements with minimum sizing per ECUA Design Standard Drawings.

2.2.8.4 *Pump Mounting Baseplate* – Delegate Engineer shall design pump mounting baseplate as part of Delegated Engineering Documents requirements with minimum sizing per ECUA Design Standard Drawings.

2.2.8.5 *Design Submittal* – Delegate Engineer shall submit wetwell design as part of the Delegated Engineering Documents for ECUA's review and approval.

2.2.9 *Antenna Height* – A radio path study will be provided by ECUA on CIP and System Extension projects. The study will determine the appropriate antenna height for the EOR's use in the design plans. Once the proposed lift station site location has been confirmed by ECUA, the EOR shall then request the radio path study to be performed by ECUA. The ECUA Project Engineer shall forward results of study as they become available.

2.2.10 *Fencing* – Fencing shall be designed in accordance with ECUA specification Section 2830 and Lift Station Design Standard Drawings, unless specifically waived by ECUA's Engineer.

2.2.10.1 The Gulf Power service meter location shall be designed to be outside the fence or located in order to be read without entering the fence.

2.2.10.2 On all ECUA lift stations, gate shall be 14’ wide aluminum cantilever slide gate. On System Extension Projects (AKA Developer), ECUA shall pay the incremental cost increase between a rolling gate and a cantilever slide gate, via ECUA cost sharing and oversizing program.

2.2.11 *Bypass Pumping* – Emergency bypass (aka pump-out) piping with plug valve and quick-connect coupling shall be the same size (up to 8-inch diameter) as the station piping, and shall be designed and located per ECUA's Lift Station Design Standard Drawings. Additionally, for stations with long driveways, an underground pump-out connection shall be designed and located in the connecting road ROW per ECUA’s Lift Station Design Standard Drawings.

2.2.12 *Emergency Power* – Standby emergency power will be required as follows:

2.2.12.1 At a minimum, ECUA lift stations shall be designed with a manual transfer switch for connecting a portable generator, unless one of the options below is incorporated.

2.2.12.2 Some lift stations shall be designed with an automatic transfer switch (ATS) for connecting to either a permanent generator or portable generator dedicated to the site. EOR shall coordinate with ECUA on the location and type of switch required for each station.

2.2.12.3 Lift stations that discharge through a 12-inch diameter or larger piping shall require an on-site emergency generator suitably located and wired for automatic transfer. Generator will be of sufficient size to run all of the station equipment. For duplex lift stations, the generator must be sized to run two pumps at a time. For triplex lift stations, the generator must be sized to run the remaining pump(s) with the largest pump out of service.

2.2.13 *Flow Measurement* – Flow measuring devices shall be provided with lift stations that have a design flow of 1,200 gpm or greater (per FDEP) or as required by ECUA. Flow measurement device shall have instantaneous, totalizing, and recording capabilities.

2.2.14 *Mixers/Chemical Feed Equipment* – Mixers and/or chemical feed equipment may be required at lift stations or elsewhere in the collection system if hydrogen sulfide and other gases create problems. If chemical feed equipment is not required initially, access must be provided for possible future use.

# APPENDIX

## Lift Station Design Reference Data

***FORCE MAIN FLOWS (GPM)***

| Velocity (fps) | Force Main Diameter | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2"** | **3"** | **4"** | **6"** | **8"** | **10"** | **12"** | **14"** | **16"** | **20"** | **24"** |
| 2 | 20 | 40 | 80 | 180 | 310 | 490 | 700 | 960 | 1250 | 1960 | 2820 |
| 2.5 | 25 | 60 | 100 | 220 | 390 | 610 | 880 | 1200 | 1570 | 2450 | 3520 |
| 3 | 30 | 70 | 120 | 260 | 470 | 730 | 1060 | 1440 | 1880 | 2940 | 4230 |
| 4 | 40 | 90 | 160 | 350 | 630 | 980 | 1410 | 1920 | 2510 | 3910 | 5640 |
| 5 | 50 | 110 | 200 | 440 | 780 | 1220 | 1760 | 2400 | 3130 | 4890 | 7050 |
| 6 | 60 | 130 | 230 | 530 | 940 | 1470 | 2110 | 2880 | 3760 | 5870 | 8460 |
| 7 | 70 | 150 | 270 | 620 | 1100 | 1710 | 2470 | 3360 | 4380 | 6850 | 9860 |
| 8 | 80 | 180 | 310 | 700 | 1250 | 1960 | 2820 | 3840 | 5010 | 7830 | 11270 |
| 9 | 90 | 200 | 350 | 790 | 1410 | 2200 | 3170 | 4320 | 5640 | 8810 | 12680 |
| 10 | 100 | 220 | 390 | 880 | 1570 | 2450 | 3520 | 4800 | 6260 | 9790 | 14090 |

***PIPE VOLUMES (Gal/100 FT):***

| **Diam.** | **2"** | **3"** | **4"** | **6"** | **8"** | **10"** | **12"** | **14"** | **16"** | **20"** | **24"** | **36"** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Vol.** | 19 | 42 | 70 | 153 | 259 | 405 | 573 | 800 | 1044 | 1632 | 2350 | 5284 |

***VOLUMES PER VERTICAL FOOT (Gal)***

| | Manholes | | | Wetwells | | | |
|---|---|---|---|---|---|---|---|
| **Diameter** | **4'** | **5'** | **6'** | **8'** | **10'** | **12'** | **14'** |
| **Volume** | 94 | 147 | 211 | 376 | 587 | 846 | 1151 |

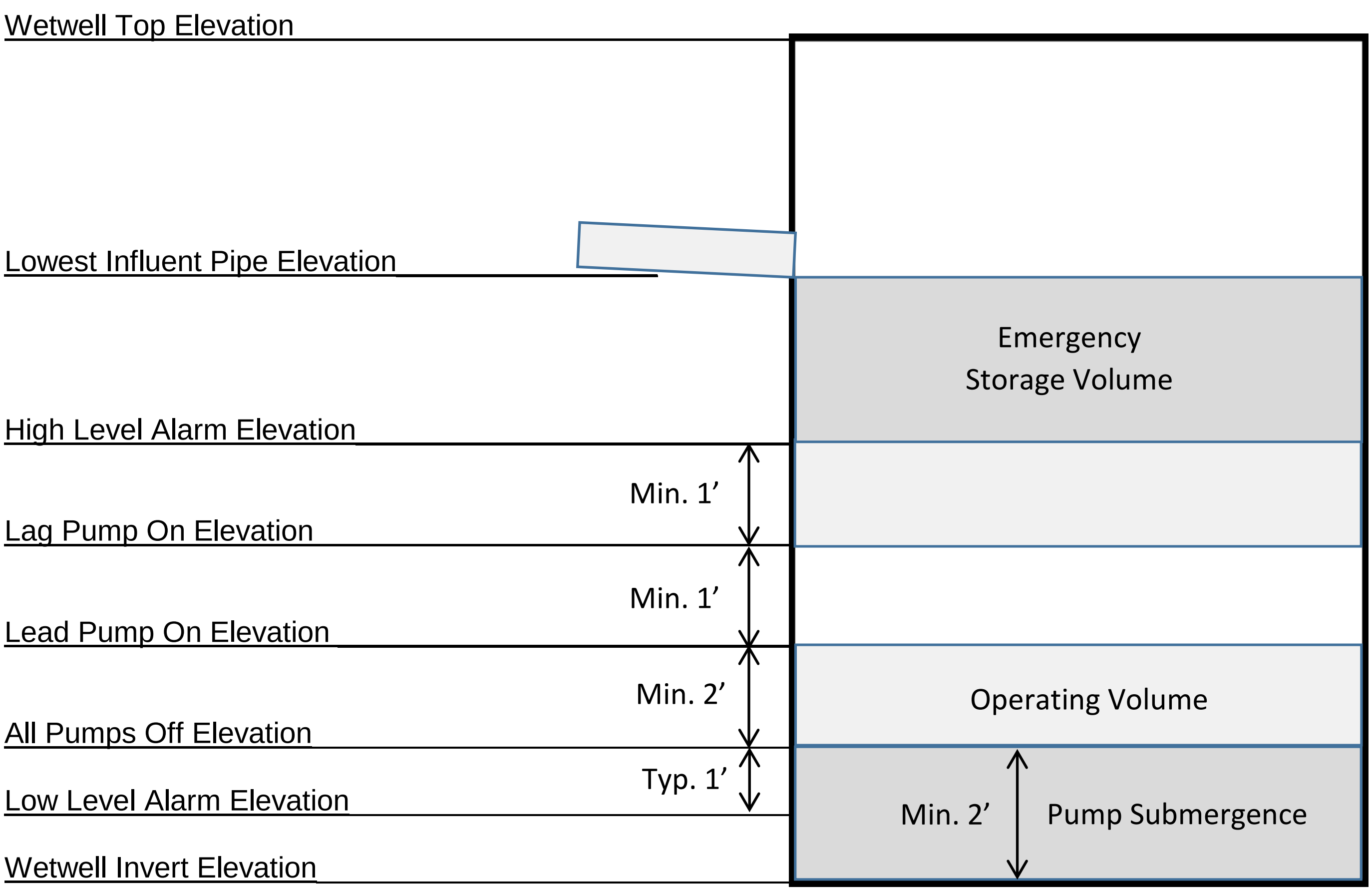
***STANDARD MOTOR SIZES, FULL LOAD AMPS, AND STARTER TYPE SELECTION***
*(Data below is for reference purposes only. EOR shall use pump supplier motor sizes, FLA ratings, and then consult with ECUA on motor starter selection.)*

| Motor Size (HP) | Typical Full Load Amps | | Typical Motor Starter Selection |
|---|---|---|---|
| | **230 V** | **460 V** | |
| 5 | 15.2 | 7.6 | FVNR(ATL) |
| 7.5 | 22 | 11 | FVNR(ATL) |
| 10 | 28 | 14 | FVNR(ATL) |
| 15 | 42 | 21 | FVNR(ATL) |
| 20 | 54 | 27 | RVSS (Soft start), or VFD |
| 25 | 68 | 34 | RVSS (Soft start), or VFD |
| 30 | 80 | 40 | RVSS (Soft start), or VFD |
| 40 | 104 | 52 | RVSS (Soft start), or VFD |
| 50 | 130 | 65 | VFD |
| 60 | 154 | 77 | VFD |
| 75 | 192 | 96 | VFD |
| 100 | 248 | 124 | VFD |

***Wetwell Sizing and Liquid Level Control Elevation Guidelines***

The following elevations and volumes shall be included in the EOR's design calcs and plans:

a. **Wetwell Top Elevation:** Use elevation per site plan design.
b. **Lowest Influent Pipe Elevation:** Use elevation per collection system design.
c. **Emergency Storage Volume:** Calculate volume based on 30 minutes of average daily flow, determine height of volume based on wetwell diameter.
d. **High Level Alarm Elevation:** Set elevation per bottom of emergency storage volume calcs.
e. **Lag Pump On Elevation:** Set elevation minimum 1' below high level alarm elevation.
f. **Lead Pump On Elevation:** Set elevation minimum 1' below lag pump on elevation.
g. **Operating Volume:** Calculate operating volume: $V_{[gal]}$ = t Q / 4, where t (pump cycle time) = 10 minutes and Q = pumping rate (gpm). Determine height of volume based on wetwell diameter. Minimum height shall be 2'.
h. **All Pumps Off Elevation:** Set elevation per bottom of operating volume calcs.
i. **Low Level Alarm Elevation:** Set elevation one foot below the all pumps off elevation.
**j.** **Minimum Pump Submergence:** Shall be the greater of either 2' depth or depth as dictated by pump manufacturer.
k. **Wetwell Invert Elevation:** Set elevation based on selected minimum pump submergence and all pumps off elevation.



## *Friction Loss per 100 Feet Length of Pipe. Hazen-Williams "C"=140. Pipe Sizes in Inches.*

*(Multiply friction losses below by the corresponding multipliers for "C" Factors other than 140: ("C"…multiplier): 100…1.86, 110…1.56, 120…1.33, 130…1.15)*

| Flowrate (gpm) | 1/2 -inch | | 3/4 -inch | | 1 -inch | | 1 1/4 -inch | | 1 1/2 -inch | | 2 -inch | | 2 1/2 -inch | | 3 -inch | | 4 -inch | | 5 -inch | | 6 -inch | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Veloc. (fps) | Loss (ft) | Veloc. (fps) | Loss (ft) | Veloc. (fps) | Loss (ft) | Veloc. (fps) | Loss (ft) | Veloc. (fps) | Loss (ft) | Veloc. (fps) | Loss (ft) | Veloc. (fps) | Loss (ft) | Veloc. (fps) | Loss (ft) | Veloc. (fps) | Loss (ft) | Veloc. (fps) | Loss (ft) | Veloc. (fps) | Loss (ft) |
| **2** | 2.11 | 4.07 | 1.20 | 1.03 | 0.74 | 0.32 | 0.43 | 0.08 | 0.32 | 0.04 | 0.19 | 0.01 | 0.13 | 0.00 | 0.09 | 0.00 | 0.05 | 0.00 | 0.03 | 0.00 | 0.02 | 0.00 |
| **4** | 4.23 | 14.69 | 2.41 | 3.73 | 1.49 | 1.15 | 0.86 | 0.30 | 0.63 | 0.14 | 0.38 | 0.04 | 0.27 | 0.02 | 0.17 | 0.01 | 0.10 | 0.00 | 0.06 | 0.00 | 0.04 | 0.00 |
| **6** | 6.34 | 31.13 | 3.61 | 7.91 | 2.23 | 2.44 | 1.29 | 0.64 | 0.95 | 0.30 | 0.57 | 0.09 | 0.40 | 0.04 | 0.26 | 0.01 | 0.15 | 0.00 | 0.10 | 0.00 | 0.07 | 0.00 |
| **8** | 8.46 | 53.04 | 4.82 | 13.48 | 2.97 | 4.16 | 1.72 | 1.10 | 1.26 | 0.52 | 0.77 | 0.15 | 0.54 | 0.06 | 0.35 | 0.02 | 0.20 | 0.01 | 0.13 | 0.00 | 0.09 | 0.00 |
| **10** | 10.57 | 80.18 | 6.02 | 20.38 | 3.71 | 6.29 | 2.15 | 1.66 | 1.58 | 0.78 | 0.96 | 0.23 | 0.67 | 0.10 | 0.43 | 0.03 | 0.25 | 0.01 | 0.16 | 0.00 | 0.11 | 0.00 |
| **12** | 12.69 | 112.38 | 7.22 | 28.56 | 4.46 | 8.82 | 2.58 | 2.32 | 1.89 | 1.10 | 1.15 | 0.33 | 0.80 | 0.14 | 0.52 | 0.05 | 0.30 | 0.01 | 0.19 | 0.00 | 0.13 | 0.00 |
| **15** | 15.86 | 169.89 | 9.03 | 43.18 | 5.57 | 13.34 | 3.22 | 3.51 | 2.37 | 1.66 | 1.44 | 0.49 | 1.01 | 0.21 | 0.65 | 0.07 | 0.38 | 0.02 | 0.24 | 0.01 | 0.17 | 0.00 |
| **18** | 19.03 | 238.13 | 10.84 | 60.52 | 6.69 | 18.70 | 3.86 | 4.92 | 2.84 | 2.33 | 1.72 | 0.69 | 1.21 | 0.29 | 0.78 | 0.10 | 0.45 | 0.03 | 0.29 | 0.01 | 0.20 | 0.00 |
| **20** | | | 12.04 | 73.56 | 7.43 | 22.72 | 4.29 | 5.98 | 3.15 | 2.83 | 1.91 | 0.84 | 1.34 | 0.35 | 0.87 | 0.12 | 0.50 | 0.03 | 0.32 | 0.01 | 0.22 | 0.00 |
| **25** | | | 15.05 | 111.20 | 9.29 | 34.35 | 5.37 | 9.05 | 3.94 | 4.27 | 2.39 | 1.27 | 1.68 | 0.53 | 1.09 | 0.19 | 0.63 | 0.05 | 0.40 | 0.02 | 0.28 | 0.01 |
| **30** | | | 18.06 | 155.86 | 11.14 | 48.15 | 6.44 | 12.68 | 4.73 | 5.99 | 2.87 | 1.78 | 2.01 | 0.75 | 1.30 | 0.26 | 0.76 | 0.07 | 0.48 | 0.02 | 0.33 | 0.01 |
| **35** | | | | | 13.00 | 64.06 | 7.51 | 16.87 | 5.52 | 7.97 | 3.35 | 2.36 | 2.35 | 1.00 | 1.52 | 0.35 | 0.88 | 0.09 | 0.56 | 0.03 | 0.39 | 0.01 |
| **40** | | | | | 14.86 | 82.03 | 8.59 | 21.60 | 6.31 | 10.20 | 3.83 | 3.03 | 2.68 | 1.27 | 1.74 | 0.44 | 1.01 | 0.12 | 0.64 | 0.04 | 0.44 | 0.02 |
| **45** | | | | | 16.72 | 102.03 | 9.66 | 26.87 | 7.10 | 12.69 | 4.31 | 3.76 | 3.02 | 1.58 | 1.95 | 0.55 | 1.13 | 0.15 | 0.72 | 0.05 | 0.50 | 0.02 |
| **50** | | | | | | | 10.73 | 32.66 | 7.88 | 15.43 | 4.78 | 4.57 | 3.35 | 1.93 | 2.17 | 0.67 | 1.26 | 0.18 | 0.80 | 0.06 | 0.56 | 0.02 |
| **60** | | | | | | | 12.88 | 45.77 | 9.46 | 21.62 | 5.74 | 6.41 | 4.02 | 2.70 | 2.61 | 0.94 | 1.51 | 0.25 | 0.96 | 0.08 | 0.67 | 0.03 |
| **70** | | | | | | | 15.02 | 60.90 | 11.04 | 28.77 | 6.70 | 8.53 | 4.69 | 3.59 | 3.04 | 1.25 | 1.77 | 0.33 | 1.12 | 0.11 | 0.78 | 0.05 |
| **80** | **8 -inch** | | | | | | 17.17 | 77.98 | 12.62 | 36.84 | 7.65 | 10.92 | 5.36 | 4.60 | 3.47 | 1.60 | 2.02 | 0.43 | 1.28 | 0.14 | 0.89 | 0.06 |
| **90** | | | | | | | 19.32 | 96.99 | 14.19 | 45.81 | 8.61 | 13.58 | 6.03 | 5.72 | 3.91 | 1.99 | 2.27 | 0.53 | 1.44 | 0.18 | 1.00 | 0.07 |
| **100** | **Veloc. (fps)** | **Loss (ft)** | | | | | | | 15.77 | 55.69 | 9.57 | 16.51 | 6.71 | 6.95 | 4.34 | 2.42 | 2.52 | 0.64 | 1.60 | 0.21 | 1.11 | 0.09 |
| **110** | | | | | | | | | 17.35 | 66.44 | 10.52 | 19.70 | 7.38 | 8.30 | 4.78 | 2.88 | 2.77 | 0.77 | 1.77 | 0.26 | 1.22 | 0.10 |
| **120** | 0.77 | 0.03 | **10 -inch** | | | | | | 18.92 | 78.05 | 11.48 | 23.14 | 8.05 | 9.75 | 5.21 | 3.39 | 3.03 | 0.90 | 1.93 | 0.30 | 1.33 | 0.12 |
| **130** | 0.83 | 0.04 | | | | | | | 20.50 | 90.53 | 12.44 | 26.84 | 8.72 | 11.31 | 5.65 | 3.93 | 3.28 | 1.05 | 2.09 | 0.35 | 1.44 | 0.14 |
| **140** | 0.89 | 0.04 | **Veloc. (fps)** | **Loss (ft)** | | | | | | | 13.39 | 30.79 | 9.39 | 12.97 | 6.08 | 4.51 | 3.53 | 1.20 | 2.25 | 0.40 | 1.56 | 0.16 |
| **150** | 0.96 | 0.05 | | | | | | | | | 14.35 | 34.99 | 10.06 | 14.74 | 6.51 | 5.12 | 3.78 | 1.37 | 2.41 | 0.45 | 1.67 | 0.19 |
| **160** | 1.02 | 0.05 | 0.65 | 0.02 | **12 -inch** | | | | | | 15.31 | 39.43 | 10.73 | 16.61 | 6.95 | 5.77 | 4.04 | 1.54 | 2.57 | 0.51 | 1.78 | 0.21 |
| **170** | 1.09 | 0.06 | 0.69 | 0.02 | | | | | | | 16.26 | 44.11 | 11.40 | 18.58 | 7.38 | 6.46 | 4.29 | 1.72 | 2.73 | 0.57 | 1.89 | 0.23 |
| **180** | 1.15 | 0.07 | 0.74 | 0.02 | **Veloc. (fps)** | **Loss (ft)** | **14 -inch** | | | | 17.22 | 49.04 | 12.07 | 20.65 | 7.82 | 7.18 | 4.54 | 1.91 | 2.89 | 0.64 | 2.00 | 0.26 |
| **190** | 1.21 | 0.07 | 0.78 | 0.03 | | | | | | | 18.18 | 54.20 | 12.74 | 22.83 | 8.25 | 7.93 | 4.79 | 2.11 | 3.05 | 0.70 | 2.11 | 0.29 |
| **200** | 1.28 | 0.08 | 0.82 | 0.03 | | | **Veloc. (fps)** | **Loss (ft)** | | | 19.13 | 59.60 | 13.41 | 25.10 | 8.69 | 8.73 | 5.04 | 2.33 | 3.21 | 0.77 | 2.22 | 0.32 |
| **225** | 1.44 | 0.10 | 0.92 | 0.03 | 0.64 | 0.01 | | | | | 21.53 | 74.13 | 15.09 | 31.22 | 9.77 | 10.85 | 5.67 | 2.89 | 3.61 | 0.96 | 2.50 | 0.39 |
| **250** | **1.60** | **0.12** | **1.02** | **0.04** | **0.71** | **0.02** | **0.52** | **0.01** | | | **23.92** | **90.11** | **16.76** | **37.95** | **10.86** | **13.19** | **6.30** | **3.52** | **4.01** | **1.17** | **2.78** | **0.48** |
| **275** | 1.76 | 0.15 | 1.12 | 0.05 | 0.78 | 0.02 | 0.57 | 0.01 | **16 -inch** | | | | 18.44 | 45.28 | 11.94 | 15.74 | 6.94 | 4.19 | 4.41 | 1.40 | 3.06 | 0.57 |
| **300** | 1.92 | 0.17 | 1.23 | 0.06 | 0.85 | 0.02 | 0.63 | 0.01 | | | | | 20.12 | 53.20 | 13.03 | 18.49 | 7.57 | 4.93 | 4.81 | 1.64 | 3.33 | 0.67 |
| **325** | 2.08 | 0.20 | 1.33 | 0.07 | 0.92 | 0.03 | 0.68 | 0.01 | **Veloc. (fps)** | **Loss (ft)** | | | | | 14.11 | 21.44 | 8.20 | 5.72 | 5.22 | 1.90 | 3.61 | 0.78 |
| **350** | 2.24 | 0.23 | 1.43 | 0.08 | 0.99 | 0.03 | 0.73 | 0.02 | | | | | | | 15.20 | 24.60 | 8.83 | 6.56 | 5.62 | 2.18 | 3.89 | 0.89 |
| **375** | 2.40 | 0.26 | 1.53 | 0.09 | 1.06 | 0.04 | 0.78 | 0.02 | 0.60 | 0.01 | **18 -inch** | | | | 16.29 | 27.95 | 9.46 | 7.45 | 6.02 | 2.48 | 4.17 | 1.01 |
| **400** | 2.55 | 0.30 | 1.64 | 0.10 | 1.14 | 0.04 | 0.83 | 0.02 | 0.64 | 0.01 | | | | | 17.37 | 31.50 | 10.09 | 8.40 | 6.42 | 2.80 | 4.44 | 1.14 |
| **425** | 2.71 | 0.33 | 1.74 | 0.11 | 1.21 | 0.05 | 0.89 | 0.02 | 0.68 | 0.01 | **Veloc. (fps)** | **Loss (ft)** | | | 18.46 | 35.24 | 10.72 | 9.39 | 6.82 | 3.13 | 4.72 | 1.28 |
| **450** | 2.87 | 0.37 | 1.84 | 0.12 | 1.28 | 0.05 | 0.94 | 0.02 | 0.72 | 0.01 | | | | | 19.54 | 39.18 | 11.35 | 10.44 | 7.22 | 3.48 | 5.00 | 1.42 |
| **475** | 3.03 | 0.41 | 1.94 | 0.14 | 1.35 | 0.06 | 0.99 | 0.03 | 0.76 | 0.01 | 0.60 | 0.01 | **20 -inch** | | 20.63 | 43.30 | 11.98 | 11.54 | 7.62 | 3.84 | 5.28 | 1.57 |
| **500** | 3.19 | 0.45 | 2.04 | 0.15 | 1.42 | 0.06 | 1.04 | 0.03 | 0.80 | 0.02 | 0.63 | 0.01 | | | | | 12.61 | 12.69 | 8.02 | 4.23 | 5.56 | 1.73 |
| **600** | 3.83 | 0.63 | 2.45 | 0.21 | 1.70 | 0.09 | 1.25 | 0.04 | 0.96 | 0.02 | 0.76 | 0.01 | **Veloc. (fps)** | **Loss (ft)** | | | 15.13 | 17.79 | 9.63 | 5.92 | 6.67 | 2.42 |
| **700** | 4.47 | 0.84 | 2.86 | 0.28 | 1.99 | 0.12 | 1.46 | 0.06 | 1.12 | 0.03 | 0.88 | 0.02 | | | | | 17.65 | 23.67 | 11.23 | 7.88 | 7.78 | 3.22 |
| **800** | 5.11 | 1.07 | 3.27 | 0.36 | 2.27 | 0.15 | 1.67 | 0.07 | 1.28 | 0.04 | 1.01 | 0.02 | 0.82 | 0.01 | **24 -inch** | | 20.18 | 30.31 | 12.84 | 10.09 | 8.89 | 4.13 |
| **900** | 5.75 | 1.33 | 3.68 | 0.45 | 2.55 | 0.19 | 1.88 | 0.09 | 1.44 | 0.05 | 1.14 | 0.03 | 0.92 | 0.02 | | | | | 14.44 | 12.55 | 10.00 | 5.13 |
| **1000** | 6.39 | 1.62 | 4.09 | 0.55 | 2.84 | 0.23 | 2.09 | 0.11 | 1.60 | 0.06 | 1.26 | 0.03 | 1.02 | 0.02 | **Veloc. (fps)** | **Loss (ft)** | | | 16.05 | 15.26 | 11.11 | 6.24 |
| **1100** | 7.03 | 1.94 | 4.50 | 0.65 | 3.12 | 0.27 | 2.29 | 0.13 | 1.76 | 0.07 | 1.39 | 0.04 | 1.12 | 0.02 | | | | | 17.65 | 18.20 | 12.22 | 7.44 |
| **1200** | 7.66 | 2.27 | 4.91 | 0.77 | 3.41 | 0.32 | 2.50 | 0.15 | 1.92 | 0.08 | 1.51 | 0.04 | 1.23 | 0.03 | 0.85 | 0.01 | | | 19.26 | 21.38 | 13.33 | 8.75 |
| **1300** | 8.30 | 2.64 | 5.31 | 0.89 | 3.69 | 0.37 | 2.71 | 0.17 | 2.08 | 0.09 | 1.64 | 0.05 | 1.33 | 0.03 | 0.92 | 0.01 | | | 20.86 | 24.80 | 14.45 | 10.14 |
| **1400** | 8.94 | 3.02 | 5.72 | 1.02 | 3.97 | 0.42 | 2.92 | 0.20 | 2.24 | 0.10 | 1.77 | 0.06 | 1.43 | 0.04 | 0.99 | 0.01 | **36 -inch** | | | | 15.56 | 11.64 |
| **1500** | 9.58 | 3.44 | 6.13 | 1.16 | 4.26 | 0.48 | 3.13 | 0.23 | 2.40 | 0.12 | 1.89 | 0.07 | 1.53 | 0.04 | 1.06 | 0.02 | | | | | 16.67 | 13.22 |
| **1600** | 10.22 | 3.87 | 6.54 | 1.31 | 4.54 | 0.54 | 3.34 | 0.25 | 2.55 | 0.13 | 2.02 | 0.07 | 1.64 | 0.04 | 1.14 | 0.02 | **Veloc. (fps)** | **Loss (ft)** | | | 17.78 | 14.90 |
| **1700** | 10.86 | 4.33 | 6.95 | 1.46 | 4.83 | 0.60 | 3.55 | 0.28 | 2.71 | 0.15 | 2.14 | 0.08 | 1.74 | 0.05 | 1.21 | 0.02 | | | | | 18.89 | 16.67 |
| **1800** | 11.50 | 4.82 | 7.36 | 1.63 | 5.11 | 0.67 | 3.75 | 0.32 | 2.87 | 0.17 | 2.27 | 0.09 | 1.84 | 0.06 | 1.28 | 0.02 | 0.57 | 0.00 | | | 20.00 | 18.53 |
| **1900** | 12.14 | 5.33 | 7.77 | 1.80 | 5.39 | 0.74 | 3.96 | 0.35 | 3.03 | 0.18 | 2.40 | 0.10 | 1.94 | 0.06 | 1.35 | 0.03 | 0.60 | 0.00 | | | | |
| **2000** | 12.77 | 5.86 | 8.18 | 1.98 | 5.68 | 0.81 | 4.17 | 0.38 | 3.19 | 0.20 | 2.52 | 0.11 | 2.04 | 0.07 | 1.42 | 0.03 | 0.63 | 0.00 | | | | |
| **2100** | 13.41 | 6.41 | 8.58 | 2.16 | 5.96 | 0.89 | 4.38 | 0.42 | 3.35 | 0.22 | 2.65 | 0.12 | 2.15 | 0.07 | 1.49 | 0.03 | 0.66 | 0.00 | | | | |
| **2200** | 14.05 | 6.99 | 8.99 | 2.36 | 6.25 | 0.97 | 4.59 | 0.46 | 3.51 | 0.24 | 2.78 | 0.14 | 2.25 | 0.08 | 1.56 | 0.03 | 0.69 | 0.00 | | | | |
| **2300** | 14.69 | 7.59 | 9.40 | 2.56 | 6.53 | 1.05 | 4.80 | 0.50 | 3.67 | 0.26 | 2.90 | 0.15 | 2.35 | 0.09 | 1.63 | 0.04 | 0.73 | 0.01 | | | | |
| **2400** | 15.33 | 8.21 | 9.81 | 2.77 | 6.81 | 1.14 | 5.01 | 0.54 | 3.83 | 0.28 | 3.03 | 0.16 | 2.45 | 0.10 | 1.70 | 0.04 | 0.76 | 0.01 | | | | |
| **2500** | 15.97 | 8.85 | 10.22 | 2.99 | 7.10 | 1.23 | 5.21 | 0.58 | 3.99 | 0.30 | 3.15 | 0.17 | 2.55 | 0.10 | 1.77 | 0.04 | 0.79 | 0.01 | | | | |
| **2750** | 17.56 | 10.56 | 11.24 | 3.57 | 7.81 | 1.47 | 5.74 | 0.69 | 4.39 | 0.36 | 3.47 | 0.20 | 2.81 | 0.12 | 1.95 | 0.05 | 0.87 | 0.01 | | | | |
| **3000** | 19.16 | 12.41 | 12.26 | 4.19 | 8.52 | 1.73 | 6.26 | 0.82 | 4.79 | 0.43 | 3.78 | 0.24 | 3.07 | 0.14 | 2.13 | 0.06 | 0.95 | 0.01 | | | | |

# Section 576

## Wastewater Force Main Systems

### PART 1: General

1.1 *General Description of Work* –

This section applies to all new developments requiring or requesting a new or modified wastewater force main system. For these new developments, a Pre-Design Meeting is required (see below) to assist in defining the appropriate point of service. ECUA reserves the right to specify the point of service, the size of service, the type of service, and the general layout of the overall system within the guidelines established in this manual.

All wastewater force main systems that are to be additions or extensions to the ECUA collection system shall be designed in accordance with these Standards (see Part 2) and constructed in accordance with technical requirements outlined in ECUA Manual Section 2576-"Wastewater Force Main Systems".

The Engineer shall coordinate the location of the wastewater force main system and related sewer facilities with other utilities (electric, gas, telecommunication, drainage and cable) to minimize conflicts. Facilities shall be designed such that conflicts with driveways and sidewalks are minimized.

In general, gravity sewers are preferable to pressure sewers. However, costs and conditions often make gravity sewers not feasible. A low-pressure sewer system (small diameter force mains designed to receive wastewater flow from individual pumping systems at each point of service) shall be considered for areas with conditions not favorable for the installation and operation of conventional gravity sewage collection systems. A low-pressure sewer system shall be allowed only by special exception with approval by ECUA and with appropriate permits from the FDEP. Design shall be in accordance with the most recent edition of the "Design and Specification Guidelines for Low Pressure Sewer Systems".

1.2 *Pre-Design Meeting* – System extensions shall be designed to avoid lift stations to the maximum extent practicable. A pre-design meeting can be held with ECUA Engineering personnel to discuss the utilization of the correct and most current ECUA standards and to allow ECUA the opportunity to coordinate the design with the ECUA Master Plan for Wastewater and other known proposed projects within the service area.

1.3 *Utility Construction Notes* – The following notes, at a minimum, shall be included on all plan submittals. Any deviation from the standards shall be requested by the Design Engineer and shall be approved, in writing, by ECUA.

1.3.1 All wastewater force main system work shall be constructed in accordance with the latest ECUA Design Standards, all applicable local and state regulatory rules and regulations, and other applicable ECUA rules.

1.3.2 All wastewater force main system construction work shall be provided by a contractor qualified as required under the current Florida Statute or by an Underground Utility Contractor, licensed under the provisions of Chapter 489 FS.

1.3.3 The Contractor shall be responsible for obtaining City or County Right-Of- Way (R/W) permits for work in the City R/W, County R/W or a FDOT permit for work in the FDOT R/W.

1.3.4 The Contractor shall contact ECUA's Field Inspector a minimum 48 hours prior to initiating the wastewater force main system work, including all utility main taps by the constructor.

1.3.5 The minimum horizontal and vertical separation requirements for the wastewater force main system or sewer improvements shall conform to the latest ECUA and FDEP rules. The minimum horizontal separation requirements between the proposed sewer utilities and ponds or structures shall conform to the latest ECUA Design Standards.

1.3.6 Typically, wastewater force main system pipes shall be constructed with a minimum of 30 inches of cover in unpaved areas and a minimum of 36 inches of cover in paved areas. The maximum cover for utilities utilizing Horizontal Directional Drill methods shall comply with the latest ECUA Design Standards.

1.3.7 The Contractor shall minimize service interruptions to existing ECUA customers. If ECUA approves a service interruption, then the Contractor will be responsible for coordinating the notification of impacted customers in accordance with the latest ECUA rules.

1.4 *Calculations* – Hydraulic calculations including influent flow data, hydraulic analysis of the system, pump operating points, etc. shall be signed and sealed by a Florida registered Professional Engineer and submitted to ECUA for review and acceptance prior to construction.

## PART 2: <u>Standards</u>

2.1 *U.S. Environmental Protection Agency and U.S. Public Health Service* – The governing standards of these agencies shall be followed when applicable.

2.2 *State of Florida Department of Environmental Protection* – The wastewater collection system shall conform to the applicable Florida State Department of Environmental Protection laws, policies, standards, rules, and regulation for public wastewater collection systems.

2.3 *Plumbing Codes* – The provisions of the Plumbing Code of the City of Pensacola or Escambia County as it pertains to sanitary wastewater collection, service line locations and materials, and onsite plumbing, except as provided for elsewhere in these criteria, shall apply. It is the intent of this standard that the applicable Plumbing Code(s) apply to sewer collection infrastructure constructed beyond the public right-of-way or public utility easements.

2.4 *Recommended Standards for Wastewater Facilities* – Policies for the Design, Review, and Approval of Plans and Specifications for Wastewater Collection and Treatment Facilities; Great Lakes—Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers as adopted by the Florida Department of Environmental Protection.

2.5 *Emerald Coast Utilities Authority* – All wastewater collection systems that are to be connected to the ECUA system shall be designed and constructed in accordance with these standards. Materials, installation of materials, and construction methods and procedures shall be in accordance with the current ECUA material and installation specifications. Refer to the Technical Specifications of the ECUA Engineering Manual. All discharges into the ECUA sewer system shall meet the requirements of the ECUA Code.

**PART 3: Design Parameters and Functional Criteria**

3.1 *General* – This section provides the minimum guidelines for the design of wastewater force main systems. The method of design and/or construction shall be according to accepted engineering practices, with these Standards (see Part 2), the latest edition of the Recommended Standards for Sewage Works (Ten State Standards), and all applicable Sections of the Florida Department of Environmental Protection Rules and Regulations for Water and Sewer Systems.

3.2 *Design Flows* –

3.2.1 Design flows for new wastewater force main system shall be based upon Table I of the State of Florida Department of Health (FDOH), Chapter 64E-6.008 F.A.C., Standards for Onsite Sewage Treatment and Disposal Systems or other approvable method where historical data is not available.

3.2.2 An Equivalent Dwelling Unit (EDU) is the equivalent flow that can be anticipated from one residential connection. In the ECUA system, assume 100 gallons per capita per day (gpcd) to calculate the average daily flow (ADF). To calculate the ADF from a single EDU, multiply the gpcd by 3.5.

3.2.3 Sewer systems and facilities shall be designed for peak flows calculated in accordance with the Recommended Standards for Sewage Works, latest edition (Ten State Standards), and as shown below.

Peak Flow = Peaking Factor * Average Daily Flow (ADF)

Peaking Factor = $[18+ \sqrt{(\frac{\text{Population}}{1000})}] \,/\, [4+ \sqrt{(\frac{\text{Population}}{1000})}]$

3.3 *"C" Factor* – Use the following Hazen-Williams roughness coefficients for new construction:

| **Hazen-Williams Roughness Coefficients** | |
|---|---|
| **Pipe Size / Type** | **Coefficient of Roughness** |
| 16" diameter and larger ductile iron pipe | 120 |
| Less than 16" diameter ductile iron pipe | 125 |
| PVC | 130 |
| HDPE | 140 |

3.4 *Rate of Flow* – The design shall give appropriate consideration to rate of flow as it relates to pipe sizes in the riser, force main, and receiving sewer as described below.

3.4.1 The force main velocity at the initial pumping rate shall not be less than 2.5 feet per second (fps). The force main velocity at the design pumping rate shall preferably not be greater than 6 fps, with 8 fps maximum.

3.4.2 The velocity in a wet well discharge riser shall not be less than 5 fps nor more than 10 fps.

3.4.3 The capacity in the receiving sewer and downstream lift stations shall be checked for ability to accept the flows generated by the proposed lift station.

3.4.4 When the force main will manifold into an existing force main, the impact on the receiving force main and connected lift stations shall be considered.

3.4.5 When there exists an alternative to connect a new force main to an existing lift station or to manifold with the force main exiting the existing lift station, an analysis shall be performed to determine which is best in the long-term interest of ECUA.

3.5 *Optimal Size Selection* – When and where applicable, and feasible, calculate system head: static, friction, and velocity. For projects involving a lift station or pump upgrades or the manifolding of force mains, both the maximum and minimum flow and head conditions must be calculated for consideration.

3.5.1 Force main sizing calculations may require several iterations to arrive at optimum design for sound economic selection over the proposed design period. The determination of optimum size must consider initial and future demands.

3.5.2 Force mains shall be a minimum 4 inch diameter in the right-of-way or within ECUA easement if the main is to be dedicated. Exceptions may be granted for low pressure systems or low flow pump stations which discharge directly into a gravity sewer system.

3.6 *Low Pressure Sewer Systems* – The following serves as guidelines for the design and construction of Low Pressure Sewer Systems.

3.6.1 *Number of Connections for Designated Pipe Sizes* – The beginning of a low pressure sewer system (the farthest point from discharge) in a residential application should use a pipe diameter of 2 inches. As more connections are made to the system the diameter of the common collection pipe may increase. It is the responsibility of the designer to size the low pressure sewer system adequately and within documented velocity limits. The table below, suggesting pipe diameters for cumulative numbers of homes connected to the system, is provided as a reference only.

| **Number of Connections for Designated Pipe Sizes** | |
|---|---|
| **Cumulative # of Service Connections** | **Pipe Diameter** |
| 0 - 8 | 2 inch |
| 9 - 20 | 3 inch |
| 21 - 50 | 4 inch |

3.6.2 Low Pressure Service Laterals - Pipe from a single grinder pump or other low pressure sewer system to be connected to an ECUA force main shall be 1.5 inches in diameter from the right-of-way to the main (see Detail D-20). All residential service laterals shall be located in the center of the property line nearest to the collection system.

3.6.3 *Flushing Stations* – Flushing stations are to be sized and constructed as per Detail D-22 – “Low Pressure Flushing Connections”. Inline Flushing Connections shall be installed approximately 20 feet upstream of significant bends (45° & 90°) and generally at 1,000 foot spacing along the force main. Flushing Stations shall be installed in vicinity to side property lines to minimize impact from construction of future driveways, drainage features, etc.

## PART 4: Technical Criteria

4.1 *General* – See the ECUA Engineering Manual, Section 2576-“Wastewater Force Main Systems” for technical specifications.

# Lift Station Detail Drawings

The Lift Station Detail Drawings are not included in this printed version of the Engineering Manual. The Lift Station Detail Drawings can be viewed on the ECUA website at the following address:

http://www.ecua.fl.gov/business/proposed-engineering-manual

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# Division 3 – Technical Specifications

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# Section 1000

# Miscellaneous Project Support

## PART 1: Testing Laboratory Services

1.1 *General Description of Work* – The Contractor shall employ, at his/her expense, a certified testing laboratory, acceptable to the Engineer, to provide testing services as prescribed in these specifications and associated Contract Documents. Required tests may include, but are not necessarily limited to: compressive strength tests for placed concrete, mix design and density tests for asphalt paving or patching, Procter density curves for backfill material, in-place densities for placed fill materials, leak detection and pressure testing for completed pressure piping, and start-up testing for new pumps and equipment.

1.1.1 The Contractor shall be responsible for providing materials which meet the requirements indicated. For manufactured materials such as reinforcing steel, expansion joint materials, concrete pipe, cement, miscellaneous steel, cast iron materials, etc., the Contractor will be required to furnish a Manufacturer's Certificate that the material meets the requirements specified for this project.

1.1.2 The Engineer shall monitor all materials incorporated into the project and their placement by testing at the Contractor's expense. The Engineer does not guarantee the accuracy or validity of the data nor does the Project Engineer or Owner assume any responsibility for the Contractor's interpretation of the data. Materials or work which does not meet the specifications shall be removed or modified.

1.1.3 All retesting for work rejected on the basis of the initial test results will be at the expense of the Contractor and the extent of the retesting shall be determined by the Engineer. The Engineer may require additional testing for failing tests and may require two passing retests. Acceptance will be made by the Engineer.

1.1.4 The testing laboratory will be approved by the Engineer and shall perform all work in a professional manner.

1.2 *Laboratory Duties and Limits of Authority* –

1.2.1 Cooperate with Engineer and Contractor to provide qualified personnel as required promptly on notice.

1.2.2 Acquaint Engineer's personnel with testing procedures and with all special conditions encountered at the site.

1.2.3 Perform specified inspections, sampling and testing of materials and construction methods:

1.2.3.1 Comply with specified standards, ASTM and other recognized authorities.

1.2.3.2 Ascertain compliance with the Contract requirements.

1.2.4 Promptly notify the Engineer of irregularities or deficiencies of work which are observed during performance of services.

1.2.5 Promptly submit 3 copies of reports of observations and tests to the Engineer including but not limited to:

1.2.5.1 Date issued

1.2.5.2 Project title and number

1.2.5.3 Testing laboratory name and address

1.2.5.4 Name and signature of technician

1.2.5.5 Date of sampling

1.2.5.6 Record of temperature and weather

1.2.5.7 Date of test

1.2.5.8 Identification of product and specification section

1.2.5.9 Location of product

1.2.5.10 Type of test

1.2.5.11 Observations regarding compliance with the Contract documents

1.2.6 Perform additional services ordered by the Engineer.

1.2.7 Laboratory is not authorized to:

1.2.7.1 Release, revoke, alter or enlarge on the Contract requirements.

1.2.7.2 Approve or accept any portion of work.

1.2.7.3 Perform any duties of the Contractor.

1.3 *Contractor's Responsibilities* –

1.3.1 Furnish products and complete installation of prescribed work to meet or exceed the Contract requirements.

1.3.2 Cooperate with laboratory personnel; provide access to the work or to the Manufacturer's operations.

1.3.3 Provide to laboratory preliminary representative samples of materials to be tested in specified quantities.

1.3.4 Furnish copies of test reports.

1.3.5 Furnish verification of compliance with the Contract requirements for materials and equipment.

1.3.6 Furnish casual labor and facilities:

*1.3.6.1* To provide access to work to be tested

*1.3.6.2* To obtain and handle samples at site

*1.3.6.3* To facilitate inspections and tests

*1.3.6.4* For laboratory's exclusive use for storage and management of test samples.

1.3.7 Notify Engineer 24 hours in advance of operations to allow for the assignment of personnel.

1.3.8 Notify laboratory 24 hours in advance of operations to allow for the assignment of personnel.

1.3.9 Correct work which is defective or which fails to conform to the Contract documents. Corrective work shall not delay the project or the work of other Contractors.

1.3.10 Pay all costs of retesting when test results indicate non-compliance with the Contract requirements.

1.3.11 Patch all surfaces and areas disturbed by testing operations.

## PART 2: <u>Soils and Subsurface Investigations</u>

2.1 *General* - Depending on the project requirements, the Engineer may have obtained geotechnical information, which may include subsurface data, logs of soil borings and recommendations from geotechnical consultants.

2.1.1 If soil borings have been prepared, they will be included in the specifications or on the plans.

2.1.2 Any geotechnical information included is for information only. The ECUA and the Engineer do not assume any responsibility for the Contractor's interpretation or conclusions drawn from the data.

2.1.3 The Contractor may, at his option, perform additional subsurface investigations at his own expense.

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# Section 1900

# Building Demolition

## PART 1: General

1.1 *Summary –*

1.1.1 Furnish all labor, materials, tools, equipment, and services for Demolition, as indicated, in accordance with provisions of Contract Documents.

1.1.2 Completely coordinate with work of other trades.

1.1.3 Work includes:

1.1.3.1 Demolition of structures or portions of structures indicated.

1.1.3.2 Removal of demolition debris.

1.1.3.3 Protection of construction to remain, including:

1.1.3.3.1 Utilities to remain.

1.1.3.3.2 Other items indicated.

1.1.3.3.3 Salvage of items.

1.2 *Definitions –*

1.2.1 *Demolish* – Completely remove and legally dispose of off-site.

1.2.2 *Recycle* – Recovery of demolition waste for subsequent processing in preparation for reuse.

1.2.3 *Salvage* – Carefully detach from existing construction, in a manner to prevent damage, and deliver to ECUA ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

1.2.4 *Remove* – Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

1.2.5 *Remove and Salvage* – Detach items from existing construction and deliver them to ECUA ready for reuse.

1.2.6 *Remove and Reinstall* – Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

1.2.7 *Existing to Remain* – Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 *Submittals –*

1.3.1.1 *Demolition Plan* – Contractor shall submit a plan for the required demolition activities for each structure.

1.3.1.1.1 The plan shall discuss the sequence of operations, description of the methods, and equipment to be used for each operation, removal, temporary storage, and disposition of demolished materials. ECUA may require that the Contractor submit a detailed schedule of the work to be conducted.

1.3.1.1.2 Contractor is required to coordinate with ECUA and compile a list of items to be removed and salvaged. Include list with demolition plan.

1.3.1.1.3 Contractor is required to submit photograph(s) and/or video which shows the existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by building demolition operations.

1.3.1.1.4 When applicable, Contractor is to submit a detail outlining special measures proposed to protect adjacent building(s) to remain.

1.3.1.1.5 ECUA may require Contractor to provide an engineer's report documenting that proposed demolition methods are safe and will not result in an unplanned or uncontrolled collapse.

1.3.1.2 *Miscellaneous Submittals* – Contractor shall provide copies of receipts documenting the transportation and disposal of all demolished material.

1.4 *Quality Assurance –*

1.4.1 Contractor shall conduct work in accordance with OSHA and EPA requirements and shall comply with governing EPA notification regulations prior to the start of demolition.

1.4.2 Conduct work in accordance with ANSI A10.6 and NFPA 241.

1.4.3 Use only firms or individual trades qualified to perform work required under this section.

1.5 *Project Conditions –*

1.5.1 Preliminary investigations –

1.5.1.1 Contractor shall perform investigations prior to demolition to detect hazards that may result from demolition activities.

1.5.1.2 Conditions which would be apparent by such investigation will not be allowed as cause for claims for extra costs.

1.5.2 *Condition of existing structures to be demolished –*

1.5.2.1 ECUA assumes no responsibility for actual condition of structures to be demolished.

1.5.2.2 Conditions existing at time of inspection for bidding purposes will be maintained by ECUA insofar as practicable.

1.5.2.3 Contractor shall notify ECUA Project Manager, Engineer of Record, and/or Architect of discrepancies between existing conditions and the Plans prior to proceeding with demolition.

1.5.3 *Permits* – Before start of work contractor shall obtain and pay for permits required by authorities having jurisdiction and notify interested utilities companies.

1.5.4 *Approval of Local Authorities* – Contractor shall obtain approval of authorities having jurisdiction for work which affects existing means of ingress/egress to the project site as well as authorities which have environmental or municipal jurisdiction.

1.5.4.1 Review with and obtain approval of authorities for temporary construction which affects such areas.

1.5.4.2 Obtain approval of fire authorities, if necessary.

1.5.5 *Hazardous Materials and Toxic Wastes* – Contractor shall separate, store and dispose of Hazardous Materials and Toxic Wastes in accordance with local and EPA regulations and additional criteria listed below:

1.5.5.1 Disposal of fluorescent tubes to open containers is not permitted.

1.5.5.2 Disposal of ballasts and other building elements containing PCBs to open containers is not permitted.

1.5.5.3 Disposal of building elements containing mercury to open containers is not permitted.

## PART 2: Execution

2.1 *Preparation* –

2.1.1 Contractor shall coordinate with ECUA and other indicated utility suppliers whose infrastructure services the site or structure(s) to be demolished.

2.1.1.1 Arrange to shut off indicated utilities with utility suppliers. ECUA will arrange to shut off indicated utilities when requested by Contractor.

2.1.1.2 If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, Contractor is to provide temporary utilities that bypass buildings and/or structures to be demolished and that maintain continuity of service to other buildings and/or structures.

2.1.1.3 Subsequent to any necessary bypass being setup, pipe or conduit for existing services shall be cut a minimum of 24 inches below grade or cut off pipe or conduit in walls or partitions that are to remain. Cap, valve, or plug and seal remaining portion of pipe or conduit according to the requirements of ECUA and other authorities having jurisdiction.

2.1.2 Review record documents of existing construction provided by ECUA, if available. ECUA does not guarantee that existing conditions are same as those indicated in the record documents.

2.1.3 Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged. Provide this information as a written list to the ECUA Project Manager or Engineer of Record.

2.2 *Pollution Controls –*

2.2.1 Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations.

2.2.2 Return adjacent areas to condition existing prior to start of work.

2.3 *Items to be Salvaged for ECUA –*

2.3.1 Remove salvage items at appropriate stage of demolition, but early enough to prevent damage to them by demolition operations. Salvage items per list included in demolition plan which was coordinated with ECUA.

2.3.2 Remove salvage items as a unit:

2.3.2.1 Clean, list, and tag for storage.

2.3.2.2 Protect from damage.

2.3.2.3 Salvage each item with auxiliary or associated equipment required for operation.

2.3.3 Historic items, relics, antiques, and similar object including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to ECUA that may be uncovered during demolition remain the property of ECUA.

2.3.4 Carefully salvage in a manner to prevent damage and promptly return to ECUA.

2.4 *Items to be Salvaged for Contractor –*

2.4.1 Items of salvage value to Contractor may be removed from structure as work progresses. Contractor must receive written permission from ECUA for the items Contractor wishes to salvage.

2.4.2 Transport salvaged items from site as they are removed in a timely manner. If items are not removed in a timely manner ECUA reserves the right to remove the salvaged items from the site.

2.4.3 Storage or sale of removed items not permitted on site.

2.5 *Items to be Removed and Reinstalled –* Remove items designated for re-use.

2.5.1 Tag, protect from damage, store if required, and deliver to locations designated.

2.5.2 Brace mechanical equipment attached to flexible mountings until reinstallation.

2.6 *General Demolition Procedures –*

2.6.1 *Demolition of Entire Structures or Portions of Structures –*

2.6.1.1 Demolish and remove from site as indicated on the plans or as directed by ECUA Project Manager.

2.6.1.2 Use such methods as required to complete work within limitations of governing regulations.

2.6.2 *Adherence to Demolition Plan* – Start and complete work as established by approved demolition plan; operational procedures and sequence of work are optional provided Contract schedule is maintained.

2.6.3 *Protection of Property to Remain –*

2.6.3.1 Contractor is to coordinate with ECUA and other utility providers in order to maintain existing infrastructure that may be at risk of damage during demolition operations. Items of interest to ECUA may include, but are not limited to, wellheads, piping, fences, pumps, generators, hardscape, landscaping, treatment equipment, and other mechanical equipment.

2.6.3.2 If demolition is in the vicinity of a well head protection area, Contractor must coordinate with ECUA Project Manager specific to the protection of the wellhead.

2.6.3.3 Contractor is to perform demolition operations in a manner that protects the existing items of interest to ECUA or other parties. Any damage to these items during demolition shall be the responsibility of the Contractor to repair or recover in a timely manner at no cost to ECUA.

2.6.3.4 Conduct operations to prevent damage by falling debris or other cause to adjacent buildings, structures, and other facilities as well as persons.

2.6.3.5 Provide interior and exterior shoring, bracing, or support to prevent movement, settlement or collapse of structures.

2.6.4 Contractor shall conduct operations to ensure minimum interference with roads, walks, entrances, exits, and other adjacent occupied facilities.

2.6.4.1 Do not close or obstruct private drives, walks or other occupied or used facilities unless approved in writing.

2.6.4.2 Do not close or obstruct public thoroughfares or walks unless approved by authorities having jurisdiction.

2.6.4.3 Do not obstruct exits from existing facilities without approval of authorities having jurisdiction.

2.6.4.4 Provide alternate routes around closed or obstructed traffic ways upon receiving prior approval from the authority having jurisdiction.

2.6.5 Contractor shall provide covered passageways where necessary to ensure safe passage of persons in or near areas of work.

2.6.6 Contractor shall provide barricades and/or safety lights as required to prevent injury to people and damage to adjacent buildings and facilities to remain.

2.6.7 Contractor shall maintain existing utilities that are indicated to remain.

2.6.7.1 Keep in service, and protect against damage during demolition.

2.6.7.2 Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by ECUA Project Manager.

2.6.7.3 Provide temporary services during interruptions to existing utilities, as acceptable to ECUA and other utility supplier(s).

2.6.8 *Structural Demolition* –

2.6.8.1 Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.

2.6.8.2 Maintain fire watch during and for at least 48 hours after flame cutting operations.

2.6.8.3 Maintain adequate ventilation when using cutting torches.

2.6.8.4 Proceed with demolition of structural framing members systematically from higher to lower level.

2.6.8.5 Demolish concrete and masonry in small sections.

2.6.8.6 Perform removal to avoid excessive loads on supporting walls, floors or framing.

2.7 *Excavation* – When conditions exist that soils on site contain chemicals of concern, ECUA Project Manager may provide the Contractor specific directive on how to handle the excavation and disposal of contaminated soils.

2.8 *Backfill* –

2.8.1 Backfill and uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

2.8.2 Completely fill below-grade areas and voids resulting from building or site demolition operations with satisfactory soil materials according to backfill requirements in Section 2100, Earthwork, of the latest edition of the ECUA Engineering Manual.

2.9 *Protection of Occupied Facilities to Remain* –

2.9.1 Protect occupants from injury and discomfort.

2.9.2 Provide temporary dustproof partitions between demolition areas and occupied areas.

2.9.2.1 In public areas use clean, painted, minimum ½ - inch (13 mm) thick, plywood.

2.9.2.2 Where authorities having jurisdiction require, use fire rated construction.

2.9.3 Provide temporary weather protection and insulation as necessary to prevent damage to existing facilities and discomfort to persons in occupied areas.

2.9.3.1 Insulation value: RSI 3.5 R 19.

2.10 *Pollution Controls* – Contractor is to utilize proper erosion and pollution control methods in order to maintain an orderly site found suitable to the ECUA Project Manager. Erosion control measures shall be used to maintain sediment on site and minimize the risk of offsite transportation of sediment.

2.11 *Clean-Up and Disposal of Demolition Materials* –

2.11.1 Contractor shall remove debris, rubbish, and materials resulting from demolition operations.

2.11.1.1 Remove from site; legally dispose of off-site.

2.11.1.2 Burning or burying demolition material on-site is prohibited. Any burning or burying shall be done in an approved manner at off-site locations only when appropriate permits and approvals have been obtained.

2.11.1.3 Remove and transport demolished material in a manner that prevents spillage on roads and adjacent areas. Immediately report any spilled material.

2.11.1.4 Costs of disposal are the responsibility of the Contractor.

2.11.1.5 Do not store or sell Contractor salvaged items or materials on site.

2.11.1.6 Clean up other debris resulting from this work.

2.11.2 Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations.

2.11.3 Return adjacent areas to a condition existing prior to start of work.

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# Section 2000

## Clearing and Grubbing/Grassing/Sodding

**PART 1: General**

1.1 *General Description of Work –*

1.1.1 *Clearing and Grubbing –*

1.1.1.1 Clearing and grubbing on project site of trees, stumps, brush, roots, vegetation, logs, rubbish and other objectionable matter within limits described in specifications or as shown on plans.

1.1.1.2 Clearing and grubbing shall be in advance of grading and trenching operations except that in cuts over 3 feet in depth, grubbing may be done simultaneously with excavation, provided objectionable matter is removed as specified.

1.1.1.3 Disposal of all debris resulting from clearing and grubbing work.

1.1.2 *Grassing* – Extent of grassing work is as specified or shown on the construction plans. Sodded areas disturbed during construction shall be re-sodded to match existing. All other areas disturbed during construction operations shall be seeded, unless noted otherwise on plans.

1.1.3 *Sodding –*

1.1.3.1 This work consists of sodding areas cleared during construction and not paved, or as otherwise shown on the Construction Plans. All material and construction methods shall be in accordance with Section 570 and 981 of the Florida Department of Transportation Standard Specifications, Latest Edition.

1.1.3.2 Areas noted on Construction Plans shall be sodded.

1.2 *Protection of Adjacent Work* – Protect existing improvements, adjacent property, utilities and other facilities, and trees and plants which are not to be removed from injury or damage.

1.3 *Protection from Erosion* – Contractor shall protect all disturbed areas from erosions, repair any areas damaged by erosion, and clean erosion sediment from affected areas.

1.4 *Quality Assurance* – All seed used shall be labeled in accordance with U.S. Department of Agriculture Rules under the Federal Seed Act in effect on the date of invitation for bids. All seed shall be furnished in sealed standard containers, unless exception is granted in writing by the Owner. Seed which has become wet, moldy, or otherwise damaged in transit or in storage shall not be used. Fertilizer shall be delivered to the site in the original, unopened containers, each bearing the manufacturer’s guaranteed analysis. Any fertilizer which becomes cake of otherwise damaged, making it unsuitable for use, shall not be used. Seed, fertilizer and other grassing materials shall be stored under cover and protected from damage which would make then unacceptable for use.

1.5 *Submittals* – Approvals, except those required for field installations, field applications, or field tests shall be obtained before delivery of materials or equipment to the project site. The results of laboratory tests performed on the topsoil material shall be submitted. The reports shall include the pH level, the amount of organic matter, and available phosphoric acid and potash of the soil intended for use in the work. Certificate of conformance will be required for the following:

1.5.1 Grass seed shall be certified by registered, certified seed association or a registered testing laboratory not more than ten months prior to seeding.

1.5.2 Sprigs

1.5.3 Fertilizer

1.5.4 Lime

1.5.5 Mulching

## PART 2: <u>Products</u>

2.1 *Clearing and Grubbing Materials* – Provide materials required to perform work as specified.

2.2 *Soil Amendments* –

2.2.1 *Lime* – Ground limestone (Dolomite) shall contain not less than 85 percent of total carbonates, and shall be ground to such a fineness that 50 percent will pass a 100-mesh sieve and 90 percent will pass a 20-mesh sieve.

2.2.2 *Fertilizer* – Fertilizer shall be a 16-16-16 formulation. The nitrogen shall be 60 percent urea-formaldehyde form. Fertilizer shall conform to the applicable Stat Fertilizer laws and shall be granulated so that 80 percent is held on a 16-mesh screen, uniform in composition, dry and free-flowing.

2.2.3 *Mulch* – Clean hay or fresh straw mulch.

2.3 *Grass Materials* –

2.3.1 Grass Seed

Federal Specifications JJJ-S-18 and shall satisfy the following requirements:

| Seed | Pure Seed | Hard Seed | Weed Seed |
|---|---|---|---|
| Argentine Bahia (Paspalum notatum) | 85% | 15% | 0.25% |

Seed failing to meet the purity or germination requirements by not more than twenty-five percent may be used, but the quantity shall be increased to yield the required rate of pure live seed. Seed failing to meet the weed seed requirements shall not be used.

2.4 *Sod Materials* – Use Argentine Bahia. The sod shall be live, fresh, and uninjured at the time of planting and shall have a thick mat of roots with enough adhering soil to assure growth. Sod shall be free of monofilament support netting prior to placement. No type of sod netting is acceptable.

Apply sod within 48 hours of cutting or stack and keep moist. Do not plant dormant sod if ground is frozen.

## PART 3: Execution

3.1 *Clearing –*

3.1.1 Clear all areas covered by dikes, roads, structures and embankments within project limits unless otherwise shown in plans.

3.1.2 Remove all saplings, brush, down-timber, and debris unless shown or directed otherwise.

3.2 *Grubbing –*

3.2.1 Trees, stumps, root systems, rocks and other obstructions shall be removed to the depths shown when they fall within the construction boundary.

3.2.2 Blasting is not permitted.

3.3 *Removal of Debris and Cleanup –*

3.3.1 Burn as permitted by regulating agencies or the Engineer as work progresses.

3.3.2 Unguarded fires will not be permitted.

3.3.3 Permits will be obtained, where required, for necessary burning or disposal sites.

3.3.4 Dispose of all waste materials not burned by removal from site.

3.3.5 Materials cleared and grubbed shall be the property of the Contractor and shall be his responsibility for disposal.

3.4 *Grassing –*

3.4.1 *Grading* – Areas to be grassed shall be graded to remove depressions, undulations, and irregularities in the surface before grassing.

3.4.2 *Tillage* – The area to be grassed shall be thoroughly tilled to a depth of four inches using a plow and disc harrow or rotary tilling machinery until a suitable bed has been prepared and no clods or clumps remain larger than 1-1/2 inches in diameter.

3.4.3 *Application of Lime* – The pH of the soil shall be determined. If the pH is below 5.0, sufficient lime shall be added to provide a pH between 5.5 and 6.5. The lime shall be thoroughly incorporated into the top three to four inches of the soil. Lime and fertilizer may be applied in one operation.

3.4.4 *Application of Fertilizer* – Fertilizer shall be applied at the rate of 6 pounds per 1,000 square feet and shall be thoroughly incorporated into the top three to four inches of soil.

3.4.5 *Planting Seeds* – All areas disturbed during construction shall be seeded as specified herein. Immediately before seeds are sown and after fertilizer and lime are applied, the ground shall be scarified as necessary and shall be raked until the surface is smooth, friable, and uniformly fine texture. Areas to be grassed shall be seeded evenly with a mechanical spreader, raked lightly, rolled with a 200- pound roller, and watered with a fine spray.

3.4.5.1 *Seed Application* – Seed shall be applied at the following rate:

| Seed | Rate of Application |
|---|---|
| Argentine Bahia grass (paspalum notatum) | 6 lbs./1000 sq. ft.<br>260 lbs./acre |

3.4.5.2 *Mulching* – Seeded areas shall be mulched at the rate of not less than 1-1/2 inch loose measurement over all seeded areas. Spread by hand, blower, or other suitable equipment. Mulch shall be cut into the soil with equipment capable of cutting the mulch uniformly into the soil. Mulching shall be done within 24 hours of the time seeding is completed.

3.4.6 *Rolling* – After seeding and mulching, a cultipacker, traffic roller, or other suitable equipment shall be used for rolling the grassed areas. Areas shall then be watered with a fine spray.

3.4.7 *Winter Cover* – All areas to be grassed shall be protected against erosion at all times. For protection during winter months (November 1st through March 31st) Italian rye grass shall be planted at the rate of four pounds per 1,000 square feet on all areas which are not protected by permanent grass.

3.4.8 *Clean-up* – All excess soil, excess grass materials, stones, and other waste shall be removed from the site daily and not allowed to accumulate.

3.4.9 *Maintenance* – Maintenance shall begin immediately following the last operation of grassing and continue until final acceptance. Maintenance shall include watering. Mowing, replanting, and all other work necessary to produce a uniform stand of grass. Grassing will be considered for final acceptance when the permanent grass is healthy and growing on 97 percent of the area with no bare areas larger than 12 inches square.

3.4.10 *Acceptance* – The Contractor shall submit to the Owner two copies of a written request for final acceptance of the grassing work. The request shall be submitted at least ten days prior to the anticipated date of acceptance. The condition of the grass will be noted, the Contractor will be notified if maintenance is to continue.

3.5 *Sodding* –

3.5.1 *Placement* – Prepare the ground by loosening the soil and raking. Place sod on the prepared soil to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to avoid a continuous downhill seam. Tamp or roll lightly to ensure contact with subgrade. Tamp the outer edges of the sodded area to produce a smooth contour. Work sifted soil into minor cracks between pieces of sod; remove excess in order to avoid smothering of adjacent grass, Water sod thoroughly with a fine spray immediately after planting.

3.5.2 *Watering* – Keep sod continuously moist to a depth below the root zone for three weeks after placement. If there is not water available to the site, the Contractor shall provide the water for the sod, and include cost of same in his bid.

3.5.3 *Maintenance* – Maintain sod by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading, and re-planting as required to establish a lawn free of eroded or bare areas and acceptable to the Architect/Engineer. Where inspected work and materials do not comply with requirements, replace rejected work and continue maintenance until re-inspected by Architect/Engineer and found to be acceptable. Remove rejected materials promptly from the project site. Contractor shall include costs for maintaining sod in their bid.

## PART 4: Measurement and Payment

4.1 *Clearing and Grubbing* – Clearing and grubbing shall be measured for payment either in acres or by lump sum only for areas indicated on the plans, or as provided in the proposal and contract.

4.2 *Grassing/Sodding* – Grassing/Sodding shall be measured for payment either in square yards or by lump sum only for areas indicated on the plans, or as provided in the proposal and contract.

4.3 General –

4.3.1 When not listed as a separate contract pay item, clearing and grubbing shall be considered as incidental work, and the cost thereof shall be included in such contract pay items as are provided in the proposal contract.

4.3.2 Compensation, whether by contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

## PART 5: Warranty

5.1 Contractor shall warranty all work and material for a period of 90 days beginning from date of acceptance of substantial completion.

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# Section 2100

# Earthwork

## PART 1: General

1.1 *Related Documents* – Drawings and general provisions of contract, including General and Supplementary Conditions and other Specification Sections within this project manual, apply to this section.

1.2 *Summary* – This section includes the following:

1.2.1 Extent of earthwork is indicated on drawings. This work consists of grading in order to achieve finished elevations shown on the construction plans.

1.2.2 Preparation of subgrade for slabs, walks, concrete swales and pavements is included as part of this work.

1.2.3 All graded surfaces shall be smooth and uniform, without abrupt changes in slope or grade. Areas to be covered with paving shall be fine graded to the required elevations and slopes. Finished surfaces in all other areas may vary up to 0.1 feet from the required elevations.

1.2.4 Excavating and Backfilling of trenches for storm sewer is included in the work of this section.

1.2.5 Excavation and backfill required in conjunction with underground mechanical and electrical utilities and buried mechanical and electrical appurtenances is included as work of this section.

1.3 *Definitions* –

1.3.1 *Excavation* – Removal of material encountered to subgrade elevations indicated or below subgrade elevations as directed by the Engineer and subsequent disposal of materials removed.

1.3.2 *Unauthorized Excavation* – Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Architect/Engineer. Unauthorized excavation, as well as remedial work directed by Architect/Engineer, shall be at Contractor's expense. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill maybe used to bring elevations to proper position, when acceptable to Architect/Engineer.

1.3.3 *Additional Excavation* – When excavation has reached required subgrade elevations, notify Architect/Engineer, who will make an inspection of conditions. If Architect/Engineer determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by Architect/Engineer.

1.3.4 *Subgrade* – The undisturbed earth or the compacted soil layer immediately below base, fill, or topsoil materials.

1.3.5 *Structure* – Buildings, foundations, slabs, tanks, curbs, end walls, mitered end sections, inlets, manholes, or other man-made stationary features occurring above or below ground surface.

1.4 *Submittals* – Submit the following reports directly to Architect/Engineer from the testing services, with copy to the Contractor:

1.4.1 Test reports on borrow material.

1.4.2 Verification of suitability of each footing subgrade material, in accordance with specified requirements.

1.4.3 Field reports; in-place soil density tests.

1.4.3.1 One optimum moisture-maximum density curve for each type of soil encountered.

1.4.3.2 Report of actual unconfirmed compressive strength and/or results of bearing tests of each strata tested.

1.5 *Quality Assurance* –

1.5.1 *Codes and Standards* – Perform excavation work in compliance with applicable requirements of authorities having jurisdiction. All material and construction methods shall be in accordance with Section 120 of the Standard Specification of Roads and Bridges, State of Florida, Department of Transportation, latest edition.

1.5.2 *Testing and Inspection* – Employ, at the Contractor's expense, a geotechnical testing laboratory, acceptable to the Owner, to perform soil testing and inspection service for quality control testing during earthwork operations. Contractor shall replace materials removed for testing purposes. Should any work of materials fail to meet the requirements set forth in the plans and specifications, Contractor shall pay for re-testing of same.

1.6 *Project Conditions* –

1.6.1 *Site Information* –

1.6.1.1 Data in subsurface investigation reports were used for the basis of the design and are available to the Contractor for information only. Conditions are not considered representations or warranties of accuracy or continuity between soil borings. The Architect/Engineer and the Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.

1.6.1.2 Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

1.6.2 *Existing Utilities –*

1.6.2.1 Contact the Sunshine811 Call Center a minimum of two (2) days prior to beginning excavation operations to have existing underground utilities located in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.

1.6.2.2 Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult Utility Owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of Architect/Engineer and Utility Owner.

1.6.2.3 Do not interrupt existing utilities serving any facility during occupied hours, except when permitted in writing by Architect/Engineer and then only after acceptable temporary utility services have been provided.

1.6.2.4 Provide minimum of 48-hour notice to Architect/Engineer, and appropriate utility company and receive written notice to proceed before interrupting any utility.

1.6.2.5 Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.

1.6.2.6 Perform Excavation by hand within drip line of trees to remain. Protect root systems from damage or dry out to the greatest extent possible. Maintain moist conditions for root system and cover exposed roots with moistened burlap.

1.6.3 *Use of Explosives* – Use of explosives is not permitted.

1.6.4 *Protection of Persons and Property –*

1.6.4.1 Barricade open excavations occurring as part of this work and post with warning lights.

1.6.4.2 Operate warning lights as recommended by authorities having jurisdiction.

1.6.4.3 Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

## PART 2: Products

2.1 *Fill –*

2.1.1 Soils used as fill shall be clean sands. Non-structural fill shall contain less than 5 percent material passing the No. 200 sieve, and structural fill shall contain less than 12 percent material passing the No. 200 sieve. The sand shall have a maximum dry density of at least 100 pounds per cubic foot according to the Standard Proctor Compaction Test, (ASTM D 698). Soil materials shall be free of debris, waste, frozen materials, vegetation and other deleterious matter.

2.1.2 In order to insure proper bond and prevent slipping between the original ground and fill, the surface of the original ground shall be scarified to a depth of at least three inches. Each layer of fill material shall be compacted until the required density is achieved.

2.2 *Cut* – Where required, the site shall be excavated to the grades depicted upon the plans. Excavated material that is suitable shall be used in the fill sections of the site. Any excess material shall be hauled away from site.

## PART 3: <u>Execution</u>

3.1 *General* – The site shall be stripped of all organic and deleterious materials in phases, so as to prevent and impede erosion and sedimentation.

3.2 *Compaction of Subgrade, Cut and Fill* –

3.2.1 Compaction requirements shall be as determined by the Modified Proctor Test (ASTM D 1557 or AASHTO T-180) or Standard Proctor Test (ASTM D 698) on existing soils, with a soil at or near optimum moisture content. In unpaved areas the top 8 inches of subgrade shall be compacted to a minimum soil density of 95 percent of the Standard Proctor Test with large traffic sized non-vibratory equipment. In paved areas the top 12 inches of subgrade shall be compacted to a minimum soil density of 96 percent of the Modified Proctor Test. All roots and other materials that would diminish the efficiency of the compaction operation shall be removed prior to compacting.

3.2.2 Remove and replace or scarify and air dry soil materials that are too wet to permit compaction to specified density. Only suitable materials free from excessive moisture shall be used for fill or backfill. Suitable soil materials that have been removed because they are too wet and compaction cannot occur, may be stockpiled or spread and allowed to dry. Assist in drying may be discing. Harrowing, or pulverizing until the moisture content is reduced to a satisfactory value.

3.3 *Stabilized Subgrade* – Subgrade stabilization shall be done in accordance with applicable portions of these specifications.

3.4 *Excavation* – Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

3.5 *Stability of Excavations* –

3.5.1 All excavation work shall conform to OSHA Publication “Excavations 2226,” 1990 Revision, and OSHA Excavation; Final Rule 29, CFR, Part 1926, October 31, 1989. The Contractor will provide written assurance of compliance with the law and with the laws of Florida Chapter 90-96.

3.5.2 The Contractor’s method of providing protective support to prevent cave-ins shall be submitted with the Bid and conform to OSHA requirements. Slope excavations, shoring, and trench box usage in the field will be based on tabulated data and designed by the Contractor.

3.5.3 *Shoring and Bracing –*

3.5.3.1 Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

3.5.3.2 Provide permanent steel sheet piling or pressure treated CCA timber sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures. Cut off tops a minimum of 2.5 feet below final grade and leave permanently in place.

3.5.4 The Contractor shall do all shoring required to perform and protect the excavation and as necessary for the safety of the employees.

3.6 *Dewatering –*

3.6.1 Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

3.6.2 The Contractor shall prevent the accumulation of water in the excavated areas, and shall remove by pumping or other means, any water which accumulates in the excavation. The Contractor shall prevent the accumulation of water in both structural and trench excavations and shall remove by well point system or by other means, water which accumulates in the excavation. The Contractor shall provide, install, operate and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations. The Contractor shall include the cost of this equipment and work in the price he bids for the work.

3.6.3 Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting of runoff areas. Do not use trench excavations as temporary drainage ditches.

3.6.4 The Contractor shall be responsible for and ensure all effluent water from the dewatering operations meets or exceeds F.D.E.P. and C.O.E. water quality standards prior to entering jurisdictional water bodies.

3.7 *Storage of Excavated Materials –*

3.7.1 Stockpile excavated materials acceptable for backfill and fill where directed. Place, grade, and shape stockpiles for proper drainage.

3.7.2 Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.

3.7.3 Dispose of excess excavated materials not acceptable for use as backfill or fill offsite in a legal manner.

3.8 *Excavation for Structures –*

3.8.1 Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, and other construction and for inspection.

3.8.2 Excavations for footings and foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.9 *Excavation for Pavements* – Cut surface under pavements to comply with cross-sections, elevations and grades as indicated.

3.10 *Trench Excavation for Storm Pipes, Conduit, and Irrigation Pipes* – See Section 2221 – "Trench Excavation, Backfill and Compaction" for requirements related to trench excavation.

3.11 *Other Excavations* –

3.11.1 Excavation for manholes, catch basins, junction boxes and other accessories shall be sufficient to leave at least 12 inches in the clear between their outer surfaces and the embankment of timber that may be used to protect them. Backfill of earth around manholes shall be filled with thoroughly compacted sane or gravel at the expense of the Contractor.

3.11.2 Excavations for footings and foundations shall be made to the dimensions and elevations indicated on the drawings, and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection. Do not disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottom to required lines and grades to leave a solid base to receive other work.

3.11.3 Excavations for Mechanical and Electrical structures shall be made to the dimensions and elevations indicated on the drawings and a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and inspection. Do not disturb bottom of excavations intended for bearing surface.

3.11.4 Excavation for all structures shall be made to the dimensions and elevation indicated on the drawings. Where the excavation is made below the indicated elevations, the excavation shall be restored to the proper elevation with concrete fill, or the heights of walls and footings shall be furnished by the Contractor without extra compensations, except where additional excavation is ordered to obtain proper bearing in which case the Contract price will be adjusted to cover such additional work.

3.12 *Cold Weather Protection* – Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

3.13 *Backfill and Fill* –

3.13.1 *General* – Place soil material in layers to required subgrade elevations, for each area classification listed below.

3.13.1.1 Under grassed areas, use satisfactory non-structural fill, excavated or borrow materials.

3.13.1.2 Under walks and pavements, use satisfactory structural fill, excavated or borrow materials, or a combination.

3.13.2 Backfill excavations as promptly as work permits, but not until completion of the following:

3.13.2.1 Acceptance of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.

3.13.2.2 Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.

3.13.3 Removal of concrete formwork

3.13.3.1 Remove of shoring and bracing, and backfill voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in such a manner as to prevent settlement of the structure and/or utilities, or leave in place if required.

3.13.3.2 Remove trash and debris from excavation

3.14 *Backfilling* –

3.14.1 Trenches shall be backfilled with excavated materials, free from large clods and stones. Backfill shall be deposited in layers not to exceed 6 inches (6") in thickness, moistened, and compacted to density equal to or greater than 95 percent of the Modified Proctor Density (ASTM D 1557), to a minimum depth of 12 inches over the pipe. The remainder of the backfill shall be placed in 8-inch layers compacted to 95 percent maximum density of the Modified Proctor Test unless the backfill is beneath paved or building areas in which case it shall be compacted to 98 percent of the Modified Proctor Test.

3.14.2 Selected materials shall be used for all backfill, trash shall not be allowed to accumulate in spaces to be backfilled, and this space shall be well cleared before backfill is placed.

3.14.3 No fill material shall be placed, spread or rolled while the ground or fill is frozen or thawing or during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until the moisture content and density of the fill are as previously specified.

3.15 *Grading (Only as Applicable per Plans)* –

3.15.1 *General* – Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

3.15.1.1 *Unpaved Areas* – Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.

3.15.1.2 *Concrete Swales* – Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation.

3.15.1.3 *Walks* – Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than ½-inch above or below required subgrade elevation.

3.15.1.4 *Pavements* – Shape surface of areas under pavement to line, grade, and cross-section with finish surface not more than ½-inch above or below required subgrade elevation.

3.15.2 *Compaction* – After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

3.16 *Field Quality Control* –

3.16.1 *Quality Control Testing During Construction* – Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.

3.16.2 *Compaction Test* – A minimum of one compaction test shall be performed on each different type of material encountered which will be subject to applicable field density tests.

3.16.2.1 *Density Test* – Perform field density tests in accordance with ASTM 1556 (sand cone method) or ASTM D 2167 (rubber balloon method), as applicable.

3.16.2.1.1 Field density tests may also be performed by the nuclear method in accordance with ASTM D 2922, providing that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gauges in accordance with ASTM D 3017.

3.16.2.1.2 If field tests are performed using nuclear methods, make calibration checks of both density and moisture gauges at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect/Engineer.

3.16.2.2 *Footing Subgrade* – For each strata of soil on which footings will be placed, perform at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata when acceptable to Architect/Engineer.

3.16.2.3 *Paved Areas* – Perform at least one field density test of subgrade for every 300 square yards of paved area at 8 inches below subgrade in cut sections. In each compacted fill layer, perform one field density test for every 300 square yards of paved area. Location of tests shall be determined by the Architect/Engineer.

3.16.2.4 *Unpaved Areas* – Perform at least one field density test of subgrade for every 1000 square yards of non-paved area at 8 inches below subgrade in cut sections. In each compacted fill layer, perform one field density test for every 1000 square yards of non-paved area. Location of tests shall be determined by the Architect/Engineer.

3.16.2.5 *Unsatisfactory Tests* – If in opinion of Architect/Engineer, based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained at no additional cost.

3.17 *Erosion Control* – The Contractor shall be responsible for the prevention of erosion from the site, the control of turbidity generated on site and for maintaining graded surfaces, for the duration of the project.

3.18 *Maintenance* –

3.18.1 *Protection of Graded Areas* – Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

3.18.2 *Repairs* – Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

3.18.3 *Reconditioning Compacted Areas* – Where completed compacted areas are disturbed by subsequent construction operations, or adverse weather, scarify surface, reshape and compact to required density prior to further construction.

3.18.4 *Settling* – Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.19 *Existing Utility Lines* – Attention is called to the fact that the Contractor is responsible for contacting all utility companies to obtain locations of all existing utilities or obstructions which he may encounter during construction. After location of utilities by the appropriate utility company and Owner, it is the Contractor's liability to protect all such utility lines, including service lines and appurtenances, and to replace at his own expense any which may be damaged by the Contractor's equipment or forces during construction of the project.

3.20 *Barricades, Guards, and Safety Provisions* – To protect persons from injury and to avoid property damage, adequate barricades, construction signs, torches, red lanterns and guards, as required, shall be placed and maintained by the Contractor during the progress of the construction work. Rules and regulations of the local authorities with respect to safety provisions shall be observed.

3.21 *Traffic Controls* – Excavations for pipe laying operation shall be conducted in a manner to cause the least interruption to traffic. When traffic must cross open trenches, the Contractor shall provide suitable bridges.

3.22 *Flow Drain and Sewer Maintenance* – Adequate provision shall be made for the flow of sewers, drains, and water courses encountered during construction, and the structures which may have been disturbed shall be satisfactorily restored by the Contractor.

3.23 *Property Protection* – Trees, fences, poles, manholes, and all other property shall be protected unless their removal is authorized; and any property damaged shall be satisfactorily restored by the Contractor at the Contractor's expense.

3.24 *Clean-Up* – Before final inspection and acceptance the Contractor shall clean ditches, shape shoulders, and restore all disturbed areas, including street crossings, grass plots, re-grassing if necessary, to as good a condition as existed before work started. All trenches shall be leveled, and loose material removed from pavement, gutters, and sidewalks, employing hand labor if necessary.

3.25 *Disposal of Excess, and Waste Materials* – Remove waste materials, including trash, and debris, and dispose in a legal manner.

# Section 2221

## Trench Excavation, Backfill and Compaction

### PART 1: General

1.1 *General Description of Work* –

1.1.1 *Topics Covered* – Excavation, shoring, dewatering, pipe bedding, trench backfill, compaction, grading, and cleanup of all pipeline trenching for the project.

1.1.2 *Requirements* – All work must be done in accordance with these specifications and the safety requirements of the State and OSHA standards.

1.1.3 *Contractor Visitation* – Prior to submittal of bid, the Contractor shall visit the site and become thoroughly familiar with site conditions existing along the route of the planned work. The Contractor shall accept site in condition existing during Contract time frame.

1.1.4 *Groundwater/Surface Water* – Management of groundwater/surface water encountered during construction are conditions of the Contract and responsibility of Contractor.

### PART 2: Products

2.1 *Source Materials* – Determination of source of materials for bedding and backfill shall be responsibility of Contractor, but use of such materials shall be subject to approval of Engineer.

2.2 *Pipe Bedding and Backfill* – Pipe bedding shall be angular material.

2.3 *Sand Backfill* – (Where specified on plans). Use sand or fine aggregate with source of material subject to approval of Engineering.

2.4 *Cradling Rock* – Use crushed rock or stone with 70-100 percent passing 1-inch sieve and no more than 50 percent passing ¾-inch sieve.

2.5 *Controlled Density Fill* –

2.5.1 *Mixture* – Use high slump mixture of portland cement, fly ash and fine aggregate formulated, licensed and marketed as K-Krete or equal.

2.5.2 *Strength* – Provide mixture with minimum 28-day compressive strength of 70 psi with no measurable shrinkage or surface settlement.

2.6 *Sheeting, Shoring, and Bracing* – All excavation and trench safety measures shall be OSHA compliant. Use sound timber or structural steel. Use shapes and sizes as required.

## PART 3: Execution

3.1 *General –*

3.1.1 *Dewatering –*

3.1.1.1 Prevent surface water from flowing into excavation.

3.1.1.2 Provide equipment for handling water encountered as required. Obtain approval of proposed method of dewatering. All dewatering discharges which result in a point source discharge to surface waters of the State, as defined by Chapter 62-620 F.A.C. shall be in accordance with the State of Florida “Generic Permit for the Discharge of Produced Groundwater from any Non-Contaminated Site Activity.” All costs associated with required sampling and testing shall be borne by the Contractor. The initial testing shall be completed and results verified prior to initiation of ongoing dewatering operations. If any of the analytical test results required by the permit are exceeded, the Contractor shall terminate the discharge as promptly as can be safely accomplished and notify the ECUA Inspector and Engineer immediately.

3.1.1.3 No sanitary sewer shall be used for disposal of trench water.

3.1.2 *Protection of Existing Utilities –*

3.1.2.1 Contact the Sunshine811 Call Center a minimum of two (2) days prior to beginning excavation operations to have existing underground utilities located in areas of excavation work.

3.1.2.2 Locations and elevations of utilities shown on plans are to be considered approximate only. Notify utility and Engineer of conflicts between existing and proposed facilities.

3.1.2.3 Repair, relay, or replace existing utilities damaged, destroyed, or disrupted during work. Unless specified otherwise, replacement will be at the Contractor's expense.

3.1.3 *Sheeting, Shoring, and Bracing –*

3.1.3.1 Provide as necessary, to hold walls of excavation, prevent damage to adjacent structures, and to protect workmen and property.

3.1.3.2 Leave sheeting and shoring in place where removal might cause damage to work or as otherwise indicated on drawings.

3.1.3.3 When moveable trench shield is used below spring line of pipe, it shall be lifted prior to any forward movement to avoid pipe displacement.

3.1.4 *Changes in Grade* – Minor adjustments to grades may be made from plan grades to suit unforeseen construction conflicts or conditions with approval from Engineer. Additional compensation will be made for such minor changes.

3.2 *Excavation and Trenching –*

3.2.1 *General –*

3.2.1.1 Method of excavation at the Contractor's option.

3.2.1.2 The Contractor will use caution when excavating under tree roots, under and around structures and utilities.

3.2.1.3 Stockpile and replace topsoil equal to pre-existing depth for surface restoration in grassed or agricultural areas where specified or shown on plans.

3.2.2 *Trench Characteristics –*

3.2.2.1 *Depth* – As indicated for pipe installation to lines and grades required with proper allowance for thickness of pipe and type of bedding specified or indicated.

3.2.2.2 *Width* – Keep width of trench as narrow as possible and yet provide adequate room for backfilling and jointing. Maximum trench width of 30-inch or pipe O.D. plus 18 inches where soil conditions permit.

3.2.2.3 *General –*

3.2.2.3.1 For pipes and equipment 6 inches or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90 degrees (bottom ¼ of the circumference). Fill depressions with tamped sand backfill.

3.2.2.3.2 At each pipe joint, dig bell holes to relieve pipe bell of loads and ensure continuous bearing of pipe barrel on bearing surface.

3.2.2.3.3 Trench bottom shall be free of large stones and other foreign material.

3.3 *Organic or Unstable Materials –*

3.3.1 *Guidelines* – Stop work and notify Engineer. Perform remedial work as directed.

3.3.2 *Unsuitable Material* – If material is judged unsuitable and removal is authorized, remove and replace with trench stabilizing material as directed by Engineer.

3.4 *Rock Excavation –*

3.4.1 *Guidelines* – Excavate any rock to maintain a minimum 6-inch clearance around pipe. Dispose of rock material not suitable for backfill as directed by Engineer.

3.4.2 *Explosives* – The use of explosives is not permitted without prior written authorization from Owner and Engineer. If authorization to use explosives is given, the Contractor must provide Special Hazard Insurance covering liability for blasting operations.

3.5 *Bedding* – Place after bottom of trench has been excavated to proper depth and grade. Place, compact and shape bedding material to conform to barrel of pipe to insure continuous firm bedding for fill length of pipe.

Provide bedding as described in following table unless indicated otherwise on Plans or in Special Conditions:

| **Pipe Bedding** | |
|---|---|
| **Pipe Material** | **Minimum Bedding Class** |
| Ductile Iron Pipe | Class D* |
| Flexible or Composite Pipe | Class 1** |

*Refers to ECUA standard detail, “Pipe Envelope Requirements”, D-60
**Refers to ECUA standard detail, “Flexible Pipe Bedding”, D-61

3.6 *Trench Backfill* –

3.6.1 *Guidelines* –

3.6.1.1 Use excavated material backfill unless otherwise specified or directed.

3.6.1.2 Use suitable backfill for all trenches within 5 feet of buildings and beneath walks, parking areas, paved streets or existing exposed utilities.

3.6.2 *Initial Backfill* –

3.6.2.1 Place after pipe has been bedded and checked for alignment, grade, and internal obstructions.

3.6.2.2 Carry out in an orderly fashion after authorization to cover pipe has been given.

3.6.2.3 Allow no more than 300 feet of trench to be open at one time.

3.6.2.4 Do not backfill until concrete or mortar has sufficiently cured.

3.6.2.5 Record location of connections and appurtenances before backfilling.

3.6.2.6 Place by hand and hand tamp to not less than 12 inches above top of pipe, in approximately 4-inch layers.

3.6.2.7 Backfill simultaneously on both sides of pipe to prevent displacement.

3.6.2.8 Place cushion of 4 feet above pipe envelope before using heavy compacting equipment.

3.6.3 *Subsequent Backfill* –

3.6.3.1 Place backfill into trench at an angle so that impact on installed pipe is minimized.

3.6.3.2 Compaction of all backfill material shall be performed in a manner that shall not crack, crush, and/or cause the installed pipe to be moved from the established grade and/or alignment.

3.6.3.3 Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.

3.6.3.4 Area under pavement and walks shall be mechanically compacted to the top of the subgrade in 6-inch lifts to a minimum of 100 percent Standard Proctor Density.

3.6.3.5 Areas not subject to vehicular traffic shall be backfilled and compacted in layers not more than 12 inches in depth.

3.6.3.6 Compaction method at discretion of the Contractor with following exceptions:

3.6.3.6.1 If in the Engineer's opinion compaction method presents potential damage to pipe, it will not be allowed.

3.6.3.6.2 Compaction of any backfill material by flooding or jetting will require prior written authorization of Engineer.

3.6.3.7 Mound excavated materials no greater than 6 inches in open areas only.

3.6.3.8 Fill upper portion of trench with topsoil as specified hereinbefore.

3.6.3.9 No trench shall be open overnight.

3.6.4 *Controlled Density Fill –*

3.6.4.1 Use where shown on plans.

3.6.4.2 Provide suitable forms to limit volume of controlled density fill material.

3.6.4.3 Protect exposed utility lines during placement.

3.6.4.4 Place material in accordance with suppliers' written recommendations unless directed otherwise by Engineer.

3.6.4.5 Where the backfill material is deposited in water the layer and density requirements shall not apply until a one-foot layer of comparatively dry material is obtained, but this one-foot layer shall be thoroughly compacted by tamping.

3.6.4.6 If the Contractor has compaction equipment with which the required density can be obtained in thicker lifts than permitted above and upon satisfactory evidence that the proposed equipment will produce work equal in quality to that produced by the specified methods, ECUA may permit placement of granular material of soil groups A-1, A-2, or A-3 in lifts up to a maximum of three foot compacted thickness. The Contractor will be required to furnish equipment and labor to excavate and backfill test pits to be dug for the performance of density tests.

3.6.4.7 Use of thick lift compaction procedures will not be allowed for first stage backfilling (beneath the haunches) of pipe culverts and storm sewers.

3.7 *Excess Material* – Dispose of waste excess excavated material as directed by the Engineer.

3.8 *Testing* –

3.8.1 *Failed Test Payment* – Payment of failed tests will be the responsibility of the Contractor.

3.8.2 *Standard Proctor Density* –

3.8.2.1 ASTM D698.

3.8.2.2 One (1) required for each type of material encountered.

3.8.3 *In Place Density* –

3.8.3.1 ASTM D1556 (Sand Cone)

3.8.3.2 ASTM D2167 (Balloon)

3.8.3.3 ASTM D3017 (Nuclear)

## PART 4: Measurement and Payment

4.1 *Trench Excavation* –

4.1.1 *Guidelines* –

4.1.1.1 Trench excavation shall be considered incidental to pipeline installation.

4.1.1.2 Payment shall be made at the contract unit price per cubic yard only if a bid item is established in the Contract.

4.2 *Backfill* –

4.2.1 *Guidelines* –

4.2.1.1 Payment for backfill shall be made at the contract unit price per cubic yard only if a separate bid item is established in the Contract.

4.2.1.2 No allowance for waste shall be made.

4.2.1.3 If Engineer orders an initial backfill material other than that specified in the Contract, it shall be paid for as an extra in price per cubic yard as compacted in place, EXCEPT if a higher-class embedment is ordered by Engineer because the Contractor has over-excavated the trench width.

4.2.1.4 If the Contractor over-excavates the trench width and the Engineer orders the next higher class of embedment to be used, the embedment shall be paid for as if the original specified embedment was used.

4.2.1.5 If the Engineer orders the excavated material to be removed and disposed of and replaced with another material and a separate bid item is not established as a bid item, the material shall be paid as an extra.

4.2.1.6 If the Contractor fails to compact the backfill to the density requirements, the Engineer may order the material removed and replaced at no cost to the Owner.

# Section 2300

## Horizontal Directional Drilling (HDD)

**PART 1: General**

1.1 *General Description of Work* – This section governs the installation of water and sewer mains sized 4 inches in diameter and larger using horizontal directional drilling. This section also governs the casing of pipe.

1.1.1 *Requirements* – The Contractor shall furnish all labor, equipment, materials, and supplies and shall perform all work necessary to provide ECUA with a complete, finished installation. The proposed alignment, length, profile, and grade to which the HDD shall be installed are noted on the applicable drawings. Casing pipe, if applicable, are shown on drawings.

1.2 *Quality Assurance* –

1.2.1 The requirements set forth in this Specification outline a wide range of procedural precautions necessary to insure that the basic, essential aspects of a proper Directional Bore installation are adequately controlled. The Contractor is ultimately responsible for the satisfactory completion of the drilling.

1.2.2 The Contractor shall perform the work in general conformance with all pipe Manufacturer's requirements for handling, storage, maximum longitudinal and bending stresses, etc. for the selected pipe material. For polyethylene pipe installations, the work shall be in general conformance with ASTM Standard F1962-05, current edition, "Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe of Conduit under Obstacles, Including River Crossings".

1.3 *Submittals* – Prior to beginning work, the Contractor shall submit to the Engineer five (5) copies of a report to include the following:

1.3.1 *Soil Analysis* – Contractor shall make statement that he has reviewed any ECUA supplied soils analysis, along with any soils analysis as obtained by the Contractor. The Contractor is solely responsible for verifying soil conditions as necessary to ensure well-informed bore planning.

1.3.2 *Equipment/Procedure/Materials List* – Contractor shall submit to ECUA the rig size with rated maximum pullback force and maximum allowable pullback force of pipe and shall make statements as to how the pipe pullback forces will not be exceeded by the rig. The Contractor shall also submit a list of other equipment, procedures, and materials expected to be used for the Directional Bore.

1.3.3 *Schedule* – Contractor shall submit to ECUA a time schedule for completing the Directional Bore, including any delays due to anticipated soil conditions.

1.3.4 *Contingency Plan* – Contractor shall submit to ECUA a Contingency Plan clearly defining methods for management of unplanned releases of drilling mud. The plan shall address monitoring, immediate response plan, and anticipated mitigation techniques.

1.3.5 *Staging/Maintenance of Traffic Plan* – A Staging/Maintenance of Traffic (MOT) Plan shall be submitted to ECUA that delineates staging areas for pipe storage, fusing operations, pits, etc.

1.4 *Drilling Hours* – All drilling operations shall be accomplished during daylight hours. In emergency situations, or where delay would increase the likelihood of a failure, night work may be allowed to complete a delayed crossing.

## PART 2: <u>Products</u>

2.1 *Equipment* –

2.1.1 *General* – All equipment for the Directional Bore shall have the capacity, stability, and necessary safety features required to fully comply with the specifications and requirements of this section without showing evidence of undue stress or failure. It shall be the responsibility of the Contractor to assure that the equipment to be used in the Directional Bore is in sound operating condition. Backup equipment shall be required in the event of an equipment breakdown and where the condition of the equipment to be used indicates that routine component replacement or repair will likely be necessary during the Directional Bore.

2.1.2 *Spoils Equipment* – The Contractor shall be responsible for the offsite disposal of all surplus bentonite mixture, cuttings, soil, and debris generated by the project. The surplus materials shall be removed, hauled, and disposed of in accordance with all regulatory agencies having jurisdiction.

2.1.3 *Stoppages* – If equipment breakdown or other unforeseen stoppages occur and forward motion of the directional cutting head is halted at any time other than for reasons planned in advance (addition of drill stems, etc.), the boring path shall be filled with a proper bentonite solution immediately, or as directed by the Engineer.

2.1.4 *Pipe Materials* – Pipe materials shall be per plans. Pipe markings will include nominal size, material, classification (i.e. DIPS), designation (i.e. AWWA C900), dimension ratio, pressure class, Manufacturer's name and date, etc. Sewer pipe shall be green in color, or shall be black with three coextruded green stripes for its full length. Water pipe shall be blue in color or shall be black with three coextruded blue stripes for its full length.

2.1.4.1 *End Connections* – Terminate all HDPE pipe with fusion welded HDPE/PVC mechanical joint adapters and kit.

2.1.4.2 *Casing End Seals* – Install 1-inch thick HDPE special end termination cap as manufactured by ISCO or approved equal.

## PART 3: <u>Execution</u>

3.1 *Personnel Requirements* –

3.1.1 *Supervisor* – A competent and experienced supervisor representing the Drilling Contractor shall be present at all times during actual operations. A responsible representative, who is thoroughly familiar with the equipment and type work to be performed, must be in direct charge and control of the operation at all times. In all cases, the supervisor must be continually present at the job site during the actual Directional Pilot Hole, over reaming and pullback operations.

3.1.2 *Mud Mixing and Recycle Unit Operator* – The Drilling Contractor shall have an experienced and competent mud mixing and recycle unit operator to monitor the viscosity, sand/small fines, mud weight, gel strengths, filtration control and other fluid conditions to ensure optimal performance during pilot hole, over reaming and pullback operations.

3.1.3 *Number of Workers Present* – The Contractor shall have a sufficient number of competent workers on the job at all times to ensure the Directional Bore is made in a timely and satisfactory manner. Adequate personnel for carrying out all phases of the actual Directional Bore operation must be on the job site at the beginning of work.

3.1.4 *Welders* – HDPE or PVC pipe thermal butt fusion welding to be completed by a welder certified by the Manufacturer of the pipe or pipe welding equipment.

3.2 *Installation* –

3.2.1 *Maintenance of Traffic Plan* – The Contractor shall be responsible for providing a Maintenance of Traffic (MOT) Plan to the Engineer and local traffic law enforcement agency for review. The MOT Plan shall show the location of all barricades, signs, devices, and alternate routes for local traffic and pedestrian safety. Erection of the appropriate safety and warning devices in accordance with the USDOT/FHWA "Manual of Uniform Traffic Control Devices" (MUTCD) shall be completed prior to beginning work and maintained until all construction is completed and the site restored.

3.2.2 *Excavation* – All excavation for entry and recovery pits and any other excavation necessitated by the Directional Bore shall be as specified in FDOT's Standard Specifications for Road and Bridge Construction, latest edition. All excavations shall comply with the requirements of the Occupational Health and Safety Administration.

3.2.3 *Restoration Costs* – The Contractor is responsible for the cost of restoring pavement, curb, sidewalk, driveways, lawns, storm drains, etc., and other landscaped facilities unless otherwise noted.

3.2.4 *Process Outline* – The following is a general outline of steps for the Directional Bore operation:

3.2.4.1 Contractor shall clear the right-of-way and temporary work space as shown on the drawings. Contractor to install and maintain all soil erosion and sediment control devices, until project completion with approved permanent site stabilization.

3.2.4.2 Contractor shall haul, string, assemble restrained pipe, and air test the pipeline in one section, above ground, unless otherwise approved by Engineer. The Contractor shall provide adequate site security and shall be responsible for the integrity of the pipe until after the pullback, final test of the pipeline, and acceptance of the work by the Owner.

3.2.4.3 All assembled pipe sections shall be securely plugged at the end of each workday. The pipe interior is to be protected at all times against dirt, dust, drilling mud, pipe cuttings, debris, animal access, and other sources of contamination.

3.2.4.4 Contractor shall provide adequate support rollers for the pipeline during pullback of the pipe string into the pre-drilled hole. The rollers and cradles shall be of a type that will prevent damage to the pipe and will be of sufficient number, as recommended by pipe Manufacturer, to prevent over stressing due to sagging and/or bends during the pullback procedure. The pipe shall be supported at all times, including pullback, to maintain a free stress arc which limits pipe bending and internal hoop stresses to within Manufacturer's limits.

3.2.4.4.1 Pipe which is not properly protected and supported and shows indications of excessive stressing, gouges, cuts, abrasions or other damage which may affect the operational performance intended for the pipe, as recommended by pipe Manufacturer, shall be removed from the site and replaced at no additional cost as directed by the Owner or Engineer.

3.2.4.5 Contractor will mobilize the drilling equipment, erect the rig, drill a pilot hole, enlarge the hole as necessary to a minimum diameter of 1.5 times the nominal diameter of the pipe, and pullback the prefabricated pipe string under the waterway crossing.

3.2.4.6 Contractor will supply portable mud tanks or construct temporary mud pits to contain excess drill fluids during construction. Mud pits are to be protected at all times against unauthorized access and be stabilized at all times against surface water runoff and containment berm failure. Contractor will pump, haul, and dispose of any drill cuttings and excess drill fluids in a manner consistent with the local and state regulations at no additional cost to the Owner.

3.2.4.7 The bore pipe will be pulled back in one continuous section and contractor must utilize a swivel to minimize the rotation of the product pipe during pullback. Swivel shall utilize lubricated internal bearings, which are fully protected from external contamination and over lubrication. Contractor must select a swivel of a capacity to continuously support all live, static and friction loads during pullback and demonstrate swivel operation prior to pullback.

3.2.4.8 During pullback, the Contractor shall maintain records for submission to Engineer indicating job, date, time, constant pipe footage progress, mud flow rates, pulling forces required and torque readings.

3.2.4.9 Engineer shall have access at all times to any measuring or gauging devices used for the horizontal drill as well as any drilling logs maintained by the Contractor.

3.2.4.10 In the event that the Contractor must abandon the drill hole before completion of the crossing, the Contractor will seal the borehole with neat cement grout starting at the low point or end of the drill hole (Rule 62-532.500(4) F.A.C.) and redrill the crossing at no extra cost to Owner.

3.3 *Pipeline Alignment and Profile Tolerances* –

3.3.1 *Entry and Exit Angles* – Ground entry and exit angles shall be as listed on the Contract drawings. Should none be listed, then maximum angles shall be based on drill rig and pipe Manufacturer's recommendations.

3.3.2 *Bend Stress* – Stresses induced by bending shall not exceed 72 percent of the Manufacturers specified minimum yield strength of the pipe. Design bending radii shall be planned accordingly.

3.3.3 *Exit Point* – The actual exit point shall be sufficiently close to the design exit point as to not require additional fittings, conflicts with other utilities, or detrimental alteration of existing utility alignment. The actual exit point shall be no more than 10 feet in front of or 20 feet beyond of the proposed exit point.

3.3.4 *Depth* – The vertical profile as shown on the drawings is the minimum depth to which the pipeline shall be installed. Pipelines installed under waterways shall maintain a 15-foot depth below the deepest part of the channel unless otherwise directed by ECUA. Contractor may, at his option and with the permission of Owner, elect to install the pipe at a greater depth than shown on the drawings, at no additional cost to the Owner.

3.3.5 *Pull Force* – Contractor shall limit the longitudinal pull force on the pipe to not exceed pipe Manufacturer's recommended bending or tensile stress of the pipe unless otherwise approved by the pipe Manufacturer or authorized representative. Contractor will continuously monitor and record the longitudinal pulling forces during pipeline pullback to ensure that Manufacturer's recommended maximum stresses are not exceeded.

3.3.6 *Pipe Relaxation* – After pullback, pipe shall be allowed to relax at least 24 hours or per Manufacturer's recommendations, whichever is greater, prior to any testing or connections.

3.4 *Field Quality Control* –

3.4.1 *Flushing* – The newly installed distribution or transmission main shall be flushed with potable water, and/or swabbed as may be specified for the carrier pipe, to remove any sediment, solids, and/or foreign material prior to any in place testing. Owner's representative shall be notified 48 hours prior to flushing.

3.4.2 *Hydrostatic Test (In ground - After Pipe Pullback)* – Testing shall be in accordance with the applicable section of the ECUA Engineering manual for the specific type of carrier pipe.

3.5 *Water for Construction and Testing* – The Contractor shall be responsible for all permits, fees, temporary meter rental/provisions, temporary back flow preventer rental/provision, and other water utility requirements for supplying water during construction. The Contractor shall use the existing water system only at locations, times and conditions as set forth by the system owner or its representatives.

3.6 *As-Built Records* –

3.6.1 *Welds* – All welds shall be made using a data logger which records temperature, time, and pressure. Weld recording data shall be submitted as part of the as-built record drawings.

3.6.2 *Pipe Location* – Pipe location shall be determined with the use of an electronic walkover tracking system or a magnetic guidance system probe. Location data shall include station, offset, depth, and pipe elevation every 50 feet and at major points of distinction (i.e. edge of pavement, center creek, etc.).

3.6.3 *Submittal Format* – Where ACAD plans are available, Contractor shall submit info on ACAD drawings. Where ACAD plans are not available, Contractor shall submit info as noted on plans in a clear and legible format.

3.7 *Measurement* – Straight line field measurement from HDPE/MJ adapter to HDPE/MJ adapter. Contractor shall adjust unit prices to compensate for additional piping as needed for vertical alignment.

3.8 *Payment* – Compensation shall be for all pipe, materials, labor, equipment, drill mud haul and disposal, and all other incidental work and testing required by the plans and specifications for a complete and fully functional system.

# Section 2310

# Jack and Bore

## PART 1: General

1.1 *General Description of Work* – This work shall consist of boring and jacking operations related to the installation of water pipe and sanitary sewer pipe, in areas where trenching is not feasible or permitted, or as designated on the plans.

## PART 2: Products

2.1 *Pipe* –

2.1.1 *Requirements* – Steel casing shall be used for all installations requiring casing sizes 8- inches or larger.

2.1.1.1 The steel casing shall be seamless or electric resistance-welded tubing for sizes up to 24-inch O.D. and standard double-submerged arc-weld for sizes over 24 inches.

2.1.1.2 Steel pipe shall be new, unused, ASTM A-139, Grade B, straight seam, minimum yield strength of 35,000 psi, and minimum tensile strength of 60,000 psi, with one beveled end (to 37 degrees) and other end square cut.

2.1.1.3 The table provided on the next page represents ECUA minimum requirements. The Project Engineer shall review project specific requirements such as soil and loading conditions along with requirements of the applicable transportation authority having jurisdiction over the subject real estate to determine whether the specific project warrants heavier walled casing than the minimum depicted herein.

| Casing Size Versus Carrier Size | | |
|---|---|---|
| **Carrier Pipe I.D.** | **Steel Casing Diameter** | **Minimum Wall Thickness** |
| 2” | 8” | .188” |
| 3” | 10” | .188” |
| 4" | 12” | .188” |
| 6" | 14” | .188” |
| 8" | 16” | .250” |
| 10" | 18” | .250” |
| 12" | 20” | .250” |
| 14" | 24” | .250” |
| 16" | 24” | .250” |
| 18" | 30” | .312” |
| 20" | 30” | .312” |
| 24" | 36” | .312” |
| 30" | 42” | .375” |
| 36" | 48” | .500” |
| 42" | 60” | .500” |
| 48" | 72” | .625” |

2.2 *Smaller Casing Sizes* – For casing sizes eight inches and smaller, install in accordance with Section 3.2; steel, PVC, or PE material may be used.

2.3 *Spacers* – Acceptable spacers shall be non-corroding, non-rotting and non-settling. Spacers shall be of type to slide easily in casing without causing damage to casing. Approved Manufacturers shall be RACI Spacers North America, BWM Co., CCI Pipeline Systems, Cascade Waterworks Manufacturing Co., or equal as approved by ECUA in writing.

2.4 *End Seals – Both ends of bore shall be sealed watertight. A*cceptable end seals shall include either rubber seal with stainless steel band retainers or grout.

## PART 3: <u>Execution</u>

3.1 *Requirements –*

3.1.1 Boring shall be performed to alignment and grade as shown on the construction drawings.

3.1.2 Equipment shall be of adequate size and capability to install the product and in conformance with the equipment Manufacturer’s recommendations for all power equipment used in the installation. Equipment shall have a means for controlling line and grade and a means for centering the cutting head inside the borehole. Equipment shall provide a means for preventing voids by assuring:

3.1.2.1 In stable, cohesive conditions, the rear of the cutting head must be prevented from advancing in front of the leading edge of the casing by more than 1/3 times the casing diameter, not to exceed 8 inches.

3.1.2.2 In unstable conditions, such as granular soil, loose or flowable materials, the cutting head must be retracted into the casing a distance that permits a balance between pushing pressure, pipe advancement and soil conditions.

3.1.3 Every effort shall be made to prevent formation of voids. Upon completion of the boring operations, voids around the outside face of the casing shall be filled by grouting.

3.1.4 The Contractor shall be responsible for protecting any underground utilities and for any damage resulting to located utilities.

3.1.5 The Contractor shall be fully responsible for producing a sound, tight installation, true to line and grade. All pipe shall be installed through the casing using casing spacers per the applicable ECUA Standard Detail.

3.1.6 Only workmen experienced in boring operation shall perform the work.

3.1.7 Joint restraint for pressure pipe shall be provided in accordance with Standard Detail D-65.

3.1.8 If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. Such work shall be sheeted securely and braced in accordance with OSHA Trench Safety requirements.

3.1.9 Heavy duty jacks suitable for pushing the casing through the soil shall be provided. In operating jacks, even pressure shall be applied to all jacks used so that pressure will be applied to the casing uniformly around the ring of the casing.

3.1.10 A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides properly braced together, to support the section of the casing and to direct it in the proper line and grade.

3.1.11 The whole jacking assembly shall be placed so as to line up with the direction and grade of the casing. In general, soil material shall be excavated just ahead of the casing and material removed through the casing and the casing forced through the soil with jacks, into the space thus provided.

3.1.12 The casing, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the casing from the line and grade established by the Engineer shall not exceed 0.1 feet per 50 linear feet of pipe for gravity flow installations, provided that such variation shall be regular and only in one direction and that the final grade or flow line shall be in the direction indicated.

3.1.13 If the Contractor desires, he may use a cutting edge of steel plate around the head end of the casing extending a short distance beyond the end of the casing with inside angles or lugs to keep the cutting edge from slipping onto the casing.

3.1.14 When jacking of casing is once begun, the operation shall be carried on without interruption, insofar as practical, to prevent the casing from becoming firmly set in the soil.

3.1.15 Any casing damaged in jacking operations shall be removed and replaced at Contractor's entire expense.

3.1.16 Immediately after jacking is complete and the carrier or encasement pipe is accurately positioned and approved for line and grade, the clearance space between the pipe and soil shall be completely filled by pressure grouting for the entire length of the installation.

3.1.17 The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the casing has been completed.

3.1.18 Spacers shall be installed at spacing recommended by spacer manufacturer or minimum spacing to ensure that carrier pipe does not contact casing. If spacing requirements do not coincide, the closer spacing shall prevail. Casing or carrier pipe damaged during carrier pipe installation shall be replaced at Contractor's expense.

3.1.19 If utilized as end seal, grout shall be minimum 4 inches thick and supported by interior soil "donut" sufficient to provide watertight seal.

3.1.20 If rubber end seal is utilized, install rubber end seal with stainless steel band retainers per manufacturer's recommendation to ensure watertight seal.

3.2 *Smaller Casing Sizes* – For casing or sleeve sizes eight inches or smaller, alternate casing installation methods are allowed subject to the approval of the applicable transportation authority having jurisdiction over the subject real estate. These methods may include pneumatic mole, punching, or pushing methods.

## PART 4: <u>Measurement and Payment</u>

4.1 *Measurement* –

4.1.1 Measurement shall be per linear foot of installed casing, and shall include furnishing all labor, materials, equipment, and work involved in the boring operations.

4.1.2 The unit measurement shall also include skids, steel ties, grouting, and other items associated with the boring and casing.

4.2 *Payment* –

4.2.1 The accepted quantities for boring and jacking will be paid at the unit bid price per linear foot of installed casing.

4.2.2 Payment for carrier pipe will be paid in accordance with Section 2556-"Water Distribution Systems" and Section 2570-"Gravity Sewer Collection Systems".

4.2.3 When not listed as a separate Contract pay item, boring, drilling and jacking conduit or jacking shall be considered as incidental work, and the cost there of shall be included in such Contract pay item(s) as provided in the Contract proposal.

4.2.4 Compensation, whether by Contract pay item or incidental work will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

# Section 2320

## Cured-In-Place Pipe Lining

**PART 1: General**

1.1 *Description –*

1.1.1 Provide all materials, equipment, labor and incidentals for the installation and testing of cured-in-place pipe lining (CIPPL) within the sewer main.

1.1.2 The sewer main CIPPL process shall consist of inserting a resin-impregnated flexible tube into an existing sewer, expanding the tube out against the sewer pipe, and curing the tube to form a pipe liner. Curing shall be accomplished by applying ultraviolet light or circulating heated water or steam to affect the desired cure throughout the tube extending full length from manhole to manhole.

1.1.3 The CIPPL shall cure into a hard, impermeable liner pipe of the specified thickness and form a structurally sound liner pipe with a uniformly smooth interior.

1.2 *References* – Standards referenced in this Section are listed below:

| | |
|---|---|
| ASTM D543-06 | Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents |
| ASTM D790-07 | Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials |
| ASTM D2990-01 | Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics |
| ASTM D3567-97 (2006) | Standard Practice for Determining Dimensions of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings |
| ASTM D5813-04 | Standard Specification for Cured-In-Place Thermosetting Resin Sewer Pipe |
| ASTM D1216-07B | Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube |
| ASTM F1743-96 (2003) | Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP) |
| ASTM F2019-03 | Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP) |

1.3 *Qualifications* – The Contractor shall have a minimum of three years of continuous experience installing the product proposed for this project. Additionally, the Contractor shall have successfully completed projects using the proposed product on projects of the same size and installation conditions as this project. The Contractor shall provide experienced crews using the product proposed and installed under the same installation conditions as this project.

1.4 *Delivery, Storage, and Handling* –

1.4.1 Care shall be taken in shipping, handling and storage to avoid damaging the liner. Extra care shall be taken during warm weather construction. Any liner damaged in shipment shall be replaced as directed by the Owner at no additional cost to Owner.

1.4.2 While stored, the CIPPL shall be adequately supported and protected. CIPPL shall be stored in a manner as recommended by the Manufacturer and as approved by the Engineer.

1.5 *Quality Control* –

1.5.1 No change of material, design values, or procedures may be made during the course of the Work without the prior written approval of the Engineer.

1.5.2 All liner to be installed under this Work may be inspected at the Manufacturer plant(s) and wet-out facility for compliance with these Specifications by Owner or Engineer. The Contractor shall require the wet-out facility's cooperation in these inspections. The cost of inspection will be the responsibility of the Owner.

1.5.3 At the time of manufacture, inspect each lot of liner for defects. At the time of delivery, the liner shall be homogeneous throughout, uniform in color, free of cracks, holes, foreign materials, blisters, or deleterious faults.

1.5.4 Contractor shall have a Quality Control Plan or Procedure in place that will allow the Engineer to monitor the resin impregnation process.

1.5.5 All test results shall be provided by an independent, certified ISO 17025 testing facility

1.6 *Warranty* – All lining work shall be fully guaranteed by the Contractor for a period of 5 years from the date of Final Acceptance unless otherwise stipulated in writing by the Owner prior to the date of Conditional Acceptance. During this period, all defects discovered by the Owner or Engineer shall be addressed by the Contractor in a satisfactory manner at no cost to the Owner. The Owner may conduct independent inspections, at its own expense, of the lining Work at any time prior to the completion of the guarantee period.

1.7 *Submittals* –

1.7.1 *Cured-In-Place Pipe* –

1.7.1.1 Summary table of CIPP material properties, including short-term flexural modulus of elasticity, 50-year flexural modulus of elasticity, short-term flexural strength (bending stress), 50-year flexural strength (bending stress), chemical resistance, and hardness. Certified test reports shall be submitted verifying each value as described below

1.7.1.2 Independent third party certified laboratory test reports demonstrating that the exact resin/liner combination to be used for this project meets the requirements for initial structural properties (performed in accordance with ASTM F1216, ASTM F2019, and ASTM D790) and chemical resistance (performed in accordance with ASTM F1216-Appendix X2 or ASTM D5813). If the architecture of the CIPP is such that the physical properties vary depending on the direction of testing (i.e., axial versus circumferential), submit test data on both directions in accordance with the test methods listed above in this paragraph.

1.7.1.3 Independent third party certified laboratory test reports demonstrating that the exact resin and liner to be used for this project has been tested for long-term flexural modulus of elasticity and long-term flexural strength (i.e. 10,000 hour minimum creep testing performed in accordance with ASTM D2990 for design conditions applicable to this project). When filled resins are proposed, complementary data of the same data for unfilled resin shall also be provided. If the architecture of the CIPP is such that the physical properties vary depending on the direction of testing (i.e., axial versus circumferential), submit test data on both directions in accordance with the test methods listed above in this paragraph. If the data submitted in not for the exact materials to be used on this project, submit a detailed description of the physical properties of both the materials used in the test and the materials to be used for this project to demonstrate that the two sets of materials are comparable in terms of physical properties.

1.7.1.3.1 Test will be performed for a minimum of 10,000 hours under test conditions and loadings described below. The data points from 1,000 hours to 10,000 hours, or such other time period as determined by the Engineer based on the curve or slope of the plotted data, of the Long-term Flexural Modulus shall be extrapolated using a Microsoft Excel log-log scale linear regression analysis to determine the minimum service life performance of the materials.

1.7.1.3.2 Testing will be conducted at:

1.7.1.3.2.1 Temperature: 21-25°C

1.7.1.3.2.2 Relative humidity: 50 percent minimum

1.7.1.3.2.3 Load: Load shall be equivalent to a load that is 25 percent of the yield stress as measured by ASTM D790, or as approved by Engineer.

1.7.1.3.3 If non-round host pipes (ovality greater than 10 percent) are to be rehabilitated and if the architecture of the CIPP is such that the physical properties vary depending on the direction of testing (i.e., axial versus circumferential), only ASTM D2990 test results on a specimen prepared in accordance with ASTM D790 will be accepted; no other testing methodology for long-term creep will be accepted.

1.7.1.4 The name of the liner and resin Manufacturer, the location of the facility where each was manufactured, and a list of appurtenant materials and accessories to be furnished.

1.7.1.5 Structural design calculations and specification data sheets listing all parameters used in the liner design and thickness calculations based on Appendix X1 of ASTM F1216 for each pipe segment with less than 10 percent ovality.

1.7.1.6 The Quality Control report for the wet-out facility that ensures proper materials and amounts are used in the resin impregnation process and in liner shipping and storage. At a minimum, the Quality Control report should include, for each CIPP segment, resin lot numbers, volumes of resin, catalyst, and enhancers, date of wet-out, and storage and transportation controls and quality assurance procedures. Include a checklist so that each critical step in the resin impregnation process is checked off and initialed.

1.7.1.7 Installation and quality control plan, including bypass pumping plans, mainline sewer cleaning plan and cleanliness requirements, liner shot plan and sequence, liner installation standard procedures (including, but not limited to, minimum and maximum allowable installation pressures and speeds, and minimum and maximum allowable curing temperatures, pressures, and curing durations and speeds, all certified by the resin and tube Manufacturers), intermediate manhole exposed liner restraining method, boiler sizing calculations, light train sizing, temperature monitoring plan, odor controls procedures, and plan to manage flow to/from laterals during lining.

1.7.1.8 Curing schedule for each shot, including heating, curing, and cool-down schedules.

1.7.1.9 Available standard written warranty from the Manufacturer of wet-out liner.

1.7.2 *Methods and Materials* – Material and method of installation for hydrophilic end seals, cured-in-place pipe end seals, and pre-liners.

1.7.3 *Contingency Planning* – Contingency Plan, including methods and equipment to be used to repair unacceptable liner defects and for removing failed liners, and for availability and accessibility of backup equipment such as air compressors and lateral reinstatement cutters.

1.7.4 *Inspection Documentation* – Documentation of Pre-Construction Inspection, Post-construction Inspection and Warranty Inspection.

1.7.5 *Data and Other Information* –

1.7.5.1 Curing log of CIPPL temperatures and pressures at the upstream and downstream manholes during the curing process to document that proper temperatures, pressures and cure times have been achieved. Curing log shall list as a minimum the temperature of the hot water, steam and/or interior of the liner, the temperature of external thermocouples, pressures, and rate of travel of the ultraviolet assembly (for UV-cured CIPPL) at least once every five minutes or as recommended by the resin and tube Manufacturers, whichever is more frequent.

1.7.5.2 Name and credentials of testing laboratory.

1.7.5.3 Post-installation testing results.

## PART 2: Products

2.1 *Design Requirements –*

2.1.1 *General* – The CIPPL lining shall be a resin-impregnated flexible tube which is inserted into the sewer to be rehabilitated and cured-in-place by an acceptable curing method. The tube may have a suitable polyurethane membrane coating for protection of the interior surface and to provide a uniform, smooth flow surface and may be removed after installation and curing is completed. The resin shall be a liquid thermosetting resin and shall be suitable for the design conditions as well as the curing process.

2.1.2 *50-Year Flexural Strength (ASTM D790, D2990)* - 2,500 psi minimum.

2.1.3 *50-Year Flexural Modulus (ASTM D790, D2990)* - 175,000 psi minimum with no greater than a 50 percent reduction from initial (hour 0) strength.

2.1.4 *CIPPL Thickness –*

2.1.4.1 The required structural CIPPL wall thickness shall be based, as a minimum:

2.1.4.1.1 In accordance with ASTM F1216, Appendix X1, Design Considerations for a fully deteriorated or partially deteriorated host pipe, for a circular host pipe with 10 percent ovality or less.

2.1.4.1.2 A safety factor of 2.

2.1.4.1.3 A minimum service life of 50 years under continuous service.

2.1.4.1.4 A modulus of soil reaction of 1000 psi.

2.1.4.1.5 A soil density of 115 $lbs/ft^3$.

2.1.4.1.6 A Poisson's ratio of 0.3.

2.1.4.1.7 An enhancement factor of 7.

2.1.4.1.8 A groundwater elevation shall be at grade for each pipe segment.

2.1.4.1.9 Ovality for each segment shall be considered 3 percent unless otherwise noted on the drawings.

2.1.4.1.10 Live loads for each segment shall be assumed to be HS-20 unless otherwise noted on the drawings.

2.1.4.1.11 Soil depth for each segment to be lined will be based on the max distance in feet measured between the crown of the pipe and the highest point of soil cover over the length of the pipe.

2.1.4.2 The flexural modulus and flexural strength used in the design shall be the values as rated for the specified service life and as submitted in Paragraph 1.7.1. When filled resins are proposed, complementary data of the same data for unfilled resin shall be provided.

2.1.5 The liner thickness of each pipe segment shall be determined by the Contractor and submitted per Paragraph 1.7 of this Section. Minimum CIPPL design thicknesses are listed in the table below for each pipe diameter in this project.

| CIPPL Liner Thickness | |
|---|---|
| **Pipe Segment Diameter** | **Minimum CIPPL Design Thickness (felt/fiberglass)** |
| 8-inch | 6.0 mm / 3 mm |
| 10-inch | 6.0 mm / 3 mm |
| 12-inch | 7.5 mm / 5 mm |
| 15-inch | 7.5 mm / 5 mm |
| 18-inch | 9.0 mm / 7 mm |
| 21-inch | 10.5 mm / 7 mm |
| 24-inch | 12.0 mm / 7 mm |
| 30-inch | 15.0 mm / 9 mm |
| 36-inch | 16.5 mm / 11 mm |
| 42-inch | 19.5 mm / 11 mm |
| 48-inch | 22.5 mm / 13 mm |

2.1.6 CIPPL installations that result in thicknesses that exceed the design thickness by 15 percent or more as certified by an independent testing laboratory in accordance with paragraph 3.7, may be considered non-compliant if, in the judgment of the Engineer, will impede O&M and future work.

2.1.7 When cured, the liner shall form a continuous, tight fitting, hard, impermeable liner that is chemically resistant to chemicals found in both domestic sewage and seawater.

2.1.8 The liner shall be fabricated to a size that when cured will tightly fit the sewer being rehabilitated. Allowance for longitudinal and circumferential expansion shall be taken into account when sizing and installing the liner. Field verify all dimensions prior to delivery of the liner. The contact tolerance for pipe with a conic section (i.e., oval or round, but not arch pipe) is 2.0 mm; in these cases where any space or gap between the outside surface of the liner and the inside surface of the existing pipe exceeds 2.0 mm, the liner fit will be deemed deficient and corrective action will be required. Where irregularities of the existing pipe exist such as offset joints, protrusions, bumps, and deformations, and the irregularities remain after the sewer has been prepared in accordance with the Contract Documents, exception to the contact tolerance will be allowed in the irregularity zone. The exception shall not present an obstruction to sewage flow.

2.1.9 The length of the liner shall be that deemed necessary by the Contractor to effectively carry out installation and seal the liner at the inlet and outlet of each manhole/structure as specified herein. Field verify all lengths prior to construction.

2.1.10 Approved products

2.1.10.1 Insituform

2.1.10.2 Inliner CIPP

2.1.10.3 Masterliner

2.1.10.4 National Liner

2.2 *Flexible Tube –*

2.2.1 The tube shall consist of one or more layers of absorbent non-woven felt fabric that meets the requirements of ASTM F1216 or fiberglass laminate tube that meets the requirements of ASTM F2019.

2.2.2 The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material shall be included in the tube that may cause delamination in the CIPPL. No dry or unsaturated layers shall be evident.

2.2.3 The felt content of the liner shall be determined by the Contractor, but shall not exceed 25 percent of the total impregnated liner volume.

2.2.4 The wall color of the interior pipe surface of CIPPL after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.

2.3 *Resin –*

2.3.1 The liquid thermosetting resin shall saturate the tube and produce a properly cured liner which is resistant to abrasion due to solids, grit, and sand.

2.3.2 Polyester, vinyl ester, or epoxy resin and catalyst system shall comply with the following requirements and that when properly cured meets the requirements of ASTM F1216. Resins created from recycled materials are not allowed.

2.3.3 Resin enhancers are allowed and may be used by the Contractor. The maximum amount of enhancer allowed is 30 pounds enhancer per 100 pounds resin. Submit data verifying amount of enhancer and certify the limit of enhancer has not been exceeded.

2.3.4 Resin enhancers shall utilize a suitable bond enhancing compound to increase the bond between resins and other materials. Submit certification that bond enhancing compound is suitable for use in aqueous environments.

2.4 *Hydrophilic Seals* – The hydrophilic waterstop end seals shall be bands that are 20 mm wide and 5 mm high and installed at every entrance to a manhole.

| **Approved Manufacturers** | |
|---|---|
| **Manufacturer** | **Model/Style** |
| Hydrotite | RS-0520-3.51 |
| Adeka Ultra Seal | MC-2005T |
| Or equal as approved by ECUA in writing | |

2.5 *Cured-In-Place Pipe End Seal –*

2.5.1 Provide cured-in-place pipe (CIPPL) end seals where directed by the Owner or as shown on the Drawings to seal watertight the end of the CIPP where it enters the manhole.

2.5.2 Provide 316 stainless steels bands for securing end seal to CIPPL and the original host pipe.

2.5.3 CIPPL end seal shall match the diameter of the existing CIPPs where it will be installed.

2.5.4 Product and Manufacturer: Provide CIPPL End Seal as manufactured by NPC, Inc. of Milford, NH or approved equal.

2.6 *Pre-Liners* – Pre-liners shall be 10 mil thick PVC or polyethylene tubes sized to nominal host pipe inside diameter.

## PART 3: <u>Execution</u>

3.1 *Preparation* –

3.1.1 Review Owner's television inspection logs and/or conduct additional inspection of the pipes as deemed necessary by Contractor to plan rehabilitation work. Determine the location of all active service connections prior to lining. Dye test to verify all active service connections, if necessary, or otherwise required by the Contract Documents. Do not reopen taps that are not active.

3.1.2 Clean pipes prior to Pre-Construction Inspection, such that the pipes are free of roots, grease, sand, rocks, sludge, tuberculation (to a tolerance of 0.25 inches projection) and other debris.

3.1.3 Remove intruding taps and seal material prior to Pre-Construction Inspection.

3.1.4 Submit and obtain Engineer's approval of Pre-Construction Inspection prior to wetting out liner. Inspect and confirm the inside diameter, alignment and condition of each segment to be lined. Use the data and information collected from this inspection to verify the size of the liner and refine the installation techniques. If unknown physical conditions in the work area are uncovered during the investigation that materially differ from those ordinarily encountered, notify the Engineer.

3.1.5 As required, provide for continuous flow around the section of pipe that is to be lined. The pump and bypass lines shall be of adequate capacity and size to handle the flow of the sewers. The proposed bypassing system shall be reviewed in advance by the Engineer. The review of the bypassing system by the Engineer shall in no way relieve the Contractor of his responsibility and liability.

3.1.6 Clear the line of obstructions such as solids or broken pipe that will prevent the insertion of the liner. If inspection reveals an obstruction that cannot be removed by the conventional cleaning equipment, make an excavation and repair the obstruction. Excavation work shall be approved by the Engineer prior to commencement of the work and shall be paid under a Change Order.

3.1.7 Remove pockets of water from the pipe.

3.1.8 In presence of Engineer, perform a pre-lining CCTV inspection immediately prior to CIPPL lining to demonstrate that the pipe is clean and free of roots, grease, sand, rocks, sludge, PACP Runners or Gushers, pockets of water, or structural impediments that would affect long-term viability of the pipe liner. Obtain Engineer's verbal approval of the acceptability of the existing pipe condition prior to installation of the CIPPL.

3.2 *Bypass Pumping –*

3.2.1 Maintain commercial and residential sewer service during the installation process. If necessary to properly complete the work, the Contractor may interrupt flow from services if such interruption is first coordinated with and allowed by the property Owner(s). Contact the property Owners and notify them of any service interruptions. Upon completion of the work, immediately reinstate all services and notify the property Owner(s) that service is again available. The Contractor assumes all responsibility for notifying property Owners of service interruptions. The Contractor also assumes all responsibility for blockages, back-ups or damages caused to public or private property as a result of the interruption of service, whether caused by the Contractor's or property Owner's actions.

3.2.2 Bypass pump sewage from individual laterals, if needed.

3.3 *CIPPL Installation Procedures –*

3.3.1 *Lateral Cutters* – Maintain two working lateral reinstatement cutters at the job site at all times. Lining work shall not commence if the Contractor does not have the required number of working cutters on site. No additional time or compensation shall be awarded to the Contractor in the event that work is stopped due to the Contractor's failure to comply with this requirement.

3.3.2 *Resin Impregnation (Wet Out)* – Designate a location where the flexible tube will be impregnated with resin. Thoroughly saturate flexible tube prior to installation. For tubes with exposed resin faces, add five percent excess resin to account for resin migration in pipe defects and joints and resin loss through the ends of the liner. Adjust roller gap setting so that the excess resin is uniformly distributed throughout the length of the liner. Wet-out logs shall provide proper documentation that excess resin was added. Tubes that have a coating between the inside surface of the host pipe and the exterior surface of the tube do not require excess resin. A catalyst system, or additive compatible with the resin and flexible tube, may be used as recommended by the Manufacturer and with approval of the Engineer. Handle the resin-impregnated flexible tube to retard or prevent resin setting until it is ready for insertion.

3.3.3 *Insertion* – Insert flexible tube through an existing access way. The liner material shall be inserted through a manhole by means and method required by the Manufacturer, and shall be fully extended to the lower manhole. Where practical, insert the tube such that the seam of the liner is positioned at the 6 o'clock position. Use only lubricants approved by the tube Manufacturer. Follow the Manufacturer's standards during the elevated curing temperature so as not to over stress the flexible tube and cause damage or failure of the liner prior to cure. Make allowance for circumferential stretching during inversion. Make allowances for longitudinal stretching during pull-in or inversion. Do not utilize overlapped layers of felt in longitudinal seams that cause lumps in the final product. Extend head end (A-side) and tail end (B-side) of the liner for taking samples as required in Paragraph 3.8. If recirculation hoses are used during the curing process, extend the end of such hoses and liner beyond the end of the host pipe and into the downstream manhole.

3.3.4 *Restraint Sleeves* – CIPPL restraint sleeves shall be approved for use at the insertion and receiving manholes only. Ensure that the sleeve system does not enter the host pipe. Sleeve restraint systems will not be allowed in intermediate manholes. Cover exposed CIPPL in intermediate manholes with cut PVC pipe and sandbags to prevent overstretching of the liner or insufficient curing.

3.3.5 *Waterstops* – Insert continuous or properly trimmed hydrophilic waterstops at each manhole opening, centered within the intersection of the host pipe and the manhole wall. Trimmed waterstop edges shall be butted up against each other at the crown of the pipe using a 45-degree miter cut. Waterstops with any gap between the ends will not be accepted. For manholes with outside drops, install two hydrophilic waterstops, one approximately one inch inside the manhole wall and another approximately nine inches upstream of the outside drop and reinstate the drop opening through the CIPPL. If defects in the host pipe near the manhole are such that the end seal will not form a watertight seal between the liner and host pipe, apply hydraulic cement to the defects in the host pipe to provide a smooth surface to receive the end seal.

3.3.6 Pressure Head – The pressure head used during the installation process shall be sufficient to hold the liner tight to the pipe wall, produce dimples at all service connections and the two access manholes, and prevent wrinkles in the cured liner. The same head shall be great enough to prevent infiltration from entering the pipeline during the curing process. Pressure head shall be maintained sufficiently long enough to allow pockets of water to exfiltrate through the host pipe and prevent lifts in the liner and resin washout.

3.3.7 *Curing* –

3.3.7.1 Follow submitted cure schedule in curing of liner.

3.3.7.2 After insertion is completed, for non-light cured products, apply a suitable recirculation system capable of delivering air, steam, or water at various temperatures, and as required by the liner system Manufacturer, uniformly throughout the section to achieve a consistent cure of the resin while allowing any moisture to migrate from the liner. Maintain the curing temperature or exposure times as recommended by the liner system Manufacturer. Prevent excessive temperatures that could scald or bubble the liner. Scalded or blistered liner will be rejected if, in the opinion of the Engineer, the performance of the liner is compromised.

3.3.7.3 Fit suitable monitors to any heat source to gauge the temperature of incoming and outgoing water or steam supply or UV lamps, where appropriate.

3.3.7.4 Monitor temperatures through two thermocouples placed between the CIPPL and the invert of the host pipe at each manhole. Record temperature measurement every 5 minutes. Record temperature in Fahrenheit.

3.3.7.5 Continue uninterrupted curing until the desired product is achieved.

3.3.7.6 Provide for vapor tight connections in the downstream manhole such that no vapors enter downstream pipes. Alternatively and at no additional cost to the Owner, provide styrene odor reducing agents, venting, and downstream plugs sufficient to prevent steam, styrene, or other odors from entering downstream buildings.

3.3.8 *Cool Down* – Initiate a controlled cool-down to cool the hardened liner to a temperature below 110°F, in accordance with the cure schedule. Maintain the cool down rate as recommended by the liner system Manufacturer. Take care in release of the pressure column so that a vacuum will not develop that could damage the newly installed liner. Cooling/Curing water shall only be discharged into ECUA's sanitary sewer. Discharging of cooling/curing water to the ground or storm water system is not permitted. Do not discharge water in excess of 100°F into the sewer system.

3.3.9 *Finished Pipe* – Provide a finished CIPPL that is continuous and free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, delamination, and wrinkles at any location totaling more than 5 percent of host pipe inside diameter.

3.3.10 *Reopening Services* – Reopen all of the existing active service connections in each length of sewer immediately following installation of the liner. Reopen active service connections from inside the sewer by means of a remote controlled, CCTV assisted cutting device appropriate for the liner material and the rehabilitated sewer pipe. Each active service connection shall be cut completely open and shall have smooth edges with no protruding material capable of hindering flow or catching and holding solids contained in the flow stream. If the service connection cannot be fully reopened due to time constraints, open each service connection to a minimum of 75 percent before the end of each working day. Partially opened service connections must be entirely opened by no later than the next working day.

Do not reopen capped or inactive lateral connections. Confirm the locations of all capped or inactive laterals during pre-construction CCTV inspections.

3.4 *Trimming At Manholes* –

3.4.1 Delay final trimming and sealing of the liner at manholes according to Manufacturer's guidelines.

3.4.2 Neatly and smoothly trim the finished ends of the liner to within two inches of host pipe end. Do not leave any rough edges that may catch debris. Do not leave any portion of CIPPL within the manhole channel unless directed by the Owner to remain.

3.4.3 Provide a smooth transition between the existing manhole channel invert and the effluent liner using cementitious or other approved material to prevent settling of sediments or debris from catching on the liner.

3.5 *CIPPL End Seal Installation* –

3.5.1 Field measure existing CIPP inside diameter prior to ordering CIPP end seal units.

3.5.2 Cut out, remove and dispose of a portion of the existing CIPP to expose a minimum of 1.5 inches of the host pipe. Remove the minimum amount of CIPP necessary to properly install the CIPP end seal.

3.5.3 Clean the CIPP and original host pipe so they are free of debris and grease.

3.5.4 Install CIPP end seal units in accordance to the Manufacturer's recommended procedure. Position the stainless steel expansion band closest to the manhole so it is located within the outer wall of the manhole.

3.5.5 Remove all debris resulting from the installation of CIPP end seal units.

3.6 *Post-Construction Inspection of Completed Work* –

3.6.1 *Inspection Documentation* – Provide post-construction inspection video documentation showing completed work.

3.6.2 *Quality Assurance* – Correct all defects discovered during the television inspection before Conditional Acceptance. After the defects are corrected, repeat the Post-construction Inspection for that sewer line.

3.6.3 *Final Cleanup* – Upon completion of rehabilitation work and testing, clean and restore project area affected by the Work.

3.7 *Quality Control Tests* –

3.7.1 For each installation of CIPPL, collect a restrained pipe sample by placing a section of PVC pipe on the B-Side end (opposite of insertion side) of the liner in the downstream manhole for steam and ultraviolet cures and on the insertion end, A-Side of the liner in the insertion side manhole for water cures. Select PVC material and size to match the inside diameter of the sewer being lined as closely as practical. The length of PVC pipe shall be equal to the length of the two required samples plus 12 inches, minimum. Run the impregnated tube through the pipe and cure the CIPPL under restrained conditions. Cut two cylindrical samples from the center of the restrained pipe sample. Each sample shall be a minimum of 9 inches long or 25 times the CIPPL thickness, whichever is greater. Label samples with the Contract number, date of installation, street location, segment number(s), and specified thickness. Deliver one sample to Contractor's testing facility. Contractor may elect to take additional samples at no additional cost to the Owner.

3.7.2 The following tests at the following minimum frequencies will be performed by the Contractor on CIPPL liners installed. The Owner may elect to perform additional testing. The Contractor may, at his discretion and cost, conduct additional testing to improve the resolution of performance test characterization. Any testing Owner elects to perform shall be performed by an independent, certified ISO 17025 testing facility. Each test shall be performed by a laboratory with an American Association for Laboratory Accreditation (A2LA) for the specific test to be performed.

3.7.2.1 Short-term Flexural (Bending) Properties: The initial tangent flexural modulus of elasticity and flexural yield strength measured in accordance with ASTM D790.

3.7.2.1.1 Frequency: 1 test per inversion shot.

3.7.2.2 Thickness measured in accordance with ASTM D5813/D3567.

3.7.2.2.1 Frequency: 1 test per inversion shot.

# Section 2330

## Cured-In-Place Lateral Lining

**PART 1: General**

1.1 *Summary* – It is the intent of this portion of the specification to provide for the re-construction of a service lateral and connection in 8-inch through 24-inch mainline pipes, normally without excavation, by the installation of a one piece resin impregnated, flexible, non-woven felt tube installed into the existing lateral connection utilizing a pressure apparatus positioned in the mainline pipe. Curing shall be accomplished by use of ambient cure resin or other approved method to cure the resin into a hard impermeable cured-in-place (CIPP) pipe liner. When cured, the liner shall have a watertight connection seal at the mainline and extend over the length of the service lateral in a continuous one piece structural pipe- within-a-pipe.

1.2 *Qualifications of Contractor* – The Contractor or Subcontractor performing the work of this section shall be employees of the company manufacturing the CIPP Lateral Lining system components, or shall be licensed by the system Manufacturer. The Manufactured System must have a minimum of a five (5) year history of satisfactory performance with a minimum of 10,000 CIPP lateral installations. The Contractor or Subcontractor shall have a minimum of two (2) years of service continuous experience installing CIPP Lateral Lining in pipe of similar size, length and configuration as proposed in this project. In addition, the Contractor or Subcontractor shall have successfully installed 5,000 CIPP laterals in a wastewater collection system application. The onsite Superintendent must have installed over 2,500 CIPP laterals of like condition for this geographic area and have a minimum of 5 years of CIPP industry experience.

1.3 *References* – This specification references ASTM test methods which are made a part hereof by such reference and shall be the latest edition and revision thereof.

| | |
|---|---|
| ASTM F1216 | Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube |
| ASTM F1743 | Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP) |
| ASTM D5813 | Standard Specification for Cured In Place Thermosetting Resin Sewer Piping Systems |

1.4 *Submittals* –

1.4.1 *Product Data* –

1.4.1.1 *Resin* –

1.4.1.1.1 Long term test creep data confirming the resin system's 50 year design life in accordance with ASTM D2990.

1.4.1.1.2 Chemical Resistance per ASTM F1216

1.4.1.1.3 Certificate of Compliance with ASTM 1216

*1.4.1.2 Tube –*

1.4.1.2.1 Certificate of Compliance with ASTM F1216

1.4.1.2.2 If glass fiber reinforcement is used, CIPP strain Corrosion testing data in accordance with ASTM D3681

1.4.2 CIPP wall thickness design calculations (for lateral liner) in accordance with ASTM F1216.

## PART 2: Products

2.1 *Materials –*

2.1.1 *General Requirements –*

2.1.1.1 Tube and resin will meet the requirements of ASTM F1216, F1743 and D5813.

2.1.1.2 In industrial areas subject to possible flows other than domestic sewage, the Owner shall obtain samples of the dry weather sewage flow to be analyzed for chemical content. This analysis shall be supplied to the Installer for his information.

2.1.2 *CIPP Lateral Materials –*

2.1.2.1 The liner shall be fabricated to a size that when installed will neatly fit the internal circumference of the conduit specified by the Owner. Allowance shall be made for circumferential stretching during insertion. The liner shall be a one piece joint-less polyester felt tube that will create a watertight seal at the mainline interface.

2.1.2.2 The minimum length shall be 36 inches (3 feet) to effectively span the distance from the lateral connection at the main or to the desired termination location in the service lateral pipe. The lateral liner must provide a watertight seal at the mainline and a structural repair of the lateral over the specified length. The Installer shall verify the lengths in the field before impregnation of the resin.

2.1.2.3 Unless otherwise specified, the Installer shall furnish a specially designed, unsaturated, Polyester or Vinylester resin catalyst system compatible with the cured-in-place process that provides cured physical strengths specified herein.

2.1.3 *Physical Strength –*

2.1.3.1 The structural performance of the finished pipe must be adequate to accommodate all anticipated loads throughout its design life. No cured-in-place pipe reconstruction technology will be allowed that requires bonding to the existing pipe for any part of its structural strength. Only resin vacuum impregnation will be allowed. If reinforcing materials (fiberglass, etc.) are used, the reinforcing material must be fully encapsulated within the resin to assure that the reinforcement is not exposed, either to the inside of the pipe or at the interface of the CIPP and the existing pipe.

2.1.3.2 Design methods are to be derived from traditionally accepted pipe formulas for various loading parameters and modes of failure. All equations will be modified to include ovality as a design parameter. The design method shall be submitted to the Engineer for approval prior to the pre-bid conference.

2.1.3.3 The CIPP lateral pipe shall conform to the minimum structural standards as listed in the table below:

| Structural Standards for CIPP Lateral Pipe | | |
|---|---|---|
| **Property** | **ASTM Standard** | **Results** |
| Flexural Stress | ASTM D 790 | 4,500 psi |
| Flexural Modulus | ASTM D 790 | 250,000 psi |

2.2 *Approved Manufacturers/Products –*

2.2.1 BLD “Service Connection Seal + Lateral” of BLD Services, LLC

2.2.2 LMK Enterprises

2.2.3 or pre-approved equal

## PART 3: Execution

3.1 *Installation Preparations –*

3.1.1 *Access* – If the Contractor requires access through a cleanout or access pit to complete the lateral lining, the costs associated with the cleanout or access pit will be the responsibility of the Contractor. If a cleanout already exists or is required by the Owner, it shall be constructed of materials which provide a four inch (4”) minimum diameter circular opening, if service lateral is six inch (6”) than a six inch minimum diameter opening is required. Any cleanouts must be 2-way wye connections (Tee connection will not be permitted) to allow video inspection, cleaning and lining access.

3.1.2 *Safety* – The Installer shall carry out his operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving entering confined spaces.

3.1.3 *Cleaning of Sewer Line* – The intent of this specification is for cleaning of the lateral to be accomplished from the mainline pipes via lateral launching equipment. If the lateral cannot be cleaned using industry standard cleaning heads that can be launched from the mainline then a cleanout will be required and considered changed conditions. The laterals shall be cleaned a sufficient length to ensure the specified length of sewer is ready for lining. It shall be the responsibility of the Installer to verify, prior to installation, that all internal debris has been removed from the sewer line. Internal debris consists of broken pipe sections, roots, loose gravel, etc.

3.1.4 *Inspection of Pipelines* – It is the intent of this specification for inspection of the lateral to be accomplished from the mainline pipes via lateral launching equipment. If the lateral cannot be inspected using industry standard inspection equipment that can be launched from the mainline then a cleanout will be required and considered changed conditions. Inspection of pipelines shall be performed by experienced personnel trained in locating breaks and obstacles by closed circuit television. The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent proper installation of the lateral liner into the pipelines, and it shall be noted so that these conditions can be corrected. A DVD and suitable log shall be kept for later reference by the Owner.

3.1.5 *Bypassing Sewage* – The Installer, when required, shall provide for the flow of sewage around the section or sections of mainline pipe where the service lateral designated for lining is located. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. It is assumed that flows in the lateral specified for lining will not require bypass pumping.

3.1.6 *Service Lateral Deactivation* – It is required that the service lateral be inactive during the time of installation. This is normally accomplished by turning off the Homeowner's services or requesting that the Homeowner relinquish using his services during the period of installation. Notification will be distributed to impacted residents 24 hours in advance of the lateral liner installation.

3.1.7 *Line Obstructions* – If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, as in solids, dropped joints or collapsed pipe then the Installer shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the Owner's representative prior to the commencement of the work and shall be considered as a separate pay item.

3.1.8 *Lined Mainlines* – In the case of lined mainline pipes, the lateral connection specified for rehabilitation shall be reinstated to 100 percent of its original size to accept the CIPP lateral.

3.2 *Installation Of Lateral Lining* –

3.2.1 *General* – The Installer shall designate a location where the liner will be vacuum impregnated prior to installation. The Installer shall allow the Owner to inspect the materials and "wet-out" procedure. A catalyst system compatible with the resin and liner shall be used.

3.2.2 *Wet-Out Liner* – The wet-out liner shall be loaded inside a pressure apparatus above ground and utilizing a hydrophilic sealant (or equivalent) on the backside of the connection to enhance a watertight seal. Also, a two-part 100 percent solid epoxy (reference ASTM C-881) or a Silicate Resin shall be applied to the lateral interface to enhance adhesion against the host pipe. The pressure apparatus, with an end attached to a robotic device, shall be winched through the mainline pipe to the service connection. The robotic device, together with a television camera, will be used to position the pressure apparatus' inversion elbow at the service connection opening. Air pressure, supplied to the pressure apparatus through an inversion hose, shall be used to invert the wet-out liner through the lateral pipe to the cleanout/access point or "Right of Way" point. The inversion head will be adjusted to be of sufficient pressure to cause the impregnated liner to invert completely in the lateral pipe and hold the tube tight to the pipe wall. Care shall be taken during the curing process so as not to overstress the tube.

3.2.3 *Curing* – In most circumstances, an accelerated ambient-temperature curing resin system will be utilized, however if a heat cure is required, the Installer shall supply a suitable heat source and recirculation equipment. The equipment shall be capable of delivering the approved heating medium throughout the section to the temperature required to affect a cure of the resin. This temperature shall be determined by the resin/catalyst system employed.

3.2.3.1 If a heat cure is required, the heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing air/steam or water supply. Fluid temperature in the line during the cure period shall be recommended by the resin Manufacturer. <u>NOTE: No UV cure systems will be allowed.</u>

3.2.3.2 Initial cure shall be deemed to be completed when inspection of the exposed portions of the CIPP appears to be hard and sound and/or the temperature gauge indicates that the temperature is of a magnitude to realize an exotherm. The cure period shall be of a duration recommended by the resin Manufacturer, as modified for the installation process.

3.2.4 *Cool-down* – The Installer shall cool the hardened CIPP to a temperature below 100°F before relieving the pressure in the pressure apparatus. Cool-down may be accomplished by the introduction of cool air into the pressure apparatus to replace water being forced out of the pressure apparatus. Care shall be taken to maintain proper pressure throughout the cure and cool-down period.

3.2.5 *Finish* – The finished CIPP shall be a watertight connection seal at the mainline and extend continuous over the entire length of the service lateral and be free of dry spots, lifts, and delamination. This continuous one piece structural pipe-within-a-pipe shall not inhibit the closed circuit television post video inspection of the mainline or service lateral pipes.

3.2.6 *Testing* – For every 50 laterals, one flat plate sample shall be taken and sent to a 3rd party test laboratory for confirmation of short term flexural modulus and strength properties in accordance with ASTM F1216. The test results shall meet or exceed the values used in the design of the CIPP lateral liner.

3.2.7 *Close-out* – After the work is completed, the Installer will provide the Owner with a CD or DVD showing the completed work including the restored conditions.

3.3 *Clean-Up* – Upon acceptance of the installation work, the Installer shall reinstate the project area affected by his operations.

3.4 *Measurement And Payment* –

3.4.1 Measurement for the work included in this section will be in accordance with the units set forth in the proposal. Unit prices shall include all labor, materials and equipment required to complete the work as specified. The unit prices shall also include CCTV prior to and after lining, lateral cleaning, bypass pumping of mainline flow, installation of cleanouts (if required by the lateral lining process) and traffic control (standard cones and signs).

3.4.2 Payment for the work included in this section will be in accordance with the prices set forth in the proposal for the quantity of work performed. Progress payments will be made monthly based on the work performed during that period.

3.5 *Warranty* –

3.5.1 Contractor warrants to Owner that all products and work provided by Contractor to Owner under this Agreement will be free from material defects in workmanship and materials for a period of five years from the earlier of the date on which Contractor's work is accepted by Owner or the date on which the Contractor completes performance and leaves the worksite. In the event that a material defect in workmanship or materials supplied by Contractor is found during the five year period following acceptance of the work, then such defect shall be repaired, replaced or adjusted by Contractor at no additional cost to Owner. Owner's exclusive remedy in the event of any warranty claim hereunder is limited to correction of such defect, adjustment, repair or replacement as the Contractor shall at its sole option elect. The foregoing warranty is the exclusive warranty provided by Contractor and is given in lieu of all other warranties, whether express, implied or statutory, including but not limited to, any implied warranties of merchantability or fitness or suitability for a particular purpose or use; and all other warranties are hereby expressly disclaimed.

3.5.2 In no event shall Contractor's liability for warranties hereunder exceed the purchase price paid by the Owner for Contractor's work and materials.

3.5.3 The warranty set out above shall be void and of no effect in the event that

3.5.3.1 Contractor is not notified of claim of defect within the five year period provided above;

3.5.3.2 Contractor is not provided timely and unrestricted access to the site at which the claimed defect is located in order to investigate and/or repair, adjust or replace the work or materials claimed to be defective or Contractor is not provided suitable working conditions to perform such investigation, repair, adjustment or replacement;

3.5.3.3 Any materials or work is exposed to chemicals or substances other than those listed in the Specifications to this Agreement as accepted by Contractor;

3.5.3.4 Site conditions or pipeline, conduit or access way conditions are other than those disclosed to and accepted by Contractor;

3.5.3.5 Owner's site, pipeline, conduit or access ways are cleaned or modified in a manner not disclosed in writing to and accepted in writing by Contractor in advance of commencement of Contractor's work or tampered with prior to, during or after completion of Contractor's work;

3.5.3.6 Or the work, the site at which the work is performed or the materials provided by Contractor are otherwise abused or misused.

# Section 2340

## Pipe Bursting

### PART 1: General

1.1 *General Description of Work –*

1.1.1 This specification shall cover the rehabilitation of existing sanitary sewer via The Pipe Bursting Method. Pipe bursting is a system by which a bursting unit splits the existing pipe while simultaneously installing a new Polyethylene Pipe of the same size or larger where the old pipe existed. Only equipment with either front or rear expanders for the proper connection to the Polyethylene Pipe will be allowed for use. The bursting tool must be used in conjunction with a constant tension/variable speed winch. The winch shall have twin cable pulling capstans with twin hydraulic drive motors and twin gear boxes for independent operation of either 20, 10 or 5 tons. The size of the winch depends on the diameter of the pipe to be replaced. In no case is the constant tension on the winch to exceed 20 tons.

1.1.2 This specification shall also cover the repair of manhole openings upsized by pipe bursting to provide a permanent, watertight connection between the pipe and manhole structure. The Contractor shall reform and reconstruct manhole benching and channels for upsized piping.

1.2 *References* – The following documents form a part of this specification to the extent stated herein and shall be the latest editions thereof. Where differences exist between codes and standards, the one affording the greatest protection shall apply, as determined by the ECUA.

| | |
|---|---|
| ASTM D1248 | Polyethylene Plastics Molding and Extrusion Materials |
| ASTM 02657 | Heat Joining of Thermoplastic Pipe and Fittings |
| ASTM D3035 | Polyethylene Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter |
| ASTM D3261 | Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing |
| ASTM 03350 | Polyethylene Plastic Pipe and Fitting Materials |
| ASTM F714 | Standard Specification for Polyethylene Plastic Pipe Based on Outside Diameter |

1.3 *Submittals –*

1.3.1 The Contractor shall submit catalog cuts, specifications, dimensioned drawings, installation details and sketches, and other pertinent information associated with the work. All materials provided shall fully comply with the requirements of the referenced specifications listed above.

1.3.2 The Contractor shall verify all connection details with the pipe Manufacturer.

1.3.3 The Contractor shall submit detail drawings and a written description fully describing construction procedures and sequences. This information will include locations for bypass insertion and receiving pits, a plan to bypass sewage flow from the host sewer and service laterals, method for disconnection and reconnection of the sewer service lateral connections, and details for installing new service laterals.

1.3.4 Certification of workmen training as required herein.

1.4 *Quality Assurance* –

1.4.1 The Contractor shall be certified by the particular pipe bursting system Manufacturer that he/she is a fully trained user of the pipe bursting system.

1.4.2 The Pipe Bursting Contractor must have successfully completed five (5) pipe bursting projects of similar size and scope within the United States in the last four (4) years using the pipe bursting equipment and material for the type that meet the requirements stated within these specifications.

1.4.3 The Project Superintendent and pipe bursting machine operator are require to have at least two (2) years of pipe bursting experience using the similar type of equipment required for this project.

1.4.4 Polyethylene pipe jointing shall be performed by personnel trained in the use of butt-fusion equipment and recommended methods for new pipe connections. Personnel directly involved with installing the polyethylene pipe. Training shall be performed by qualified representatives.

1.4.5 The Contractor shall hold the Owner and Engineer whole harmless in any legal action resulting from patent infringements.

1.5 *Pre-Installation Procedures* –

1.5.1 *Cleaning* – Prior to pipe bursting operations, the Contractor shall thoroughly clean the existing sewer pipe. The cleaning shall constitute removal of all debris, solids, roots and other deposits in the existing sewer system.

1.5.2 *Pre-Inspection and Measuring of Service Connections* – The Contractor shall inspect the existing sewer pipe immediately before the pipe bursting operation to assure that the existing pipe conditions are acceptable for the installation. The Contractor shall also create a log as well as video documentation with exact measurements of each service connection in the sewer pipe, in order to re-connect the service connections after the installation. The service connection log shall at least state the exact distance from the manhole wall to the middle of each service connection, the manhole number from where the measurement has been taken and the location of the service connection {i.e. 9 o'clock, 11 o'clock etc.)

## PART 2: <u>Products</u>

2.1 *General* –

2.1.1 *Material* – The Contractor shall provide polyethylene pipe as specified. The pipe shall be fabricated to the diameter and tolerance in accordance with ASTM 03035. The minimum ratio of orthogonal diameter prior to installation shall be 0.95. All pipes shall be made from virgin grade materials. The pipe shall be of the diameter and class shown or specified and shall be furnished complete with all fabricated fitting and other appurtenances required to complete the entire project as designed.

2.1.2 *Markings* – Pipe materials shall be legibly marked by the pipe Manufacturer with the following information:

2.1.2.1 Name and trademark of the Manufacturer

2.1.2.2 Nominal pipe size

2.1.2.3 Dimension ratio

2.1.2.4 The letters PE followed by the polyethylene brand per ASTM 01248, followed by the Hydrostatic Design Basis in hundreds of PSI.

2.1.2.5 Manufacturing Standard Reference

2.1.2.6 A production code from which the date and place of manufacture can be determined

2.2 *HDPE Pipe* –

2.2.1 *Pipe Properties and Features* – Shall be high molecular weight, high-density polyethylene pipe. The materials shall be listed by the Plastic Pipe Institute (PPI) with a designation for PE 3408 and have a minimum cell classification of 345434C, D, or E as described in ASTM 03350. The pipe material shall meet the requirements for Type III, Class B or C, Category 5, Grade P34 material as described in ASTM D1248. The pipe shall contain no recycled compound except that generated in the Manufacturer's own plant from resin of the same specification from the same raw material pipe. Pipe (excluding black colored pipe) stored outside shall not be recycled. Pipe and fittings shall be made in conformance with ASTM F714 and ASTM D 3261 as modified for the specified material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects. It shall be uniform in density and other physical properties. Any pipe not meeting these criteria shall be rejected.

2.2.2 *Markings* – HDPE pipe color shall be gray with green striping. Striping shall be three, one half inch wide stripes equally spread around the pipe circumference for the entire length.

2.2.3 *Size* – HDPE pipe shall be DIPS DR 17.

2.2.4 *Service Laterals* – All existing service laterals shall be reconnected to the new HDPE sewer line and replaced to the easement line and tested.

Connection of the new service lateral to the mainline shall be accomplished by means of a compression-fit service connection. The service connection shall be specifically designed for connection to the sewer main being installed, and shall be INSERTA TEE® as manufactured by INSERTA FITTINGS Co., Hillsboro, Oregon, Telephone (503) 357-2110 Fax (503) 359-5417; or approved equal. Install using procedures and equipment as referenced in Manufacturer's written installation instructions.

The Contractor may optionally provide service connection via a fusible HDPE tee/wye connection.

## PART 3: EXECUTION

3.1 *General* – The Contractor shall protect existing and new facilities including utilities, road pavement, and private property from damage by forces generated by the pipe bursting and supporting equipment. Any damage to the existing facilities that result from the pipe bursting operation shall be the responsibility of the Contractor.

If it is found that the damage is a result of the pipe bursting operation, the cost to repair or replace the damaged facility shall be the responsibility of the Contractor.

3.2 *Preparation -*

3.2.1 All sewer service connections shall be located by the pre-construction video and marked prior to commencing any pipe bursting operation and pipe insertion. Upon commencement, pipe insertion shall be continuous and without interruption from one manhole to another, except as approved by the Engineer. Upon completion of the insertion and installation of the new pipe, the Contractor shall expedite the reconnection of lateral service connections to minimize inconvenience to the citizens/customers.

3.2.2 Contractor shall determine the location of any obstacles to bursting the existing pipe, such as steel repair collars or steel reinforcement, by electromagnetic induction, magnetic susceptibility, research of repair records, video inspection, and/or other methods.

3.3 *Handling and Storage –*

3.3.1 The Contractor shall exercise special care during unloading, handling and storage of all polyethylene pipe to ensure that it is not cut, gouged, scored, or otherwise damaged. Any pipe segment with pipe wall cuts exceeding 10 percent of the wall thickness shall be cut out and removed from the site at the Contractor's expense. The pipe shall be stored in such a manner that it is not deformed axially or circumferentially to the extent that it may hinder pipe installation. After unloading any pipe material ordered to the project site and before installing the pipe, the Contractor shall inspect all pipe to verify its condition.

3.3.2 Polyethylene pipe without an ultraviolet inhibitor shall not be stored unprotected against the outside elements.

3.4 *Sags in Line* – If the pre-installation video inspection reveals a sag in the existing sewer greater than one half the diameter of the existing pipe, the Contractor will install replacement pipe to provide an acceptable grade without the sag. The Contractor shall take necessary measures to eliminate these sags by digging a sag elimination pit and bringing the bottom of the pipe trench to a uniform grade in line with the existing pipe invert or by other measures that shall be acceptable to the Engineer.

3.5 *Pipe Joining –*

3.5.1 The Contractor shall join the polyethylene pipe into continuous lengths on the job site. Pipe joining shall be accomplished through use of the butt fusion method and shall be performed in strict accordance with the pipe Manufacturer's recommendations and specifications. Fusion equipment used in the joining procedure shall meet all conditions recommended by the pipe Manufacturer, including, but not limited to, fusion temperature, alignment, and fusion pressure. Electrofusion means, methods, and materials may be used for field closures where trench environment safely permits such utilization.

3.5.2 A fire-retardant bag or suitable enclosure shall be used with the heater plate to facilitate control of heating process and to protect the heater plate surfaces from dirt and other debris when not in use. The heater plate surfaces shall be cleaned regularly as needed to prevent accumulation of fusion welding residues or other substances that may result in faulty pipe joining.

3.5.3 Butt fusion shall conform to ASTM 02657 and pipe Manufacturer's criteria for the type of joining. Joint strength shall be equal to that of the adjacent pipe.

3.5.4 The inside and outside of pipe ends shall be cleaned with a cotton or non-synthetic cloth to remove dirt, water, grease, and other foreign materials. The pipe ends shall be cut square, faced, and carefully aligned immediately prior to heating.

3.5.5 Upon achieving the proper melt pattern, the pipe ends shall be brought together in a firm, rapid motion applying sufficient pressure to form a pipe bead (1/8 inch to 3/16 inch in height) around and inside the entire circumference of the pipe.

3.5.6 Terminal sections of pipe that are joined within the insertion pit shall be connected with Central Plastics Electrofusion Couplings or connectors with tensile strength equivalent to that of the pipe being joined.

3.6 *Pipe Installation* –

3.6.1 After the service connections have been located and marked by the Contractor the Contractor will excavate and expose so the Contractor can isolate all sewer service connections prior to replacing the existing sewer. Service Lateral excavation shall be performed in such as manner as to avoid humps in the new sewer due to unevenly distributed resistance on the sides of the exposed existing sewer.

3.6.2 Where practical, the Contractor may utilize existing manholes or machine or insertion pits. If the Contractor for his convenience uses a manhole not designated for replacement, the Contractor will replace the manhole at his own expense. Manhole inverts, benches, and channels shall be removed to permit access for installation equipment as appropriate. When installing through an existing manhole, the input and output pipe openings shall be enlarged sufficiently to accommodate the maximum OD size of the pipe bursting device. At no time shall the bursting device and/or the installation process place undue stress on the existing manhole opening surface. Benches and channels shall be reconstructed after the new pipe is in place.

3.6.3 *Bursting Head* – The pipe bursting tool shall be designed and manufactured to force its way through existing pipe materials by cutting and fragmenting the pipe and compressing the old pipe sections into the surrounding soil as it proceeds. The bursting unit shall generate sufficient force to cut, burst, and expand the existing pipe line.

The pipe bursting tool shall be pulled through the sewer by a winch located at the upstream manhole. The bursting unit shall pull the polyethylene pipe (PE) with it as it moves forward. The bursting head shall incorporate a shield/expander to prevent collapse of the hole ahead of the PE pipe. The pipe bursting unit shall be remotely controlled.

The bursting action of the tool shall increase the external dimensions sufficiently, causing breakage of the pipe at the same time expanding the surrounding ground. This action shall not only cut and break the pipe but also create the void into which the burster can be winched and enables forward progress to be made. At the same time the polyethylene pipe, directly attached to the sleeve on the rear of the burster, shall also move forward.

The burster shall have its own forward momentum while being assisted by power winching. The power winch shall give the burster constant tension by which it can move forward. To form a complete operating system, the burster must be matched to a constant tension power winching system.

3.6.4 *Winch Unit* – A winch shall be attached to the front of the bursting unit, connecting to or through the guide head. The winch shall provide a constant tension to the bursting in order that it may operate in an efficient manner. The winch shall have twin capstan with twin hydraulic drive motors and twin gear boxes for independent operation. In no case shall the winch cable storage spool be considered part of the twin capstan pulling system.

The winch shall be hydraulically operated providing a constant tension throughout the operation. The winch shall be of the constant tension type but shall be fitted with a direct reading load gauge to measure the winching load.

The winch must automatically maintain a constant tension at a set tonnage reading.

The constant tension winch shall supply sufficient cable in one continuous length so that the pull may be continuous between approved winching points.

The winch, cable and cable drum must be provided with safety cage and supports so that it may be operated safely without injury to persons or property.

The Contractor shall provide a system of guide pulleys and bracing at the exit pit to minimize cable contact with the existing line between launch and exit pits.

The supports to the trench shoring in the insertion pit shall remain completely separate from the winch boom support system and shall be so designed such that neither the pipe nor the winch cable shall be in contact with them.

The Contractor shall secure the pipe to concrete structures or manholes after the pipe has been installed through the length of sewer being replaced. The Contractor shall install an Engineer approved water stop or flange adapter that is fused and seated perpendicular to the pipe axis, around the pipe exterior, and grouted into the structure wall to create a watertight seal at the manhole wall. The new pipe shall be installed to initially extend 12 inches inside the manhole opening. The structure or manhole connections shall be made a minimum of 12 hours after pipe insertion.

3.7 *Low Pressure Air Testing* – Provide low pressure air testing of the newly installed HDPE per the requirements of Section 2570-“Gravity Sewer Collection Systems”.

3.8 *Construction Method* –

3.8.1 Equipment used to perform the work shall be located away from buildings so as not to create noise impact. Provide a silent engine compartment with the winch to reduce machine noise, as required to meet local codes and regulations.

3.8.2 The Contractor shall install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing manholes, and to protect the pipe from damage during installation. Lubrication may be used as recommended by the pipe and lubricant Manufacturers. Lubrication fluids shall be contained in stabilized mud pits or tanks. Lubrication fluids shall be removed and disposed of by the Contractor at no additional cost to the Owner. Under no circumstances will the pipe be stressed beyond 72 percent of polyethylene pipe Manufacturer's specified minimum yield strength. Winch line is to be centered in pipe to be burst with adjustable boom.

3.8.3 The installed pipe shall be allowed to cure for the Manufacturer's recommended amount of time, but not less than four (4) hours, for cooling and relaxation due to tensile stressing prior to any reconnection of service lines, sealing of the annulus or backfilling of the insertion pit. Sufficient excess length of new pipe, but not less than four (4) inches, shall be allowed to protrude into the manhole to provide for occurrence.

Restraint of pipe ends shall be achieved by means of Central Plastics Electrofusion couplings or equivalent. The Electrofusion couplings shall be slipped over pipe ends against manhole wall and fused in place. Installation of Electrofusion couplings shall be done in accordance with the Manufacturers recommended procedures.

3.8.4 Following the relaxation period, the annular space shall be sealed. Sealing shall be made with non-shrink, watertight materials approved by the Engineer and shall extend a minimum of eight (8) inches into the manhole wall in such a manner as to form a smooth, uniform, watertight joint. The terminating, pipe ends in manholes shall be connected by Central Plastics Electrofusion couplings, or equivalent, to eliminate ground water infiltration. Installations of electrofusion couplings shall be done in accordance with the Manufacturers recommended procedures.

3.9 *Final Cleaning and Television Inspection –*

3.9.1 Prior to final inspection and acceptance of the new pipe, the Contractor shall flush and clean the system by removing all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the pipe.

3.9.2 After completion of the pipe installation service reconnecting, finish work at the manholes, and final cleaning, the sewer shall be televised.

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# Section 2350

## Test and Seal

**PART 1: General**

1.1 *General Description of Work –*

1.1.1 Provide all labor, materials, tools, equipment and incidentals as shown, specified, and required for testing lateral tap connections to the sewer by hydraulically applying a positive pressure to the joints, monitoring the pressure in the void and monitoring the test medium flow rate. The test medium shall be air.

1.1.2 The intent of lateral tap testing is to identify those lateral taps that are not watertight and that can be successfully sealed by packer injection grouting.

1.1.3 Test tap connections to the sewer main.

1.2 *Requirements* – This Contract requires work in active sewers. Follow all federal, state and local requirements for safety in confined spaces.

1.3 *Qualifications –*

1.3.1 Contractor shall have a history of at least five years of pressure testing and grouting sewers and shall have successfully pressure tested a minimum of 5,000 sewer pipeline joints and 250 lateral connections.

1.3.2 All Work shall be supervised by a foreman having previously performed pressure testing and chemical grout sealing of a minimum of 3,000 sewer pipeline joints and 250 lateral tap connections.

1.4 *Submittals –*

1.4.1 Equipment operating procedures and systems.

1.4.2 Submit complete records collected during the joint testing activities, identifying the following:

1.4.2.1 Location of the pipeline segment in which the testing is being done.

1.4.2.2 Location of each lateral tap tested.

1.4.2.3 Location of any lateral taps not tested and the reason for not testing.

1.4.2.4 Test pressure achieved and the duration of test maintained for each lateral tap passing the air test.

1.4.2.5 Retest test pressure for each lateral tap passing air test after the application of grout.

1.4.3 Documentation of Testing Observations.

1.5 *Reference Standards* – National Association of Sewer Service Companies (NASSCO) prepared Pipeline Assessment and Certification Program (PACP}, Second Edition Reference Manual, 2001.

## PART 2: Products

2.1 *Equipment* –

2.1.1 The basic equipment used for mainline pipe joints and for laterals connected to the mainline shall consist of a remotely operated television camera capable of pan and tilt, joint testing device such as a packer, and test monitoring equipment. The equipment shall be constructed in such a way as to provide means for introducing air under pressure into the void area created by the expanded ends of the joint testing device and a means for continuously measuring the actual static pressure of the test medium within the void area only.

2.1.2 The device for testing lateral tap connections shall consist of inflatable mainline end elements and a lateral grouting plug that creates a void area extending beyond the tap connection. Whenever possible, use a lateral grouting plug sized to match the diameter of the lateral being grouted with an effective sealing length of no less than 3 feet. Where the Contractor elects to abandon a capped or inactive lateral shown on the Drawings using grout, utilize alternate lateral grouting plug or equipment sized appropriately for the capped/inactive lateral. If the lateral transitions from 6 inches to 4 inches in diameter, use a 4-inch lateral grouting plug, but no relief for excess residual grout will be provided. Maintain a variety of lengths of lateral grouting plugs and adjust length of lateral grout plug as required to grout capped/inactive laterals. The device shall provide a means for continuously measuring the static pressure of the test medium and chemical grout within the void area created by the inflation of the device. All pressure measurements shall be made within the void area.

2.1.3 Void pressure data shall be transmitted electronically from the void area to the monitoring equipment. All test monitoring shall be carried out in the TV studio.

## PART 3: Execution

3.1 *Preparation* –

3.1.1 Testing will not be required on pipe exhibiting the following conditions or characteristics. Provide Engineer with digital image and intention not to grout any such defect.

3.1.1.1 Longitudinally fractured or broken pipe, as classified by PACP, or on sections of the pipe between joints.

3.1.1.2 Any section of pipe that is scheduled to receive a cured-in-place point repair.

3.1.1.3 Any section of pipe that is scheduled for replacement or other work involving excavation or new connections.

3.1.1.4 Engineer or Contractor determines that, significant structural damage of the pipe would occur as a result of the pressure test.

3.1.2 Clean sewer and remove all roots in mainline sewer except minor hair roots prior to testing.

3.1.3 Attempt to test and, if needed, grout any joint separated less than 1-inch. For joints separated by more than 1-inch, the Engineer may elect to install a cured in place point repair (CIPPR) by separate contract.

3.1.4 Attempt to test and, if needed, grout any small or medium offset joint as classified by PACP. For offset joints that are classified as large offset by PACP, the Engineer may elect to install a CIPPR by separate contract.

3.1.5 Clean lateral and remove roots from lateral when directed.

3.1.6 Confirm the inside diameter of the lateral pipe to be tested and apply the appropriate packer.

3.1.7 During testing and sealing, provide sewer flow control so as to provide unimpeded view of the packer.

3.1.8 Record the testing procedure. The recording shall show the location of the lateral tap connection and the test pressure in subtitles. Sealing of the failed lateral tap connection will be incorporated on the same recording.

3.2 *Documentation of Roots in Lateral Taps –*

3.2.1 During mainline sewer cleaning or testing, document all lateral taps containing roots that are either (a) greater than fine roots or (b) of a nature to prevent testing and sealing of tap connection. For each such tap connection, submit a screen shot image clearly showing the extent of roots. Submit images in electronic format, labeled and organized in a manner to easily retrieve the image for the lateral tap in question. The list of lateral taps with roots shall include upstream and downstream manhole numbers, station, property address served, plan sheet number where tap is located and photograph of outside cleanout, if present.

3.2.2 Engineer will review the list of lateral taps containing roots and direct Contractor as to which laterals are to be (a) cleaned and grouted, (b) grouted without cleaning - in which case such lateral tap would be excluded from warranty testing, or (c) removed from the scope of work - in which case no payment for such lateral will be made. Successful cleaning of lateral taps (i.e. such that no more than fine hair roots remain) will be paid per the applicable item on the Schedule of Prices. No payment will be made for unsuccessful attempts to clean lateral taps.

3.3 *Lateral Tap Testing Procedure –*

3.3.1 Lateral tap joint testing pressure shall be equal to 2 psi per vertical foot of pipe depth plus 2 psi; however, test pressure shall not exceed 10 psi without approval of the Engineer.

3.3.2 Air testing lateral taps shall be accomplished by isolating the area to be tested with the lateral tap packer and by applying positive pressure into the isolated void area. A pan and tilt camera shall be used to position the lateral packer for laterals directly connected to the mainline sewer. The lateral bladder shall be inverted from the mainline assembly into the lateral pipe and inflated. The mainline elements shall then be inflated to isolate the lateral connection and the portion of the lateral to be tested. Direct visual observation and measured cable lengths shall be used to position the lateral packer for laterals directly connected to manholes. A sensing unit shall be located within the void area and will accurately transmit continuous pressure readout to the control panel.

3.3.3 The test procedure will consist of applying air pressure into each isolated void area. A sensing unit shall be located within the void area and will accurately transmit continuous pressure readout to the control panel. Air shall then be slowly introduced into the void area until a pressure equal to or greater than the required test pressure, but in no cases greater than 2 psi above the required test pressure, is observed on the pressure monitoring equipment. Once the designated pressure in the isolated void is displayed on the meter of the control panel, the application of air pressure will be stopped and a twenty-second waiting period will commence. The void pressure will be observed during this period. If the void pressure drop is greater than 1.0 psi, the lateral shall be considered to have failed the air test and shall be grouted and retested.

3.3.4 After completing the air test for each individual lateral specified herein, derate the lateral packer, with the void pressure meter continuing to display void pressure. If the void pressure does not drop to approximately zero, the equipment shall be adjusted to provide a zero void pressure reading at the monitor.

3.4 *Control Test –*

3.4.1 Prior to starting the testing phase of the Work, demonstrate the acceptable performance of air test equipment in the presence of the Engineer by conducting demonstration tests daily, or more frequently as directed by the Engineer.

3.4.1.1 For pipe less than or equal to 18 inches in diameter, provide a straight pipe of appropriate diameters and sufficient length to test mainline packers and lateral push packers and a wye tap mockup of appropriate diameters and sufficient length to test the lateral tap connected to mainline packer. All of these test devices shall be fitted with a 1/8-inch diameter tap hole with a plug or screw that can be removed to test the packer under both sound and leaking conditions. For pipe greater than 18 inches in diameter, the below method shall be used.

3.4.1.2 After entering each pipeline segment with the test equipment, but prior to the commencement of testing, position the test equipment on a section of sound sewer pipe between pipe joints, and perform a test as specified. The equipment shall hold a 10 psi test pressure for a period of 60 seconds with a pressure drop of less than 1 psi. In the event of a failed test, repair any defective equipment and re-test to verify proper operation of all equipment at no additional compensation. Should it be found that the barrel of the sewer pipe will not meet the test requirements, then the performance testing shall be waived or modified as determined by the Engineer.

3.4.1.3 If air testing equipment cannot be performed successfully, repair or otherwise modify air test equipment and repeat the tests until the results are satisfactory to the Engineer. This test may be required at any other time during the performance of testing work if the Engineer suspects the testing equipment is not functioning properly.

## PART 4: Packer Injection Grouting

4.1 *General Description of Work* –

4.1.1 *General* – Provide all labor, materials, tools, equipment and, incidentals as shown, specified, and required to grout lateral tap connections using a packer injection.

4.1.2 *Packer Injection Grouting* – Packer injection grouting is used to reduce the infiltration within the pipeline, seal lateral tap connections that have failed the test criteria and prevent further loss of pipe bedding into the pipe.

4.1.3 *Method* – Packer injection grouting shall be accomplished by pressure injection of chemical grout into the soils encompassing the pipe joint. Chemical grouts shall be designed to be injected into the soil surrounding the pipe, which stabilizes the soil and forms a permanent impermeable seal called a soil ring. Adequate volumes of grout must be injected to form an effective seal. This application will be through structurally sound joints and penetrations from within the pipe (packer method) in tandem with a closed circuit television inspection system.

4.1.4 *Plug Size* – Use a lateral grouting plug sized to match the diameter of the lateral being grouted with an effective sealing length of no less than 3 feet.

4.1.5 *Site Conditions* – The site is characterized by a water table that is seasonally above the joints, but does experience extended periods when the pipe bedding becomes dry.

4.2 *Requirements* –

4.2.1 This Contract requires work in active sewers. Adhere to all federal, state and local requirements for safety in confined spaces.

4.2.2 Worker safety training should include reviewing the hazards associated with hoses, pumps, tanks, couplers, compressors, bottles, motors, and all other related application apparatus. Additional safety considerations including safely handling, mixing, and transporting of chemical grouts should be provided by the grout Manufacturer or supplier or both. Their safe operating practices and procedures should describe appropriate personal protective equipment (PPE) for the various grouting operations. Operations covered should include the proper storage, transportation, mixing, and disposal of grouts, additives, and their associated containers.

4.3 *Qualifications* –

4.3.1 Contractor shall have a history of at least five years of pressure testing and grouting sewers and shall have successfully pressure tested and grouted a minimum of 5,000 sewer pipeline joints and 250 lateral connections.

4.3.2 All work shall be supervised by a foreman having previously performed pressure testing and chemical grout sealing of a minimum of 3,000 sewer pipeline joints and 250 lateral tap connections.

4.4 *Submittals –*

4.4.1 Grout Information:

4.4.1.1 Description of chemical grout.

4.4.1.2 Grout mixture ratio (including additives). Include procedure for adjusting grout mixture for variations of ambient temperatures and changes of temperature of grout through hoses exposed to atmosphere.

4.4.1.3 Curves of grout gel time versus temperature.

4.4.1.4 Instructions for addition of agents.

4.4.1.5 MSDS Sheets.

4.4.2 Equipment operating procedures and systems to be used, including Manufacturer's literature on grout pumps, operating pressures, packers, and lateral blockage clearing equipment.

4.4.3 Annular space between the packers and the host pipe.

4.4.4 Upon completion of grouting each reach, submit to Engineer a report showing the following data for each lateral tap connection tested, grouted or attempted to be grouted:

4.4.4.1 Pipe material and diameter.

4.4.4.2 Stationing.

4.4.4.3 Time, date, and temperature.

4.4.4.4 Grout mixture formation, including additives and catalyst mixture formulation and proportion of each.

4.4.4.5 Pumping pressure.

4.4.4.6 Gel time.

4.4.4.7 Quantity of grout used to seal the joint.

4.4.4.8 Step grouting, if applicable.

4.4.4.9 Post-grout pressure test results.

4.4.4.10 Regrouting and retesting giving above data as required.

4.4.4.11 Video recording cross-reference index.

4.4.5 Documentation of Post-construction Inspection and Warranty Inspection.

## PART 5: Products

5.1 *General* –

5.1.1 All grout materials must have the following characteristics:

5.1.1.1 While being injected, the grout must be able to react/perform in the presence of water (groundwater).

5.1.1.2 The cured grout must withstand submergence in water without degradation.

5.1.1.3 The resultant grout formation must prevent the passage of water (infiltration) through the pipe joint.

5.1.1.4 The grout, after curing, must be flexible, under both dry and wet conditions.

5.1.1.5 The grout must not be biodegradable.

5.1.1.6 The cured grout should be chemically stable and resistant to acids, alkalis, and organics found in sewage.

5.1.1.7 Residual grout shall be easily removable from the sewer line to prevent blockage of the sewage flow.

5.1.2 Handle, formulate, and store grout in accordance with the Manufacturer's recommendations. The uncured grout shall be delivered to the Site in unopened containers with the date of manufacture clearly indicated. Do not utilize uncured grout manufactured more than six months prior to the date of application. Immediately remove from the Site any uncured grout compound determined to be more than six months old. Once a container of uncured grout has been opened it shall be used within 72 hours.

5.1.3 All material shall be clearly dated by the Manufacturer. Engineer shall be provided the opportunity to inspect the Contractor's storage facilities at any time. Any material found to have exceeded its shelf life or found to be stored under improper temperature and humidity conditions, as determined by Manufacturer's recommendation, shall be marked rejected, shall not be used, and shall be removed from the Site immediately.

5.1.4 Mix and handle the grout and the constituents producing it, which may be toxic on contact or inhalation, as recommended by the Manufacturer and to minimize hazard to personnel. Provide appropriate protective measures to ensure that the grout components and the chemicals produced in mixing are under the control of the Contractor at all times and are not available to unauthorized personnel or others. Dispose of excess grout resulting from sewer grouting operations in a safe manner. All equipment and material shall be subject to the review of Engineer.

5.1.5 All grout materials used shall meet the following minimum application requirements:

5.1.5.1 All component materials shall be easily transportable by common carriers.

5.1.5.2 Packing of component materials shall be compatible with field storage requirements.

5.1.5.3 Grout components shall be packed in such a fashion as to provide for maximum worker safety when handling the materials and minimize spillage when preparing for use.

5.1.5.4 Mixing of the components shall be compatible with field applications and not require precise measurements.

5.1.5.5 The concentration of the grout and additives shall be within the limits recommended by the Manufacturer.

5.1.5.6 Catalyzation shall take place at the point of injection/repair.

5.1.5.7 Cleanup shall be done without inordinate use of flammable or hazardous chemicals.

5.1.6 Do not use this method to attempt repair of longitudinally cracked pipe, structurally unsound pipe, flattened, or out-of-round-pipe.

5.2 *System Description –*

5.2.1 Grouting equipment shall consist of two separate pumping systems capable of supplying an uninterrupted flow of sealing materials to completely fill the voids. The gel side of the system shall be a closed system to minimize exposure to moisture. Pumps, fittings, and hoses shall be designed to transport a high viscosity material and shall not be affected by acetone or ketone solvents. The sizing of the system shall be such that the water side can transport materials at 1 to 1 or 8 to 10 times the ratio of the gel side. Pumps shall be sized to deliver a minimum of 3 GPM.

5.2.2 Grout shall pass from the pumping system through instant reading, controlled flow meters and then through a dual hose system into the sealing device. The device (referred to hereafter as a packer) shall be a cylindrical case of a size less than pipe size, with the cables at either end used to pull it through the line. The packer shall be constructed in such a manner as to allow a restricted amount of sewage to flow at all times.

5.2.3 Generally, the equipment shall be capable of performing the specified operations in sewers where flows do not exceed 25 percent of pipe diameter.

5.2.4 For mainline joint packers, air impervious inflatable sleeves shall be mounted over the cylinder with the ends of the sleeve sealed to the ends of the casing. The sleeves shall be so constructed that they can be pneumatically expanded from the center to both ends. The center portion of the sleeve shall be sealed to the casing by a broad confining band. When the packer is inflated, two widely spaced annular bladders shall be formed, each having an elongated shape and producing an annular void around the confined portion of the sleeve. The central portion of the packer (between the ends) shall be expandable in order to reduce the amount of wasted grout in the void area. No sealing device which is expanded mechanically nor where the expansion sleeve is not continuous will be allowed in order to prevent damage to the pipe from excessive amounts of sealing pressures or air leakage in the center area of such sealing device. Only low void packers with annular space less than 14 gallon shall be used.

5.2.5 Tap and lateral service sealing shall be accomplished using the lateral grouting plugs and push packers.

5.2.6 Provide back-up bladders for all packers on-site any time grouting work is being conducted. Equipment for cleaning lateral blockages shall be present on-site where any grouting work is being conducted.

5.3 *Grouts* –

5.3.1 Acrylamide base grout shall have the following characteristics:

5.3.1.1 A minimum of 12 percent acrylamide base material by weight in the total grout mix. A higher concentration of acrylamide base material may be used to increase strength or offset dilution during injection.

5.3.1.2 The ability to tolerate some dilution and react in moving water during injection.

5.3.1.3 A viscosity of approximately 2 centipoise, which can be increased with additives.

5.3.1.4 A constant viscosity during the reaction period.

5.3.1.5 A controllable reaction time from 10 seconds to 1 hour.

5.3.1.6 A reaction (curing) that produces a homogenous, chemically stable, non-biodegradable, finn, flexible gel.

5.3.1.7 The ability to increase mix viscosity, density and gel strength by the use of additives.

| **Approved Manufacturers** | |
|---|---|
| **Manufacturer** | **Model** |
| Avanti | AV-100 |
| Or approved equal as determined by ECUA in writing | |

5.3.2 Acrylic base grout shall have the following characteristics:

5.3.2.1 A minimum of 12 percent acrylic base material by weight in the total grout mix. A higher concentration of acrylic base material may be used to increase strength of set dilution during injection.

5.3.2.2 The ability to tolerate some dilution and react in moving water during injection.

5.3.2.3 A viscosity of approximately 2 centipoise, which can be increased with additives.

5.3.2.4 A constant viscosity during the reaction period.

5.3.2.5 A controllable reaction time from 5 seconds to 6 hours.

5.3.2.6 A reaction (curing) that produces a homogenous, chemically stable, non-biodegradable, flexible gel.

5.3.2.7 The ability to increase mix viscosity, density and gel strength by the use of additives.

| **Approved Manufacturers** |
|---|

| Manufacturer | Model |
|---|---|
| Avanti | AV-118 |
| DeNeef Construction Chemicals | AC400 |
| Or approved equal as determined by ECUA in writing | |

5.3.3 Urethane base grout shall have the following characteristics:

5.3.3.1 One part urethane resin thoroughly mixed with 8 parts of water weight (11percent resin). When high flow rates from leaks are encountered, the ratio of water being pumped may be lowered to no less than 5 parts (17 percent resin).

5.3.3.2 A liquid having a solids content of 75 to 95percent, and a specific gravity of greater than 1.00.

5.3.3.3 Viscosity of between 100 and 1500 centipoise at 70°F that can be pumped through 500 feet of 1-inch hose with a 1000-psi head at a flow rate of 1 ounce per second.

5.3.3.4 The water used to react the resin should have a pH of 5 to 9.

5.3.3.5 A reaction (curing) that produces a homogenous, chemically stable, non-biodegradable, flexible gel.

5.3.3.6 The ability to increase mix viscosity, density and gel strength by the use of additives.

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Model** |
| Avanti | AV 254 |
| | AV 350 |
| DeNeef Construction Chemicals | Hydro Active Multigel NF |
| Or approved equal as determined by ECUA in writing | |

5.4 *Additives –*

5.4.1 For lateral tap connection grouting, add latex additive (or equal) to strengthen the grout. The quantity of latex additive will be according to the Manufacturer recommendation. Adjust the grout admixture to meet specified viscosity and reaction time. Follow Manufacturer's recommendations for product handling and start. Latex additive shall have the following characteristics:

| Required Characteristics of Latex Additive | | |
|---|---|---|
| Solids Content | 49% minimum | ASTM D-1010 |
| pH | 7.5-8.5 | 8.0 Average |
| Viscosity | 130 cps @ 77°F | ASTM D-1638 |
| Density | 8.52 lbs./gal. | ASTM D-1564W |
| Solvent | Water | |

5.4.1.1 Shall provide protection against shrinkage and improve the strength of the gel.

5.4.1.2 Shall not contain organic solvents.

5.4.2 Add a root deterrent chemical such as dichlobenil to the grout in proportions as recommended by the Manufacturer.

5.4.3 Use a shrink control agent that is a water-based emulsion with the grout. The shrink control agent shall reduce shrinkage and improve strength of the grout providing the resultant cured material with both improved hydrostatic pressure resistance and flexibility. The agent shall be added in proportions as recommended by the Manufacturer.

5.4.4 Add gel time extending agent in accordance with the Manufacturer's recommendations to extend gel time as necessary.

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Product** |
| Avanti | Potassium Ferricyanide (KFe) |
| Or approved equal as determined by ECUA in writing | |

## PART 6: Execution

6.1 *General* –

6.1.1 Remove roots and test laterals.

6.1.2 Grout all lateral tap connections and transitions that failed the pressure test by the injection method or equal. Generally, this shall be accomplished by forcing grout through a system of pumps and hoses into and through the joints of the sewer from the packer within the sewer pipe. Jetting or driving pipes from the surface that could damage or cause undermining of the pipelines, shall not be allowed. Except where specifically shown on the Drawings or called for in the Specifications, do not uncover the pipe by excavation.

6.1.3 Remove excess grout from pipe and laterals. Excess grout shall be defined as a thickness of grout greater than 1 inch thick at any point or an amount of grout that, given its location, size and geometry, in the judgment of the Engineer, could cause a blockage. Flush or push forward to the next downstream manhole, remove from the sewer system, and properly dispose of excess grout. In no case shall excess grout material be allowed to accumulate or flushed down the sewer.

6.1.4 All decisions regarding allowable roots or excess grout shall be made in the field during the work by the Engineer and shall be final. It is the Contractor's responsibility to either remove all grout and roots or obtain Engineer approval to leave them in place.

6.1.5 Any structurally undamaged joint that structurally fails (breaks) during testing and grouting under normal pressure conditions that are documented on video shall be the Owner's responsibility and cost to repair. Any structurally failed pipe or joint that is grouted at the Engineer's direction that further fails/breaks during testing and grouting under normal pressure conditions that are document on video shall be the Owners responsibility and cost to repair. Promptly repair any sewer damage resulting from the Contractor's operations at no additional compensation.

6.2 *Sewer Flow Control* – During grouting, provide sewer flow control so as to provide unimpeded view of the packer.

6.3 *Grout Preparation –*

6.3.1 Mix all grout at the Site in the presence of the Engineer. Do not use grout that has been mixed off-site and is in the Contractor's tank when the truck arrives on Site. Follow the Manufacturer's recommendations for the mixing and safety procedures to protect personnel from any adverse effects of the grouting compounds. Add and mix powder and additives at rates that will eliminate the formation of lumps within grout tanks solutions. Use accurate scale(s) to weigh the various non-water grout solution components. Thoroughly mix all additives in the grouting component tanks. Provide accurate thermometers to verify temperature of grouting components in tanks.

6.3.2 At the beginning of each day, prior to application of grout, perform a pump test to determine if proper ratios are being pumped from the grout component tanks at the proper rates and to measure pump rates. Use separate containers to capture the discharges from the grout component tanks. Take corrective action if unequal quantities are being pumped. Repeat the pump test until equal quantities are pumped from the grout tanks. Pump one gallon of grout and count the pump strokes to confirm the number of pump strokes required to achieve the delivery rate. Repeat the pump test until proper ratios and delivery rates are pumped from the grout tanks.

6.3.3 At the beginning of each day, when new batches of grout are mixed, when grout additives are modified to change gel times, at the beginning of any new pipe segment or manhole, and whenever the temperature in the tanks or ambient temperature have changed by more than 10°F from the previous gel test, perform a grout gel test in the presence of the Engineer to determine the grout mixture gel time by collecting a sample of grout from the packer discharge.

6.3.4 Add gel time extending agent, as necessary and in the presence of the Engineer, to compensate for changes in temperature in grout component tanks or hoses. The addition of dilution water to extend gel times is not acceptable unless resulting base material exceeds 12 percent by weight.

6.3.5 During the grouting process, the Contractor and Engineer shall monitor the grout component tanks to make sure that proper ratios are being pumped. If unequal levels are noted in the tanks, repeat the pump test as described above.

6.3.6 Gel times shall be within 5 seconds of the following unless otherwise approved by Engineer.

$$Gel\ time = \frac{(volume\ of\ annular\ space\ (gal. + (pipe\ diameter\ (in.)/4\ \ (60\ \ sec./\mathrm{min.}) +\ 5\ sec.}{Pumping\ Rate\ (gpm)}$$

6.4 *Lateral Tap Connection Sealing By Packer Injection Grouting –*

6.4.1 Lateral tap sealing begins if the lateral tap does not pass the air test, shows evidence of leakage, has been successfully cleaned to remove roots, or where Contractor has been directed to grout a tap that contains visible roots. The lateral packer shall remain in position during the pressure test, thus maintaining the isolated void. Pressure inject grout through the lateral packer into the annular space between the lateral grouting plug and the lateral pipe. Pump the grout out into the soil through leaking joints and pipe defects.

6.4.2 Pump grout materials into this isolated area. Run the pump continuously until refusal. Refusal shall mean the mixed grout has flowed through any joint failure, through any annular space, and into the surrounding soil; gelled or filled the available void space; and formed a cohesive seal stopping further grout flow, and an 8 psi back pressure is achieved while pumping. If the grout pumped exceeds 1 gallon per foot of lateral bladder plus 3 gallons, it will be suspected that there are significant voids on the outside of the pipe or that the packer is not properly sealed. Check that the packer is sealed properly. If it is, modify grouting procedure to step grouting by pumping additional grout in 4 gallon increments, waiting 1 full minute, retesting; and, if needed, continuing with additional 4 gallon grout steps until successful test or until directed to stop by the Engineer. Record the amount of grout pumped on the sealing log.

6.4.3 Upon completion of the lateral tap sealing procedure, air test the lateral tap a second time to confirm the sealing of the connection. If the lateral tap fails this air test, repeat the grouting procedure at no additional cost to the Owner. Repeat this sequence of air testing, grouting and subsequent air testing until either the lateral tap is sealed or it is determined that the grout consumption is too high and may result in the blockage of the lateral pipe. The final determination to stop subsequent attempts to seal a lateral tap will be made jointly between the Engineer and the Contractor. Air tests after grouting laterals containing roots is not required.

6.4.4 Confirm lateral flow after sealing of each lateral tap. With the lateral packer in position, retract the inversion tube and inject air pressure into the lateral. Should a pressure build in the lateral and not drop to approximately zero in a few seconds, move the packer off the connection and view the connection with a television camera. With the camera viewing the connection point, attempt to obtain water flush by the occupant. If no water is viewed during this procedure, it will be assumed that the building sewer connection is substantially blocked with grout and the Contractor shall immediately clear the lateral at no additional cost to the Owner. Blockages in the lateral that are not the result of grouting operations shall not be the responsibility of the Contractor.

6.5 *Lateral Tap Connection Warranty Testing –*

6.5.1 Conduct warranty testing on 15 percent of the mainline lateral tap connections (excluding grouted taps that contained roots) 18 to 24 months after Conditional Acceptance. Engineer will select the lateral tap connections to be warranty tested. Actual period for testing shall be determined by the Engineer and will ideally be conducted during high groundwater conditions. Contractor will be provided with 60-day notice of the warranty testing. Conduct all warranty testing in the presence of the Engineer.

6.5.2 If more than 10 percent of the warranty tested lateral tap connections fail, test an additional 15 percent of the lateral tap connections. If more than 10 percent of the second group of warranty tested lateral tap connections fail, test 100 percent of the remaining, untested, lateral tap connections at no additional compensation.

6.5.3 Grout and retest all lateral tap connection joints failing warranty testing at no additional compensation.

6.5.4 Perform a Warranty Inspection of all lateral taps that are warranty tested.

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# Section 2556

# Water Distribution Systems

## PART 1: General

1.1 *General Description of Work* – The Contractor shall furnish and install all pipes, fittings, structures and accessories required for water transmission, distribution and/or service lines in accordance with the requirements of the Construction Plans and related Contract Documents.

1.2 *Commonly Used Acronyms* –

| | |
|---|---|
| ANSI | American National Standards Institute |
| ASME | American Society of Mechanical Engineers |
| ASSE | American Society of Safety Engineers |
| ASTM | American Society for Testing and Materials |
| AWWA | American Water Works Association |
| CA | Concrete Asbestos |
| CI | Cast Iron |
| DI | Ductile Iron |
| DIPS | Ductile Iron Pipe Standard |
| ECUA | Emerald Coast Utilities Authority |
| FAC | Florida Administrative Code |
| FDEP | Florida Department of Environmental Protection |
| FLG | Flange |
| HDPE | High-Density Polyethylene |
| MJ | Mechanical Joint |
| MSS | Manufacturer's Standardization Society |
| NSF | National Standards Foundation |
| OD | Outside Diameter |
| PVC | Polyvinyl Chloride |
| SBR | Styrene Butadiene Rubber |
| SF | Suction Flange |

1.3 *Quality Assurance –*

1.3.1 *AWWA Standards* – Construction materials and methods shall comply with the requirements of the latest published edition of American Water Works Association (AWWA) Standards. Applicable standards include, but may not be limited to, the following:

| | |
|---|---|
| AWWA C104 | Cement Mortar Lining for Ductile Iron Pipe and Fittings |
| AWWA C105 | Polyethylene Encasement for Ductile-Iron Pipe Systems |
| AWWA C110 | Ductile-Iron and Gray-Iron Fittings |
| AWWA C111 | Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings |
| AWWA C151 | Ductile Iron Pipe, Centrifugally Cast |
| AWWA C153 | Ductile Iron Compact Fittings, For Water Service |
| AWWA C213 | Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines |
| AWWA C301 | Prestressed Concrete Cylinder Pressure Pipe (PCCP), 16-in. and Larger |
| AWWA C502 | Dry Barrel Fire Hydrants |
| AWWA C504 | Rubber Seated Butterfly Valves 3-in. (75 mm) Through 72-in. (1,800 mm) |
| AWWA C509 | Resilient Seated Gate Valves For Water Supply Service |
| AWWA C510 | Double Check Valve Backflow Prevention Assembly |
| AWWA C511 | Reduced-Pressure Principle Backflow Prevention Assembly |
| AWWA C515 | Reduced-Wall, Resilient Seated Gate Valves For Water Supply Service |
| AWWA C550 | Protective Interior Coatings for Valves and Hydrants |
| AWWA C600 | Installation of Ductile Iron Water Mains & Their Appurtenances |
| AWWA C605 | Underground Installation of Polyvinyl Chloride (PVC) And Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings |
| AWWA C651 | Disinfecting Water Mains |
| AWWA C800 | Underground Service Line Valves and Fittings |
| AWWA C900 | PVC Pipe And Fabricated Fittings, 4-in. Through 12-in. (100 mm through 300 mm), For Water Transmission And Distribution |
| AWWA C901 | Polyethylene (PE) Pressure Pipe and Tubing 1/2-in. (13 mm) through 3-in. (76 mm), For Water Service |
| AWWA C905 | Polyvinyl Chloride (PVC) Pressure Pipe & Fabricated Fittings, 14-in. through 48-in. (350 mm through 1200 mm) |
| AWWA C906 | Polyethylene (PE) Pressure Pipe & Fittings, 4-in. (100 mm) through 63-in. (1600 mm) for Water Distribution And Transmission |

1.3.2 *ASTM and NSF Standards* – In addition, construction materials and methods shall also comply with the requirements of the latest published editions of the American Society for Testing and Materials (ASTM) Standards, and the National Sanitation Foundation (NSF) Standard 61.

| | |
|---|---|
| ASTM A126 | Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings |
| ASTM A48 | Standard Specification for Gray Iron Castings |
| ASTM B584 | Standard Specification for Copper Allow Sand Castings for General Applications |
| ASTM B62 | Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM B88 | Standard Specification for Seamless Copper Water Tube |
| ASTM D1248 | Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable |
| ASTM D1598 | Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure |
| ASTM D1599 | Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings |
| ASTM D1693 | Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics |
| ASTM D2241 | Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series) |
| ASTM D2737 | Standard Specification for Polyethylene (PE) Plastic Tubing |
| ASTM D3350 | Standard Specification for Polyethylene Plastics Pipe and Fittings Materials |
| ASTM D429 | Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates |
| ASTM F477 | Standards Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |

1.3.3 *ASME and ANSI Standards* – In addition, construction materials and methods shall also comply with the requirements of the latest published editions of the American Society of Mechanical Engineers (ASME) Standards, and the American National Standards Institute (ANSI).

| | |
|---|---|
| ASME/ANSI B16.20 | Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed |
| ASME/ANSI B16.1 | Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 |
| ASME/ANSI B 1.1 | Unified Inch Screw Threads, UN and UNR Thread Form |
| ASME/ANSI B 1.20.1 | Pipe Threads, General Purpose (Inch) |
| ASME/ANSI B 1.20.3 | Dryseal Pipe Threads (Inch) |

**PART 2: Materials and Equipment**

2.1 *General* – All pipe, fittings and accessories shall be new, and shall be suitable and rated for potable water use. All pipe, fittings and accessories shall be rated for a pressure of 160 psi or greater. All water pipe and fittings shall be color coded blue in accordance with FDEP and AWWA requirements, and FAC 62-555.320.

2.2 *Delivery, Storage, and Handling* – Certificates of Compliance with the Specifications may be required for all materials used on the Project. All materials are to be transported, stored, handled, and installed in accordance with the Manufacturer's recommendations to avoid physical damage. All materials shall be stored to prevent physical deterioration due to sun and weather. The ECUA reserves the right to reject material which in any way does not meet the requirements of these Specifications.

2.3 *Water Mains* –

2.3.1 *Polyvinyl Chloride Pipe (PVC)* – PVC pipe shall meet the designations of the "ECUA Pipe Material Chart". PVC pipe shall be provided with push-on joints with the bell integrally cast into the pipe. PVC pipe shall be installed with elastomeric gaskets meeting ASTM Standard F477.

2.3.1.1 *Fusible Polyvinyl Chloride Pipe (fPVC)* – Fusible PVC pipe shall meet the designations of PVC pipe as listed in the "ECUA Pipe Material Chart". Fusible PVC may only be used in trenchless installation applications and shall not have any service lines connected to it.

2.3.1.2 *Markings* – PVC pipe shall be marked to indicate the following:

2.3.1.2.1 Nominal pipe size and OD base

2.3.1.2.2 Material Code Designation

2.3.1.2.3 Dimension Ratio

2.3.1.2.4 Pressure Class or Pressure Rating

2.3.1.2.5 Manufacturer's Name or Trademark

2.3.1.2.6 National Sanitation Foundation Approved Marking

2.3.1.2.7 Appropriate AWWA or ASTM Standard Number

2.3.1.2.8 Date Pipe Was Manufactured

2.3.2 *Ductile Iron Pipe (DIP)* – Ductile iron pipe shall meet the designations of the "ECUA Pipe Material Chart" for design operating pressures of up to 150 psi, installed in Class 2 Trenching conditions. Increase pressure class or bedding class as required by AWWA C151 for surface loads greater than indicated or operating pressures greater than 150 psi. DIP shall be constructed with push-on joints using rubber gaskets in accordance with AWWA Standard C111. Other methods of joint construction, such as mechanical, flanged, or ball-and-socket, may be required in special applications as appropriate. DIP shall be lined in accordance with AWWA Standard C104, unless otherwise specified and approved.

2.3.2.1 *Markings* – Each ductile iron pipe section shall be marked to indicate the following:

2.3.2.1.1 Weight class or nominal thickness

2.3.2.1.2 Casting period

2.3.2.1.3 The Manufacturer's mark

2.3.2.1.4 Country where cast

2.3.2.1.5 Year in which the pipe was produced

2.3.2.2 *Lettering* – Letters DI or DUCTILE shall be cast or stamped on the pipe. All required markings shall be clear and legible, and all cast marks shall be on or near the bell. All letters and numerals on pipe sizes 14-inch and larger shall be not less than 0.5-inch in height.

2.3.2.3 *Color Code* – Pipe is to be Color Coded with two 2-inch blue stripes and in accordance with current FDEP and AWWA requirements, and FAC 62-555.320.

2.3.2.4 *Soil Corrosion Protection Encasement* – When required, DIP shall be encased in plastic sheet material in accordance with AWWA Standard C105 as stated on project plans/specifications if applicable.

2.3.3 *Polyethylene Pipe (HDPE) 4 Inch Through 63 Inch* – HDPE pipe shall meet the designations of the "ECUA Pipe Material Chart" and shall be high performance, high molecular weight, high density polyethylene pipe and shall conform to ASTM D 1248 (Type III C, Class C, Category 5). Minimum cell classification values shall be 345434C, as referenced in ASTM D 3350 - latest edition. All pipe resin shall be manufactured by the same company that manufactures the pipe itself in accordance with these specifications to insure complete resin compatibility and total product accountability. The fittings shall be molded or manufactured from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe.

2.3.3.1 *Quality Control* – Refer to the following guidelines regarding quality control.

2.3.3.1.1 The resin used to manufacture the pipe shall be produced by the pipe Manufacturer, thus maintaining complete control of the pipe quality. The pipe shall contain no recycled compound except that generated in the Manufacturer's own plant from resin of the same specification and from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects, and shall be identical in color, density, melt index, and other physical properties.

2.3.3.1.2 The Engineer may request, as part of the quality control records submittal, certification that the pipe produced is represented by the quality assurance testing. Additionally, test results from Manufacturer's testing or random Manufacturer's representation, may be cause for rejection of pipe represented by the testing. These tests may include density and flow rate measurements from samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM D 3350, 10.1.9.

2.3.3.1.2.1 *Verification* – The Owner or the specifying Engineer may request certified lab data to verify the physical properties of the materials supplied under this specification or may take random samples and have them tested by an independent laboratory.

2.3.3.1.2.2 *Rejection* – Polyethylene pipe and fittings may be rejected for failure to meet any of the requirements of this specification.

2.3.3.1.2.3 *Pipe dimensions* – Refer to the ECUA Pipe Material Summary Chart regarding pipe dimensions.

2.3.3.2 *Color Coding* – HDPE water pipe shall be color-coded with a minimum of two 2-inch wide blue stripes or have an integral, extruded blue coating. Color coding shall be in accordance with FDEP and AWWA requirements, and FAC 62-555.320

2.3.3.3 *Approved Manufacturers* – Approved Manufacturers shall be approved by ECUA in writing.

2.3.4 *Alternate Pipe Materials* – ECUA may consider other pipe materials as appropriate for the needs of the Project. Alternate pipe materials identified during design and approved for use on the Project shall be noted on the Construction Plans, and a detailed Technical Specification shall be prepared and included in the Contract Documents.

2.4 *Water Main Appurtenances* –

2.4.1 Water Main Fittings –

2.4.1.1 *Ductile Iron Pipe Fittings* – Water main fittings shall include Tees, Wyes, Bends, Reducers, and other appurtenances commonly used in pipe construction. Fittings shall be ductile iron meeting AWWA Standard C110 or C153 with pressure ratings of not less than that specified for adjacent pipe. Fittings shall be constructed with mechanical joints, unless otherwise specified, and shall be supplied complete with low alloy bolts and nuts, SBR gaskets and other necessary parts required for field assembly. Fittings shall be cement-mortar lined in accordance with AWWA Standard C104/A21.4.

2.4.1.2 *HDPE Pipe Fittings* – Refer to the following guidelines regarding water main fittings:

2.4.1.2.1 Mechanical connections of HDPE pipe sized under 4 inches to ductile iron or PVC piping, mechanical joint fittings, or valves shall be through a self-restraining, fusible mechanical joint adapter. Mechanical joint adapter shall be the same SDR rating as the pipe. Provide the mechanical joint adapter, including but not limited to longer tee bolts and all thread rods with nuts at the mechanical joint bell. Transition fittings of HDPE by male iron pipe threaded end installed by butt fusion may be used.

2.4.1.2.2 Mechanical connections of HDPE pipe (4 inches and larger) to ductile iron or PVC piping, mechanical joint fittings, or valves shall be through the use of the above specified mechanical joint adapter if available.

2.4.1.3 *Pipe Couplings* – Refer to the following guidelines regarding pipe couplings:

2.4.1.3.1 Pipe couplings shall be solid sleeve type with mechanical joints at each end containing a compression gasket. Couplings shall be ductile iron, 12 inches minimum in length, with low alloy bolts and nuts, and SBR gaskets. Rings and gaskets shall be sized to conform exactly to the requirements of the pipe Manufacturer.

2.4.1.3.2 For transition between asbestos cement and PVC or DI pipe types, Hymax 2000 Series, Romac Macro HP, Couplings, or ECUA approved equal, shall be used.

2.4.1.3.3 Polyethylene pipe and fittings may be joined using approved electro fusion couplings. Fittings shall be PE3408 HDPE. Electro fusion fittings shall have a pressure rating equal to the pipe.

2.4.1.4 *Pipe Cut-in Sleeves* – Cut-in sleeves shall be solid ductile iron, one end plain for insertion to female fitting, the other end flanged mechanical joint, furnished with loose attaching flange and fastener, nominal length of 20-21 inches. Specify pipe main size and type of pipe fabrication.

| **Approved Manufacturers – Pipe Cut-in Sleeves** | | |
|---|---|---|
| **Manufacturer** | **Model** | **Application** |
| Clow | F-1220 | for centrifugally cast or sand cast pipe (special) |
| | F-3459 | for all classes of centrifugally cast pipe |
| Union Foundry | 21-4520<br>21-4610<br>24-4800 | MJ X PE<br>FLG X PE<br>MJ X FLG |
| Others as approved by ECUA in writing. | | |

2.4.1.5 *Repair Clamps* – Repair clamps shall not be used in the installation of new pipe except with the written permission of the Engineer. Repair clamps shall be full circle and selected based on the table below.

| Repair Clamp Sizes | |
|---|---|
| **Pipe Diameter** | **Maximum Sections** |
| Up to 12-inch | Single Section |
| 14-inch to 24-inch | Double Section |
| 26-inch and above | Triple Section |

2.4.1.5.1 Repair clamps shall be composed of stainless steel bands and bolts, DI lugs and full gridded virgin SBR compounded gasket.

2.4.1.5.2 Repair clamps shall be sized so that the OD of the existing pipe being repaired falls within the designated range for the clamp size. Repair clamps shall have ample length to give full gasketing at both ends.

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Model** |
| Ford | F1, FS1 (all SS), Fordflex (SS-DI Lugs) |
| Smith Blair | 2XX* |
| JCM | 101,102,103,104,131,132,133,134 |
| Mueller | 520, 530 |
| ROMAC | CL1 |
| Others as approved by ECUA in writing. | |

* See Manufacturer’s catalog to complete model numbers by size.

2.4.1.6 *Pipe and Fitting Restraints –*

2.4.1.6.1 Joint restraints and thrust blocks are required for 90 degree bends, 45 degree bends, tees, tapping sleeves, dead-ends, and fire/flushing hydrants. Joint restraints shall be used in conjunction with all water line pipe, fittings and appurtenances. Joint restraints shall be used on pipe and fittings in each direction in accordance with ECUA Standard Details D-52 and D-62.

2.4.1.6.2 Restraints shall have set or anchor screws used to secure body to pipe with torque limit break away head design. Alternately, fittings with integral restraint mechanisms (“One-Bolt”) may be used with the approval of the ECUA Engineer.

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Model** |
| Ebaa Iron Works | MegaLug Series 1100, 1500, 2000, 2500, 3000, 3600, 6500 |
| Ford | UNI-Flange UAI, UBI, UI, 1300, 1340, 1390, 1400 |
| Sigma | SLC, SLD, PVP |
| Star Pipe Products | Series 3000 for 3” – 48” ductile iron |
| ROMAC | Grip Ring / Roma Grip / 600 series |
| Tyler Union | TufGrip |
| SIP Inc. | EZD, EZP, PTP, PTPDF, PTPFC |
| Others as approved by ECUA in writing. | |

2.4.1.7 *Expansion Joints* – Refer to the following guidelines regarding expansion joints:

2.4.1.7.1 Expansion joint fittings shall be used where specified on the Construction Plans. They shall be of the rigid or flexible type as specified, and manufactured of ductile iron in accordance with the table in Paragraph 2.4.1.5. They shall be capable of expanding or contracting to the extent specified by the Engineer, but in no case less than 4-inches axially, and designed to prevent separation beyond the maximum extension without the use of external tie rods.

2.4.1.7.2 Fittings shall be flanged or provided with restrained mechanical joints, individually pressure tested to a minimum of 350 psi against their own restraints, and internally coated on all exposed surfaces with a minimum of 15 millimeters of fusion bonded epoxy conforming to AWWA C116. They shall be capable of deflecting at least 15 degrees by means of an integral ball at each joint in the case of flexible types.

| Approved Manufacturers | | |
|---|---|---|
| **Type** | **Manufacturer** | **Model** |
| Rigid | EBAA Iron, Inc. | EX-TEND 200 |
| Flexible | EBAA Iron, Inc. | Flex-Tend |
| Others as approved by ECUA in writing. | | |

2.4.1.8 *Tapping Sleeves* – Refer to the following guidelines regarding tapping sleeves:

2.4.1.8.1 The minimum size tapping sleeve shall be 4 inches. Connection of 3-inch lines to existing pipes 4 inches and larger shall be made by a 4-inch tapping sleeve with appropriate reducing fitting. Tapping saddles shall be used for smaller connections.

2.4.1.8.2 Tapping sleeves shall be designed for a working pressure of 200 psig without leakage. Tapping sleeves shall be all stainless steel including stainless steel flange. The outlet branch connection shall have a recessed flanged face for connection of tapping valve with standard dimensions in accordance with Manufacturers Standardization Society (MSS) SP-60. A complete set of neoprene or other elastomer gaskets shall be furnished. Sleeves shall be furnished to fit ductile iron, cement-asbestos, or Class 160 or C900/905 PVC pipe with side connection as shown on plans or specifications in standard pipe sizes. Sleeves shall be furnished with all necessary installation parts.

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Model** |
| Ford | FAST |
| Mueller | H-304SS |
| JCM Industries | 432 |
| Romac | |
| Smith-Blair | 663, 665 |

Note: To specify exact fitting when ordering, confirm line outside diameter and material. Confirm compatibility of selected fitting with existing main material.

2.4.2 *Pipe Hangers and Supports* – Hangers and supports shall be in compliance with Federal Specification WW-H-171E, or Manufacturer's Standardization Society SP-69, or UL listed. Materials of construction shall be in accordance with the requirements outlined in the table below.

| **Approved Materials for Construction of Pipe Hangers and Supports** | |
|---|---|
| **Part I.D.** | **Material** |
| Clamps | Steel - Epoxy Coated or Galvanized<br>Cast Iron - Galvanized<br>Malleable Iron |
| Hanger Rods | Steel - Electro Galvanized<br>Steel - Stainless 304 |
| Roller Bases/Roller Stands | Cast Iron |
| Fasteners/Fittings | Galvanized Steel<br>Stainless |
| Hanger Rod Inserts | Steel - Cadmium Plated<br>Steel - Galvanized<br>Universal Concrete Insert - Cast Iron - Galvanized |
| Rod Attachments | Clevis - Forged Steel<br>Turnbuckle: 1) Forged Steel, 2) Malleable Iron<br>Sockets, Eye Nuts, Extension - Malleable Iron |
| Roller Bases/Roller Stands | Cast Iron |
| Rollers | Steel or Iron Core, Insulated from Structure |

| **Approved Manufacturers – Pipe Hangers and Supports** | | |
|---|---|---|
| **Manufacturer** | **Part I.D.** | **Model No.** |
| Utility Pipe Sales | Clevis Hanger | 590 |
| | Socket Clamp | 224<br>246 |
| | <u>Concrete Inserts</u>:<br>CB-Universal<br>Screen Insert | <br>282<br>152 |
| | <u>Rod Attachments:</u><br>Eye Nut<br>Forged Clevis<br>Forged Turnbuckle<br>Carbon Steel<br>Couplings<br>Socket Eye<br>Extension | <br>290<br>299<br>230<br>233<br>136<br>110R<br>157 |
| | <u>Pipe Rolls:</u><br>Adjustable Swivel<br>Adjustable Steel Yoke | <br>174<br>181 |
| | Pipe Roll with Base | 274 |
| | Pipe Roll and Plate | 277 |
| Others as approved by ECUA in writing. | | |

2.4.3 *Valves* – All valves shall be manufactured in accordance with the current appropriate AWWA Standard and shall be NSF approved for use in potable water.

2.4.3.1 *Resilient Seated Gate Valves* – Resilient seated gate valves shall be designed and fabricated in accordance with the current AWWA Standard C-509 or C-515. The basic design of the gate valves shall have an iron body, elastomer encapsulated iron disc, bronze stem and operating nuts with non-rising stem design. When circumstances dictate, valves 24-inches and larger may be equipped with right angle gears (bevel gearing) for horizontal installation. The valve working pressure for all sizes shall be a minimum of 250 psig with a test pressure of 500 psig.

2.4.3.1.1 *Materials and Construction* – Valves shall open counterclockwise with a 2-inch square iron operating nut secured to the valve stem by a corrosion resistant Type 304 stainless steel nut to threads on the valve stem. The valve stem shall be made of high tensile strength bronze and shall be of one piece construction sealed by O-Rings. The thrust collar shall be secured in place by a stuffing box or bonnet cover with a thrust washer located above the thrust collar. Valve construction shall be so that upper O-Rings can be replaced with the valve in service. The disc shall be cast iron encapsulated with an elastomer material bonded in accordance with ASTM D429 and shall be secured to the threaded stem by a bronze nut. The disc shall effect a seal that is bubble-tight at 250 psig.

2.4.3.1.2 *Body-Disc-Bonnet-Operating Nut Material* – Cast ductile iron construction in accordance with current AWWA Standard C-509 and C-515 and AWWA Standard C-153. Body bolts shall be equipped with square or hex head bolts for easy removal.

2.4.3.1.3 *Corrosion Resistant Coatings* – All interior and exterior cast iron surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.

2.4.3.1.4 *Body Sizing* – Valve body length shall be per ASME/ANSI B16.20 for the type of end connections specified. In the full open position, the valve internal bore shall be smooth and obstruction-free without cavities or projections that could accumulate solids. The internal cross-sectional area of the valve shall be approximately equal to the nominal cross-sectional area for Schedule 40 PVC pipe of the same nominal internal diameter.

2.4.3.1.5 *End Connections* – Refer to the following guidelines regarding end connections:

2.4.3.1.5.1 Valves shall be furnished with mechanical joint end connections, complete with accessory kits, unless otherwise specified on the plans or purchase order.

2.4.3.1.5.2 When flanged ends are specified they shall be flat face class 125, conforming to ASME/ANSI B16.1 with bolt holes straddling the vertical center line.

| Approved Manufacturers - Resilient Seated Gate Valves | | | | | | |
|---|---|---|---|---|---|---|
| Manufacturer & Specs | | | Valve Body Connections | | | |
| | | | Mechanical Joint (MJxMJ) | Flange & Mechanical Joint (FLGxMJ) | Flanged End (FLGxFLG) | Mechanical Joint for Tapping (MJxSF) |
| American Flow Control | | Size: | 2" - 48" | 2" - 48" | 2" - 48" | 2" - 48" |
| | | Model No.: | AFC2500 | AFC2500 | AFC2500 | AFC2500 |
| Clow | C-509 | Size: | 2" - 12" | 3" - 12" | 2" - 12" | 3" - 12" |
| | | Model No.: | F-6100 | F-6106 | F-6102 | F-6114 |
| | C-515 | Size: | 4" - 48" | 4" - 48" | 4" - 48" | 4" - 24" |
| | | Model No.: | F-6100 | F-6106 | F-6102 | F-6114 |
| Kennedy | C-509 | Size: | 2" - 12" | 3" - 12" | 2" - 12" | 4" - 12" |
| | | Model No.: | 8571SS | 8572SS | 8561ASS | 8950SS |
| | C-515 | Size: | 2" - 12" | 3" - 12" | 2" - 12" | 4" - 12" |
| | | Model No.: | 7571SS | 7572SS | 7561SS | 7950SS |
| M&H | C-509 | Size: | 2" - 12" | 3" - 12" | 2" - 12" | 4" - 12" |
| | | Model No.: | 4067-01 | 4067-13 | 4067-02 | 4751-01 |
| | C-515 | Size: | 2" - 16" | 3" - 16" | 2" - 16" | 4" - 16" |
| | | Model No.: | 7571 | 7572 | 7561 | 7950 |
| Mueller | C-509 | Size: | 3” - 12” | 3” - 12” | 3” - 12” | 3” - 12” |
| | | Model No.: | A-2362 | A-2362 | A-2362 | A-2362 |
| | C-515 | Size: | 4” - 54” | 4” - 54” | 4” - 54” | --- |
| | | Model No.: | A-2361 | A-2361 | A-2361 | --- |

2.4.3.2 *Resilient Seated Tapping (Gate) Valves* – Resilient seated gate valves shall be designed and fabricated in accordance with the current AWWA Standard C-509 or C-515. The basic design of the gate valves shall have an iron body, elastomer encapsulated iron disc, bronze stem and operating nuts with non-rising stem design. When circumstances dictate valves 16-inches and larger shall be equipped with right angle gears (bevel gearing) for horizontal installation. The valve working pressure for all sizes shall be a minimum of 250 psig with a test pressure of 500 psig.

2.4.3.2.1 *Materials and Construction* – Valves shall open counterclockwise with a 2-inch square iron operating nut secured to the valve stem by a corrosion resistant (Type 304 Stainless Steel) nut to threads on the valve stem. The valve stem shall be made of high tensile strength bronze or 304 stainless steel and shall be of one piece construction sealed by O-Rings. The thrust collar shall be secured in place by a stuffing box or bonnet cover with a thrust washer located above the thrust collar. Valve construction shall be so that upper O-Rings can be replaced with the valve in service. The disc shall be iron encapsulated with an elastomer material bonded in accordance with ASTM D429 and shall be secured to the threaded stem by a bronze nut. The disk shall effect a seal that is bubble-tight at 250 psig.

2.4.3.2.2 *Corrosion Resistant Coatings* – All interior and exterior cast iron surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.

2.4.3.2.3 *Body Sizing* – Valve body length shall be per ASME/ANSI B16.20 for tapping valves. Tapping valves shall conform to Specification AWWA C509 or C515, latest revision, covering gate valves except as modified for passage and clearance of tapping machine cutters. The opening through the valve shall be at least 1/4-inch larger than nominal valve diameter. Tapping valves shall allow full size shell cutters to be used.

2.4.3.2.4 *End Connections* – Valves shall be furnished with one end of the body with projecting face flange in accordance with specification MSS SP-60 for tapping valve/saddle connections to bolt to a standard tapping sleeve and the other end for mechanical joint.

2.4.3.3 *Butterfly Valves* – All butterfly valves shall be of the rubber-seated, tight-closing type. They shall meet or exceed AWWA Standard C504. All valves must use full AWWA C504 Class 150B valve shaft diameter, and full Class 150B underground service operator torque rating throughout entire travel, to provide capability for operation in emergency service.

2.4.3.3.1 *Valve Construction* – Valve body shall be high-strength ductile iron ASTM A126 with ASTM 276 18-8 Type 304 stainless steel body seat. Valve vane shall be high-strength cast iron ASTM A126, having rubber seat mechanically secured with an integral 18-8 stainless steel clamp ring and 18-8 stainless steel self-locked screws. Shaft shall be one piece ASTM 276 Type 304 stainless steel. Bearings shall be sleeve-type, self-lubricated with O-Ring seals.

2.4.3.3.2 *Operators* – Operator shall be of the traveling-nut type, sealed, gasketed, and lubricated for underground service. It shall be capable of withstanding an overload input torque of 450 ft. lbs. at full-open or closed position without damage to the valve or valve operator. Operator shall have operating nut or post indicator as specified.

2.4.3.3.3 *End Connection* – End connections shall be mechanical joint, wafer-type with flange meeting ANSI B16.1 Class 125, and furnished as specified.

| **Approved Manufacturers** | |
|---|---|
| **Manufacturer** | **Model** |
| Clow | F-53XX* |
| M & H | 450, 1450, 4500 |
| Others as approved by ECUA in writing. | |

* XX: See Manufacturer's catalog to complete model numbers by size.

2.4.3.4 *Valve Insertions –*

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Size Range** |
| Romac | 4” – 42 “ |
| Hydra-Stop | 4” – 12” |
| Others as approved by ECUA in writing. | |

2.4.4 *Valve Boxes* – Valve boxes shall be provided for all direct buried valves. Use nominal (5 ¼) inch cast-iron, slip-type or screw-type pipe shaft with cover and base casting. The box top shall be set at finished grade and encased with a concrete ring in unpaved areas. Each valve box shall be furnished with a drop-in cover marked “WATER”. See ECUA Standard Detail D-43.

2.4.5 *Line Stops* – Line stops are to be used where specified to temporarily stop water line water flow without depressurizing the entire line. The line stop parts and installation equipment are to be rated at a minimum of 150 psig working pressure unless otherwise specified.

2.4.5.1 *Materials and Construction* – Tapping saddles shall have 360-degree clamping on the main. All tapping saddles shall be fabricated of 304 Stainless Steel. All bolts and fasteners are to be 304 Stainless Steel, and the saddle shall be installed with Buna-N or neoprene rubber full facing gasket.

2.4.5.1.1 The stopping device attaching nozzle to be vendor’s standard with connecting threads or flange face, and the nozzle I.D. to be manufactured with a shelf to provide a position stop for the closure plug.

2.4.5.1.2 The closure plug is to be fabricated carbon steel, ductile iron, or malleable iron with at least one Buna-N or neoprene O-Ring seal on the outside diameter.

2.4.5.2 Corrosion-Resistant Coatings – Non-stainless steel permanently installed parts to have Manufacturer’s standard red or black water base epoxy coating.

2.4.5.3 *Connection* – Tapping saddle shall be fabricated with dimensions to fit on concrete, steel, CA, PVC, CI, DI main as specified.

2.4.5.4 *Installation* – Temporary line stops shall only be installed by vendor personnel or Contractor Personnel trained and certified for stop by the vendor.

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Model** |
| Romac | SST - X |
| JCM | 440 |
| Hydra-Stop | HSF 250 |
| Others as approved by ECUA in writing. | |

2.4.6 *Location Aids* – All new water main and service line installations shall include an approved method for locating lines from the ground surface after completion.

2.4.6.1 *Tracer Wire* – Tracer wire for water lines shall be minimum 12 gauge copper with blue PVC insulation for open trench installation. For trenchless installation, 8-gauge copper with blue PVC insulation shall be used. Tracer wire systems shall be electrically continuous covering all mains and services within the project. Wire-to-wire connectors shall be made with silicone-filled wire nuts. Wire-to-appurtenance attachments shall be made with lug-type terminals. Wire shall be secured to the top of each pipe joint with nylon ties or PVC tape placed on 10-foot intervals. Wire shall be secured to pipe with blue colored PVC Tape.

| **Approved Manufacturers (Tracer Wire Silicone-filled Wire Nut Connectors)** | |
|---|---|
| **Manufacturer** | **Model** |
| Ideal Industries | Twister® DB Plus |
| King Technology, Inc. | Failsafe™ |
| Others as approved by ECUA in writing. | |

2.4.6.2 *Pipeline Markers* – When specified, markers shall be of a passive electronic type that reflects a signal back to an electronic hand-held transmitter/detector. Electronic components shall be enclosed in a blue waterproof polyethylene housing. Markers shall have a different response frequency for each service line type.

2.4.6.2.1 Markers shall be ScotchMark® products manufactured by 3M Telecom Systems Group, Austin, Texas. Alternate Manufacturers by ECUA in writing.

| **Pipeline Markers** | | | | |
|---|---|---|---|---|
| **Application** | **Usable Depth** | **Dimension/Configuration** | **Service** | **Model** |
| Near Surface | 2 Feet | 3½"L X 5/8" ∅ Cylinder | Water | 1434 |
| Medium Depth | 4 Feet | 4" ∅ Ball | Water | 1403 |
| Deep | 6 Feet | 8" ∅ X 1" Thick Disc | Water | 1257 |

2.5 *Hydrants and Flushing Equipment* –

2.5.1 *Fire Hydrants* – Fire Hydrants shall be in compliance with the AWWA Standard C-502, with rated working pressure of 250 psig. The basic design of the fire hydrant shall be of the dry barrel type of breakaway traffic design. Use 304 stainless steel bolting below grade, and use fusion bond epoxy coating on mechanical joint inlet shoe, per AWWA C-550.

2.5.1.1 *Hydrant Construction* – Refer to the following guidelines regarding hydrant construction:

2.5.1.1.1 The hydrant inlet connection shall be 6-inch mechanical joint type complete with Accessory kit.

2.5.1.1.2 The hydrant shall be designed with a safety feature incorporating a break-away flanged design. Split ring retainer-type breakaway design with pinch bolts is not acceptable. The hydrant design shall allow the upper barrel to be rotated 360 degrees in order to assure proper nozzle orientation.

2.5.1.1.3 The drain valve shall assure quick and complete drainage of the hydrant and the drain hole shall be brushed with bronze if passing through ductile iron. The drain valve sealing facing shall be made of Buna N, nylon or urethane. If the valve top plate comes in contact with the bronze seat ring to facilitate draining of the hydrant, the valve top plate shall be made of bronze.

2.5.1.2 *Main Hydrant Valve* – Refer to the following guidelines regarding main hydrant valve:

2.5.1.2.1 The main hydrant valve shall be compression type, opening counterclockwise against system pressure and closing clockwise with system pressure. The main valve connection opening shall not be less than 5¼-inches. The main valve shall have a resilient seat.

2.5.1.2.2 The hydrant shall be designed such that the operating threads on the stem are prevented from coming in contact with potable water and shall be enclosed in an operating chamber and sealed by O-Rings at the top and bottom of the chamber. The chamber shall be constructed for grease or oil lubrication with an installed grease fitting for maintenance.

2.5.1.2.3 The operating nut shall be 1½-inches in size and pentagon in shape and of one-piece construction.

2.5.1.2.4 The hydrant shall have one 4½-inch pumper nozzle, and two 2½-inch pumper nozzles having National Standard Hose coupling threads. The nozzles shall be field replaceable utilizing either a threaded or quarter-turn fitting with an O-Ring seal.

2.5.1.3 *Operation and Maintenance Features* – Refer to the following guidelines regarding operation and maintenance features:

2.5.1.3.1 The hydrant shall not incorporate parts requiring field adjustment for proper operation.

2.5.1.3.2 The hydrant shall be designed to permit the removal of all working parts from the hydrant through the barrel without disturbing the earth around the hydrant.

2.5.1.3.3 Removal of the working parts of the hydrant shall be accomplished by use of a seat removal wrench. Hydrants requiring other special tools to perform removal of interior parts will not be accepted.

2.5.1.4 *Materials* – All operating parts including operating nut, hold-down nut, drain ring and seat ring shall be bronze. The valve seat ring shall thread into a bronze insert or drain ring to provide bronze-to-bronze seating. Breakaway stem coupling is to have bronze or stainless steel bolts or pins.

2.5.1.5 *Markings* – The fire hydrant shall have permanent markings identifying the Manufacturer by name, initials or insignia, the size of the main valve opening, and the year of manufacture.

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Model No.** |
| American Flow Control | B84B |
| M & H | 129T |
| Mueller | A423 |
| Others as approved by ECUA in writing. | |

2.5.2 *Fire Hydrant Appurtenances* –

2.5.2.1 *Extensions Kits* – Refer to the following guidelines regarding extension kits:

2.5.2.1.1 Where required, hydrants shall be installed using original Manufacturer hydrant extension kits as necessary to position the hydrant breakaway flange above finish grade per ECUA Standard Detail D-50.

2.5.2.1.2 Stand extension shall be in standard lengths of 12, 24, 36, 48, and 60 inches.

2.5.2.2 *Hydrant Connectors* – Refer to the following guidelines regarding hydrant connectors:

2.5.2.2.1 Hydrant connector spools shall be ductile iron per AWWA C151 used for connection between the hydrant and lead valve, and shall incorporate joint restraints. One end of the connector spool shall have swivel flange. See ECUA Standard Detail D-50.

2.5.2.2.2 Standard hydrant connector sizes shall be as follows:

2.5.2.2.2.1 6-inch X 12-inch long

2.5.2.2.2.2 6-inch X 24-inch long

2.5.2.2.2.3 6-inch X 36-inch long

2.5.2.2.2.4 6-inch X 48-inch long

2.5.2.2.2.5 6-inch X 60-inch long

2.5.2.2.3 *Hydrant Offset Connectors* – When a height adjustment is required to avoid an obstruction between the hydrant shut-off valve and the hydrant, an offset fitting shall be used. Material to be ductile iron per ANSI/AWWA C153/A21.53. Sizes shall be as follows:

2.5.2.2.3.1 6-inch X 18-inch long with 6-inch offset

2.5.2.2.3.2 6-inch X 30-inch long with 12-inch offset

2.5.2.2.3.3 6-inch X 41-inch long with 24-inch offset

| Approved Manufacturers | | |
|---|---|---|
| **Manufacturer** | **Straight Hydrant Connector** | **Offset Connector** |
| Assured Flow Sales, Inc. | N/A | GRADELOK |
| Clow | ✓ | N/A |
| Others as approved by ECUA in writing. | | |

2.5.3 *Flushing Hydrants* – Flushing hydrants shall be in general compliance with AWWA Standard C-502, with rated working pressure of 200 psig. A fully restrained gate valve shall be installed at each flushing hydrant per ECUA Standard Detail D-51.

2.5.3.1 *Hydrant Construction* – Flushing hydrants shall meet the requirements of Paragraph 2.5.2.1, except the breakaway feature is not required.

2.5.3.2 *Main Valve* – Generally the same as Paragraph 2.5.1.2, except main valve opening shall be not less than 2-1/8 inches and the flushing hydrant shall have one (1) 2½-inch nozzle having national standard hose coupling threads.

2.5.3.3 *Operation and Maintenance Features* – Unless otherwise specified, the hydrant bury length shall be 30-36 inches. The bury length is the distance measured to the nearest 1/2 foot, from the bottom of the connecting pipe to the ground line of the hydrant.

2.5.3.4 *Materials* – All operating parts including operating nut, hold-down nut, drain ring and seat ring shall be bronze. The valve seat ring shall thread into a bronze insert or drain ring to provide bronze-to-bronze seating.

2.5.3.5 *Markings* – Flushing hydrant markings shall meet the requirements of Paragraph 2.5.1.5 for fire hydrants.

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Model** |
| M & H | Style 33 |
| Mueller | A-411 |
| Others as approved by ECUA in writing. | |

2.6 *Water Service Lines* –

2.6.1 *Polyethylene Tubing (HDPE)* – Polyethylene service tubing shall meet the designations of the “ECUA Pipe Material Chart” for water supply. However, only sizes up to 2 inches will be allowed. All tubing must have a minimum cell classification of 445574 with code letter “C” for black tubing or code letter “D” (interior) and code letter “E” (exterior) for blue colored tubing. PE tubing dimensions shall conform to ASTM D2737 with Copper Tubing OD base. Refer to paragraph 2.3.3 for service lines greater than 3 inches in diameter.

2.6.1.1 *Markings* – Use the Following Markings:

2.6.1.1.1 Nominal Size

2.6.1.1.2 Standard PE Code: 4710

2.6.1.1.3 Tubing: DR-9

2.6.1.1.4 Pressure Class: PC200

2.6.1.1.5 Manufacturer's Name or Trademark

2.6.1.1.6 Blue Markings and Stripes

2.6.1.1.7 Date Manufactured

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Model** |
| Endot Industries | Endopure |
| Others as approved by ECUA in writing. | |

2.6.2 *Copper Water Service Tubing* – Copper water service tubing shall be Type K suitable for underground potable water services. Tracer wire is not required with copper tubing.

2.6.2.1 *Material* – Tubing is to be supplied in conformance with ASTM B88 for dimension and materials.

2.6.2.2 *Pressure Rating* – Test pressure shall be 200 psi. Operating pressure shall be 150 psi. Refer to the table below.

| Copper Water Tubing Dimensions (ASTM B88) | | |
|---|---|---|
| **Size (inches)** | **Nominal OD** | **Wall Thickness** |
| 1 | 1.125 | .065 |
| 2 | 2.125 | .083 |

2.6.2.3 *Pipe Markings* – Use the following markings:

2.6.2.3.1 Nominal Size

2.6.2.3.2 Type K

2.6.2.3.3 ASTM B88

2.6.2.3.4 Manufacturer's Name or Logo

2.6.2.3.5 NSF Seal

2.6.2.3.6 Date Manufactured

2.6.3 *Pipe Sleeves for Long Water Services* – Long water services shall be sleeved in PVC or PE pipe color coded blue or black with blue stripes. The sleeves shall be a minimum of 2-inch diameter with no fittings and shall extend one-foot either side of the paved surface. The sleeve shall be one continuous leak free piece which is open on each end. The long service shall be sized according to the table shown below.

| Pipe Sleeve Sizing For Long Water Services | |
|---|---|
| **Service Size (inches)** | **Sleeve Size (inches)** |
| 1 | 2 |
| 2 | 4 |

2.7 *Service Line Appurtenances* –

2.7.1 *Fittings and Valves* – Fittings and valves shall be manufactured in accordance with AWWA C-800 and be listed and approved by NSF for underground use in potable water service.

2.7.1.1 *Material* – Refer to the following guidelines regarding material:

2.7.1.1.1 Fitting and valve bodies, plugs, and compression nuts shall be bronze, copper alloy no. C83600 and meet chemical and mechanical requirements of ASTM B62 or ASTM B584.

2.7.1.1.2 Component parts such as fasteners, seals, and packing may be of other materials selected for adequate endurance, corrosion resistance and strength in accordance with AWWA C-800.

2.7.1.2 *Pressure* – Fittings and valves shall be high pressure type for maximum allowable pressure of 150 PSIG, nominal operating pressure 100 psig.

2.7.1.3 *Markings* – Fittings and valves shall be marked as appropriate with the following information: Manufacturer's name or logo; pressure rating; direction of flow; and size.

2.7.1.4 *Thread Specifications* - Refer to the following table regarding thread specifications:

| **Thread Specifications** | |
|---|---|
| **Thread Type** | **Standard** |
| Unified Inch | ANSI/ASME B1.1 |
| General Purpose Pipe | ANSI/ASME B1.20.1 |
| Dryseal | ANSI/ASME B1.20.3 |

2.7.1.5 *Pack Joint Couplings* – Refer to the following table regarding pack joint couplings:

| **Pack Joint Couplings** | | |
|---|---|---|
| **Type** | **Manufacturer** | **Model** |
| Copper or Plastic<br>Tube X MPT | Ford<br>Mueller | C84-XX<br>H-15428-X |
| Copper or Plastic<br>Tube X FPT | Ford<br>Mueller | C14-XX<br>H-15451-X |
| Copper or Plastic<br>Tube to Tube | Ford<br>Mueller | C44-XX<br>H-15403-X |
| Female Copper Pipe<br>(replaces flare nut)<br>X Copper or Plastic Tubing | Ford<br><br>Mueller | CO4-XX<br><br>H-15071-X |
| Others as approved by ECUA in writing. | | |

* XX: See Manufacturer's catalog to complete model numbers by size.

2.7.1.6 *Tapping Saddles* – Tapping saddles shall be either bronze or ductile iron with shop coat, with the exception of saddles for PE pipe. Saddles used to tap Class 160 PVC pipe shall be designed with mechanical features or stops to prevent over-tightening.

2.7.1.6.1 *Saddle Sizes* – Use the following saddle sizes:

2.7.1.6.1.1 Main Pipe: 2-inch and above

2.7.1.6.1.2 Tap Size: 1-inch, or 2-inch

2.7.1.6.2 Refer to the following table regarding saddle sizes.

| **Acceptable Manufacturers** | | |
|---|---|---|
| **Manufacturer** | **Application** | **Model** |
| Ford | 1-inch tap on PVC/steel OD pipe | S-70 and S-90 |
| | 1-inch tap on DI and CI Pipe | F-202 |
| Mueller | | H-105 DR2A |
| Smith Blair | | 313 |
| JCM | C900 / C905 or DI | 402 |
| Romac | C900 / C905 or DI | 202U |
| Others as approved by ECUA in writing | | |

2.7.1.7 *Water Tubing Couplings* – Water tubing couplings in sizes 1-inch, 1 ½-inch, and 2-inch only shall be bronze compression-type, inlet and outlet for PE or copper tubing. Crimp-type couplings are not acceptable.

| **Acceptable Manufacturers** | |
|---|---|
| **Manufacturer** | **Model** |
| Ford | C44-XX-NL* |
| Mueller | H-15403-XX* |
| Others as approved by ECUA in writing | |

* XX: See Manufacturer's catalog to complete model numbers by size.

2.7.1.8 *Meter Couplings* – Meter couplings shall be bronze and sized as appropriate to accommodate the relevant meter. Inlet shall have male pipe thread.

| **Acceptable Manufacturers** | |
|---|---|
| **Manufacturer** | **Model** |
| Ford | C38-XX* |
| Mueller | H-15428-XX* |
| Others as approved by ECUA in writing | |

* XX: See Manufacturer's catalog to complete model numbers by size.

2.7.2 *Service Line Valves* –

2.7.2.1 *Corporation Stops* – Corporation stops shall be brass, high-pressure class, ball type, with inlet taper CC thread. Outlet shall be compression-type for PE or copper tubing. Corporation stops shall be sized for 1-inch, or 2-inch tubing as appropriate.

| Acceptable Manufacturers | |
|---|---|
| **Manufacturer** | **Model** |
| Ford | F-1000 and FB-1000 |
| Mueller | 300, P15008 Ball-type |
| Others as approved by ECUA in writing. | |

2.7.2.2 *Curb Stops* – Cub stops shall be brass, high pressure, ball-type with locking wings. Inlet shall be compression-type for PE tubing. Outlet shall be female iron pipe threads. Curb stops shall be sized for 1-inch, or 2-inch tubing as appropriate.

| Acceptable Manufacturers | | |
|---|---|---|
| **Manufacturer** | **Size** | **Model** |
| Ford | 1-inch<br>2-inch | B41 – 444W<br>B41 –777W |
| Others as approved by ECUA in writing. | | |

2.7.3 *Owner's Control Valve* – An appropriately sized valve shall be installed at the property line to allow the Owner to stop the flow of water.

2.8 *Backflow Prevention Assemblies* – Backflow prevention assemblies shall be manufactured in accordance with AWWA C-510 and AWWA C-511, and shall also be approved by ASSE and/or approved by NSF for use in potable water systems with a maximum continuous operating pressure of 150 psig, and capable of sustaining a hydrostatic test pressure of 300 psig. Backflow prevention devices shall be located immediately downstream of the Owner's control valve.

2.8.1 *Materials and Construction* – The body shall be cast iron with hot dip galvanized coating or fusion bonded epoxy on the interior and exterior, or cast bronze with a maximum lead content of 5 percent. Working parts and springs shall be bronze or stainless steel; valve discs shall be silicone rubber; diaphragms shall be fabric reinforced neoprene, and O-rings shall be Buna-N, neoprene, or silicone rubber. Check valve enclosures shall be glass-filled nylon or Teflon, or bronze or stainless steel. Other working parts shall be bronze or stainless steel.

2.8.2 *Double-Check Valve* – A double check valve assembly (DC) is a mechanical backflow preventer that consists of two independently acting, spring-loaded check valves. It includes shutoff valves at each end of the assembly and is equipped with test cocks. A DC is effective against backpressure backflow and backsiphonage but should be used to isolate only non-health hazards.

2.8.3 *Reduced Pressure Assembly* – A reduced pressure valve assembly (RP) is a mechanical backflow preventer that consists of two independently acting, spring-loaded check valves with a hydraulically operating, mechanically independent, spring-load pressure differential relief valve between the check valves and below the first check valve.

2.8.4 *Pressure Vacuum Breaker* – The pressure vacuum-breaker assembly (PVB) is a mechanical backflow preventer that consists of an independently acting, spring-loaded check valve and an independently acting, spring loaded, air inlet valve on the discharge side of the check valve. It includes shutoff valves at each end of the assembly and is equipped with test cocks. A PVB may be used to isolate health or non-health hazards but is effective against backsiphonage only and can only be used in an irrigation setting.

2.8.5 *Appurtenances* – All backflow assemblies shall be provided and installed as a complete assembly with all necessary fittings to enable testing in place. Tapped test ports shall be fitted with test petcocks in each body cavity. Inlet and outlet gate or ball valve shall be of the same line size as that of the body.

2.8.6 *Approved Assemblies* – The word “approved” when used with reference to a backflow prevention assembly, an assembly which has been manufactured in full conformance with the standards established by the American Water Works Association titled: *AWWA C510-89 Standard for Double Check Valve Backflow Prevention Assembly*, or *AWWA C511-89 Standard for Reduced-Pressure Principle Backflow Prevention Assembly*, as such standards may be amended from time to time, and which comply with the laboratory and field performance specifications of the Foundation for Cross-Connection Control and Hydraulic Research of the University of Southern California established by “Specification of Backflow-Prevention Assemblies” - Section 10 of the most current issue of the Manual of Cross-Connection Control and in accordance with the ECUA guidelines.

2.9 *Yoke Box Assemblies* – Meter box assemblies for 5/8-inch meters shall be cast iron open bottom per ASTM A-48 with cast iron lid with ECUA imprint. The box assembly shall include a ball valve with locking nuts, pack joint coupling for copper or PE tubing with expansion connection and gaskets as needed.

| **Acceptable Manufacturers** | | |
|---|---|---|
| **Manufacturer** | **Model** | **Meter Size** |
| Ford | G148-133 (modified) w/ 1” pack joint for copper or PE tubing | 5/8” |
| Others as approved by ECUA in writing | | |

2.10 Meter Box Assemblies – Meter box assemblies for 1-inch meters shall use plastic meter boxes. 1 ½-inch meters shall use jumbo meter box. Meter box and cover for meters 2-inch and larger shall be constructed in accordance with ECUA Standard Details D-44 and D-45.

| **Acceptable Manufacturers** | | |
|---|---|---|
| **Manufacturer** | **Model** | **Meter Size** |
| Carson | 1015-12 with C. I. reading lid | 1” |
| | 1015 with C. I. reading lid | 1.5” |
| Pentex | 170111 with C. I. reading lid | 1” |
| | 190111 with C. I. reading lid | 1.5” |
| Others as approved by ECUA in writing | | |

## PART 3: Execution

3.1 *General* – The Contractor shall provide all labor, equipment and materials as required to install all pipes, valves, fittings, and other appurtenances as indicated on the construction plans or as specified in the Contract documents.

3.2 *Potable Water Line Separation From Sanitary Sewer Lines* –

3.2.1 *Crossing Over or Under Water Lines* – A gravity sewer line will only be allowed to cross over a water line when approved by ECUA in writing. When a gravity sewer line must cross under a water line with less than 18-inch vertical clearance, one of the following methods may be used:

3.2.1.1 Use equally rated pressure pipe for the sewer lines with no joints closer than 12 feet apart and at least 6-inch vertical clearance.

3.2.1.2 Install sewer pipe into at least a 20-foot section of steel casing (casing I.D. slightly larger than sewer pipe bell O.D.) and center over crossing. Seal the ends of the casing with non-shrink grout. Refer to Section 2310-"Jack and Bore", for casing and boring requirements.

3.2.2 *Residential or Commercial Water Service Crossings* – When the water line being crossed is a residential or commercial building water service, 2-inch or smaller, and is a continuous piece of PE DR9 or copper tubing, then the rules in 5.2.A may be waived. The water service shall be located so that the distance from a sewer or force main joint is as great as possible.

3.2.3 *Running Gravity Sewer Lines Parallel to Potable Water Lines* – When a gravity sewer line must run parallel to and less than 18 inches below a potable water line and:

3.2.3.1 For cases where lines are 6 to 10 feet apart for less than 40 feet, use either method found in paragraph 3.2.1.

3.2.3.2 For cases where lines are 6 to 10 feet apart for more than 40 feet, use method from paragraph 3.2.1.1 and stagger joints.

3.2.3.3 For cases where lines are 3 to 6 feet apart for any distance, use a higher rated pressure pipe as in method from paragraph 3.2.1.1.

3.2.4 *Running Sanitary Force Mains Parallel to Potable Water Lines* – When a sanitary force main must run parallel to and less than 18 inches below a potable water line and:

3.2.4.1 For cases where lines are 6 to 10 feet apart for any distance, use a higher rated pressure pipe as in method from paragraph 3.2.1.1

3.2.4.2 For cases where lines are 3 to 6 feet apart, use a higher rated pressure pipe for both water and force main.

3.3 *Pipe Installation* – The Contractor shall utilize equipment and methods in accordance with pipe Manufacturer's requirements and standard construction practices to insure pipe installation to line and grade as indicated.

3.3.1 *Trench Excavation* – Refer to ECUA Engineering Manual, Section 2221-"Trench Excavation Backfill and Compaction." Maintain minimum of 30 inches and maximum of 36 inches of cover below finished grade unless otherwise approved by ECUA in writing.

3.3.2 *Alignment* – Pipe shall be installed along the alignment indicated by the construction plans. Accomplish horizontal and vertical changes in alignment of pipe with bends or other appropriate fittings. Joint deflection shall not exceed the recommendations of the pipe Manufacturer.

3.3.3 *Pipe Preparation* – The Contractor shall clean the interior of all pipes, fittings, and joints prior to installation. Pipes shall be inspected for defects prior to installation. Damaged pipe shall be rejected and removed from the project.

3.3.4 *Pipe Installation* –

3.3.4.1 Install pipe only when weather and trench conditions are suitable. Do not lay pipe in water. Join pipe in accordance with Manufacturer's recommendations.

3.3.4.2 Provide initial backfill or anchoring as necessary to prevent displacement and preserve alignment after establishing final position.

3.3.4.3 Encase water pipe in steel casing or use ductile iron pipe when crossing under pipe, conduit, or structure when a 6-inch separation distance cannot be maintained. This protection shall extend a minimum of 5 feet beyond crossed structure. (See Section 3.2 for Potable Water Line Separation From Sanitary Sewer Lines)

3.3.5 *Crossings* –

3.3.5.1 Where the crossing of a roadway, water body, rail, or other obstacle requires trenchless installation, the materials and installation methods shall conform to Section 2300-"Horizontal Directional Drilling" or Section 2310-"Jack and Bore", as applicable.

3.3.5.2 Jack and bore shall be the standard requirement for road crossings. If jack and bore is not possible, as determined by ECUA, a horizontal directional method will be allowed. If directional bore methods are used, the Contractor must install a sleeve or casing in addition to the primary carrier pipe.

3.3.6 *Protection* – Prevent the introduction of foreign matter into the pipe at all times. Close open ends of pipe with water tight fitting closures or plugs. Do not let water fill trench, but include provisions to prevent flotation should water control measures prove inadequate. Remove water, sand, mud and other undesirable materials from trench before removal of pipe closure piece.

3.3.7 *Cutting* – PVC or PE pipe shall be cut in a neat workmanlike manner, and the spigot end shall be beveled per Manufacturer's recommendation. Ductile iron pipe shall be cut in accordance with Manufacturer's recommendation. Do not allow excessive heat to develop. Smooth and bevel cut end as per Manufacturer's recommendations. Use of pipe with damaged lining is unacceptable.

3.3.8 *Service Lines* – Service lines shall be constructed where shown on plans and in accordance with ECUA Standard Detail D-40. For residential subdivisions, the owner/developer shall coordinate the location of the water meter with the power company prior to installation.

3.3.8.1 *Long Service Lines* – Unless noted on plans, HDPE pipe and tubing shall be installed at the shallowest depth that can safely and reasonably be achieved (but no less than 36 inches minimum). Depth shall take into account all utility conflicts, bend radius of the pipe, and bend radius of the drill stem. Where utilities cross under DOT, county and/or city roads, depth of cover shall comply with applicable permits and shall be adequate to provide reasonable measures to avoid damage to the road surface and/or road base.

3.3.9 *Closure Pieces* – Closure pieces shall only be used where called for on plans, or with written permission of the ECUA. Closure may be accomplished with sleeve coupling as long as its length is such that gaskets are not less than 3 inches from pipe ends.

3.3.10 *Restraints and Thrust Blocking* – Mechanical joint restraints shall be furnished and installed for all water line fittings and appurtenances. Reference ECUA Standard Detail D-62. Restraints and thrust blocks are required for 11.25, 22.5, 45 and 90 degree bends, tapping sleeves, tees, dead-ends, behind fire hydrants, and flushing hydrants. Reference ECUA Standard Details D-52 and D-62.

3.4 *Appurtenance Installation* –

3.4.1 *Valves* – Valves shall be installed with operating stems vertical when installation is direct burial. Valves shall be installed on a suitable bearing surface so as to prevent vertical displacement.

3.4.2 *Valve Boxes* – Valve boxes shall be centered on the valve. The earth shall be compacted around each valve box to a distance of 4 feet on all sides of box, or to undisturbed trench face if less than 4 feet. An 18-inch diameter by 4-inch thick collar shall be constructed and sloped to direct water away from the valve box. In lieu of the constructed collar, a 24-inch by 4-inch thick pre-cast, sloped, concrete collar may be used.

3.4.3 *Tracer Wire* – Tracer wire shall be installed on all new water mains and on all new water service lines. The tracer wire shall be placed directly above the pipe and electrically continuous throughout the project. Tracer wire shall be secured to the pipe with PVC tape the same color as the wire insulation, at a maximum of 10-feet on center between tapings. The tracer wire shall be brought to the ground surface at each valve location in accordance with ECUA Standard Detail D-43. Splices and/or connections in the tracer wire shall be installed with silicone-filled wire nuts designed for direct burial.

3.5 *Fire Hydrant Flushing Equipment Installation* –

3.5.1 *Hydrants* – Hydrants shall be installed in accordance with ECUA Standard Detail D-50.

3.5.2 *Flush Stands and Valves* – Flush stands shall be installed as shown on ECUA Standard Detail D-51, depending on line size.

3.6 *Service Line Installation* –

3.6.1 *General* – The Contractor shall install individual services with tracer wire from the new main to a convenient point on the right-of-way or property line for each house, building or unit that is currently served through an ECUA meter. New services for undeveloped lots shall be located 1 foot from the common property line.

3.6.1.1 This section will deal with service line tubing 1-inch and 2-inches in diameter, to serve 5/8-inch, 1-inch, 1 ½-inch, and 2-inch meters. The installation of service lines for 3-inch meters and larger shall be in accordance with the requirements for water main installation, (See Section 3.3).

3.6.2 *Service Line Connections* – Service lines shall be installed in accordance with ECUA Standard Detail D-40. Tubing shall be installed in one continuous length from corporation stop to curb stop with no intermediate fittings. Service lines damaged after initial installation but before acceptance may be repaired by means of a single splice, except that no repair fittings will be permitted under any paving. The tap location shall be at least 10 feet from any sanitary sewer joint with less than 18 inches vertical clearance. Potable water taps shall be made with a tapping machine designed for the pipe material being tapped. Other types of tapping machines may be used upon prior approval by the ECUA Inspector or Engineer.

3.7 *Taps on Pressurized Lines* – Taps for service lines of 2-inch and smaller PE tubing shall be made using a tapping saddle. The Contractor shall perform taps on pressurized lines for the installation of pipes other than service lines of 2-inch and smaller PE tubing in accordance with these requirements:

3.7.1 *Materials* – All materials used for taps on pressurized lines shall meet the requirements of these specifications. Tapping sleeves shall be properly sized for the pipe being tapped. (See Section 2.4.1.8) Resilient seated tapping valves shall be furnished with special end connections. (See Section 2.4.2.2) All other material used to accomplish the tap shall meet the standards set forth by the AWWA for potable water construction.

3.7.2 *Procedure* – The Contractor shall notify the ECUA Inspector three working days in advance of work. The Contractor shall in the presence of an ECUA inspector:

3.7.2.1 Expose the existing pipe at the location shown on the plans, and clean the section of the pipe to receive the tapping sleeve.

3.7.2.2 Check the tapping sleeve and valve for defects and make sure the gate fully retracts in the valve to allow the shell cutter free passage.

3.7.2.3 Assemble the tapping sleeve on the pipe, then install the tapping valve.

3.7.2.4 Hydrostatically pressure test the tapping sleeve and valve after it has been assembled on the water main using the test plug on the sleeve. The test shall be 150 psi minimum. The duration of the test shall be 15 minutes.

3.7.2.5 Pour a thrust block behind the tapping sleeve sufficient to withstand the pressure of the new line. Also, provide a concrete pad or suitable bearing surface sufficient to support the weight of the sleeve, valve, and tapping machine. Refer to Section 3.3 and ECUA Standard Detail D-52. Concrete shall be in place a minimum of 24 hours prior to testing the main installation.

3.7.2.6 Assemble an approved tapping machine and proceed to make the necessary cut in accordance with the recommendation of the tapping machine Manufacturer. Approved tapping machines shall be:

3.7.2.6.1 In good working condition.

3.7.2.6.2 Designed for and have a cutting bit for the pipe material to be cut.

3.7.2.6.3 Equipped with a depth of cut gauge.

3.7.2.6.4 Designed to capture the coupon.

3.7.2.6.5 Equipped with the Manufacturer’s recommended diameter shell cutter for the tap to be made.

3.7.2.6.6 Tapping machine power head to be hydraulic or pneumatic drive; use of electric motor drives expressly prohibited.

3.7.2.6.7 Tapping machine shall be disinfected prior to each use for potable water taps.

3.7.2.7 The following tapping chart may be used for field reference only:

| Tap Size Reference Chart | | |
|---|---|---|
| **Nominal Main Size** | **Tapping Valve ID AWWA Standard** | **Tapping Machine Shell Cutter OD** |
| 2-inch | 2 1/8-inch | 1½ -inch |
| 3-inch | 3 1/8-inch | 2½-inch |
| 4-inch | 4 1/4-inch | 3½ -inch |
| 6-inch | 6 1/4-inch | 5½ -inch |
| 8-inch | 8 1/4-inch | 7½ -inch |
| 10-inch | 10 1/4-inch | 9½ -inch |
| 12-inch | 12 1/4-inch | 11½ -inch |
| 14-inch | 14 1/4-inch | Per Manufacturer's Recommendation. |
| 16-inch | 16 1/4-inch | Contractor shall submit shop drawings for valves and tapping machine for approval, prior to use. Per Manufacturer's Recommendation. |
| 18-inch | 18 1/4-inch | |
| 20-inch | 20 1/4-inch | |
| 24-inch | 24 1/4-inch | |

3.7.2.8 Tap coupon shall be given to the ECUA Inspector. If the coupon is lost in the main, Contractor shall, at his expense, dismantle main to retrieve the coupon. Main will be reassembled, pressure tested and bacteriological tests retaken as required at Contractor's expense.

## PART 4: Acceptance Requirements

4.1 *Inspection* – Upon completion of the installation, the system shall be inspected to ascertain that valves, fittings, fire hydrants, flush hydrants, etc. are located in conformance with the plans, and confirm that all 'as-built' measurements have been accurately taken. The ECUA Inspector shall observe all appropriate activities related to properly placing the line in service including flushing, pressure and leakage testing, disinfection, and bacteriological sampling. Final connections and testing of fire hydrants shall be accomplished after final clearance of lines. Tracer wire shall be tested for continuity by the Contractor with the ECUA Inspector present. The Contractor, with the ECUA Inspector, shall make sure all main valves and hydrant valves are open.

4.2 *New Water Main Cleaning* – All newly installed water lines shall be flushed with potable water to remove any sediment, solids and/or foreign matter prior to testing. ECUA will make water available to the Contractor. Flushing shall be conducted at a sufficient velocity to clear the pipe. Discharge of flushing water must be through a 2-inch diameter pipe (or larger) and must be controlled so as not to cause any property damage. Chlorinated water must be disposed of in an acceptable manner. Flush water source connection shall incorporate backflow preventer when required by the ECUA Inspector or Engineer.

4.2.1 Larger Pipe – Pipe 12 inches or larger in diameter shall be flushed and swabbed a minimum of 3 passes until line is clear. To facilitate this process, pigging launch stations and receiving pits shall be installed and incorporated into system.

4.3 *Pressure/Leakage Test* –

4.3.1 *General* – All newly installed water lines and appurtenances shall be pressure/leak tested to assure the strength of materials and quality of workmanship of the installation. Testing shall be conducted in accordance with ECUA Standard Detail D-41 and the requirements of AWWA Manual 23 for PVC and other flexible pipe or AWWA C600 for Ductile Iron Pipe. Leakage testing may be conducted concurrently with the pressure test.

4.3.2 *Procedure* –

4.3.2.1 Contractor shall notify the ECUA Inspector three ECUA working days prior to a scheduled test. Tests are to be conducted in segments not to exceed three thousand (3,000) feet of pipe. Water in the new line shall be pumped up to a pressure of 150 psi minimum. This pressure shall be maintained for a minimum of one (1) hour by pumping a quantifiable amount of water into the line and record the amount of water added during the test period. This represents the leakage.

4.3.2.2 Pressure/leakage tests shall be deemed acceptable when leakage does not exceed that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133200} \text{ (or 11.65 gpd/mi/inch/dia)}$$

or $$L = \frac{ND\sqrt{P}}{7400} \text{ for DI pipe 18' lengths}$$

or $$L = \frac{ND\sqrt{P}}{6600} \text{ for PVC pipe 20' lengths}$$

where: L = Maximum leakage, in gallons per hour.
S = Length of pipe under test, in feet.
N = Number of pipe joints in segment under test.
D = Nominal internal diameter of pipe, in inches.
P = Average actual leakage test pressure, psig.

4.3.2.3 Record all data for submission with as-built plans.

4.3.2.4 An ECUA Construction Inspector shall be present during test.

4.3.2.5 Refit and replace all pipe not meeting the leakage requirements. Repair clamps are not permitted.

4.3.2.6 Repair all visible leaks regardless of the amount of leakage.

4.3.2.7 When a satisfactory pressure/leakage test has been completed, reduce the pressure at or below normal line pressure, and continue on with line disinfection.

4.4 *Disinfection* –

4.4.1 *General – The* Contractor shall provide all equipment, materials and testing apparatus required to perform disinfection in accordance with AWWA C651, ECUA Standard Detail D-41.

4.4.2 *Procedure –*

4.4.2.1 Prior to beginning disinfection, the Contractor shall submit information to the Engineer for approval of proposed materials and methods. ECUA will determine the number and location of all sampling points. Temporary sampling taps may be required consisting of a corporation cock with copper tube.

4.4.2.2 Method of disinfection shall be the continuous feed method as described in AWWA-C651. Add chlorine to attain an initial concentration of 25 mg/l chlorine with 10 mg/l remaining after 24 hours.

4.4.2.3 Initial concentration is to be obtained by mixing proper amount of HTH granules (65 percent Cl) into auxiliary tank, then pump/meter into regulated flow into or through the pipe section.

4.4.2.4 Check the chlorine concentration at all sampling points after the line has been filled and air expelled. Check residual chlorine concentration at the end of 24 hours to confirm that 10 ppm (minimum) is present.

4.4.2.5 Alternate methods of disinfection such as “tablet” and “slug” methods as described in AWWA C651 will not be allowed.

4.4.3 *Water Supply for Cleaning, Flushing and Disinfection* – ECUA shall supply water for testing from the nearest available source. Flush main until chlorine concentration is 2 mg/l or less prior to taking bacteriological samples. Contractor shall provide a backflow preventer device as required by the ECUA Inspector or Engineer.

4.4.3.1 Check concentration at all sample point locations.

4.4.3.2 Disposal of chlorinated water shall be the Contractor’s responsibility and shall be done without damage to public or private property. Chlorinated water disposal shall meet all State, Federal and local regulations.

4.4.4 *Collection of Samples* – Contact ECUA for collection of samples. Two (2) satisfactory bacterial sample sets taken 24 hours apart must meet State requirements before placing the main into service.

4.4.5 *Repeat Testing* – Repeat flushing and disinfection procedure should initial disinfection fail to yield acceptable bacteriological results at no additional cost to the Owner.

4.5 *Other Connections* – After new system piping has been satisfactorily tested and cleared for use, make any approved additional connections to the pre-existing distribution system. Exercise care in making connection and disinfect as needed. When total system is approved for use, an ECUA Inspector shall verify that the Contractor has opened all interior valves as required. Valves connecting new installations to ECUA’s existing distribution system shall then be opened by an ECUA Inspector.

4.6 *Testing Fire Hydrants* – All newly-installed fire hydrants shall be flow tested by ECUA prior to final acceptance in accordance with established procedures. (Refer to AWWA-M17 and AWWA

C502.) Static Leak Test of hydrant shall be done in conjunction with Section 4.3 with hydrant valve open. Hydrant flow tests not meeting the minimum requirements of ECUA's Design Standards shall be immediately reported to the Engineer-of-Record. The system shall not be placed into service until the system meets the minimum requirements.

## PART 5: Measurement and Payment

5.1 *General* – Measurements shall be made to the nearest tenth of units and rounded to the nearest whole unit when totaled. Payments shall be for providing all labor, tools, equipment and materials as needed for: 1) furnishing, handling, and installing the required materials, fittings or fixtures; 2) excavation, backfill and compaction, including shoring, bracing and dewatering as required; 3) temporary removal and replacement of existing obstacles, including minor relocation and repair of other utilities; and 4) all required testing, disinfection and flushing. Payment for water main installations shall include the installation of tracer wire. All items stated are to be included in the unit price of pipe unless individually identified in the bid form.

5.2 *Water Mains* – Water mains shall be measured in lineal feet by the specified pipe size along the pipe centerline with no deduction for fittings. Payment shall be based on the Contract unit price per lineal foot.

5.3 *Appurtenances* – Water main appurtenances include fittings and valves as outlined in Section 2.4 of the specifications. Incidental appurtenances such as joint restraints, couplings, tracer wire, etc. are not considered separate pay items and their cost should be included in the unit price of the installed pipe.

5.3.1 *Fittings* – Water main fittings including bends, reducers, tees, wyes, tapping sleeves, expansion joints, pipe restraints, pipe hangers/supports, and cut in sleeves shall be measured and paid for on a unit (per each) basis. Fittings shall be listed by size and type.

5.3.2 *Valves* – Water main valves inclusive of any required valve boxes or other appropriate appurtenances shall be measured and paid for on a unit (per each) basis. Valves shall be listed by size and type.

5.3.3 *Line Stops* – Line stops shall be measured and paid for on a unit (per each) basis.

5.4 *Hydrants and Flushing Equipment* – Hydrants and flushing equipment shall be measured and paid for on a unit (per each) basis to include a complete installed assembly. Fire hydrant assemblies shall include the installed water main tee or tapping sleeve, lead valve and box, connectors (up to 10 feet of lateral distance), gravel pack, extensions, offset connectors and hydrant.

5.5 *Water Service Lines* –

5.5.1 *Service Lines (up to 2-inch diameter)* – Water service lines shall be measured and paid for on a unit (per each) basis. Each service line installation shall include the main tap, corporation stop, service tubing, and curb stop. Service lines shall be listed by tubing size and nominal length. Nominal length shall typically be categorized as "short" (for services on the same side of the street as the water main), and "long" (for services on the opposite side of the street from the water main).

5.5.2 *Large Service Lines (3-inch diameter and larger)* – Large service lines, including fire lines, shall be measured and paid for in accordance with the requirements for water mains (see 5.2 and 5.3 above).

5.6 *Taps on Pressurized Lines* – Taps on pressurized lines shall be measured and paid for on a unit price (per each) basis to include tapping sleeve, tapping valve, and valve box complete, in-place. Taps shall be listed by main and branch diameters.

# Section 2570

## Gravity Sewer Collection Systems

### PART 1: General

1.1 *General Description of Work* – Furnish and install all sewer pipe, fittings, structures, and accessories required for sanitary sewer construction as indicated.

1.2 *Product Delivery, Storage, and Handling Guidelines* –

1.2.1 Store materials to prevent physical damage.

1.2.2 Protect materials during transportation and installation to avoid physical damage.

1.3 *Quality Assurance* –

1.3.1 *Compliance* – Comply with latest published editions of American Society of Testing and Materials (ASTM) Standards:

| | |
|---|---|
| ASTM C478 | Precast Reinforced Concrete Manhole Sections |
| ASTM D1784 | Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds |
| ASTM D2321 | Practice for Underground Installation of Flexible Thermoplastic Sewers and Other Gravity-Flow Applications |
| ASTM D2564 | Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems |
| ASTM D3212 | Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| ASTM D3034 | Type PSM – Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings |

### PART 2: Materials and Equipment

2.1 *General Requirements* –

2.1.1 *Pipe Material* – Pipe shall meet the designations of the “ECUA Pipe Material Chart”, with standard pipe material for gravity sewer applications being that of PVC unless shown otherwise on plans or bid forms.

2.1.2 *Pipe Markings* – All pipes shall be marked in accordance with applicable standard specification under which pipe is manufactured unless otherwise specified.

2.2 *Delivery, Storage, and Handling* – Certificates of Compliance with the Specifications shall be required for all materials used on the Project. All materials shall be protected during transportation, storage, handling, and installation to avoid physical deterioration due to sun and weather. The ECUA reserves the right to reject material, which in any way does not meet the requirements of these Specifications.

2.3 *Sewer Mains –*

2.3.1 *Polyvinyl Chloride Pipe (PVC) –*

2.3.1.1 See “ECUA Pipe Material Chart” for pipe requirements.

2.3.1.2 Use single elastomeric gasket push-on joints complying with ASTM D3212.

2.4 *Structures and Pipe Accessories –*

2.4.1 *Fittings –*

2.4.1.1 Fittings shall be allowed only on service laterals and drop manholes.

2.4.1.2 Fittings shall equal or exceed quality and strength of pipe. See “ECUA Pipe Material Chart” for pipe requirements.

| **Approved Manufacturers** | |
|---|---|
| **Manufacturer** | **Type** |
| Tigre-ADS USA, Inc. | SDR 26 Gasketed |
| Others as approved by ECUA in writing. | |

2.4.2 *Manholes & Sections –*

2.4.2.1 Construction shall be precast reinforced concrete capable of sustaining an H-20 loading.

2.4.2.2 Manholes shall be constructed in accordance with ASTM C-478, using Type II or Type III Portland Cement with waterproofing additive (Xypex or approved equivalent) and anti-microbial additive (ConBlock MIC or approved equal).

2.4.2.3 Manholes shall have a minimum I.D. of 48 inches, unless otherwise noted on plans.

2.4.2.4 Base section shall be monolithic to a point 6 inches above the crown of the incoming pipe with minimum thick bottom section and 5-inch wall section and made in accordance with ASTM C-478. Doghouse manholes shall be used only with prior written approval of ECUA.

2.4.2.5 Pipe holes shall be properly located and either cast in place with appropriate boot or required shape, or core drilled after concrete has set. Minor field adjustments may be made with approval of ECUA. The invert of the lowest pipe shall be a minimum of 4 inches above the inside floor of the base section. The manhole base section shall include a preformed invert channel conforming to the shape and radius of the sewer pipe. The depth of the invert channel shall be no less than 2/3 of the pipe diameter.

2.4.2.6 Cone (top) sections shall be eccentric narrowing from 48 inches to 24 inches I.D., unless otherwise noted on plans.

2.4.2.7 Flat top sections shall be used in place of cone sections for manholes less than 5 feet deep. The access hole shall be offset to allow easy access and shall be reinforced to support an H-20 loading.

2.4.2.8 The joints between sections shall be one of the following:

2.4.2.8.1 Lap joint design with the upper lip inside and suitably shaped to accommodate a bitumastic joint sealer, (“Ram-Neck” or approved equivalent).

2.4.2.8.2 Rubber "O" ring gasket.

2.4.2.9 Completed joints shall be sealed inside and out with cement grout.

2.4.2.10 All joints shall be covered with a thermo-adhesive wrap as manufactured by Wrapid Seal or approved equal. See section 2.4.3.2 for sealing of the manhole chimney.

2.4.2.11 Pipe to manhole seals shall be made utilizing one of the following or approved equivalent:

2.4.2.11.1 Kore-N-Seal or Lock-Joint, with stainless steel bands and screws.

2.4.2.11.2 A-LOK.

2.4.2.12 Brick manholes shall only be used with consent of ECUA.

2.4.3 *Manhole Accessories* –

2.4.3.1 *Manhole Lid and Cover* – Refer to the following guidelines regarding manhole lid and cover:

2.4.3.1.1 Gray cast iron, with nominal opening of twenty-four (24) inches for standard four-foot diameter manholes. Manholes larger than four-foot diameter shall have a nominal opening no less than thirty-two (32) inches.

2.4.3.1.2 Cover shall be embossed with ECUA logo and marked "SANITARY SEWER" as shown on detail drawings.

2.4.3.1.3 The lifting holes shall not extend through cover.

2.4.3.1.4 Inflow protecting inserts as manufactured by Southwestern Packing and Seals (model C1) or an approved equal shall be installed in all manholes access covers. Manhole insert shall be manufactured of 304 stainless steel with a thickness of not less than 18 gauge. The insert shall have a straight side design to allow a loose fit into ring for easy removal.

2.4.3.2 Chimney Sealing – Refer to the following guidelines regarding covers:

2.4.3.2.1 The chimney of the manhole shall be constructed using the I&I Barrier system as manufactured by Strike Products, Cannon Falls, Minnesota and shall be installed in accordance with the manufacturer’s specifications. See Section 3.3.3.4 Joint Wrapping for additional requirements.

2.5 *Approved Rings and Covers –*

2.5.1 *Covers* – Refer to the following guidelines regarding covers:

| Standard Non-Bolting Covers | |
|---|---|
| **Within FDOT Right-Of-Way*** | **Outside FDOT Right-Of-Way** |
| U. S. Foundry 170 Bj (200# Cover) | U.S Foundry 170 E (130 # Cover) |
| Approved Equivalent | Approved Equivalent |

* Any cover for use within the FDOT right-of-way shall meet FDOT weight requirements (Min 195#).

Note: For non-standard applications requiring bolted covers or applications in flood prone areas, submit proposed ring and cover for review and approval by ECUA prior to installation.

2.6 *Manhole Coating* – Manholes receiving discharges from force mains, and at a minimum the next two manholes downstream of the receiving manhole, shall be lined with an ECUA approved lining or coating system as identified in Section 2573 – Manhole Rehabilitation of the specifications. Additional manholes shall be lined or coated if required by ECUA. Manholes to be lined or coated shall be noted on plans by Engineer.

2.7 Flexible Transition Couplings – All flexible transition couplings shall be Strongback RC series couplings as manufactured by Fernco.

## PART 3: Execution

3.1 *General* – Provide all labor, equipment, and materials and install all pipe, fitting, specials, and appurtenances as indicated or specified.

3.2 *Pipe Installation –*

3.2.1 *Handling* – Handle and store pipe in a manner to insure installation in sound and undamaged condition, and in accordance with pipe Manufacturer's requirements.

3.2.1.1 Do not drop, bump, roll or drag.

3.2.1.2 Use slings, lifting lugs, hooks and other devices designed to protect pipe, joint elements, and coatings.

3.2.1.3 Ship, move, and store with provisions to prevent movement or shock contact with adjacent units.

3.2.1.4 Handle with equipment capable of work with adequate factor of safety against overturning or other unsafe procedures.

3.2.2 *Installation* – Utilize equipment, methods, and materials insuring installation to lines and grades as indicated.

3.2.2.1 Do not lay on blocks unless pipe is to receive total concrete encasement.

3.2.2.2 Use calibrated laser for control of line and grade.

3.2.2.3 Install pipe of size, material, strength class, and joint type with embedment shown for plan location.

3.2.2.4 Insofar as possible, commence laying at downstream end of line and install pipe with bell ends in direction of laying (upstream). Sewer pipe shall have spigot ends in direction of flow. Obtain approval for deviations there from.

3.2.2.5 Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during discontinuance of installation.

3.2.2.5.1 Close open ends of pipe with watertight plugs at the end of each work day.

3.2.2.5.2 Do not let water enter trench. Pipe shall be laid in a dry trench. Include provisions to prevent pipe flotation and displacement should water control measures prove inadequate.

3.2.2.5.3 Remove water, sand, mud and other undesirable materials from trench before removal of end cap or plugs.

3.2.2.6 Inspect pipe prior to installation to determine if any pipe defects are present.

3.2.2.7 Brace or anchor as required to prevent displacement after establishing final position.

3.2.2.8 Perform only when weather and trench conditions are suitable.

3.2.2.9 Observe extra precaution when hazardous atmospheres might be encountered, especially when connecting to existing, active sanitary sewers.

3.2.2.10 Separation of sanitary sewer lines and potable water lines. See Detail D-64

3.2.2.10.1 Except as provided in paragraph 3.2.2.10.5, sewers and force mains shall be laid at least ten feet (outside to outside) horizontally from water mains. Provided the applicant demonstrates there is no reasonable alternative, the ECUA may approve smaller horizontal separation distances for sewers if one of the following conditions is met:

3.2.2.10.1.1 The top of the sewer is installed at least 18 inches below the bottom of the potable water line.

3.2.2.10.1.2 The sewer is encased in watertight carrier pipe.

3.2.2.10.1.3 Both the sewer and the water main are constructed of slip-on or mechanical joint pipe complying with public water supply design standards and pressure tested to 150 psi to assure water tightness.

3.2.2.10.1.4 The applicant provides documentation accompanying the permit application showing that another alternative will result in an equivalent level of reliability and public health protection.

3.2.2.10.2 Except as provided in paragraph 3.2.2.10.5, sewers and force mains shall be laid at least three feet (outside to outside) horizontally from any existing or proposed reclaimed water line. Smaller horizontal distances shall be approved in accordance with subsection 62-610.469(7), F.A.C.

3.2.2.10.3 Except as provided in paragraph 3.2.2.10.5, sewer pipes and force mains shall cross under water mains, unless there is no alternative. Sewers and force mains crossing water mains or reclaimed water lines shall be laid to provide a minimum vertical distance of 18 inches between the invert of the upper pipe and the crown of the lower pipe. The minimum vertical separation shall be maintained whether the water main is above or below the sewer. For sewer crossings, the crossing shall be arranged so that the sewer pipe joints are equidistant and as far as possible from the water main joints. Adequate structural support shall be provided for the sewer or force main to maintain line and grade. For sewers, provided the applicant demonstrates there is no reasonable alternative, the ECUA may approve smaller vertical separation distances if one of the following conditions is met:

3.2.2.10.3.1 The sewer is encased in a watertight carrier pipe.

3.2.2.10.3.2 The sewer is designed and constructed equal to water pipe and pressure tested to 150 psi to assure water tightness.

3.2.2.10.3.3 The applicant provides documentation accompanying the permit application showing that another alternative will result in an equivalent level of reliability and public health protection.

3.2.2.10.4 The provisions of paragraphs 3.2.2.10 (1-3) above are applicable to in-ground crossings. No vertical or horizontal separation distances are required for aboveground crossings.

3.2.2.10.5 If there are conflicts in the separation requirements between collection systems and drinking water facilities established in this subsection and those established in Section 556-“Water Distribution Systems” design standards, then the requirements in Section 556-“Water Distribution Systems”, shall apply.

3.2.2.11 Auger or jack casing in place where shown on plans.

3.2.2.12 Maintain minimum of 36 inches of cover unless directed by Engineer.

3.2.2.13 Encase sewer pipe in steel, PVC, or HDPE casing or use ductile iron pipe when crossing under pipe, conduit, or structure of 24 inches in diameter or greater when a 6-inch separation distance cannot be maintained. This protection shall extend a minimum of 10 feet beyond crossed structure.

3.2.3 *Jointing –*

3.2.3.1 Perform in accordance with Manufacturer's recommendations.

3.2.3.2 Clean and lubricate all joint and gasket surfaces with lubricant recommended.

3.2.3.3 Utilize methods and equipment capable of fully homing or making up joints without damage.

3.2.3.4 Check joint opening and deflection for specification limits.

3.2.4 *Closure Pieces –*

3.2.4.1 Connect two segments of pipelines or a pipeline segment and existing structure with short sections of pipe fabricated for the purpose.

3.2.4.2 Observe specifications regarding location of joints, type of joints and pipe materials and strength classifications.

3.2.5 *Temporary Plugs –*

3.2.5.1 Furnish, install, and secure watertight temporary plugs at each end of work for removal by others when completed ahead of adjacent contract or where indicated.

3.2.5.2 Remove from pipe laid under separate or prior contract in order to complete pipe connection when work by other contractor is finished prior to work at connection point under this Contract.

3.2.6 *Permanent Plugs –*

3.2.6.1 Use test plugs as manufactured by pipe supplier, or

3.2.6.2 Fabricate by Contractor of substantially same construction.

3.2.6.3 Must be watertight against heads up to 20 feet of water.

3.2.6.4 Secure in place in a manner to facilitate removal when required to connect pipe.

3.3 *Manhole Installation –*

3.3.1 *Precast Bases –*

3.3.1.1 Place on 12-inch layer of sand, gravel, or sandy material compacted to at least 98 percent of the maximum density as approved by Engineer. Subgrade preparation shall conform to ECUA Standard Detail D-10.

3.3.1.2 Base shall be leveled prior to installation of manhole sections.

3.3.2 *Cast-in-Place Bases –*

3.3.2.1 Cast on 12-inch layer of sand, gravel, or sandy material compacted to at least 98 percent of the maximum density as approved by Engineer. Subgrade preparation shall conform to ECUA Standard Detail D-10.

3.3.2.2 Manhole bases and channel inverts may be constructed integrally.

3.3.3 *Manhole Sections –*

3.3.3.1 Use precast sections unless cast-in-place manholes approved by Engineer.

3.3.3.2 Precast sections may be installed after base concrete has attained 75 percent of design strength.

3.3.3.3 Full circumference seals between manhole sections shall use one of the following or approved equivalent.

3.3.3.3.1 Bitumastic Seal (Kent No. 2, Ram Neck)

3.3.3.3.2 Rubber "O" ring gasket

3.3.3.4 *Joint Wrapping –*

3.3.3.4.1 A thermo-adhesive wrap shall be used on all manhole wall joints.

3.3.3.4.2 A thermo-adhesive wrap shall be used on all manhole chimney sections where the manhole is located in a low lying area that is prone to flooding, within the limits of the 100-year flood plain, or as directed by ECUA engineer.

3.3.3.4.3 The thermo-adhesive wrap shall be the WrapidSeal™ manhole encapsulation system as manufactured by CANUSA, The Woodlands, Texas.

3.3.4 *Invert Channels –*

3.3.4.1 Form invert channel as indicated. Invert channel shall conform to the shape and radius of the pipe. The depth of the invert channel shall be no less than 2/3 of the pipe diameter.

3.3.4.2 Alternate invert and shelf may be constructed of mortar over concrete fill with approval of Engineer.

3.3.4.3 Make changes in direction of flow with smooth curves of as large a radius as size of manhole permits.

3.3.4.4 Make changes in size and grade smoothly and uniformly.

3.3.4.5 Slope shelf of manhole adjacent to channels, toward the channels, and rough broom finish to provide a non-slip surface.

3.3.4.6 Finish channel bottom smoothly without roughness, irregularity, or pockets. Irregularities greater than 1/8-inch shall not be allowed.

3.3.4.7 On straight through single pipe manholes, half sections of same pipe may be used with mortar and concrete with approval of Engineer.

3.3.4.8 Precast inverts in base sections are acceptable with approval from ECUA Engineering Department.

3.3.5 *Field Coatings* – Field applied coatings shall be applied after Engineer's approval of structure.

3.4 *Wastewater Services –*

3.4.1 See ECUA Pipe Material Summary Chart for acceptable materials.

3.4.2 *Laterals* – Service laterals shall be located in accordance with requirements in the ECUA Code. Refer to the Code for clarification of availability of facilities and responsibilities of customer for the installation of service laterals. Install service laterals to each residential lot or individual business lot or property, or as directed by Engineer.

3.4.3 *Services Wyes* – Install wyes, 4-inch branch diameter unless shown otherwise on plans. See ECUA standard detail, D-1 "Typical Service Connection".

3.4.4 *Cleanouts* – Install cleanouts at the right-of-way line with cleanout cap located 1 foot below ground surface, unless shown otherwise on plans. See ECUA standard detail, D-1 "Typical Service Connection".

3.4.5 *Risers* – Risers may be used with wyes for service connections where invert of sewer is 7 feet or more below ground surface or where shown on plans. Where risers are used, the minimum available depth of sewer shall be four feet. Terminate each connection as shown on plans or as directed by Engineer. Glued 45-degree bends shall be used.

3.4.6 *General* –

3.4.6.1 Glue cap on end of stub out.

3.4.6.2 Backfill trench only after recording exact location and depth of service connection.

3.4.6.3 Street crossings shall have a minimum of 2 feet of cover to subgrade unless approved by Engineer.

3.4.6.4 Drive a ½-inch metal rebar adjacent to each service lateral cleanout, with top of post 1 foot below ground surface. As-built drawings shall reflect horizontal location and depth of lateral at property line.

3.4.6.5 Install a cleanout location marker on top of cleanout as shown in the ECUA standard detail, D-1 "Typical Service Connection".

3.5 *Connection of Service Laterals and Sewer System Facilities* –

3.5.1 *Existing Service Laterals and New Sewer Main* – When a new sewer main is installed to replace an existing sewer main, extend new sewer laterals to property line. Connect new service lateral to existing sewer lateral at property line.

3.5.2 *New Service Lateral Connections to Existing Manholes* –

3.5.2.1 Unless otherwise directed by ECUA, insert new sewer lateral six (6) inches inside of manhole. Ensure that new pipe does not obstruct flow path in existing invert channel. Where possible, orient new service line consistently with direction of flow.

3.5.2.2 Connect new laterals to existing manholes. Seal new lateral in place with hydrophilic grout.

3.5.2.3 Reconstruct manhole channel and shelf to suit new connection.

3.5.2.4 All debris to be removed.

3.5.3 *Connections to Existing Sewer –*

3.5.3.1 Where no practicable alternative exists, build new manhole around existing sewer.

3.5.3.2 Cut out existing sewer inside of manhole and construct channel and shelf to suit new connection.

3.5.3.3 New connection shall be made in such a manner to facilitate access with sewer main CCTV systems.

## PART 4: <u>Acceptance</u>

4.1 *Acceptance Tests for Sewer Pipelines and Manholes – If any acceptance test fails within the contract warranty period, the Contractor, at no additional cost to ECUA shall correct all deficiencies in a manner acceptable to the Engineer.*

4.1.1 *Infiltration Testing –*

4.1.1.1 *General* – Refer to the following general guidelines for infiltration testing:

4.1.1.1.1 Maximum infiltration for each section of sewer pipe shall not exceed 25 gpd/inch of pipe diameter/mile.

4.1.1.1.2 Manhole vacuum test in accordance with ASTM-C1244.

4.1.1.1.3 Acceptance of air test or exfiltration results will not preclude rejection of work if infiltration is measured and exceeds limitation.

4.1.1.1.4 Maximum infiltration for each manhole shall not exceed 1 gallon per vertical foot per 24 hours.

4.1.1.1.5 All tests to be witnessed by ECUA.

4.1.2 Air Test (Pipelines) – On all newly constructed sanitary sewer lines, the Contractor shall conduct a line acceptance test using low pressure air. The air test shall be conducted after the pipe has been backfilled and the cost of air testing shall be included in other items of Work. The Engineer shall be advised at least 48 hours before tests are conducted. These tests shall be conducted at all times in the presence of the Engineer. Should a line which has been previously tested indicate any infiltration, or otherwise appear suspect to the Engineer, the Contractor shall conduct confirmation air tests on the line at no additional cost. The Contractor shall provide, as required, the proper plugs, weirs, public notification, and other equipment required to perform all tests. Testing of each section of sewer installed shall include the portions of service connections that are to be installed under the contract.

4.1.2.1 Furnish all facilities required including:

4.1.2.1.1 Necessary piping connections.

4.1.2.1.2 Test pumping equipment.

4.1.2.1.3 Pressure gauges or manometers.

4.1.2.1.4 Bulkheads.

4.1.2.1.5 All miscellaneous items required.

4.1.2.1.6 Obtain approval from Engineer of equipment and methods proposed for use.

4.1.2.1.7 Plug ends of line and cap or plug all connections to withstand internal test pressures.

4.1.2.1.8 Introduce low-pressure air until internal air pressure is 4.0 psi greater than the average back pressure of ground water above the pipe. (Add 0.43 psi for each vertical foot of ground water over the top of pipe.)

4.1.2.1.9 Allow two minutes for air pressure to stabilize.

4.1.2.1.10 Time required for pressure to decrease from 3.5 to 2.5 psi greater than average back pressure of any ground water above pipe shall not be less than time in following table for given diameters.

| Air Testing Chart | |
|---|---|
| **Pipe Diameter (Inches)** | **Minutes** |
| 6 | 3.0 |
| 8 | 4.0 |
| 10 | 5.0 |
| 12 | 5.5 |
| 15 | 7.5 |
| 18 | 8.5 |
| 21 | 10.0 |
| 24 | 11.5 |
| 30 | 14.0 |
| 36 | 17.0 |

4.1.2.1.11 Repeat test as necessary after all leaks and defects have been repaired.

4.1.3 *Exfiltration Test (Pipelines) –*

4.1.3.1 Furnish all facilities required to plug pipe sections and fill with water to attain a minimum elevation of water in upstream manhole two feet higher than top of pipe in line being tested, or two feet above existing ground water in trench, whichever is higher elevation.

4.1.3.2 Maintain water level in manhole at start of test period for one hour.

4.1.3.3 Water added to maintain level (water lost) shall not exceed the following amounts:

| Exfiltration Testing Chart | |
|---|---|
| **Pipe Diameter (Inches)** | **Gallons/100 feet** |
| 8 | 0.63 |
| 10 | 0.79 |
| 12 | 0.95 |
| 15 | 1.19 |
| 18 | 1.42 |
| 21 | 1.66 |
| 24 | 1.90 |

Allowable leakage may be increased by 5 percent for each foot of head above water elevation indicated above.

4.1.4 *Infiltration Test (Pipelines)* –

4.1.4.1 May be used in lieu of air test or exfiltration test if Contractor can prove that ground water conditions are such that crown of pipe is covered with not less than two feet of water at highest point in section being tested. The test head shall be maintained for not less than 24 hours before a weir measurement is made.

4.1.4.2 Infiltration shall be measured with weir at manhole and shall not exceed amounts stated in paragraph 4.1.3 of this section, Exfiltration Test.

4.1.4.3 Engineer will require exfiltration or air test if Contractor cannot prove to satisfaction of Engineer that ground water conditions are satisfactory.

4.1.5 *Vacuum Testing (Manholes)* – The vacuum test may be performed on manholes, completely constructed, with inlet and outlet pipes in place. Test shall be conducted before any backfilling begins. Any material around the base section shall be removed to expose the entire side of the manhole. Plug pinholes and horizontal seams with a non-shrinking mortar.

4.1.5.1 Brace the inlet and outlet pipes/plugs to prevent movement during the test. Use air inflated plugs in good condition.

4.1.5.2 The vacuum test shall be performed using equipment approved by the Engineer. The equipment shall be in good operating condition. No gauges are to have any broken glass or other visible abnormalities. The test shall be performed by trained personnel familiar with the equipment and the test.

4.1.5.3 The test shall have a minimum duration of two minutes. The vacuum shall be pumped down to 10 inches (250 mm) of mercury on an approved gauge, and held. At the time the removal of air is stopped, the test time shall begin.

4.1.5.4 Any manhole that has a vacuum drop to nine inches (225 mm) of mercury or less, within the following time intervals, shall have failed the test.

0 – 10 ft. deep: less than 2 minutes.

10 ft. – 15 ft. deep: less than 2-1/2 minutes.

15 ft. – 20 ft. deep: less than 3 minutes.

4.1.6 *Deflection (Belly) Testing –*

4.1.6.1 Deflection Test for Flexible Pipe: Optional devices for testing include calibrated television, photography, properly sized "GO-NO-GO" mandrel, sewer ball or deflectometer. Maximum allowable pipe deflection shall be as shown on Detail D-14.

4.1.6.2 The deflection test shall be performed no sooner than thirty (30) days after installation.

4.1.6.3 If a deflection is identified that requires a repair, the Contractor shall complete the repair in a manner acceptable to the ECUA engineer and re-perform exfiltration/infiltration tests of the entire length of sewer main (manhole to manhole) once all repairs have been completed at no additional cost to ECUA.

## PART 5: Measurement and Payment

5.1 *Sewer Pipe –*

5.1.1 Measure in lineal feet by specified pipe size along centerline of pipe with no deduction for manholes, wye connections, or riser connections.

5.1.2 Includes furnishing, handling, laying pipe materials and specified bedding materials; trench excavation, backfill and compaction; dewatering; sheeting, shoring and bracing; testing; utilities repair and relocation; providing all labor, tools, equipment and miscellaneous associated work necessary to complete item.

5.1.3 Payment: Unit price per linear foot.

5.2 *(Standard) (Drop) (Shallow) Manholes –*

5.2.1 Includes furnishing and placing all precast and cast in place materials; excavation, backfill and compaction; frame and lid; stub pipes; providing all labor, equipment, tools and miscellaneous associated work needed to complete item.

5.2.2 Payment: Unit price per each manhole.

5.3 *Service Lateral Connections –*

5.3.1 Lump sum price for long or short service lateral as indicated.

5.3.2 Includes furnishing, handling, laying pipe materials; trench excavation, backfill and compaction; dewatering; utilities repair; providing all labor, equipment and miscellaneous associated work needed to complete item.

5.3.3 Payment: Unit price per each.

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# Section 2573

## Manhole Coatings/Rehabilitation

**PART 1: General**

1.1 *General Description of Work –*

1.1.1 Provide all materials, equipment, labor and incidentals for the installation and testing of the manhole rehabilitation lining product.

1.1.2 The manhole shall consist of spray applying a cement-based or cement/epoxy composite material to the walls, inverts, and benches of the existing sanitary sewer manhole.

1.1.3 The manhole rehabilitation product shall cure to a water tight system and a minimum thickness as described herein.

1.2 *References* – Standards referenced in this Section are listed below:

| | |
|---|---|
| ASTM C-109 | Standard Test Method for Compressive Strength of Hydraulic Cement Mortars |
| ASTM C-293 | Standard Test Method for Flexural Strength of Concrete |
| ASTM D-638 | Standard Test Method for Tensile Properties of Plastic |
| ASTM D-790 | Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials |
| ASTM D4541 | Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers |
| NACE SP0188 | Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates |
| NACE RP0274 | High Voltage Electrical Inspection of Pipeline Coating Prior to Installation |

1.3 *Qualifications* – The Contractor shall have a minimum of three years of continuous experience installing the product proposed for this project. Additionally, the Contractor shall have successfully completed projects using the proposed product on projects of the same size and installation conditions as this project. The Contractor shall provide experienced crews using the product proposed and installed under the same installation conditions as this project.

1.4 *Delivery, Storage, and Handling –*

1.4.1 Store materials to prevent physical damage and in accordance with manufacturer's recommendations.

1.4.2 Protect materials during transportation and installation to avoid physical damage and in accordance with manufacturer's recommendations.

1.5 *Quality Control –*

1.5.1 No change of material, design values, or procedures may be made during the course of the Work without the prior written approval of the Engineer.

1.5.2 All test results shall be provided by an independent, certified ISO 17025 testing facility.

1.6 *Warranty* – All lining work shall be fully guaranteed by the Contractor for **a period of 5 years** from the date of Final Acceptance unless otherwise stipulated in writing by the Owner prior to the date of Conditional Acceptance. During this period, all defects discovered by the Owner or Engineer shall be addressed by the Contractor in a satisfactory manner at no cost to the Owner. The Owner may conduct independent inspections, at its own expense, of the lining Work at any time prior to the completion of the guarantee period.

1.7 *Submittals –*

1.7.1 Submit manufacturer's product data for design mix with installation instructions for proprietary materials including reinforcement and forming accessories, admixtures, joint materials, hardeners, curing materials and others as requested by Engineer.

1.7.2 Submit 2 copies of laboratory test or evaluation reports for concrete materials and mix designs as requested by Engineer.

1.7.3 Submit 2 copies of Contractor Certification and Material Certification as requested by Engineer.

1.7.4 Submit documentation of post construction testing as requested by Engineer.

## PART 2: <u>Products</u>

2.1 *Design Requirements –*

2.1.1 *Cement-Based Rehabilitation –*

2.1.1.1 The work consists of rehabilitation of sanitary sewer manholes by spray applying a proprietary pre-blended mixture of acid-resistant calcium aluminate cement-based material to the walls, inverts, and benches of sanitary sewer manholes, resulting in a monolithic liner with a minimum thickness of 1/2-inch (500 mils).

2.1.1.2 The thickness shall be increased in accordance with the manufacturer's recommendations to account for the dimensions and existing condition of the manhole and to withstand the forces arising from the manhole's specific depth and service conditions including groundwater hydrostatic pressures and traffic loading.

2.1.1.3 Where the level of the water table is not known, it shall be assumed that the water table level is equal to the grade elevation surrounding the manhole being rehabilitated.

2.1.1.4 The water used for the rehabilitation process shall be clean and potable.

2.1.1.5 No other material shall be used or added to mixture without prior approval by the Owner.

2.1.1.6 The applicator, approved and trained, shall furnish all labor, equipment and materials for installing the lining over brick, tile, pre-cast concrete, or concrete block manholes, new or used, using approved equipment.

2.1.1.7 The installation shall be in accordance with the Contract Specifications along with manufacturer's recommendations.

2.1.1.8 Where the manufacturer’s installation and testing recommendations are more stringent than the following Contract Specifications, the manufacturer’s recommendations shall control.

2.1.1.9 The material shall be a proprietary pre-blended mixture of acid-resistant calcium aluminate cement, chemically-active aggregates, and other additives specifically selected for special properties specifically designed for sanitary sewer applications.

2.1.1.10 *Physical Properties –*

| | |
|---|---|
| Minimum Density at Placement | 145 ± 5 pcf |
| Minimum Compressive Strength, ASTM C-109 | 7,000 psi at 28 days |
| Minimum Flexural Strength, ASTM C-293 | 1,100 psi at 28 days |

2.1.1.11 The liner mix shall be made with manufacturer’s recommendations for sanitary sewer manhole applications

| **Approved Products** |
|---|
| CEMTEC Silatec CAM |
| PERMAFORM CR-9000 |
| QUADEX ALUMINALINER |
| SEWPERCOAT 2000 HS REGULAR |
| STRONG-SEAL HIGH PERFORMANCE MIX |

2.1.2 *Epoxy/Cement Composite Rehabilitation –*

2.1.2.1 The work consists of rehabilitation of sanitary sewer manholes by spray applying an epoxy/cement composite liner to the walls, inverts, and benches of sanitary sewer manholes, resulting in a monolithic liner. The cement-based liner applied to the manhole surfaces shall have a minimum thickness of 1/2-inch (500 mils) and the composite liner shall be completed with the application of an epoxy-based material at a minimum thickness of 0.125 inches (125 mils).

2.1.2.2 The thickness shall be increased in accordance with the manufacturer's recommendations to account for the dimensions and existing condition of the manhole and to withstand the forces arising from the manhole's specific depth and service conditions including groundwater hydrostatic pressures and traffic loading.

2.1.2.3 Where the level of the water table is not known, it shall be assumed that the water table level is equal to the grade elevation surrounding the manhole being rehabilitated.

2.1.2.4 The water for the rehabilitation process shall be clean and potable.

2.1.2.5 No other material shall be used or added to mixture without prior approval by the Owner.

2.1.2.6 The applicator, approved and trained, shall furnish all labor, equipment and materials for installing the lining over brick, tile, pre-cast concrete, or concrete block manholes, new or used, using approved equipment.

2.1.2.7 The installation shall be in accordance with the following Contract Specifications along with manufacturer's recommendations.

2.1.2.8 Where the manufacturer's installation and testing recommendations are more stringent than the following Contract Specifications, the manufacturer's recommendations shall control.

2.1.2.9 The material shall be a proprietary pre-blended epoxy/cement composite system specifically designed for sanitary sewer applications

2.1.2.10 The cementitious portion of the system shall be a proprietary pre-blended mixture of corrosion resistant cement, select aggregates, chemical admixtures, and other additives specifically selected for special properties and shall be formulated to ensure a tenacious bond with the protective epoxy topcoat portion.

2.1.2.11 The epoxy topcoat portion of the system shall be a proprietary 100% solids epoxy material creating a continuous, impermeable corrosion-resistant barrier.

2.1.2.12 The liner mix shall be made with manufacturer's recommendations for sanitary sewer manhole applications.

| **Approved Products** |
|---|
| CEMTEC Silatec CAM and Dura-Plate 5900 |
| DINJER CMS-10K and SG MASTIC |
| PERMACAST MS 10,000 and COR-GARD 501 |
| QUADEX ALUMINALINER and RAVEN 405 |

## PART 3: Execution

3.1 *Preparation* –

3.1.1 *Safety* – The Contractor shall perform all Work in strict accordance with all applicable OSHA regulations. Each method of manhole rehabilitation in this section requires some degree of manhole entry by workers. Particular attention is drawn to those safety requirements regarding confined space entry and respiratory protection from airborne particulate materials during cleaning and product mixing and application.

3.1.2 The Contractor shall place covers over invert before prepping. All concrete and masonry surfaces to be rehabilitated shall be cleaned prior to applying any lining system. All grease, oil, laitance, coatings, loose bricks, mortar, unsound brick or concrete and other foreign materials shall be completely removed. Methods such as wet or dry sandblasting, concrete cleaners, degreasers, or mechanical means may be required to properly clean the surface. All surfaces on which these methods are used shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products. Debris resulting from cleaning shall be removed from the manhole and not allowed to be carried downstream.

3.1.3 The Contractor shall be responsible for plugging or diverting the flow of wastewater as needed for manhole rehabilitation. Diverting the sanitary sewage to perform the required rehabilitation shall be incidental to the manhole rehabilitation.

3.1.4 The NACE/SSPC Joint Surface Preparation Standards for concrete surface preparation are incorporated in and made part of this specification. All references to SSPC SP-13/NACE No 6 designate the definitions and other requirements in these documents. The International Concrete Repair Institute (ICRI) Technical Guideline #03732, Guide to Surface Preparation of Concrete to Receive Sealers, Coatings and Polymer Overlays shall be used to visually evaluate the concrete surface profile.

3.1.5 Create a minimum surface profile for the system specified in accordance with the methods described in ICRI No. 03732 to achieve profile CSP-3 to CSP-5, or as specified by manufacturer's recommendations.

3.1.6 Concrete surface defects, such as deteriorated concrete or masonry, hollow areas, bugholes, honeycombs, cracks and voids shall be filled flush and true with the specified structural lining compound in accordance with ICRI Technical Guide No 03730 "Guide for Selecting Application Methods for the Repair of Concrete Surfaces". Fins, trowel marks, and all protrusions or rough edges shall be removed.

3.1.7 *Stopping Infiltration* –

3.1.7.1 The Contractor shall use hydraulic cement to stop infiltration at each identified point of leakage into the manhole. If the flow of water into the manhole is too great for stoppage utilizing hydraulic cement, the Contractor shall drill holes at each point of leakage that extend through the manhole wall. Chemical sealant injection devices shall be placed into the drilled holes in a manner to provide a watertight seal between the holes and the injection device.

3.1.7.2 Hoses shall be attached to the injection devices from an injection pump. A mixture of manhole chemical sealants shall then be pumped until material refusal is recorded on the pressure gauge of the pumping unit. The Contractor shall ensure that excessive pumping pressures do not develop that may cause damage to the manhole walls.

3.1.7.3 Once the injection of the chemical sealants have been completed, the injection packers shall be removed and the holes shall be filled and troweled flush with the surface of the manhole wall using a fast-set non-shrinking grout.

3.1.7.4 Excessively leaking manholes requiring chemical sealants will be considered additional manhole preparation. The Contractor must notify and receive approval from the Owner before additional preparation begins. Additional manhole preparation without approval from the Owner will be considered incidental to the Work. Payment for this item shall be at unit price bid only after the event that normal leak stoppage methods are not effective and it is approved by the Owner.

3.1.8 Loose material shall be removed from the area to be patched exposing a sound sub-base. Holes or voids around steps, joints or pipes, spilled areas, and cavities caused by missing or broken brick shall be patched and missing mortar repaired using a nonshrink patching mortar conforming to the requirements of this section. Cracks not subject to movement and greater than 1/16 inch in width shall be routed out to a minimum width and depth of ½ inch and patched with nonshrink patching mortar conforming to the requirements of this section. Bench repair and patching of walls is considered incidental to manhole preparation for liner application.

3.1.9 All manholes which have exposed cured-in-place or deformed/reformed pipe segments in the manhole invert channel shall require the use of a concrete bonding adhesive prior to the spray application of the cementitious manhole liner. The bonding agent shall be any synthetic emulsion specifically formulated for bonding new concrete to existing surfaces. The bonding agent shall be mixed and applied in accordance with manufacturer's recommendation.

3.2 *Spraying* –

3.2.1 Environmental conditions shall be monitored with proper equipment. Contractor shall provide a daily coating report that includes work performed, surface preparation, surface conditions, surface and profile measurement, ambient conditions, application information and batch numbers (if applicable).

3.2.2 The surface prior to spraying shall be damp without noticeable free water droplets or running water. Material shall be spray applied to a minimum uniform thickness to insure that all voids and crevices are filled and a smooth.

3.2.3 The application of the liner shall provide a monolithic liner of a minimum of ½". The liner shall be applied to the invert, bench and wall and shall all be equal in thickness as determined by the water table and the product manufacturer. The manhole invert and bench shall be smooth and sloped in the direction of the flow. The manhole bench shall have a gradual slope to the invert. The invert transition to the pipe shall be smooth and shall not impair the flow.

3.2.4 No application shall be made when ambient temperatures are less than 40oF and when freezing is expected within 24 hours unless specific recommendations are made by the manufacturer.

3.2.5 A minimum of 4 hours cure time or more as required by the product manufacturer shall be allowed before returning to active flow. A minimum of an additional two (2) hours of cure time shall be added if the rehabilitated manhole is subject to flows from force mains.

3.3 *Inflow Dish* – Inflow dishes shall be required in every manhole being rehabilitated and installed in accordance with the manufacturer's recommendations.

3.4 *Acceptance* –

3.4.1 Two standard samples shall be taken from each day's work with the date, location and job recorded for each sample. The samples shall be sent to an established, local, and reputable commercial testing laboratory that has been approved by the Owner to determine if lining materials meet minimum requirements specified herein. The cost to perform these tests shall be incidental to the manhole rehabilitation.

3.4.2 Vacuum Testing shall be in accordance with Section 2570 Gravity Sewer Collection System and witnessed by ECUA inspector.

3.4.3 Contractor may be required to perform adhesion tests using a pull-off adhesion tester after product has sufficiently cured. At a minimum, two (2) tests shall be performed on the manhole floor (invert) and three (3) tests shall be performed on the manhole walls. Adhesion (pull) tests shall be performed in accordance with ASTM D4541 test standards.

3.4.4 Spark Testing shall be performed on all Composite Cement and Epoxy System rehabilitated manholes.

3.4.4.1 Rehabilitated manholes shall be tested by the Contractor using high-voltage holiday detection equipment ("spark tester") following the published standards of the National Association of Corrosion Engineers (NACE International), SP0188-2006, to detect cracks, pinholes, thin spots, etc. An induced holiday shall be made on the coated surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at the particular area. The cost to perform these tests shall be incidental to the manhole rehabilitation.

3.4.4.2 The spark tester shall be initially set at 100 volts per one (1) mil of film thickness applied but may be adjusted as necessary or as recommended by the protective coating manufacturer to detect the induced holiday. All detected holidays shall be marked by abrading the protective coating with grit paper or other hand tooling methods and repaired.

3.4.4.3 All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations. All defects shall be promptly repaired and reinspected until satisfactory results are obtained.

3.4.5 Minimum requirements of the corrosion protection coatings and/or lining system are that it be free of the following:

3.4.5.1 Uncured Material

3.4.5.2 Inadequate Thickness

3.4.5.3 Pinholes

3.4.5.4 Blisters

3.4.5.5 Delamination

3.4.5.6 Foreign Matter

3.4.5.7 Unspecified Materials

3.4.6 If test results indicate noncompliance with the specification, the following corrective action may be required of the Contractor:

3.4.6.1 Remove non-compliant systems or components.

3.4.6.2 Replace system or components in 3.4.6.1

3.4.6.2.1 Repair area shall be a minimum size of 4” by 4” square or 2 inches larger than area being repaired, whichever is larger.

3.4.6.2.2 If there are more than 5 repairs per any 3 vertical feet, the complete epoxy layer must be removed and re-applied.

3.4.6.3 Assume the testing expenses.

# Section 2575

# Wastewater Lift Stations

## PART 1: General

1.1 *Scope of Work* – The Contractor shall furnish, install, test and place in operation the lift station shown on the approved drawings and specified hereinafter. All applicable sections of the ECUA Engineering Manual shall be considered part of this work. All references to Industry Standards (ASTM, ANSI, etc.) shall be to the latest revision unless otherwise stated. Only those materials included in the ECUA Engineering Manual, shall be installed. All materials shall be new unless specifically called for otherwise.

1.2 *Oversizing* – For System Extension projects, lift stations at times allow oversizing opportunities due to ECUA system growth patterns and the need to accommodate such growth with efficient planning and design of proposed stations. Oversizing options for lift stations include but are not limited to parcel size, pumping rate, wetwell size, force main size, etc. All oversizing decisions should be made by ECUA during the review process in accordance with Procedure 6 – Oversizing, and shall be documented in the Utility Service Agreement for the applicable project.

1.3 *Permits* – The Contractor shall secure and pay for all plumbing, electrical, right-of-way and other required permits and make application for electric and water meter. The Contractor shall be responsible for all costs associated with utilities used during construction and testing of the lift station.

1.4 *Pre-Construction Submittals* – ECUA requires at a minimum four types of submittals to be submitted, reviewed, and approved prior to the Contractor commencing lift station work. These submittals are Schedule of Submittals, Work Schedules, Delegated Engineering Documents, and Shop Drawings.

1.4.1 *Schedule of Submittals* – Contractor shall prepare a Schedule of Submittals that lists each Submittal requiring submission along with expected timeframes for submittal dates, along with reasonable review time for the Engineer of Record and ECUA.

1.4.2 *Work Schedule* – Contractor shall prepare and submit a detailed Work Schedule identifying critical project timelines, to include but not be limited to:

1.4.2.1 Site clearing date and excavation date for wetwell.

1.4.2.2 Wetwell delivery date and installation date.

1.4.2.3 Pump delivery date and installation date.

1.4.2.4 Control panel delivery date and installation date.

1.4.2.5 Start-up date and final inspection date.

1.4.2.6 Other critical timelines that control the Work Schedule.

1.4.3 *Delegated Engineering Documents* – The EOR plans, ECUA Engineering Manual, and contract/agreement language contain various performance and design criteria requiring the Contractor to provide professional design services in the form of Delegated Engineering Documents. The Contractor shall:

1.4.3.1 Coordinate the complete assemblage of all required Delegated Engineering Documents per requirements set forth here and in ECUA's Lift Station Design Standard Drawings. Contractor shall supply 6 full-size sets of engineering design drawings, each section being signed and sealed by the appropriate Delegate Engineer (Professional Engineer registered in Florida). Provide design calculations and supporting information on 8 ½" x 11" size documents.

1.4.3.2 Title sheet of Delegated Engineering Documents shall include the following certification and shall be signed by the Contractor:

*I certify that I have thoroughly reviewed the contents of these Delegated Engineering Documents for completeness and that the designs meet the requirements of the Contract Drawings and Specifications, and that any deviations are clearly listed and marked, and are hereby approved by me and are submitted for review and approval*.

Certified by: ______________________ Date: _____________

1.4.3.3 Provide engineered design for fiberglass wetwell to satisfy load rating requirements and manufacturing conformance to ASTM D3753.

1.4.3.4 Provide engineered design for pump mounting baseplate to satisfy ECUA minimum baseplate requirements found in the Design Standard Drawings, as well as pump weight, thrust, torque, vibration, stress, etc.

1.4.3.5 Provide engineered design for wetwell's concrete anti-flotation base to satisfy anti-flotation needs and structural support for bottom of wetwell per manufacturer's requirements.

1.4.3.6 Provide engineered design for wetwell's concrete cover to satisfy design load rating requirements.

1.4.3.7 Provide engineered design for control panel's concrete base to satisfy control panel dimensions, wind load, etc.

1.4.3.8 Provide engineered design for control panels as outlined in ECUA's Lift Station Design Standard Drawings.

1.4.3.9 Provide engineered design for work light and security light poles and base.

1.4.3.10 If applicable, provide engineered design for concrete pole and base used for SCADA antenna to satisfy wind load based on proposed antenna height.

1.4.4 *Shop Drawings (includes Product Data sheets)* – Contractor shall coordinate the assemblage of all catalog data, brochures and descriptive literature for materials and equipment that will be used on the project. The Contractor shall:

1.4.4.1 Provide 6 sets, and review and approve all shop drawings prior to submittal to the Engineer and ECUA for review. As part of the review, the Contractor shall certify the following and include this statement on each submittal:

*I certify that I have thoroughly reviewed the contents of these Shop Drawings for completeness and that the materials and equipment shown meet the requirements of the Contract Drawings and Specifications, and that any deviations are clearly listed and marked, and are hereby approved by me and are submitted for review and approval*.

Certified by: ______________________ Date: _____________

1.4.4.2 Provide sample warranty certificates for pumps, wetwells, hatches, etc.

1.4.4.3 Provide aluminum hatch information, including sizes and locations, and safety grating information.

1.4.4.4 Provide certified pump test curves. See Section 3.5 for required factory testing requirements.

1.4.4.5 Provide pump cables, pump materials, and lifting bale information.

1.4.4.6 Provide base elbow and guide rail system information.

1.4.4.7 Provide plug, gate, air-release, and check valve information.

1.4.4.8 Provide backflow prevention device information.

1.4.4.9 Provide 316 stainless steel riser piping and fittings information.

1.4.4.10 Provide pipe bracing information.

1.4.4.11 Provide float and float hangar rod assembly information.

1.4.4.12 Provide level transducer information.

1.4.4.13 Provide flow meter information (if applicable).

1.4.4.14 Provide pressure transducer and transmitter information.

1.4.4.15 Provide pipe supports and location schematic information.

1.4.4.16 Provide miscellaneous mechanical parts information.

1.4.5 *EOR's and ECUA's Review* – Review will be performed in accordance with the agreed upon Schedule of Submittals for general conformance with the Contract Documents.

1.5 *Quality Assurances* – Comply with the latest published editions of AWWA and ASTM Standards:

| | |
|---|---|
| AWWA C515 | Gate Valves for Water & Sewerage Systems |
| AWWA C509 | Swing Check Valves for Waterworks |

| | |
|---|---|
| AWWA C151 | Ductile Iron Pipe |
| ASTM A746 | Ductile Iron Pipe |
| ASTM C478 | Concrete Pipe Manholes |
| ASTM D2241 | Poly Plastic Pipe |
| ASTM F477 | Elastomeric Seals for Plastic Pipe |

## PART 2: General Requirements

2.1 *Project Schedule and Cooperation* – The project schedule shall be established on the basis of working a normal work schedule. Unless approved otherwise by ECUA, normal or general items of work such as setting wet well, field pump test, density testing and final inspections, shall be scheduled during the normal work schedule. Due to operational and manpower limitations on the ECUA systems, ECUA may require the Contractor to perform work outside of the normal work schedule in order to minimize customer service outages or due to physical system limitations. The Contractor shall plan and anticipate the cost impact of these systems limitations and provide such work or services at no additional cost to ECUA. Unless approved otherwise, an ECUA representative shall be present to observe the excavated area prior to setting (installing) the wet well. The date and time for setting (installing) the pre-cast or fiberglass wet well shall be reviewed and approved by ECUA, prior to the actual work.

2.2 *As-Built Drawings* – As-built drawings are required on all sewer, force main and pump station projects, including projects for ECUA, City of Pensacola, Escambia County, DOT, private developments, and other Authorities, etc. As-built drawings shall be reviewed and approved by ECUA. The cost to provide as-built drawings shall be included as part of the related work requirements or general conditions for the utility work. Contractor shall submit “As Built” drawings and operation and maintenance manuals before lift station start-up, no exceptions.

2.3 *Workmanship* – All work shall be constructed in accordance with the EOR’s design drawings, the Delegated Engineering Drawings, the ECUA Engineering Manual, and applicable contracts and/or agreements.

2.3.1 *Materials* – All material shall be free from defects impairing strength and durability and be of the best commercial quality for the purpose specified. All defects disclosed by tests and inspections shall be remedied immediately by the Contractor with no additional compensation.

2.3.2 Unless indicated otherwise on the drawings, all metal components in the wet well, with the exception of pumps and motors shall be 316 stainless steel as specified herein or on the plans.

2.3.3 The pumps, motors and guide rail system shall be supplied by the pump supplier to ensure unit compatibility.

2.3.4 Station piping shall conform to ECUA Water and Sewer Standards. Specifically, station piping shall be as follows:

2.3.4.1 Piping within the wet well shall be flanged schedule 10 316 stainless steel, (intermediate joints shall be welded). Fittings within the wet well shall be flanged 316 stainless steel. All nuts, bolts and accessories within the wet well shall be 316 stainless steel. All stainless steel bolts, washers and nuts shall be coated with anti-seize compound.

2.3.4.2 Pipe and fittings outside of the wet well and above ground shall be 316 stainless steel (flanged, schedule 10). All fabricated fittings shall be constructed to ANSI dimensions. If a spool piece is required, the length of the "run" or "through" dimension of a standard tee fitting of equal diameter to facilitate emergency replacement. Any variance shall be pre-approved by ECUA prior to installation. All bolts, washers and nuts shall be 316 stainless steel and shall be coated with anti-seize compound.

2.3.4.3 Force main piping below ground, outside of the wet well shall be in accordance with Section 2576-"Sanitary Sewer Force Mains" of this standards manual.

2.4 *Reference Points and Layout* – The Contractor shall be responsible for setting all grade stakes, lines and levels. The Contractor or Contractor's Surveyor will provide centerline of construction and will establish a bench mark. Any reference points, points of intersection, property corners, or bench marks, which are disturbed during construction, shall be restored by a Land Surveyor registered to practice in the State of Florida, and all costs thereof shall be borne by the Contractor. The Contractor shall assume all responsibility for the correctness of the grade and alignment stakes.

**PART 3: <u>Submersible Pumps</u>**

3.1 *Pump Selection* – Pumps shall be selected from the ECUA approved *Pump Selection Worksheet* as incorporated into the plans. Alternate pump options may or may not be considered by ECUA. At no time shall a pump be used without the pre-approval of the ECUA and Engineer of Record.

3.2 *Pump Equipment* – Pumping equipment shall be premium quality submersible non-clog pumps for sewage service. Equipment furnished and installed shall be fabricated, assembled, erected and placed in proper operating condition in full accordance with approved drawings, specifications, engineering data, instructions and recommendations of the equipment Manufacturer, unless exceptions are noted and approved by ECUA. Submersible pumps shall be complete with a submersible electric motor, floor-mounted discharge base and elbow, guide rails, motor electrical cable (minimum 50 feet in length) to connect at the control panel, disconnect, or junction box (no splicing allowed) and all other appurtenances specified or otherwise required for proper operation. Supplied pump cables are not to be trimmed without prior authorization. If trimmed, ECUA Lift Station Maintenance Staff must witness.

3.3 *Lifting Bale* – Pump removal shall be facilitated by a lifting bale only, no chains or cables are allowed unless specifically noted by ECUA. Lifting bales shall be stainless steel and shall be easily "hooked" from the top of the wet well. Lifting bale shall be designed for the full weight of the pump with a safety factor of 1.6.

3.4 *Service Conditions* – Pump performance shall be stable and free from cavitation and excessive vibration and noise throughout the specified operating head range at minimum suction submergence. Pump shall be designed so that reverse rotation at rated head will not cause damage to any component.

3.5 *Solids Handling Pumps* –

3.5.1 *Impeller* – The impeller casing shall have well-rounded water passages and smooth interior surfaces free from cracks, porosity, blowholes, or other irregularities. The impeller shall be a semi-open or enclosed one-piece casting and must pass a minimum 3-inch solid sphere. Vortex impellers may be used with prior authorization from ECUA staff on a case-by-case basis. The interior water passages shall have uniform sections and smooth surfaces and shall be free from cracks and porosity. The impeller shall be dynamically balanced and securely locked to the shaft by means of a key and self-locking bolt or nut. All interior surfaces of the wet end (impeller, volute and back plate) shall be coated with Belzona 1321 Ceramic S-metal. Hardened metallurgy may be required in sewer collection areas that are known to have a high grit content. Coatings shall be applied in accordance with coating Manufacturer's recommendations. The pump impellers shall be re-balanced after being trimmed and coated.

3.5.2 *Mechanical Seals (Upper and Lower Seals)* – Pumps shall have mechanical seals, which shall require neither maintenance nor adjustment and shall be readily accessible for inspection and replacement. The seals shall not rely upon the pumped media for lubrication and shall not be damaged if the pump is run un-submerged for extended periods while pumping under load. Mechanical seals shall be solid hard faced, (not laminated type). The bottom and top seals shall be silicon carbide.

3.5.3 *Mating Surfaces* – All mating surfaces (pump assembly), of major components shall be machined and fitted with O-rings where watertight sealing is required.

3.5.4 *Wear Rings* – Impeller and volute must have stainless steel wear ring system (except vortex impellers). Impeller wear ring shall be 350 series Brinnell hardness, minimum, and volute wear ring shall be 400 series Brinnell hardness, minimum. Wear rings may not be required if hardened metallurgy components are utilized.

3.5.5 *Discharge Base and Elbow* – The pump Manufacturer shall furnish a discharge base and discharge elbow for the pump supplied. The base shall be sufficiently rigid to firmly support the guide rails, discharge piping and pump under all operating conditions. The base shall be bolted to the pump mounting baseplate designed for the wetwell. All bolts shall be supplied with a fender and lock washer. The face of the discharge elbow inlet flange shall make contact with the face of the pump discharge nozzle flange. The discharge elbows will be coated with Belzona 1321 Ceramic S-metal on the inside. The pump and motor assembly shall be a "quick disconnect" type connected to and supported by the discharge base and guide rails allowing the pump to be removed from the wet well and replaced without the need for unbolting any flange or requiring personnel to enter the wet well. Pump shall be provided with a sealing flange and guide rail sliding bracket. The bracket shall be designed to obtain a leak proof seal between flange faces as final alignment of the pump occurs in the connected position. The bracket shall maintain proper contact and a suitably sealed connection between flange faces under all operating conditions. Metal to metal mating surfaces are unacceptable. Pump discharge base elbow shall be leveled, plumbed and aligned into position to fit connecting piping. The discharge base elbow shall be solidly secured to the wet well floor per the pump mounting baseplate design. This work shall be inspected by ECUA prior to any liquid being allowed into the wet well. After final alignment and bolting, pump discharge base elbow and all connections shall be inspected. If any movement or opening of any joints is observed, any and all piping, including pump discharge base elbow, shall be corrected.

3.5.6 *Motors* – The pump shall be driven by a totally submersible electric motor rated for service utilizing an adjustable-speed drive (VFD). Pump motor shall be of sufficient horsepower as to be non-overloading over the entire length of the pump curve unless the plans state otherwise. The stator housing shall be a watertight casing. Motor insulation shall be moisture resistant, Class H, at a minimum. Motor shall be NEMA Design B for continuous duty at 40°C ambient temperature and designed for at least 10 starts per hour. All motors shall be 3 phase unless preapproved by ECUA. Motor bearings shall be anti-friction, permanently lubricated type. Motor shall be oil-cooled and designed to operate in a totally or partially submerged condition without damage to the motor. Pump cable assembly shall bear a permanently embossed code or legend indicating the cable is suitable for submerged and hazardous duty use. Cable sizing shall conform to NEC requirements. The cable shall enter the pump(s) through a heavy-duty stainless steel assembly with grommet. An epoxy seal system shall be provided to this cable entrance assembly to achieve water tightness. The system used shall ensure a watertight submersible seal. Cable shall terminate in a junction chamber. Junction chamber shall be sealed from the motor by a compression seal and epoxy dam system. All motors shall be explosion proof. Provide motors that are FM or UL listed for use in Class I Division 1 Groups C&D hazardous locations as defined by the National Electric Code.

3.5.7 *Balance* – All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as possible. Excessive vibration shall be sufficient cause for rejection of the equipment.

3.6 *Factory Testing* – The pump Manufacturer shall perform the following tests on each pump prior to shipment. Pump test report must be provided to the Engineer prior to pump installation.

3.6.1 Megger the pump motor and cable for insulation breaks or moisture intrusion.

3.6.2 Prior to submergence, run pump dry "bump" and check for correct rotation.

3.6.3 Pump shall be run continuously for 30 minutes in a submerged condition, with a minimum submergence of 10 feet.

3.6.4 Monitor vibration and report test results, along with allowable vibration limits per Hydraulic Institute Standards.

3.6.5 Pump shall be removed from test tank, meggered immediately for moisture and all seals checked for water intrusion.

3.6.6 Pumps shall be operated at a minimum of 6 points to establish the hydraulic curve. Variable speed pumps shall be reduced in speed in increments of 200 rpm down to the minimum speed and operated at a minimum of 6 points to establish the hydraulic curves for each of the speeds. KW input shall be monitored and recorded. One test point shall be performed with discharge valve closed. Pumps shall develop appropriate capacity and head within Hydraulic Institute Standards without excessive noise or cavitation.

3.6.7 For pumps less than 100 HP, the pump supplier shall submit copies of certified Hydraulic Institute test reports including factory pump curves for each individual pump provided to ECUA.

3.6.8 For pumps 100 HP and greater, the above certified pump performance test (at a minimum) must be completed on each actual pump supplied. An ECUA representative(s) may be required to witness the certified test (ECUA's travel expenses by ECUA).

3.7 *Guide Rails* – Pump shall be equipped with two guide rails (no cable wire assembly). Guide rails shall be minimum schedule 40 pipe, 316 stainless steel, minimum of 2-inches in diameter and sized to fit the discharge base and the sliding bracket and shall extend upwards from the discharge base to the access hatch cover at the top of the wet well. Provide a minimum of three 316 stainless steel rail braces, evenly spaced. Add additional rail braces if brace spacing exceeds 10'. Braces secured to the discharge piping shall not be accepted.

## PART 4: <u>Access Hatches</u>

4.1 *Design Coordination* – It shall be the Contractor's responsibility to coordinate with the wet well supplier, pump supplier, and its Delegated Engineer providing concrete cover design on the sizing and placement of the hatches based on pump size and spacing, riser pipe size and location, etc.

4.2 *Hatch Sizing* – Minimum pump access hatch size shall be 36" x 42". Typical float access hatch size shall be 24" x 24". Pump access hatches shall be sized to provide a 4-inch minimum clearance between leafs, frame, safety grates and edge of the pump volutes as measured from all sides, to include the pump and rail system, as pumps are lifted up along guide rails through access hatch.

4.3 *Leafs* – Leafs shall be skid-proof aluminum. Single leafs shall not exceed 48" in width, else provide multiple, equal-sized leafs, each not exceeding 48" in width. Leafs shall be designed with a minimum load rating of 300 pounds per square foot, or higher when called for on the drawings. The leaf may rely upon safety grating for structural support. Load rating shall be affixed to the top of hatch frame. Provide 316 stainless steel spring assist feature for each leaf.

4.4 *Safety Grating* – Provide aluminum safety grating, powder coated in OSHA safety orange, with minimum load rating of 300 pounds per square foot. Grates shall provide openings large enough for visibility while still providing an adequate safety barrier. Provide the same number of grates to match number of leafs. Safety grate hinges shall be installed on same side of frame as leaf hinges. Installation of the safety grating shall be completed by the manufacturer and the hatch assembly shall be delivered complete with safety grating to the jobsite.

4.5 *Frames and Gaskets* – Hatch frames shall be either angle or channel. Hatches shall be gasketed to minimize water intrusion and escaping of odors. Drainage channels not required.

4.6 *Locking Mechanism* – Provide 316 stainless steel exterior locking mechanism as in padlock bar or padlock staple for easy lock access. Locking mechanisms shall not be recessed, nor coffin style, nor slam-lock. ECUA will provide locks.

4.7 *Hinge Locations/Hatch Opening Directions* – For pump access hatch, provide 316 stainless steel hinges on side of opening nearest riser piping exiting through wetwell such that leaf(s) open towards riser piping. The hinges shall be bolted to the leaf(s) with 316 stainless steel carriage bolts and nuts. The nuts shall be welded to the bolts on both leaf(s) and frame. For float access hatch, provides 316 stainless steel hinges on side of opening nearest pump access hatch such that leaf opens toward pump access hatch.

4.8 *Miscellaneous* – All hinges, fasteners and miscellaneous hardware shall be 316 stainless steel. Provide hold-open arms for leafs and grates that automatically engages to hold the leafs and grates in their full upright and locked position. Provide upper guide holder and cable holder.

4.9 *Warranty* – The complete access hatch assembly shall have a limited life time warranty on all components and warranted against defects in material and workmanship.

4.10 *Allowable Manufacturers* – Halliday Products, USF Fabrication.

## PART 5: <u>Valves</u>

5.1 *General* –

5.1.1 The Contractor shall furnish and install check valves, plug valves, and appurtenances as shown on the drawings and as specified in the ECUA Engineering Manual.

5.1.2 The coating system for the valves and appurtenances (as needed) shall be manufactured by Sherman Williams and shall be Tower Gray in color. Surface Preparation shall be based on the guidelines set forth by the Society for Protective Coatings (SSPC) as follows: 1.) New Materials - SP6, Commercial Blast, or 2.) Refurbishing Existing Piping, Valves, and Appurtenances - SP6, Commercial Blast or SP10, Near White Metal depending on level of corrosion and paint damage.

| **Coating for Valves and Appurtenances** | | |
|---|---|---|
| **Level** | **Paint** | **Dry Film Thickness (Microns)** |
| Primer | Macropoxy 646 | 6-9 |
| Intermediate | Macropoxy 646 | 6-9 |
| Top | Acrolon 218 | 2-4 |

In addition, the surface preparation requirements shall be field verified by ECUA Maintenance or Engineering Representatives.

5.1.3 Unless otherwise noted, painting system shall be applied in accordance with the Manufacturer's recommendations.

5.1.4 Tower gray is ECUA's standard color for all above-grade valves. Any variance from these standards must be approved by ECUA Engineering staff prior to application.

5.2 *Check Valves (Lever & Weight Style)* – Check valves shall conform to the requirements of AWWA C508. Check valves larger than 2-inch nominal size shall be iron body with stainless steel bolts and nuts, flanged ends, 316 stainless steel shaft connected to a steel outside lever and weight, swing-type with straight-away passageway of full pipe area. The valve shall have renewable bronze seat ring and rubber-faced disc. Check valves shall be 150 psi working pressure. Any springs shall be 316 stainless steel. It is the responsibility of the contractor/vendor to change all springs to 316 stainless steel. All interior and exterior ferrous surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.

5.3 *Plug Valves (Above Ground Only)* – Plug valves shall be of the non-lubricated, 100 percent port eccentric type with resilient faced plugs with flanged ends, furnished with all necessary joint materials. Valves are to be rated for 150 psi (non-shock working pressure), cast-iron body, nickel seat, and hard rubber Hycar coated plug with a flushing port. Valves shall be installed with the seat on the downstream side of the flow path, to provide a positive seal when closed. Valve shall include hand- wheels for operation. Valves shall be as manufactured by Dezurik. Unless otherwise approved by ECUA, plug valves will not be allowed in direct bury applications. Direct bury valves shall be resilient seated gate valves as specified in Section 2576-"Sanitary Sewer Force Mains" of the specifications. All interior and exterior ferrous surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.

## PART 6: Acceptance Testing

6.1 *Pre-Final Inspection* – Prior to final inspection, the Contractor shall conduct a pre-final site inspection (including energizing each pump), in the presence of an ECUA representative. Any deficiencies noted at this time shall be corrected prior to scheduling of the final inspection.

6.2 *Final Inspection* –

6.2.1 *Scheduling Inspection* – The Contractor shall be responsible for scheduling ECUA representatives, the Engineer, pump representative, control panel representative, and all appropriate subs. The Contractor's request shall be made at least 3 full business days prior to requested inspection date, and shall be confirmed by ECUA based on availability. The Contractor shall furnish all labor, piping, equipment, and materials required to perform the acceptance testing. Contractor shall supply clean water at its own expense via the use of fire hydrant flow meters or the lift station water meter. The pumps shall not be field tested by recirculating water through the wet well.

6.2.2 *Pump Removal* – The Contractor shall demonstrate that the pump mounting and guide rail systems are fully operational. The Contractor shall provide lifting equipment to remove and reinstall the pumps in the presence of the ECUA representative, prior to conducting the performance test.

6.2.3 *Pump Operation* – Pumps shall operate without excessive vibration or overheating. Pumping rates shall be determined by pumping a calculated volume of water in a specified time interval. Water levels during testing shall fall within the pump control levels shown on the drawings. Head and flow conditions shall be measured and recorded on the factory curve and shall include a minimum of three (3) points. Pumps shall deliver rated GPM at rated TDH comparable to system head curve. The test shall be repeated until satisfactory results are obtained. The test results shall be recorded on a Pump Test Report. Pump test data will include the factory curve and the start-up curve. If the Contractor is unable to demonstrate to ECUA that the pumping unit performs satisfactorily, the unit shall be rejected. The Contractor shall then remove and replace the defective unit at its own expense.

6.2.4 *Electrical Testing* – Amperage draws shall be monitored to determine effectiveness and efficiency of equipment. Running amperage shall be noted and recorded on each leg of power cord while pump is operating under full load. All self-test trip relays shall demonstrate ability to simulate a fault condition. Following performance testing, pumps shall be meggered for pump-moisture intrusion.

## PART 7: Water Service / Wash-down Station

7.1 *Water Service* – Water service shall include a 1.5" water meter, service lines, fittings, meter box, backflow preventer hose bibb, and hose rack per detail in Lift Station Design Standard Drawings. ECUA will install the meter. See paragraph below for instructions on applying for meter from ECUA.

7.2 *Water Meter* – The Contractor apply for the water meter by filling out an ECUA water meter application. There is no fee for a water service for an ECUA CIP Lift Station. If ECUA is not the provider of water service, the Contractor/Developer shall be responsible for all installation fees, including but not limited to permitting and tap fees from the water provider. The Contractor shall be responsible for the cost of all water used during construction and testing. The water service account name will then be transferred to ECUA upon final acceptance of the lift station.

7.3 *Backflow Preventer* – The Contractor shall furnish and install a 2 -inch diameter (minimum) reduced pressure backflow preventer which meets the requirements of ECUA's Cross Connection Control Policy and Lift Station Design Standard Drawings.

## PART 8: <u>Operation and Maintenance Manuals</u>

8.1 *Submittals* –

8.1.1 *Coordination* – Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, coordinate and assemble all information furnished by representatives for inclusion into one manual.

8.1.2 *Initial Submittal* – Submit 3 copies of draft manual at least 15 days before final inspection. Include a complete table of contents. Engineer will return 2 copies with comments within 15 days of submission.

8.1.3 *Final Submittal* – Submit 3 copies of corrected manual within 15 days of receipt of Engineer's comments. Each manual shall contain 1 compact disk with pdf file version of full Operation and Maintenance Manual. Each manual shall also include aluminum nameplate for each pump, to include pump model number, serial number, motor size, voltage, flow, TDH, and other pump related data. Nameplate shall be glued to the inside front panel of the manual.

8.2 *Manuals, General* –

8.2.1 *Binders* – Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets. Maximum binder size shall be 3-inches in thickness.

8.2.2 *Organization* – Create sections for each lift station component and/or system

8.3 *Contents* -

8.3.1 Title page

8.3.1.1 Project name, number, address

8.3.1.2 ECUA name and address

8.3.1.3 Submittal date

8.3.1.4 Contractor name, address, and telephone number

8.3.1.5 Engineer's name and address

8.3.2 Table of contents

8.3.2.1 Equipment Information

8.3.2.1.1 Manufacturer's name, product name, model number, serial number

8.3.2.1.2 Equipment function and operating characteristics

8.3.2.1.3 Standard printed data - Include only sheets for installed equipment Mark each sheet to identify equipment incorporated into the Work. If tabular data is included, identify the appropriate equipment incorporated into the Work. Prepare supplementary data if Manufacturers' standard printed data are not available and where additional information is necessary for proper operation and maintenance of equipment or systems.

8.3.2.1.4 Operational data

8.3.2.1.5 Limiting conditions

8.3.2.1.6 Care and maintenance information

8.3.2.1.7 Performance curves

8.3.2.1.8 Engineering data and tests

8.3.2.1.9 Copy of pump data plate

8.3.2.2 Drawings – Include accurate shop drawings, plan drawings, record drawings, Manufacturer's drawings and/or create drawings that correctly illustrate completed installation, Attach reinforced, punched binder tabs on drawings and bind with text. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual.

8.3.2.3 Project Photos: - Include photos of project showing various stages of progression from initial clearing to final construction.

8.3.2.4 Warranties and Bonds – Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds. Include procedures to follow and required notifications for warranty claims.

## PART 9: Warranty

9.1 *Contractor Warranty* – Notwithstanding the longer warranties periods mentioned below, the Contractor shall supply to ECUA a two (2) year unconditional warranty after final acceptance or any designated portion thereof. The warranty shall include materials and installation and shall constitute complete replacement and delivery to the site of materials and installation of same to replace defective materials or defective workmanship with new materials/workmanship conforming to the specifications.

9.2 *Fiberglass Wet Well Manufacturer Warranty* –The fiberglass wet well Manufacturer shall warrant the wet well against defects for at least twenty (20) years after final acceptance of the lift station by ECUA for operation and maintenance. Defects are defined as cracking, delamination or leaking. The warranty shall require the Manufacturer to supply all necessary labor, materials, and equipment to repair defects to the satisfaction of ECUA. The Contractor and/or Manufacturer shall not make any exemption or exception to the above stated conditions or warranty.

9.3 *Pump Manufacturer Warranty* –

9.3.1 The Manufacturer shall warrant to ECUA for permanent installation in municipal sewage service submersible pump and motor against defects in materials and workmanship including normal wear and tear to the following parts for a period of 5 years after final acceptance of the lift station, mechanical seals, bearings, shafts, motor electrical cables and motor stators.

9.3.2 The warranty shall include no less than 100 percent coverage for original equipment manufacturer (OEM) parts and in-shop labor for pump/motor repairs for the full 5 years at NO COST to ECUA. This warranty shall not apply to parts that fail due to abuse, neglect, mishandling, or acts of God.

9.3.3 Verification of guarantees of performance and warranty certificate shall be included in the shop drawing submittal and in the operation and maintenance manuals and disks (Adobe Acrobat or Microsoft Word).

9.3.4 The pump distributor shall employ and make available proficient manufacturer-authorized service technicians to perform service calls to pumps supplied to ECUA. Service personnel shall adhere to all ECUA Safety Rules & Regulations and be trained and certified for confined space entries and carry liability and workers compensation insurance.

9.3.5 During the warranty period, the pump distributor shall, at no cost to ECUA, repair the subject pump. The location address, contact names, phone numbers, (including emergency, mobile, etc.) and fax numbers of the Manufacturer- authorized warehouse and warranty service center shall be indicated in the shop drawing submittal and in the operation and maintenance manuals and disks (Adobe Acrobat or Microsoft Word).

9.4 *Access Hatch Warranty* – The manufacturer shall provide a complete access hatch assembly limited life time warranty on all components and warrant against defects in material and workmanship.

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# Section 2576

## Wastewater Force Main Systems

**PART 1: General**

1.1 *General Description of Work* – Furnish pipe, fittings, and accessories required for wastewater force main systems.

1.2 *Quality Assurance* –

1.2.1 *AWWA Standards* – Construction materials and methods shall comply with the requirements of the latest published edition of American Water Works Association (AWWA) Standards. Applicable standards are listed herein these specifications; any other standards mentioned in the standards listed herein are incorporated by reference.

1.2.2 *ASTM Standards* – In addition, construction materials and methods shall also comply with the requirements of the latest published editions of the American Society for Testing and Materials (ASTM) Standards.

**PART 2: Materials and Equipment**

2.1 *General* – All piping materials shall conform to the "ECUA Pipe Material Chart." Items furnished shall be new and unused. Ductile iron pipe and fittings shall be epoxy lined ductile iron pipe.

2.2 *Delivery, Storage and Handling* – Certificates of compliance with specifications shall be required for all materials used on the project. All materials shall be protected during transportation, storage, handling and installation to avoid physical damage. All materials shall be stored to prevent physical deterioration due to sun and weather. The ECUA reserves the right to reject material, which in any way does not meet the requirements of these Specifications.

2.3 *Low Pressure Sewer Systems* –

2.3.1 For acceptable pipe materials see the "ECUA Pipe Material Chart".

2.3.2 *Valves* – All valves shall be resilient wedge gate valve with mechanical joint ends and a square nut.

2.3.3 *Service Laterals* – Typical Low pressure sewer service laterals for a single family residence shall be 1 1/2-inch green tubing (per "ECUA Pipe Material Chart") with tracer wire (#12 gauge with green insulation). Larger services may be used if approved by the ECUA Engineering Department. Services installed under the roadway shall be encased in 3-inch green PE tubing. See ECUA Standard Detail D-20.

2.4 *Force Mains* –

2.4.1 *Polyvinyl Chloride Pipe (PVC)* – PVC pipe shall meet the designations of the "ECUA Pipe Material Chart". PVC pipe shall be provided with push-on joints with bell integrally cast into pipe, and shall be installed with elastomeric gaskets, as provided in ASTM F477.

2.4.1.1 *Markings* – PVC pipe shall be marked to indicate the following:

2.4.1.1.1 Nominal Pipe Size and OD Base

2.4.1.1.2 Material Code Designation

2.4.1.1.3 Dimension Ratio

2.4.1.1.4 Pressure Class or Pressure Rating

2.4.1.1.5 Manufacturer's Name or Trademark

2.4.1.1.6 Appropriate AWWA or ASTM Designation Number

2.4.1.2 *Color-Coding* – One of the following methods of color-coding the pipe shall be used:

2.4.1.2.1 Force main pipe shall have 3 green stripes (1/2 inch wide) with permanent ink along the entire length of pipe with the word "FORCE MAIN" in 3/4-inch tall letters every 21 inches along each stripe.

2.4.1.2.2 Green pigment to color entire pipe.

2.4.2 *Ductile Iron Pipe (DIP)* – Ductile iron pipe shall meet the designations of the "ECUA Pipe Material Chart" and installed in Class 2 Trenching conditions. Pressure class shall be determined based on bedding class and surface loads as required by AWWA C151. DIP shall be constructed with push-on joints using rubber gaskets in accordance with AWWA Standard C111. Other methods of joint construction, such as mechanical, flanged, or ball-and-socket, may be required in special applications as appropriate.

2.4.2.1 *Coating Pipe* – Ductile iron pipe and steel pipe, fittings and appurtenances **including sleeves, couplings and joints**, shall have the same type of lining as specified herein. Unless otherwise noted, minimum lining thickness (nominal dry film) shall be 40 mils. Interior lining shall be Protecto 401 as manufactured by Induron Coatings (Birmingham, AL); or Permox-CTF as manufactured by The Permite Corp. (Stone Mountain, GA).

2.4.2.1.1 *Manufacturer's Qualifications* –

2.4.2.1.1.1 Provide products from a company specializing in manufacture of high-performance epoxy coatings with a minimum 10 years of experience.

2.4.2.1.1.2 Materials shall be products of a single manufacturer or items standard with manufacture of specified coating materials.

2.4.2.1.1.3 Submit Manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.

2.4.2.1.2 *Applicator's Qualifications –*

2.4.2.1.2.1 Engage a single installer licensed or approved by the Manufacturer with a minimum of three years' experience performing this type of lining installation and with documented skill and successful experience in the installation of ceramic epoxy lining to interior of ductile iron pipe and fittings.

2.4.2.1.2.2 Submit name and qualifications to Engineer.

2.4.2.1.2.3 Submit proof of license or approval of applicator by Manufacturer to Engineer.

2.4.2.1.3 *Shop Surface Preparation –*

2.4.2.1.3.1 Prior to delivery to the application facility, the interior surfaces of the ductile iron pipe, fittings and solid sleeves shall be ground smooth by an abrasive wheel, or equivalent method, of all flakes, ripples, blow holes/bubbles or other casting imperfections by the manufacturer. All internal surfaces of ductile iron pipe and fittings shall be delivered to the application facility without asphalt or any other protective lining on the interior surface. All oils, small deposits of asphalt paint and grease shall be removed in accordance with NAPF 500-03-01 Solvent Cleaning prior to abrasive blasting.

The lining shall be applied by the coating manufacturer's certified firm with a successful history of applying linings to the interior of ductile iron pipe and fittings. The firm shall have a current ISO 9001 Quality Assurance Standard Certification. A written certificate shall be required attesting to the fact that: (1) the applicator met the requirements of this specification, (2) the material used was as specified, and (3) the material was applied as required by the specification.

2.4.2.1.3.2 Uniformly rotary-abrasive blast to a NAPF 500-03-04: Internal Pipe Surface Condition, full removal of annealing oxide layer. When viewed without magnification, the interior surfaces shall be free of all visible dirt, dust, annealing oxide, rust, mold release coating and other foreign mater. The surface shall contain a minimum angular anchor profile of 3.0 mils (76.2 microns).

2.4.2.1.3.3 Coat surface within eight hours of surface preparation.

2.4.2.1.4 *High Voltage Holiday Detection –*

2.4.2.1.4.1 The lining system shall be high voltage discontinuity (spark) tested to determine the presence and number of discontinuities (holidays) in the lining. High voltage discontinuity (spark) testing shall be performed in accordance with ASTM D5162 or NACE SP0188. High voltage discontinuity (spark) testing shall be performed using a Tinker & Rasor model AP/W Holiday Detector (or approved equal) with a voltage setting of 100 volts per mil thickness at minimum. Therefore, High Voltage holiday detection shall be performed at 4,000 volts minimum.

2.4.2.1.5 *Prior to Shipment* – Visually examine all ceramic epoxy lined pipe and fittings for film defects, including any runs, sags, and debris in the film. Shop repairs shall be made in accordance with the Manufacturer's instructions.

2.4.2.1.5.1 All ductile iron pipe and fitting linings shall be checked for thickness using a magnetic dry film thickness gauge. The thickness testing shall be in according with SSPC-PA2 film thickness rating.

2.4.2.1.5.2 The lining installer shall provide written verification that all pipe surfaces have been discontinuity tested as listed below. Verification shall be conducted by a NACE Certificated Coatings Inspector.

2.4.2.2 *Markings* – Each ductile iron pipe joint and fitting shall be marked: (1) with the Manufacturer's mark, (2) to indicate the country where cast, (3) to indicate the weight class or nominal thickness, (4) with the date when pipe produced and date of application of the lining system, and (5) with the letters DI or DUCTILE cast or stamped on the pipe.

All required markings shall be clear and legible, and all cast marks shall be on or near the bell. All letters and numerals on pipe sizes 14 inches and larger shall be not less than ½ inch in height. Ductile iron pipe, fittings and valves shall be marked, striped or coated with green coloring in accordance with paragraph 2.4.1.2 herein.

2.4.2.3 Pipe Design –

2.4.2.3.1 *Design Parameters* – All ductile iron pipes shall be designed and manufactured in accordance with AWWA C150 and AWWA C151, respectively, for the following minimum operating conditions:

2.4.2.3.1.1 The minimum internal design working pressure shall provide/ensure: (1) a 100-psi surge allowance, (2) a safety factor of 2, and (3) a total internal design pressure of 600 psi. No reduction of safety factor for transient pressures shall be allowed.

2.4.2.3.1.2 The external loads design criteria shall be a minimum of 4 foot depth of cover at 120 lbs. per cubic feet soil weight, and live load based on one AASHTO H-20 truck load. The thickness design of ductile iron pipe shall be in accordance with AWWA C150.

2.4.2.3.1.3 The horizontal deflection of epoxy lined ductile iron pipe resulting from external load conditions shall not exceed three percent of the pipe diameter.

2.4.2.3.1.4 For purposes of restrained joint calculations per the Ductile Iron Pipe Research Association (DIPRA) method, the soil classification for both the native trench soil and also the backfill soil to surround the pipe shall be defined with one or more of the following options:

| **Soil Classifications** | | | | | | |
|---|---|---|---|---|---|---|
| Option A | Option B | Option C | Option D | Option E | Option F | Option G |
| Clay 1 | Silt 1 | Clay 2 | Silt 2 | Coh-gran | Sand Silt | Good Sand |

Note: As described in DIPRA's "Thrust Restraint Design for Ductile Pipe," latest edition.

2.4.2.3.2 *Minimum Pipe Class* – Ductile iron pipe shall conform to AWWA C151. All pipes shall have a minimum pressure class of 250 PSI. All pipe shall be made in the United States.

2.4.2.4 *Joint Design* –

2.4.2.4.1 *General* – Ductile Iron pipe and fittings shall be furnished with push-on joints, push-on restrained joints, and flanged joints, as required.

2.4.2.4.2 *Push-on Joints* – Push-on joints shall conform to AWWA C111. Unless otherwise specified, gasket material shall be standard styrene butadiene copolymer (SBR). Push-on joints shall be Fastite, as manufactured by American Cast Iron Pipe Company (ACIPCO), or equivalent. The pressure rating for push-on joints shall be a minimum of 350 psi or the specified pressure rating of the pipe, whichever is less.

2.4.2.4.3 *Restrained Joints* – Restrained joints shall be "Flex-Ring" restrained joints as manufactured by ACIPCO or equivalent. When restrained joints require factory welding, the Manufacturer shall qualify all welding procedures and welders used to produce the product per the requirements of a documented quality assurance system based on ANSI/AWS D11.2. Unless otherwise specified, gasket material shall be standard SBR. Restrained joints and restrained joint pipe shall have a working pressure rating of 350 psi for 3 to 16-inch sizes and 250 psi for 18 to 48-inch sizes. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes. The Manufacturer shall furnish test results showing that restrained joints in the sizes specified have been successfully tested to at least twice the specified pressure rating of the joint without leakage or failure. Tests shall be performed on pipe with nominal metal thickness less than or equal to that specified for the project.

2.4.2.4.4 *Flanged Joints* – Ductile iron pipe and fittings 3 to 54 inches for above ground service or in below ground concrete pits shall have flanged joints and meet the following requirements:

2.4.2.4.4.1 Flanged ductile-iron pipe shall conform to current AWWA/ANSI Specification C115/A21.15 and C110/A21.10 with factory-applied screwed long hub flanges except as otherwise specified hereinafter.

Flanges shall be fully machined faced and drilled after being screwed tight on the pipe, with flanges true to 90 degrees with the pipe axis and shall be flush with end of pipe conforming to ANSI B161.1, 125 pound std. or Class 250, for the purpose intended. No welding of flanges or accessories in the field will be acceptable.

2.4.2.4.4.2 Full face type 1/16 inch thick red rubber ring gaskets shall conform to ANSI A21.11. Ring gaskets shall be of approved composition suitable for the required service.

2.4.2.4.5 *Fittings* –

2.4.2.4.5.1 *General* – Fittings shall be ductile iron in accordance with AWWA C110, AWWA C153, or AWWA C606, latest revisions. The manufacturer's name shall be cast or stamped on the fitting. All markings on fittings shall be clear and legible and shall be not less than 0.5-inch in height.

2.4.2.4.5.2 *Lining* – Fittings shall be internally lined with ceramic epoxy as specified in Section 2.4.2.1.

2.4.2.4.5.3 *Buried Service Fittings* – Fittings shall be provided with flex ring joint bells or spigots or their equivalent. Fittings, sizes 4 - 24 inches shall be rated for 350 psi working pressure. Fittings, sizes 30 - 64 inches shall be rated for 250 psi working pressure.

2.4.2.4.6 *Welded-on Outlets* –

2.4.2.4.6.1 *Outlet Size and Parent Pipe Size* – Welded-on outlets shall be limited to branch outlets having a nominal diameter not greater than 70 percent of the nominal diameter of the main line pipe or 36 inches, whichever is smaller, with all fabrications subject to further requirements of the following specification with regard to design and manufacture. The Manufacturer shall have the capability to furnish welded-on outlets as a radial (tee) outlet, tangential outlet, or lateral outlet fabricated at a specific angle to the main line pipe (in 15 degrees increments between 45 degrees and 90 degrees from the axis of the main line pipe), as indicated on the drawings. Welded-on outlets shall be fabricated by the pipe Manufacturer at the same facility where the pipe is produced. The pipe Manufacturer shall have a minimum of five years of experience in the fabrication and testing of outlets of similar size and configuration.

2.4.2.4.6.2 *Outlet Joint Types* – The joints on welded-on branch outlets shall meet, where applicable, the requirements of AWWA C111 and/or AWWA C115.

2.4.2.4.6.3 *Design* –

2.4.2.4.6.3.1 The pipe wall thickness and weld reinforcement design for welded-on outlet fabrications shall be based on a method similar to that which is described in Section 13 of AWWA Manual M11 for similar welded outlets on steel pipe (which in turn refers to Section VIII of the ASME Unfired Pressure Vessel Code for design method details). Reinforcing welds shall be placed using Ni-Rod FC 55-0 cored wire, Stoody Castweld Ni 55-0 cored wire, or Ni-Rod 55-0 electrodes manufactured by INCO Alloys (or an electrode with equivalent performance properties). Carbon steel electrodes are not acceptable. Upon request, the Manufacturer shall provide test results indicating typical mechanical properties of the utilized weld material (an all-weld sample), as well as typical mechanical properties from transverse tensile and impact specimens machined from butt-weld joined ductile iron pipe coupons to show the suitability or equivalence of the electrodes used.

2.4.2.4.6.3.2 Parent pipe and branch outlet candidate pipe shall be centrifugally cast ductile iron pipe designed in accordance with AWWA C150 and manufactured in accordance with AWWA C151. Minimum classes for parent and outlet pipe shall be: for sizes 4 - 54 inches, Special Thickness Class 53; for sizes 60 - 64 inches, Pressure Class 350.

2.4.2.4.6.3.3 All welded-on outlets 6 - 30 inches shall be rated for a working pressure of 250 psi. Welded-on outlets 36 inches and larger shall be rated for 200 psi. Welded-on outlets of all diameters and configurations must have a minimum safety factor of 2.5 based on proof of design hydrostatic test results. The Manufacturer shall, at the request of the Owner or Engineer, provide representative proof test data confirming the design, hydrostatic test results, and safety factors.

2.4.2.4.6.3.4 Prior to the application of any coating or lining in the outlet area, all weldments for branch outlets to be supplied on this project shall be subjected to an air pressure test of at least 15 psi. Air leakage is not acceptable. Any leakage shall be detected by applying an appropriate foaming solution to the entire exterior surface of the weldment and adjoining pipe edges or by immersing the entire area in a vessel of water and visually inspecting the weld surface for the presence of air bubbles. Any weldment that shows any signs of leakage shall be repaired and retested in accordance with the Manufacturer's written procedures.

2.4.2.4.6.3.5 Application shall be performed by an applicator approved by the lining Manufacturer, in accordance with Manufacturer's instructions and under controlled conditions at the applicator's shop or the pipe Manufacturer's plant. Applicator shall submit a certified affidavit of compliance with Manufacturer's instructions and requirements specified herein.

2.4.2.5 *Outside of Ductile Iron Pipe* – The options for protection of the exterior of ductile iron pipe, fittings, etc. shall consist of one of the following: (1) standard shop coating and annealing oxide layer, (2) standard coating and annealing oxide layer plus polyethylene-encased, (3) epoxy coating, or (4) epoxy coating plus heat shrink sleeves. Options (1) and (2) are typically used for buried pipe. Option (3) is typically used for pipe that is exposed, above grade. Option (4) is typically used in exposed locations where the presence of corrosive conditions may be present (e.g. ARV vaults)

2.4.2.5.1 *Standard Coating* – Coating type and amount per the requirements of the pipe and appurtenance Manufacturer.

2.4.2.5.2 *Encasement* – DIP shall be encased in the specified polyethylene material as indicated on the project plans. Where DIP is to be installed in locations where polyethylene encasement has not been identified on the plans, it shall be the Contractor's responsibility to retain a Florida licensed Professional Geotechnical Engineer or Ductile Iron Pipe Research Association (DIPRA) recognized soil testing firm to determine the location(s) where polyethylene encasement of the DIP is required, in accordance with ANSI/AWWA C105, Appendix A, latest edition and DIPRA DDM procedures. Copies of the reports or studies determining the locations for DIP polyethylene encasement shall be furnished to the Owner and Engineer prior to the start of DIP installation and be available onsite with the Contractor.

DIP shall be encased in 4 mil HDCL or 8 mil LLD polyethylene material in accordance with ANSI/AWWA Standard C105, using Encasement Method A (tube wrapped).

2.4.2.5.3 *Location Information* – The installed locations of polyethylene encasement of the DIP shall be documented on the final as-built project plans.

2.4.2.5.4 *Epoxy Exterior Coating* –

2.4.2.5.4.1 *Shop Surface Preparation* – Abrasive blast to remove loose annealing oxides, all rust and other contaminants. All surfaces shall have a minimum surface profile of 1.5 mils.

2.4.2.5.4.2 *Field Surface Preparation* – All abraded areas shall be abrasive blasted to remove all loose rust and shall result in a surface preparation equal to that listed above. All edges shall be feathered. All other surfaces shall be abraded to provide a sufficient surface profile for the proposed finish coat(s).

2.4.2.5.4.3 *Coating* – Utilize products by Sherwin Williams, SherGlass FF Epoxy for exposed piping, either above grade or within underground vaults, pits, etc. For pipe remaining exposed above ground, top-coating with a urethane (Acrolon Ultra) for color and gloss retention is required. The table below does not include the standard shop applied primer coating.

| **Approved Coating Products** | | | |
|---|---|---|---|
| **Coat** | **Product** | **Color** | **Dft** |
| 1st | * SherGlass FF Epoxy ** | White | 10.0 – 20.0 |
| 2nd | * SherGlass FF Epoxy ** | White | 10.0 – 20.0 |
| Final | * Acrolon Ultra ** | Green | 2.0 – 3.0 |

* Lining to be applied in a single coat

** Or approved equivalent

2.4.2.5.4.4 *Discontinuity Testing* – After cure of the lining, all surfaces shall be high voltage holiday tested in accordance with NACE RPO 188 (latest edition) and the recommendations of the Manufacturer.

2.4.2.5.5 *Heat Shrink Sleeves* – Heat shrink sleeve shall consist of a cross-linked and pre-stretched sheet (coated with a protective heat-sensitive adhesive) which, upon heating, will shrink to its original length. The sleeve adhesive will achieve the corrosion protection by preventing moisture and air ingress to the pipe surface. Further, the adhesive shall act to hold and anchor the backing around the joint through adhesion to the substrate and the backing. Careful attention required concerning the compatibility of the sleeves with pipe coatings. AWWA C216 covers the material and application requirements of heat-shrinkable cross-linked polyolefin coatings for the exterior of special sections, connections, and fittings for steel pipelines.

2.4.3 *Polyethylene Pipe (PE)* – The pipe supplied under this specification shall be high performance, high molecular weight, high density polyethylene pipe and shall conform to "ECUA Pipe Material Chart". All pipe resin shall be manufactured by the same company that manufactures the pipe itself in accordance with these specifications to ensure complete resin compatibility and total product accountability. The fittings shall be molded or manufactured from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe. To ensure compatibility of polyethylene resins, all fittings supplied under this specification shall be of the same manufacturer as the pipe being supplied.

| **Typical Physical Properties Of PE Pipe** | | | |
|---|---|---|---|
| Property | Test Method | Unit | Value |
| Density | ASTM D1505 | gms/cc | 0.957 |
| Melt Flow | ASTM D 1238 (190/21.60) | Gms/ 10 min. | 1.5 |
| Environmental Stress Cracking Resistance | | | |
| Condition A, B & C, $F_0$ | ASTM D1693 | hrs. | >5000 |
| Compressed Ring, $F_0$ | Proposed ASTM | hrs. | >5000 |
| Tensile Strength, Ultimate | ASTM D 638 | psi | 5000 |
| Type IV Specimen | (2"/min.) | | |
| Tensile Strength, Yield | ASTM D 638 | psi | 3500 |
| Type IV Specimen | (2"/min.) | | |
| Elongation at Break<br>Type IV Specimen | ASTM D 638<br>(2"/min.) | % | >600 |
| Impact Strength<br>Specimen Thickness 0.125 inch | ASTM D 256<br>Method A | ft.lbs./inch<br>notch | >12 |
| Vicat Softening Temperature | ASTM D 1525 | °F | 257 |
| Brittleness Temperature | ASTM D 746 | °F | <-180 |
| Flexural Modulus | ASTM D 3350 | psi | 125,000 |
| Hardness | ASTM D 2240 | Shore D | 65 |
| Coefficient of Linear Thermal Expansion<br>Molded Specimen | ASTM D 696 | in./in./ °F | 8.3x10-5 |
| Extruded Pipe | | | 1.2x10-4 |
| Thermal Conductivity | Dynatech-Colora | TRU, in./ | 2.7 |

| | | | |
|---|---|---|---|
| | Thermoconductor | ft.2/hrs./ °F | |
| Long Term Strength | | | |
| 73°F | ASTM D 2837 | psi | 1600 |
| 140°F | | psi | 800 |
| Material Cell Classification | ASTM D 3350 | | 355434C |
| Material Designation | PPI | | 3408 / 4710 |

2.4.3.1 *Quality Control* – Refer to the following guidelines regarding quality control:

2.4.3.1.1 The resin used for manufacture of the pipe shall be manufactured by the pipe Manufacturer, thus maintaining complete control of the pipe quality. The pipe shall contain no recycled compound except that generated in the Manufacturer's own plant from resin of the same specification and from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects, and shall be identical in color, density, melt index, and other physical properties.

2.4.3.1.2 Approved Manufacturers shall be Performance Pipe (A Division of Phillips Chemical Company), others as approved by ECUA in writing. The Engineer may request, as part of the quality control records submittal, certification that the pipe produced is represented by the quality assurance testing. Additionally, test results from Manufacturer's testing or random Manufacturer's representation, may be cause for rejection of pipe represented by the testing. These tests may include density and flow rate measurements from samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM D 3350, 10.1.9.

2.4.3.1.3 *Verification* – The Owner or the specifying Engineer may request certified lab data to verify the physical properties of the materials supplied under this specification or may take random samples and have them tested by an independent laboratory.

2.4.3.1.4 *Rejection* – Polyethylene pipe and fittings may be rejected for failure to meet any of the requirements of this specification.

2.4.3.1.5 *Pipe Dimensions* –

2.4.3.1.5.1 All 3-inch polyethylene pipe for force main installation supplied under this specification shall have nominal iron pipe size (IPS) O.D. size unless otherwise specified. Pipe shall have a Standard Dimension Ratio (SDR) of 11 unless otherwise specified.

2.4.3.1.5.2 All 4-inch & larger pipe supplied under this specification shall have a nominal DIPS (Ductile Iron Pipe Size) O.D. unless otherwise specified. Pipe shall have a DR of 11 unless otherwise specified.

2.4.4 *Stainless Steel Pipe and Fittings* –

2.4.4.1 Stainless steel pipe and fittings shall be Schedule 10 minimum, iron pipe size (IPS), of the nominal diameter shown on the Contract Plans. Transition to ductile iron pipe size (DIPS) outside diameter(s) shall be as shown on the Contract Plans. The stainless steel pipe and fittings shall be AISI 316L and comply with ASME/ANSI B 36.10, ASME/ANSI B36.19M, AWWA C220, latest editions and all applicable ASTM Standards.

2.4.4.2 All welded fabrication of pipe and fittings shall be in accordance with ANSI/AWS D10.4, latest edition. All welds shall be free from cold spots, pin holes, oxide inclusions, burrs, snags, rough projections and other defects. Welding shall be by AWS certified welders for austenitic chromium-nickel stainless steel pipe and tubing.

2.4.4.3 Flanged joints shall comply with AWWA/ANSI B16.5 Standards, latest edition.

2.5 *Force Main Appurtenances* –

2.5.1 *Force Main Fittings for PVC & Ductile Iron Pipe* – Force main fittings shall include tees, wyes, bends, reducers, and other appurtenances commonly used in pipe construction. Fittings shall meet AWWA Standard C110 or C153 with pressure ratings of not less than that specified for adjacent pipe. Fittings shall be constructed with mechanical joints, unless otherwise specified, and shall be supplied complete with low alloy steel bolts and nuts, EPR gaskets and other necessary parts required for field assembly. Fittings shall be ceramic epoxy lined as specified in paragraph 2.4.2.1. The manufacturer's name shall be cast or stamped on the fitting. All markings on fittings shall be clear and legible and shall be not less than 0.5-inch in height.

2.5.2 *Force Main Fittings for HDPE Pipe* –

2.5.2.1 Mechanical connections of HDPE pipe (4 inch and larger) to ductile Iron or PVC piping, mechanical joint fittings, or valves shall be through a self-restraining, fusible mechanical joint adapter. Mechanical joint adapter shall be the same SDR rating as the pipe. Provide the mechanical joint adapter, including but not limited to longer tee bolts and all thread rods with nuts at the mechanical joint bell.

2.5.2.2 Mechanical connections of HDPE pipe sized under 4 inches to ductile iron or PVC piping, mechanical joint fittings, or valves shall be through the use of the above specified mechanical joint adapter if available. As an alternate, transition fittings of HDPE by male iron pipe threaded end installed by butt fusion may be used.

2.5.2.3 Polyethylene pipe and fittings may be joined using approved electro fusion couplings. Fittings shall be PE3408 HDPE. Electro fusion fittings shall have a pressure rating equal to the pipe.

2.5.3 *Pipe Cut-in Sleeves* – Cut-in sleeves shall be solid ductile iron, one end plain for insertion to female fitting, the other end flanged mechanical joint, furnished with loose attaching flange and fastener, nominal length of 20 – 21 inches. Rings and gaskets shall be sized to conform to the requirements of the pipe Manufacturer.

| Approved Manufacturers | | |
|---|---|---|
| **Manufacturer** | **Model** | **Application** |
| Clow | F-1220 | for centrifugally cast or sand cast pipe (special) |
| | F-3459 | for all classes of centrifugally cast pipe |
| Union Foundry | 21-4520<br>21-4610<br>24-4800 | MJ X PE<br>FLG X PE<br>MJ X FLG |
| Others as approved by ECUA in Writing | | |

2.5.3.1 *Repair Clamps* – Repair clamps shall not be used in the installation of new pipe except with the written permission of the Engineer. Repair clamps shall be full circle and selected based on the following table.

| Repair Clamp Sizes | |
|---|---|
| **Pipe Diameter** | **Maximum Sections** |
| Up to 12” | Single Section |
| 14” to 24” | Double Section |
| 26” and above | Multi Section |

Repair clamps shall be composed of stainless steel bands and corrosion resistant bolts, SS lugs and full gridded virgin EPR compounded gasket.

Repair clamps shall be sized so that the OD of the existing pipe being repaired falls within the designated range for the clamp size. For pipes with diameter less than 42 inches, repair clamps shall have a minimum length of one (1) times the diameter of the pipe to give full gasketing at both ends. For pipes with diameter equal to or greater than 42 inches, minimum length is 36 inches.

| Approved Manufacturers (diameters equal to or less than 24”) | |
|---|---|
| **Manufacturer** | **Model** |
| Ford | FS series (all SS) |
| JCM | 101,102,103,104,131,132,133,134 |
| Others as approved by ECUA in writing. | |

NOTE : See Manufacturer’s catalog to complete model numbers by size

| Approved Manufacturers (diameters greater than 24”) | |
|---|---|
| **Manufacturer** | **Model** |
| PowerSeal | 3123AS |
| Others as approved by ECUA in writing. | |

2.5.4 *Pipe Restraints* – With advance approval by Engineer of Contractor’s request for substitution or where shown on drawings, retainer glands may be used in lieu of Flex-Ring or equivalent system on force main fittings and appurtenances. Such Mechanical Restraint systems shall be provided with 304 stainless steel bolts. Stainless steel all-thread tie rods may possibly be used with the advance approval of the Engineer. In cases of tees, tapping sleeves, and flushing hydrants up to 12 inches, the fitting may be restrained with thrust blocks. The manufacturer's name shall be cast or stamped on the unit. All markings shall be clear and legible and shall be not less than 0.5-inch in height. See ECUA Standard Details D-52 and D-62.

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Model** |
| EBAA Iron Works | MegaLug |
| Star Pipe Products | StarGrip Series |
| Ford | UNI-Flange UAI, UBI, UI, 1300, 1340, 1390, 1400 |
| Tyler Union | TufGrip |
| Romac Industries, Inc. | Roma-Grip Series |
| Sigma | SLC, SLD, PVP |
| SIP Inc. | EZD, EZP, PTP, PTPDF, PTPFC |
| Others as approved by ECUA in writing. | |

2.5.5 *Expansion Joints* – Expansion joint fittings shall be used where specified on the Construction Plans. They shall be of the rigid or flexible type as specified, and manufactured of ductile iron in accordance with 2.4.2 above. They shall be capable of expanding or contracting to the extent shown on the plans, but in no case less than 4 inches axially, and designed to prevent separation beyond the maximum extension without the use of external tie rods.

2.5.6 *Mechanical Joints* – Fittings shall be provided with restrained mechanical joints, individually pressure tested to a minimum of 350 psi against their own restraints, and internally coated on all exposed surfaces with a minimum of 15-mils of fusion bonded epoxy conforming to AWWA C213. They shall be capable of deflecting not less than 15 degrees by means of an integral ball at each joint in the case of flexible types.

| Approved Manufacturer | | |
|---|---|---|
| **Type** | **Manufacturer** | **Model** |
| Rigid | EBAA Iron, Inc. | EX-TEND 200 |
| Flexible | EBAA Iron, Inc. | Flex-Tend |
| Others as approved by ECUA in writing. | | |

2.5.7 *Tapping Sleeves* – The minimum size tapping sleeve shall be 4 inches. Connection of 3 inch lines to existing pipes 4 inches and larger shall be made by a 4 inch tapping sleeve with appropriate reducing fitting. Tapping saddles shall be used for smaller connections.

Tapping sleeves shall be mechanical joint or fabricated-type designed for a working pressure of 200 psig without leakage. The outlet branch connection shall have a recessed flanged face for connection of tapping valve with standard dimensions in accordance with MSS SP-60. A complete set of neoprene or other elastomer gaskets shall be furnished. Sleeves shall be furnished to fit DIP, cast-iron, cement-asbestos, Class 160 or C900/905 PVC pipe with side connection as shown on plans or specifications in standard pipe sizes of 4 x 4 inch through 16 x 12 inch. Sleeves shall be furnished with all necessary installation parts such as mechanical joint loose flange ends, bolts, fasteners, seals and gaskets. All hardware shall be stainless steel.

| Approved Manufacturers | | |
|---|---|---|
| **Manufacturer** | **Main Material** | **Model** |
| Clow | CI & C900 PVC | F-5205 |
| | Class 50, 100, 150, 200<br>10-inch & 12-inch Class 50, 100 | F-5207 4<br>F-5205 |
| American Darling | CI & C900 PVC<br>CI & CA | 2800C<br>2800A |
| Mueller | CI, DI - 4-inch - 12-inch<br>CA - 4-inch - 8-inch<br>CI Class C & D - 10-inch - 14-inch<br>CA - 4-inch-12-inch | H615<br>H615<br>H616<br>H619 |
| M & H | MJ Class A-B Pipe<br>MJ Class C-D Pipe | 1174<br>1274 |
| Others as approved by ECUA in writing | | |

Note: To specify exact fitting when ordering, state line diameter and line material.

2.5.7.1 *Mechanical Joint Tapping Sleeves* – Mechanical joint tapping sleeves shall be stainless steel with mechanical joint main ends and a standard special dimension tapping machine attaching flange on the branch connection. The sleeve shall be of split configuration and fabricated in accordance with AWWA Specification C110 with joints to AWWA Specification C111.

2.5.7.2 *Fabricated Tapping Sleeves* – Fabricated tapping sleeves shall be the high-strength type having a wide body, made of stainless steel, which conforms to and reinforces the pipe to be tapped. Body length must be at least twice that of the tap size. The sleeve shall have, as a minimum, a 7/8-inch wide recessed Buna-N gasket around the outlet, and 3/4-inch high-strength corrosion resistant alloy bolts. Sleeve to be furnished with Manufacturer's standard, corrosion resistant, coating.

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Model** |
| JCM Industries | Model 432 |
| Smith & Blair | 663 |
| Ford | FAST |
| Others as approved by ECUA in writing. | |

2.5.8 *Pipe Hangers and Supports* – Hangers and supports shall be in compliance with Federal Specification WW-H-171E, or Manufacturer's Standardization Society SP-69 or UL listed. Materials of construction shall be in accordance with the requirements outlined in the table below.

| Pipe Hangers and Supports - Materials Of Construction | |
|---|---|
| **Part I.D.** | **Material** |
| Clamps | Steel - Epoxy Coated or Galvanized<br>Cast Iron – Galvanized<br>Malleable Iron |
| Hanger Rods | Steel - Electro Galvanized<br>Steel - Stainless 304 |
| Rollers/Bases/Roller Stands | Cast Iron |
| Fasteners/Fittings | Galvanized Steel<br>Stainless |
| Hanger Rod Inserts | Steel:  Cadmium Plated<br>Steel:  Galvanized<br>Universal Concrete Insert - Cast Iron - Galvanized |
| Rod Attachments | Clevis - Forged Steel<br>Turnbuckle: 1) Forged Steel, 2) Malleable Iron<br>Sockets, Eye Nuts, Extension - Malleable Iron |
| Rollers | Steel or Iron Core, Insulated from Structure |

| Approved Manufacturer | | |
|---|---|---|
| **Manufacturer** | **Part I.D.** | **Model No.** |
| ITT Grinnell | Clevis Hanger | 590 |
| | Socket Clamp | 224<br>246 |
| | Concrete Inserts:<br>CB-Universal<br>Screen Insert | <br>282<br>152 |
| | Rod Attachments:<br>Eye Nut<br>Forged Clevis<br>Forged Turnbuckle<br>Carbon Steel<br>Couplings<br>Socket Eye<br>Extension | <br>290<br>299<br>230<br>233<br>136<br>110R<br>157 |
| | Pipe Rolls:<br>Adjustable Swivel<br>Adjustable Steel Yoke | <br>174<br>181 |
| | Pipe Roll with Base | 274 |
| | Pipe Roll and Plate | 277 |
| Others as approved by ECUA in writing. | | |

2.5.9 *Valves* – All valves shall be manufactured in accordance with the current appropriate AWWA Standard.

2.5.9.1 *Resilient Seated Gate Valves* – Resilient seated gate valves shall be designed and fabricated in accordance with the current AWWA Standard C-509 or C-515. The basic design of the gate valves shall have a cast iron body, elastomer encapsulated cast iron disc, bronze stem and operating nuts with non-rising stem design. The valve working pressure shall be 250 psig with a test pressure of 500 psig.

2.5.9.1.1 *Materials and Construction* – Valves shall open counterclockwise with a 2 inch square cast iron operating nut secured to the valve stem by a corrosion resistant nut to threads on the valve stem. The valve stem shall be made of high tensile strength bronze and shall be of one piece construction sealed by O-Rings. The thrust collar shall be secured in place by a stuffing box or bonnet cover with a thrust washer located above the thrust collar. Valve construction shall be so that upper O-Rings can be replaced with the valve in service. The disk shall be cast iron encapsulated with an EPDM rubber material bonded in accordance with ASTM D429 and shall be secured to the threaded stem by a bronze nut. The disk shall affect a seal that is bubble-tight at 250 psig.

2.5.9.1.2 *Corrosion Resistant Coatings* – All interior and exterior cast iron surfaces shall be coated with fusion-bonded epoxy in accordance with AWWA Standard C550.

2.5.9.1.3 *Body Sizing* – Valve body length shall be per ANSI Standard B16.10 for the type of end connections specified. In the full open position, the valve internal bore shall be smooth and obstruction-free without cavities or projections that could accumulate solids. The internal cross-sectional area of the valve shall be not less than the full cross-section of the adjoining pipe.

2.5.9.1.4 *End Connections* – Valves shall be furnished with mechanical joint end connections, complete with flange kits, unless otherwise specified on the plans or purchase order.

When flanged ends are specified they shall be flat face nominal 125# ANSI B16.1 Standard with bolt holes straddling the vertical center line.

| Approved Manufacturers - Resilient Seated Gate Valves | | | | | | |
|---|---|---|---|---|---|---|
| Manufacturer & Specs | | | Valve Body Connections | | | |
| | | | Mechanical Joint (MJxMJ) | Flange & Mechanical Joint (FLGxMJ) | Flanged End (FLGxFLG) | Mechanical Joint for Tapping (MJxSF) |
| **American Flow Control** | | Size: | 2" - 48" | 2" - 48" | 2" - 48" | 2" - 48" |
| | | Model No.: | AFC2500 | AFC2500 | AFC2500 | AFC2500 |
| **Clow** | C-509 | Size: | 2" - 12" | 3" - 12" | 2" - 12" | 3" - 12" |
| | | Model No.: | F-6100 | F-6106 | F-6102 | F-6114 |
| | C-515 | Size: | 4" - 48" | 4" - 48" | 4" - 48" | 4" - 24" |
| | | Model No.: | F-6100 | F-6106 | F-6102 | F-6114 |
| **Kennedy** | C-509 | Size: | 2" - 12" | 3" - 12" | 2" - 12" | 4" - 12" |
| | | Model No.: | 8571SS | 8572SS | 8561ASS | 8950SS |
| | C-515 | Size: | 2" - 12" | 3" - 12" | 2" - 12" | 4" - 12" |
| | | Model No.: | 7571SS | 7572SS | 7561SS | 7950SS |
| **M&H** | C-509 | Size: | 2" - 12" | 3" - 12" | 2" - 12" | 4" - 12" |
| | | Model No.: | 4067-01 | 4067-13 | 4067-02 | 4751-01 |
| | C-515 | Size: | 2" - 16" | 3" - 16" | 2" - 16" | 4" - 16" |
| | | Model No.: | 7571 | 7572 | 7561 | 7950 |
| **Mueller** | C-509 | Size: | 3" - 12" | 3" - 12" | 3" - 12" | 3" - 12" |
| | | Model No.: | A-2362 | A-2362 | A-2362 | A-2362 |
| | C-515 | Size: | 4" - 54" | 4" - 54" | 4" - 54" | --- |
| | | Model No.: | A-2361 | A-2361 | A-2361 | --- |

2.5.9.2 *Resilient Seated Tapping Valves* – These resilient seated gate valves shall be designed and fabricated in accordance with the current AWWA Standard C515. The basic design of the gate valves shall have a cast iron body, EPDM rubber encapsulated cast iron disc, bronze stem and operating nuts with non-rising stem design. The valve working pressure shall be 250 psig with a test pressure of 500 psig.

2.5.9.2.1 *Materials and Construction* – Valves shall open counterclockwise with a 2 inch square cast iron operating nut secured to the valve stem by a corrosion resistant nut to threads on the valve stem. The valve stem shall be made of high tensile strength bronze and shall be of one-piece construction sealed by O-Rings. The thrust collar shall be secured in place by a stuffing box or bonnet cover with a thrust washer located above the thrust collar. Valve construction shall be so that upper O-Rings can be replaced with the valve in service. The disc shall be cast iron encapsulated with an elastomer material bonded in accordance with ASTM D429 and shall be secured to the threaded stem by a bronze nut. The disk shall affect a seal that is bubble-tight at 250 psig.

2.5.9.2.2 *Corrosion Resistant Coatings* – All interior and exterior cast iron surfaces shall be coated with fusion-bonded epoxy in accordance with AWWA Standard C550

2.5.9.2.3 *Body Sizing* – Valve body length shall be per ANSI Standard B16.10 for tapping valves. Tapping valves shall conform to Specification AWWA C515, latest revision, covering gate valves except as modified for passage and clearance of tapping machine cutters. The opening through the valve shall be at least 1/4-inch larger than nominal valve diameter. Tapping valves shall allow full size shell cutters to be used.

2.5.9.2.4 *End Connections* – Valves shall be furnished at one end of the body with projecting face flange in accordance with specification MSS SP-60 for tapping valve/saddle connections to bolt to a standard tapping sleeve and the other end for mechanical joint.

2.5.9.2.5 *Approved Manufacturers* – See sections above.

2.5.9.3 *Combination Air Release and Vacuum Valves* –

2.5.9.3.1 *General* – Force mains shall be laid so as to minimize the number of high points. Air release valves shall be installed at all high points in force mains shown on the project plans. Exact locations of air release valves shall be field determined. In all cases, installation should be in the furthest downstream portion of each high point.

The valve shall be designed to operate with liquids carrying solid particles such as raw sewage. The air and vacuum air valve shall discharge air at high flow rates during the filling of the system and admit air into the force main at high flow rates during its drainage. High velocity air cannot blow the float shut. Sewage entry to the lower portion of the valve will cause the sealing of the valve. At any time during system operation, should internal pressure of the system fall below atmospheric pressure, air will re-enter the system. The smooth release of air shall prevent pressure surges and other destructive phenomena to the force main. Admitting air in response to negative pressure protects the force main from destructive vacuum conditions and prevents damage caused by water column separation. Air re-entry is essential to efficiently drain the force main.

2.5.9.3.2 *Valve Requirements* –

2.5.9.3.2.1 Working pressure range: 3 – 230 psi. Testing Pressure: 360 psi.

2.5.9.3.2.2 The valve's design shall prevent any contact between sewage and the sealing mechanism by creating an air gap at the top of the valve, under all operating conditions.

2.5.9.3.2.3 The conical body shape shall be designed to maintain the maximum distance between the liquid and the sealing mechanism.

2.5.9.3.2.4 A spring-loaded joint is to be furnished between the stem and the upper float. Vibrations of the lower float will not unseal the automatic valve. Release of air will occur only after enough air accumulates.

2.5.9.3.2.5 The funnel-shaped lower body shall be designed to ensure that residue sewage matter will re-enter the force main and will not remain in the valve.

2.5.9.3.2.6 Maintenance flushing shall be provided while the valve is under pressure, by opening a full port type 316 S.S. ball valve in the valve's lower body.

2.5.9.3.2.7 All inner metal parts of the valve shall be made of stainless steel SAE 316.

2.5.9.3.2.8 Maximum working temperature 203°F.

2.5.9.3.2.9 The valve shall be provided with an AWWA/ANSI C115 flanged joint at the base of the body. Option for threaded connections to comply per recommendations/specifications of the Manufacturer.

2.5.9.3.2.10 The valve shall be furnished with an AWWA C517 resilient seat, cast iron eccentric plug valve with a hand wheel operated, worm gear actuator.

| Approved Manufacturers | | |
|---|---|---|
| **Manufacturer** | **Size** | **Model** |
| ARI Flow Control Accessories | 2"<br>2" | D-025 (Plastic)<br>D-025-ST (Stainless Steel) |
| Others as approved by ECUA in writing. | | |

2.5.9.4 *Horizontal Swing-Check Valves* – These horizontal swing-check valves shall be the clear waterway type - designed and fabricated in accordance with the current AWWA Standard C508. Horizontal swing- check valves shall be iron body, bronze mounted with flanged ends rated for operation at 125 psi. The cover shall be cast iron with cover bolts of rust-proofed steel. The seating surfaces shall be bronze, and the disk shall be ductile or grey iron. The shaft shall be stainless steel with corrosion resistant bearing(s) at each end. Where extended outside the body, the shaft shall be sealed with double O-rings. There shall be a grease fitting between the O-rings. The check valve shall be of the adjustable external spring-loaded type. The Contractor shall adjust the tension in the spring as necessary to prevent slamming of the valve upon closing.

2.5.10 *Line Stops* – Line stops are to be used where specified to temporarily stop water line water flow without depressurizing the entire line. The line stop parts and installation equipment are to be rated at a minimum of 150 psig working pressure unless otherwise specified.

2.5.10.1 *Materials and Construction* – Tapping saddles shall have 360-degree clamping on the main. All tapping saddles shall be fabricated of 304 Stainless Steel. All bolts and fasteners are to be 304 Stainless Steel, and the saddle shall be installed with Buna-N or neoprene rubber full facing gasket.

2.5.10.1.1 The stopping device attaching nozzle to be vendor's standard with connecting threads or flange face, and the nozzle I.D. to be manufactured with a shelf to provide a position stop for the closure plug.

2.5.10.1.2 The closure plug is to be fabricated carbon steel, ductile iron, or malleable iron with at least one Buna-N or neoprene O-Ring seal on the outside diameter.

2.5.10.2 Corrosion-Resistant Coatings – Non-stainless steel permanently installed parts to have Manufacturer's standard red or black water base epoxy coating.

2.5.10.3 *Connection* – Tapping saddle shall be fabricated with dimensions to fit on concrete, steel, CA, PVC, CI, DI main as specified.

2.5.10.4 *Installation* – Temporary line stops shall only be installed by vendor personnel or Contractor Personnel trained and certified for stop by the vendor.

| **Approved Manufacturers** | |
|---|---|
| **Manufacturer** | **Model** |
| Romac | SST - X |
| JCM | 440 |
| Hydra-Stop | HSF 250 |
| Others as approved by ECUA in writing. | |

2.5.11 *Valve Insertions* –

| **Approved Manufacturers** | |
|---|---|
| **Manufacturer** | **Size** |
| Romac | 4" – 42" |
| Hydra-Stop | 4" – 12" |
| Others as approved by ECUA in writing. | |

2.5.12 *Vaults and Boxes* –

2.5.12.1 *Valve Vaults or Chambers* – All valves which are not designed for direct burial shall be installed in vaults, which shall be constructed from standard precast concrete manhole sections. They shall be sized to allow sufficient room for maintenance and repair in situ. See ECUA Standard Details D-44 and D-45.

2.5.12.2 *Valve Boxes* – Valve boxes shall be provided for all direct buried valves. Nominal 5 ¼-inch cast-iron sliding (slip) type pipe shaft with cover and base casting shall be used. The box top shall be set at finished grade and encased with a concrete ring in unpaved areas. Each valve box shall be furnished with a drop-in cover marked "SEWER". See ECUA Standard Detail D-43. The manufacturer's name shall be clearly legible on the valve box and lid.

2.5.13 *Location Aids* – All new force main and service line installations shall include an approved method for locating lines from the ground surface after completion.

2.5.13.1 *Tracer Wire* – Tracer wire for force mains shall be minimum 12 gauge copper with green PVC insulation for open trench installation. For trenchless installation, 8-guage copper shall be used. Tracer wire systems shall be electrically continuous covering all mains within the project. Wire-to-wire connectors shall be made with silicone-filled wire nuts. Wire-to-appurtenance attachments shall be made with lug-type terminals.

| Approved Manufacturers | |
|---|---|
| **Manufacturer** | **Model** |
| Ideal Industries | Twister® DB Plus |
| King Technology, Inc. | Failsafe™ |
| Others as approved by ECUA in writing. | |

2.5.13.2 *Above Grade Location Markers* – The location of all valves and bends shall be indicated by a Rhino "FiberCurve" fiberglass marker post (CRM3/072/07), or approved equal, composite plastic, green color, and UV resistant. The utility marker post shall be placed with ECUA's standard label - indicating the location of the buried sewer / force main. Placement and location of the markers shall be coordinated with the Owner's Representative.

## PART 3: Execution

3.1 *General* – The Contractor shall provide all labor, equipment and materials as required to install all pipes, valves, fittings, and other appurtenances as indicated on the construction plans or as specified in the Contract Documents.

3.2 *Potable Water Line Separation from Sewage Force Mains* – New or relocated sanitary sewer force mains must be laid to provide a horizontal separation of at least six feet, and preferably ten feet, between the outside of the sewer force main and the outside of the potable water pipe. Where it is not technically or economically feasible to comply, closer spacing may be allowed providing the following provisions are met:

3.2.1 If mains are 6 to 10 feet apart for any distance, use a higher rated pressure pipe for the force main.

3.2.2 If mains are 3 to 6 feet apart, use a higher rated pressure pipe for both water and force main.

3.3 *Pipe Installation* – The Contractor shall utilize equipment and methods in accordance with the standards and specifications in this project manual and sound construction practices to insure pipe installation to line and grade as indicated.

3.3.1 *Trench Excavation* – Refer to Section 2221-"Trench Excavation, Backfill and Compaction." Maintain minimum of 30 inches and maximum of 36 inches of cover below finished grade unless shown otherwise on the construction plans.

3.3.2 *Alignment* – Pipe shall be installed along the alignment indicated by the construction plans. Accomplish horizontal and vertical changes in alignment of pipe with bends or other appropriate fittings. Limit joint deflection to 50 percent of the pipe Manufacturer's allowable amount.

3.3.3 *Pipe Preparation* – Offloading, handling and installation of ductile iron pipe shall be in accordance with AWWA standards and applicable sections of this document. The Contractor shall clean the interior of all pipes, fittings, and joints prior to installation. Pipes shall be inspected for defects prior to installation. Damaged pipe shall be rejected and removed from the project.

3.3.4 *Pipe Installation* – Install pipe only when weather and trench conditions are suitable. Do not lay pipe in water. Join pipe in accordance with Manufacturer's recommendations.

Provide backfill, compaction and anchoring as per the standards referenced in this project manual to prevent displacement and preserve alignment after establishing final position.

Encase force main in steel casing or use ductile iron pipe when crossing under pipe, conduit, or structure when a 6-inch separation distance cannot be maintained. This protection shall extend a minimum of 5 feet beyond crossed structure.

3.3.5 *Crossings* – Where the crossing of a roadway, water body, rail, or other obstacle requires trenchless installation, the materials and installation methods shall conform to Section 2310-"Jack and Bore" or Section 2300-"Horizontal Directional Drilling", as applicable.

Jack and bore shall be the standard requirement for road crossings. If jack and bore is not possible, as determined by ECUA, a horizontal directional method will be allowed. If directional bore methods are used, the Contractor must install a sleeve or casing in addition to the primary carrier pipe.

3.3.6 *Protection* – Prevent the introduction of foreign matter into the pipefitting's and valves at all times. Close open ends of pipe with watertight fitting closures or plugs immediately after the installation of each piece or section and at the conclusion of each workday. Do not let water enter trench, and include provisions to prevent pipe flotation with suitable water control measures until completion of pipe installation and backfilling. Remove water, sand, mud and other undesirable materials from trench before removal of pipe closure piece.

3.3.7 *Cutting* – PVC pipe shall be cut in a neat workmanlike manner, and the spigot end shall be beveled per Manufacturer's recommendation. Ductile iron pipe shall be cut in accordance with Manufacturer's recommendation. Do not allow excessive heat to develop. Smooth and bevel cut end by power grinding. Ductile iron pipe lining and field cut repairs shall be in accordance with the lining Manufacturer and Paragraph 2.4.2 of this Section. Use of pipe with damaged lining is unacceptable.

3.3.8 *Closure Pieces* – Closure pieces shall only be used where called for on plans, or with written permission from ECUA. Closure may be accomplished with sleeve coupling as long as its length is such that gaskets are not less than 3 inches from pipe ends.

3.3.9 *Restrained Joints* – Restrained joints must be provided at all horizontal or vertical turns utilizing fittings, and at tees, 90 degree bends, dead-ends, and in-line valves. Restrained pipe joints shall be provided upstream and downstream of fittings and valves as indicated on the plans.

3.3.10 *Joint Restraints and Thrust Blocking* – Mechanical joint restraints shall be furnished and installed for all force main fittings and appurtenances (reference ECUA Standard Detail D-62). Restraints and thrust blocks are required for all mechanical joint fittings, valves and appurtenances (reference ECUA Standard Details D-52 and D-62).

3.4 *Appurtenance Installation* –

3.4.1 *Valves* – Valves shall be installed with operating stems vertical for valves 24 inch and smaller. For valves larger than 24 inches, the valve may be installed horizontally.

Horizontal valves shall be provided with a right-angle gear drive and flush port piping to the lower clean-out fitting (reference ECUA Standard Detail D-43). Extensions shall be provided if the valve operating nut is greater than 24 inches below finish grade. Valves shall be installed on a suitable bearing surface as shown on the project plan details, to prevent vertical displacement.

3.4.1.1 Air release valves shall be located and installed at the down-stream end of all high points as shown in ECUA Standard Detail D-30 as indicated on the approved construction plans.

3.4.1.2 Check valves, complete with vaults, shall be installed at locations shown in the approved construction plans in accordance with the Manufacturer's instructions.

3.4.2 *Valve Boxes* – Valve boxes shall be centered and plumbed on the valve-operating nut. The earth shall be compacted around each valve box to a distance of 4 feet on all sides of box, or to undisturbed trench face if less than 4 feet. An 18-inch diameter by 4-inch thick concrete collar shall be constructed and sloped to direct water away from the valve box.

3.4.3 *Tracer Wire* – Green colored tracer wire shall be installed on all new force mains. The tracer wire shall be placed directly above the pipe and electrically continuous throughout the project. The tracer wire shall be brought to the ground surface at each valve location in accordance with the project plan details and/or ECUA Standard Detail D-43. Splices and/or connections to the tracer wire shall be installed with silicone-filled wire nuts designed for direct burial.

3.5 *Taps on Pressurized Lines* – The Contractor shall perform taps on pressurized lines in accordance with these requirements. An ECUA representative shall be on-site during testing and cutting.

3.5.1 *Materials* – All materials used for taps on pressurized lines shall meet the requirements of these specifications. Tapping sleeves (Paragraph 2.5.7) shall be properly sized for the pipe being tapped. Resilient seated tapping valves (Paragraph 2.5.8.2) shall be furnished with special end connections. All other material used to accomplish the tap shall meet the relevant AWWA Standards.

3.5.2 *Procedure* – The Contractor shall:

3.5.2.1 Expose the existing pipe at the location shown on the plans, and clean the section of the pipe to receive the tapping sleeve.

3.5.2.2 Check the tapping sleeve and valve for defects and make sure the gate fully retracts in the valve to allow the shell cutter free passage.

3.5.2.3 Assemble the tapping sleeve on the pipe before installing the valve.

3.5.2.4 Pressure test the tapping sleeve and valve after it has been assembled on the force main using the test plug on the sleeve. The test pressure shall be 150 psi.

3.5.2.5 Pour a thrust block behind the tapping sleeve sufficient to withstand the pressure of the new line. Also, provide a suitable bearing surface sufficient to support the weight of the sleeve, valve, and tapping machine. Refer to Section 3.3 and ECUA Standard Detail D-52.

3.5.2.6 Assemble an approved tapping machine and proceed to make the necessary cut in accordance with the recommendation of the tapping machine Manufacturer. Approved tapping machines shall be:

3.5.2.6.1 In good working condition.

3.5.2.6.2 Designed for and having a cutting bit for the pipe material to be cut.

3.5.2.6.3 Equipped with a depth of cut gauge.

3.5.2.6.4 Designed to capture the coupon.

## PART 4: <u>Acceptance Requirements</u>

4.1 *Inspection* – Upon completion of the installation, the system shall be inspected to ascertain that pipe, valves, fittings, air/vacuum valves, etc. are located in conformance with the plans, and confirm that all 'as-built' lengths and triangulation measurements have been taken. The Owner's Inspector shall observe all appropriate activities related to properly placing the line in service including flushing, pressure and leakage testing. Final connections shall be accomplished after final clearance of lines. Tracer wire shall be tested for continuity.

4.2 *New Force Main Cleaning* – All newly installed force mains shall be flushed to remove any sediment, solids and/or foreign matter prior to testing. ECUA may provide the water for this task under certain circumstances. A written request must be submitted in advance for consideration. Flushing shall be conducted at a sufficient velocity to clear the pipe. Discharge of flushing water must be through a 2-inch diameter pipe or larger and must be controlled so as not to cause any property damage. If flushing is unsuccessful in satisfactorily removing debris from the force main, then cleaning shall be performed by swabbing (pigging).

4.2.1 Larger Pipe – Pipe 12 inches or larger in diameter shall be flushed and swabbed a minimum of 3 passes using a 5-7 lbs/cu.ft. density foam swab until the line is clear. To facilitate this process, pigging launch and receiving stations shall be installed and incorporated into the system. Contractor shall be responsible for all equipment (including tanks, pumps, and temporary piping) necessary to complete the pipe cleaning process.

4.3 *Pressure/Leakage Test* –

4.3.1 *General* – All newly installed force mains and appurtenances shall be pressure/leak tested to assure the strength of materials and quality of workmanship of the installation. Testing shall be conducted generally in accordance with the requirements of AWWA Manual 23 for PVC and other flexible pipe or AWWA C600 for Ductile Iron Pipe. Leakage testing may be conducted concurrently with the pressure test.

4.3.2 *Procedure* – Tests are to be conducted in segments not to exceed 3,000 feet of pipe or between in-line isolation valves, whichever is less. Owner shall supply water for the first test at no cost to the Contractor. An Owner's Inspector shall be present during all tests. Water in the new line shall be pumped up to a pressure of 150 psi. This pressure shall be maintained for a minimum of two (2) hours after the test pressure has been reached and stabilized due to water and pipe temperature equalization and release of all trapped air and then pumping a quantifiable amount of water into the line and recording the amount of water added during the test period. This represents the leakage.

Pressure/leakage tests shall be deemed acceptable when leakage does not exceed that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{133200}\ (or\ 11.65\ \ gpd/mi/inch/dia)$$

Or $L = \frac{ND\sqrt{P}}{7400}\ for\ 18'long\ pipe\ sections$

Or $L = \frac{ND\sqrt{P}}{6600}\ for\ 20'long\ pipe\ section$

Where:
L = Maximum leakage, in gallons per hour.
S = Length of pipe under test, in feet.
N = Number of pipe joints in segment under test.
D = Nominal internal diameter of pipe, in inches.
P = Average actual leakage test pressure, psig.

Special notes and/or requirements: (1) record all data for submission with as-built plans, (2) refit and replace all pipes not meeting the leakage requirements, (3) repair clamps are not permitted, and (4) repair all visible leaks regardless of the amount of leakage.

## PART 5: Measurement and Payment

5.1 *General* – Measurements shall be made to the nearest tenth of units and rounded to the nearest whole unit when totaled. Payments shall be for providing all labor, tools, equipment and materials as needed for: 1) furnishing, handling, and installing the required materials, fittings or fixtures; 2) excavation, backfill and compaction, including shoring, bracing and dewatering as required; 3) temporary removal and replacement of existing obstacles, including minor relocation and repair of other utilities; and 4) all required testing, and flushing. Payment for force main installations shall include the installation of tracer wire.

5.2 *Force Mains* – Force mains shall be measured in lineal feet by the specified pipe size along the pipe centerline with no deduction for fittings. Payment shall be based on the Contract unit price per lineal foot.

5.3 *Appurtenances* – Incidental appurtenances such as couplings, tracer wire, thrust blocks, etc. are not considered separate pay items and their cost should be included in the unit price of the installed pipe.

5.3.1 *Fittings* – Force main fittings including bends, reducers, tees, wyes, tapping sleeves, expansion joints, mechanical joint restraint, pipe hangers/supports, and cut in sleeves shall be measured and paid for on a unit (per each) basis. Fittings shall be listed by size and type.

5.3.2 *Valves* – Force main valves inclusive of any required valve boxes or other appropriate appurtenances shall be measured and paid for on a unit (per each) basis. Valves shall be listed by size and type.

5.4 *Taps on Pressurized Lines* – Taps on pressurized lines shall be measured and paid for on a unit price (per each) basis to include tapping sleeve, tapping valve, and valve box complete, in-place. Taps shall be listed by main and branch diameters.

5.5 *Polyethylene Wrapping* – Polyethylene wrapping shall be measured along the centerline of the pipe. Payment will be based on the Contract unit price per lineal foot.

5.6 *Dewatering* –

5.6.1 *Well Point Method* – Well Point method shall be used when specified and bid item included. Measurement shall be in linear feet of pipe trench dewatered and payment by unit price per foot.

5.6.2 *Screen and Packed Well Point* – Screened and Packed Well Point method shall only be used when specifically indicated and bid item included. Measurement shall be in linear feet of pipe trench and vertical feet of screened and packed points and payment by unit price per foot.

5.6.3 *Other Methods* – Deep Well, Eductor Well Point, Bleeder Well or Vacuum methods will only be considered when specified.

5.6.4 *Trench Bottom Sump Pumps* – Trench bottom sump pumps will not qualify for payment as dewatering.

# Section 2577

# Fiberglass Wet Wells

## PART 1: General

1.1 *Designs* –

1.1.1 *Design Plans* - The EOR shall be responsible for determining wetwell sizes, dimensions, elevations, etc per the ECUA Engineering Manual and coordination with ECUA staff.

1.1.2 *Delegated Engineering Document* - The Contractor shall provide engineered designs, signed and sealed by a Florida Professional Engineer, in the form of a Delegated Engineering Document for wetwell related components and systems. See Section 1.3 below.

1.2 *Approved Manufacturers* – Wet wells shall be manufactured by L.F. Manufacturing, Inc. (LFM), Edwards Fiberglass, Inc., or Associated Fiberglass Enterprises (AFE).

1.3 *Submittals* – Supply shop drawings, product info, Delegated Engineering Document, etc per ECUA Technical Specification 2575- Lift Stations, Section 1.4-Pre-construction Submittals.

1.4 *Warranty* – The fiberglass Manufacturer shall warrant the fiberglass wet well against defects for at least twenty (20) years after the date of acceptance by ECUA. Defects are defined as cracking, delaminating, or leaking. The warranty shall require the Manufacturer to supply all necessary labor, materials, and equipment to repair defects to the satisfaction of ECUA. The Contractor and/or Manufacturer shall not make any exemption or exception to the above stated conditions or warranty. Manufacturer's recommended installation procedures to assure 20-year warranty provided to ECUA to be included in submittal package.

1.5 *Handling* – The wet well shall not be dropped or impacted. Wet wells shall be chocked if stored horizontally. If wet wells must be moved by rolling, the ground transverses shall be smooth and free of rocks, debris, etc. FRP wet wells may be lifted by the installation of three lifting lugs as specified by the Manufacturer on the outside surface near the top or by a sling or "choker" connection around the center. Use of chains or cables in contact with the wet well surface is prohibited. Wet wells may be lifted horizontally using one support point.

## PART 2: Materials

2.1 *Resin* – The resins used shall be commercial grade unsaturated polyester resins with fiberglass reinforcements.

2.2 *Reinforcing Materials* – The reinforcing materials shall be a commercial Grade "E" type glass in the form of mat, continuous roving, chopped roving, roving fabric, or a combination of the above, having a coupling agent that will provide a suitable bond between the glass reinforcements and the resin.

2.3 *Surfacing Materials* – If reinforcing materials are used on the surface exposed to the contained substance, it shall be a commercial grade chemical-resistant glass that will provide a suitable bond with the resin and leave a resin rich surface.

2.4 *Fillers and Additives* – Fillers, when used, shall be inert to the environment and wet well construction. Additives, such as thixotropic agents, catalysts, promoters, etc., may be added as required by the specific manufacturing process to be used. The resulting reinforced plastic material must meet the requirement of this specification.

2.5 *Color* – Inside surface and outside surface of wetwell shall preferably be white in color. Light gray or light tan is acceptable, with ECUA permission. Other colors will not be accepted and will result in wetwell rejection.

2.6 *Quality Assurances* – Comply with the latest published editions of AWWA and ASTM Standards:

| | |
|---|---|
| ASTM D883 | Standard Terminology Related to Plastics |
| ASTM D3299 | Standard Specification for Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks |
| ASTM D3753 | Standard Specifications for Glass-Fiber-Reinforced Polyester Manholes and Wet Wells |
| ANSI / AWWA D120-09 | AWWA Standard for Thermosetting Fiberglass- Reinforced Plastic Tanks |

## PART 3: <u>Physical Requirements</u>

3.1 *Load Rating* – The complete wet well shall have a minimum dynamic-load rating of 16,000 ft-lbs when tested in accordance with ASTM 3753, Section 8, test methods D 790 and D 695. To establish this rating the complete wet well shall not leak, crack, or suffer other damage when load tested to 40,000 ft-lbs and shall not deflect vertically downward more than 1/4 inch at the point of load application when loaded to 24,000 lbs.

3.2 *Stiffness* – The wet well cylinder shall have a minimum pipe-stiffness value as shown in the following table when tested in accordance with ASTM D3757, Section 8.

| **Stiffness** | |
|---|---|
| **Length - Ft.** | **F/AY - PSI** |
| 10 to 20 | 2.01 |
| 21 to 30 | 3.02 |
| 31 to 40 | 5.24 |

| **Physical Properties** | | |
|---|---|---|
| **Property** | **Hoop Direction (psi)** | **Axial Direction (psi)** |
| Tensile Strength | 18,000 | 5,000 |
| Tensile Modules | $0.8 \times 10^6$ | $0.7 \times 10^6$ |
| Flexural Strength | 26,000 | 4,500 |
| Flexural Modules | | |
| (no ribs - 48", 60", 72") | $1.4 \times 10^6$ | $0.7 \times 10^6$ |
| (with ribs - 96", 144") | $0.7 \times 10^6$ | $0.7 \times 10^6$ |

## PART 4: Fabrication

4.1 *One Piece Unit* - Unless otherwise approved by ECUA, wetwell shall be a one piece unit.

4.2 *Exterior Surface* – The exterior surface shall be relatively smooth with no sharp projections. Hand-work finish is acceptable if enough resin is present to eliminate fiber show. The exterior surface shall be free of blisters larger than 1/2 inch in diameter, delamination and fiber show.

4.3 *Interior Surface* – The interior surface shall be resin rich with no exposed fibers. The surface shall be free of crazing, delamination, blisters larger than 1/2 inch in diameter, and wrinkles of 1/8 inch or greater in depth. Surface pits shall be permitted if they are less than 3/4 inch in diameter and less than 1/16 inch deep.

4.4 *Defects Not Permitted* –

4.4.1 *Exposed fibers* – Glass fibers not wet out with resin. Resin runs: runs of resin and sand on the surface. Dry areas: areas with glass not wet out with resin. Delamination: separation in the laminate.

4.4.2 *Blisters* – Light colored areas larger than ½ inch in diameter. Crazing: cracks caused by sharp objects.

4.4.3 *Pits or Voids* – Air pockets.

4.4.4 *Wrinkles* – Smooth irregularities in the surface.

4.4.5 *Sharp Projections* – Fiber or resin projections requiring gloves for handling.

4.5 *Mounting of Brackets* – Manufacturer shall affix minimum ¼" thick 316 stainless steel backer plates to exterior of wetwell at locations where brackets attach to wetwell. Manufacturer shall determine quantity and size of 316 stainless steel hardware to be used for fastening. The bolts shall be inserted through backer plates, with bolt heads welded to backer plate. Bolts and nuts shall be fastened together to bracket on interior of wetwell. Exterior backer plate shall be glassed over at factory.

4.6 *Markings* – Each wet well shall have wet well data integrated into fiberglass and affixed to top inside and top outside walls. Data required includes Manufacturer's name, ASTM designation, production and/or serial number, production date, length and diameter, and warranty length. Product data shall not be written in ink or paint. Production/serial numbers shall be kept on file by Manufacturer for a minimum of 20 years and shall be accompanied by project data for future reference and recall. The following is an example:

ABC Fiberglass Manufacturing
ASTM D3753
Serial # ABC20163461
Production date: October 22, 2016
Depth = 22'
Diameter = 10'
20 Year Warranty

4.7 *Conduit Cutouts* – Make with hole-saw and fill annular space with watertight fitting.

4.8 *Discharge Pipe Installation* – Discharge wall penetrations shall have fiberglass necks large enough to accept O.D. of pipe discharge flange and shall be installed via a gas tight-water tight Link Seal system.

4.9 *Influent Pipe Installation* – It is preferable that the Manufacturer install at factory a laminated fiberglass neck at location of influent pipe per plans. The neck diameter and length shall be sized to accept the Link Seal required for the influent pipe diameter. Annular spaces on both sides of Link Seal shall be filled with fiberglass. Alternatively, and with ECUA's prior approval, the Manufacturer may install the laminated fiberglass neck in the field. Neither the Contractor nor Manufacturer's representatives will be allowed to do this field installation. Any performed field installations shall meet or be covered by the original manufacturer's 20-year warranty.

## PART 5: <u>Excavation and Installation</u>

5.1 *General* – The limit of excavation shall be such to allow for placing and removing forms, installing sheeting, shoring, bracing, etc. Excavation shall meet the OSHA Excavation Standards (29 CFR sub- part P). The Contractor shall pile excavated material in a manner that will not endanger the work and will avoid obstructing sidewalks, driveways, power poles, etc. Drainage shall be kept clear.

5.2 *Unauthorized Excavation* – Excavation for slabs, footings, etc., that bear on earth shall not be carried below the elevation shown on the drawings. In the event the excavation is carried on below the indicated elevation, the Contractor shall bring the slab, footing etc., to the required grade by filling with concrete having a minimum compressive strength of at least 3,000 psi at 28 days.

5.3 *Vertical Sides (Sheeting, Shoring and Bracing)* – When necessary to protect existing or proposed structures or other improvements, the Contractor shall maintain vertical sides of the excavation. The limit shall not exceed three feet outside the footing on a vertical plane except where specifically approved otherwise by the Engineer. The Contractor shall provide and install any sheeting, shoring, and bracing as necessary to provide a safe work area to protect workers, structures, equipment, power supply, and property. The sheeting, shoring, and bracing shall be removed as the excavation is backfilled in such manner as to prevent injurious caving.

5.4 *Sloping Sides* – Where sufficient space is available, the Contractor shall be allowed to back slope the sides of the excavation. The back slope shall be such that the excavation shall be safe from caving. The type of material being excavated shall govern the back slope used, but in any case the back slope shall be no steeper than 1 foot horizontal to 1 foot vertical without sheeting or shoring.

5.5 *De-Watering* – The Contractor shall keep excavation free from water by use of cofferdams, bailing, pumping, well pointing, or any combination as the particular situation may warrant. All de-watering devices shall be installed in such a manner as to provide clearance for construction, removal of forms, and inspection of exterior of form work. It is the intent of these specifications that the foundation be placed on a firm dry bed. The foundation bed shall be kept in a de-watered condition a sufficient period of time to ensure the safety of the structure. The excavation shall be protected from excessive rainfall, drainage and drying. The excavation shall be inspected and approved by ECUA's representative before work on the structure is started. It is the intent of these specifications that the Contractor provides a relatively smooth, firm foundation bed for footing and slabs that bear directly on the undisturbed earth without additional cost, regardless of the soil conditions encountered. The Engineer will be the sole judge as to whether these conditions have been met.

5.6 *Bottom of Excavation and Anti-Flotation Base* – Consult Delegated Engineering Document on compaction requirements for bottom of excavation, structural reinforcement requirements, and concrete anti-flotation base dimensions. Install wetwell per Manufacturer's and Delegated Engineering Documents requirements.

5.7 *Installation* – Contractor shall install wetwell to meet final grades per plans and shall insure wetwell is plum and level.

## PART 6: Backfill

6.1 *Backfill Material* – Unless shown otherwise on the drawings, suitable soil (A-3 sand only, no clay or rocks larger than 3/4-inch size) shall be used for backfill around the wet well for a distance of two feet from the outside surface and extending from bottom of the excavation to the bottom of the top slab. The material chosen shall be free of large lumps or clods, which will not readily break down under compaction. This material will be subject to approval by the Engineer. Backfill material shall be free of vegetation or other extraneous material. Excavation materials which are to be used for fill or backfill may be stockpiled on site. Top soil should be stockpiled separately and used for finish grading around the structure.

6.2 *Backfill Placement* – The Contractor may begin backfilling of wet well as soon as the concrete has been allowed to cure and the forms removed. Place in layers of not more than 12 loose measure inches and mechanically tamped to at least 95 percent Modified Proctor Density. Flooding will not be permitted. Backfill shall be placed in such a manner as to prevent any wedging action against the structure.

# Section 2578

# Wet Well Coatings and Rehabilitation

## PART 1: General

1.1 *Section Includes* – Sanitary sewer wet well lining including:

1.1.1 Environmental Protection and leak-proofing of wet wells by the application of a 100% solids high build epoxy coating designed for the corrosion protection of concrete and steel in wastewater treatment facilities.

1.1.2 The inspection and testing of the various types of work to insure compliance.

1.2 *Lining Systems on Old Concrete (Rehab Project)*–

1.2.1 The lining system used shall result in a monolithic structure to the shape and contour of the interior of the wet well. The lining system shall be a multilayer system comprised of a structural seal coat (after surface preparation), an initial coating of the finished coat and a final coat. The structural seal coat shall be Sherwin Williams StealSeam FT910 or approved equal – 1/8" dry film thickness. The coating system shall be completely water tight and free of any joints or openings other than pipe inlets, pipe outlets and the access frame/hatch opening. The junction of the lining material with the pipe material at the inlet and outlets, all conduit and other liner penetrations shall be watertight.

1.2.2 The epoxy coating system shall be suitable for atmospheres containing hydrogen sulphide and dilute sulfuric acid as well as other gases associated with the wastewater collection systems. The coating shall be "CORE-COTE SC PLUS" manufactured by The Sherwin-Williams Company, 101 Prospect Ave., Cleveland, Ohio 44115-1075, Phone: (216) 566-2200 or an approved equal.

1.3 *Lining Systems on New Concrete/Grout* –

1.3.1 Preparation shall be per the International Concrete Repair Institute (ICRI) CSP-3 minimum, unless otherwise specified. Concrete additives are required to minimize cure time and off-gassing prior to and at time of the application of an epoxy coating system. A pre-installation meeting including the contractor, the installation subcontractor, the coating representative, and the owner's representative shall be held, once conditions are determined and understood, to discuss and clarify the need for specific additives. At a minimum, new concrete / grout to be used shall be a standard concrete ready-mix with chemical additive Silatec Microsilica (A.W. Cook Cement Products) or approved equal – to allow coating and loading times of one or two days.

1.3.2 See Section 1.2 above for information / detail concerning the required structural seal coat and epoxy coating system.

1.4 *Submittals* – Submit the following as required in the Special Conditions of Contract Documents:

1.4.1 Coating system specifications including preparation requirements, materials to be used, application methods and constraints, MSDS data sheets for all materials and test procedures. A certification of the proposed coating system signed by an authorized agent of the system supplier/manufacturer. The certification shall list all materials furnished under this section. Installation of the coating system shall not begin until a satisfactory certification has been reviewed by ECUA.

1.4.2 Certified copies of test reports of factory tests required by the applicable standards, the manufacturer, and this Section.

1.4.3 Manufacturer’s handling, storage, and installation instructions and procedures.

1.4.4 Warranty: Prior to installation, the coating system’s manufacturer or the manufacturer’s certified installation contractor shall provide a written warranty for the coating against defects for at least five years for materials and two years for labor after the date of acceptance by ECUA. Defects are defined as blistering, cracking, delaminating, pinholing, diminished adhesion, or leaking. The warranty shall require the manufacturer to supply all necessary labor, materials and equipment to repair defects to the satisfaction of ECUA. The contractor and/or manufacturer shall not make any exemption or exception to the above stated.

## PART 2: Products

2.1 *General* –

2.1.1 The materials used shall be designed, manufactured and intended for sewer wet well lining and the specific application in which they are used. The materials shall have a documented history of long term performance in exposure to municipal wastewater. All materials shall be stored and handled in accordance with recommendations of the manufacturer. All materials shall be applied in accordance with the manufacturer’s written instructions.

2.1.1.1 *100% High Solids High Build Epoxy Coating* – The epoxy used shall be a commercial grade epoxy such as Cor-Cote SC Plus or approved equal.

2.1.1.2 *Surface Preparation* – If significant spalling or other detrimental surface condition (exposed aggregate, deep holes, sharp edges, etc.) is found, areas to receive multiple coating layers of structural seal coat - in accordance with the coating Manufactuer’s written instructions.

2.1.2 The Contractor shall warrant and hold harmless the Owner and his Engineer against all claims for patent infringement and any loss thereof.

2.1.3 Handle and store all materials and dispose of all wastes in accordance with applicable regulations.

2.1.4 Each coating system shall be project specific designed for application over cast in place and pre-cast concrete surfaces without degradation of the final product and/or the bond between the Product(s) installed and the existing concrete surfaces.

## PART 3: Application

3.1 *Preparation* – The wet well surface shall be cleaned and dried, removing all oil, dust, grease, dirt and loose foreign material.to ensure adequate adhesion. The contractor shall follow the specific preparation instructions of the coating manufacturer.

3.2 *Application* – The layers of structural seal coat and epoxy coating system shall comply with manufacturer guidelines and written recommendations for the specific installation. Cure times and humidity/temperature limits for the coating shall be monitored and controlled as specified by the Manufacturer.

3.3 *Defects Not Permitted* –

3.3.1 *Exposed Concrete* – surface not wet out with primer or coating.

3.3.2 *Coating Runs* – visible runs of the coating on the surface.

3.3.3 *Dry Areas* – areas with concrete surface not wet out with primer or coating.

3.3.4 *Delamination* – separation of the coating from the concrete.

3.3.5 *Blisters* – no visible signs of blistering allowed.

3.3.6 *Crazing* – cracks in the finished product caused by sharp objects.

3.3.7 *Pin Holing* – small holes resulting from off gassing.

## PART 4: Test Methods

4.1 *General* – Tests shall be performed as specified in ASTM-F1869 to check for calcium chloride levels. Do not proceed with MVE greater than 3 pounds.

## PART 5: Execution

5.1 *Preparation* –

5.1.1 *Safety* – The Contractor shall perform all work in strict accordance with all applicable OHSA, and manufacturer's safety standards. Each method of wet well coating in this Section requires confined space entry by workers. Particular attention is drawn to those safety requirements regarding confined space entry, wastewater exposure, explosive and lack of oxygen environments, respiratory protection from airborne particulate materials during cutting, cleaning and product mixing and application.

5.1.2 *Cleaning* – All concrete and masonry surfaces to be coated shall be cleaned in accordance with SSPC-SP 13/NACE 6-4.3.1OR 4.3.2, OR ICRI No. 310.2, according to the manufacturer's requirements. All grease, oil, laitance, coatings, unsound concrete and other foreign materials shall be completely removed. Water blasting utilizing a 210 steam unit or high pressure water wash with proper nozzles shall be the primary method of cleaning; however, other methods such as wet or dry sandblasting, acid wash, concrete cleaners, degreasers or mechanical means may be required to properly clean the surface.

All surfaces on which these methods are used shall be thoroughly rinsed, scrubbed, and neutralized to remove cleaning agents and their reactant products. Debris resulting from cleaning shall be removed from the wet well.

5.1.3 *Pumping and Bypassing* – When pumping and bypassing is required, the Contractor shall supply the pumps, piping, hoses and other equipment to divert the flow of sewage around the manhole in which work is to be performed. Contractor shall ensure that all piping and hose connections and couplings are water pressure tight. Contractor shall disinfect all areas of piping or hose leakage with powdered chlorine or lime. The bypass system shall be of sufficient capacity to handle existing flow plus additional flow that may occur during a rainstorm. The Contractor shall be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system. If pumping is required on a 24 hour basis, all engines shall be equipped to keep noise to a minimum, within local noise abatement regulation with residential-critical mufflers, sound deadening enclosures, and other means.

5.1.4 *Flow Control Precautions* – When flow in a sewer line is plugged, blocked, or bypassed; sufficient precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging. Further, precautions must be taken to insure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

5.2 *Installation* –

5.2.1 Remove pumps, and all internal equipment and install new top slab with stub outs and hatch openings as shown in the construction drawings to permit installation of coating onto the interior surfaces of the wet well. Install a plug in the main incoming line and install permanent caps/plugs on incoming lines that are being eliminated.

5.2.2 Prepare interior surfaces according to coating system's Manufacturer's recommendations. See 5.1.2 above.

5.2.3 Install coating system according to Manufacturer's application instructions.

5.2.4 Caulk all joints in the concrete after application of the primer/coating.

5.3 *Acceptance* –

5.3.1 Test installed coating using the SSPC PA-2, " Procedure for Determining Conformance to Dry Coating Thickness Requirements" test method to confirm finished film thickness. , following the Manufacturer's recommendations for proper and safe procedures, ASTM Standard D-149 and NACE Standard SP0188-2006, latest edition. Spark testing of structures shall be performed after curing of coatings. Any visible leakage in the structure, before, during, or after the test shall be repaired regardless of the test results. The ECUA Inspector shall inspect each layer after application and each repair. Repairs to the initial coat (layer) shall not exceed 5% of the total surface area. Repairs shall be made as a patch no larger than 4"x4". Each patch should be taped off for uniform appearance - not just random surface applied. The final coat shall also be tested. Repairs to the final coat (layer) not to exceed ten 4"x4" areas in/on 500 sf area.

5.3.2 If repairs exceed 5% of the total surface area on Initial coat or exceed ten 4"x4" areas in/on 500 square foot area on Final coat, interior will have to be cleaned and process started over. The Contractor shall complete repairs and repeat the test procedures until satisfactory results are obtained. If the coating fails at any point after the second repair attempt at any location, the coating will be considered unacceptable and a complete rework will be required.

5.3.3 The finished surface shall be free of blisters or other indications of improper installation. No evidence of visible leaks shall be allowed. In addition, at the Owner's request, the Contractor shall be required within two years to spark and visually inspect the structure. Any work that has become defective within the two year period shall be repaired by the Contractor at no additional expense to the Owner.

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# Section 2651

# Television Inspection

## PART 1: General

1.1 *Description* – Provide all labor, materials, tools, equipment and incidentals as shown, specified, and required to perform television (TV) inspection of existing, new and rehabilitated piping including sewer mains and sewer lateral connections.

1.2 *Definitions* –

1.2.1 *Pre-Construction Inspection* – TV inspection of sewers and/or laterals to determine the location of construction, structural and O&M features and to ascertain that the condition of the pipe meets acceptable standards for the proposed rehabilitation.

1.2.2 *Post-Construction Inspection* – TV inspection of repaired or rehabilitated sewer mains, lateral connections, and laterals to verify (in association with other specified testing procedures) that all repairs have been performed.

1.3 *Requirements* – The Contractor shall be aware that this Contract requires work in active sewers and shall follow all federal, state and local requirements for safety in confined spaces.

1.4 *Performance Requirements* –

1.4.1 Inspection shall be performed by a National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) certified operator and shall meet the coding and reporting standards and guidelines as set by PACP. These same standards shall also be used for lateral inspections regardless of whether conducted using cleanout launched or mainline launched lateral camera. All report annotations, pipe conditions and pipe defects shall be identified properly using PACP codes as defined by PACP, and severity ratings shall be calculated according to PACP.

1.4.2 Quality of inspection recording shall be acceptable to ENGINEER when viewed on a standard computer monitor.

1.5 *Submittals* –

1.5.1 CCTV equipment, including make, model, age of video systems and tractors, and documentation that CCTV software is PACP v4.2 -certified. PACP-compliant software will not be accepted.

1.5.2 Copies of PACP certificate for inspectors completing the work.

1.6 *Reference Standards* – NASSCO prepared Pipeline Assessment and Certification Program, Second Edition Reference Manual, 2001. This manual includes a standard TV inspection form and sewer condition codes.

## PART 2: Products

2.1 *Television Equipment* –

2.1.1 *Closed Circuit TV Equipment* – Select and use closed-circuit television equipment that will produce a color recording. The camera and video system components shall have the following properties:

2.1.1.1 Equipped with footage counter accurate to two tenths of a foot that displays on the TV monitor the exact distance of the camera from the starting point of the recording.

2.1.1.2 Lighting system that allows the features and condition of the pipe to be clearly seen. Lighting shall not cause shadows or loss of color within the field of view of the camera.

2.1.1.3 Capable of operating in 100 percent humidity conditions.

2.1.1.4 Capable of producing a minimum 470 lines of vertical resolution color video picture. Picture quality and definition shall be to the satisfaction of the Engineer.

2.1.2 *Pipe Inspection Camera* – The pipe inspection camera and video components shall have the following additional properties:

2.1.2.1 Capable of producing a video recording using a pan-and-tilt, radial viewing, pipe inspection camera that pans ± 275 degrees and rotates 360 degrees.

2.1.2.2 Camera height adjustment so that the camera lens is always centered at one-half the inside diameter, or higher, in the pipe being televised.

2.1.2.3 Include a reflector in front of the camera if necessary to provide acceptable video image quality in large diameter pipe.

2.1.3 *TV Studio* – TV studio is to be contained in an enclosed truck, trailer or van. It shall have room and seating for the operator and the ENGINEER and also room for at least one standing visitor with the doors closed. The studio shall have air conditioning and heating. Normal operation of all equipment, including the TV camera, monitor, and winches is to be from a control panel in the studio. When joint testing and sealing is to be performed, the equipment shall be contained in the same unit as its TV equipment and shall be operated from the same control panel.

2.1.4 *Recording* – All recordings are to be in digital format.

2.1.4.1 *Image Capture* – Digitized picture images shall be stored and be exportable as JPEG formats.

2.1.4.2 *Video Capture* – Full time live video and audio files shall be captured for each pipe segment and lateral inspected. The files shall be delivered in MPEG format on a USB 2.0 external hard drive and viewable at real time and fast forward speeds on an external personal computer that utilizes MicroSoft Media Player, version 9.0. Alternate digital formats will not be accepted unless approved by the Engineer in advance of submittal. The video shall have a minimum resolution of 640 pixels (x) by 480 pixels (y) and an encoded frame rate of 29.97 frames per second. System shall perform an automatic disk image/file naming structure to allow saved video/data sections to be "Burned" to digital format. It shall have the capability of "burning" a minimum of 120 minutes of recording to the DVDR media. The video recording shall be free of electrical interference and shall produce a clear and stable image. The audio recording shall be sufficiently free of background and electrical noise as to produce an oral report that is clear and discernable. The digital recordings and inspection data shall be cross-referenced to allow instant access to any point of interest within the digital recording.

## PART 3: Execution

3.1 *Television Inspection* –

3.1.1 Prior to TV inspection, clean sewer lines, laterals and manholes. Re-clean any sewer line or manhole found to be dirty during the TV inspection process.

3.1.2 Perform Post-construction Inspections of cured-in-place mainline liners no sooner than 30 days after the completion of the lining work.

3.1.3 Televise the sewer line to document the condition of the line. Notify the Engineer 48 hours in advance of any TV inspection so that the ENGINEER may observe inspection operations. Provide a color recording showing the completed Work.

3.1.4 For mainline sewer inspections, inspections shall be from center of the starting manhole to the center of the ending manhole. Record the condition of the entire circumference of the pipe penetration. Measure distances along the pipe from the center of the upstream manhole.

3.1.5 Prior to recording the location of defects, construction features and service connections, remove slack in the cable of the television inspection camera to ensure metering device is designating proper footage. Check accuracy of the measurement meters daily by use of a walking meter, roll-a-tape, or other suitable device.

3.1.6 Perform the preset before starting to record the inspection (i.e. the counter should not suddenly reset or jump during the recording). If a preset point on the CCTV cable is used to set the counter, Contractor shall back up the camera after setting the preset and record the entry to the pipe.

3.1.7 Center the camera in the middle of the pipe.

3.1.8 Move the camera through the line (in the downstream direction whenever possible) at a uniform rate not to exceed 30 feet per minute.

3.1.9 Stop at every joint for three seconds. When infiltration or other defects are evident, use pan and tilt to document pipe condition. Stop elsewhere when necessary to ensure proper documentation of the sewer's condition.

3.1.10 Stop at every lateral connection. Center the camera so that the lighting and the pan and tilt view can be used to inspect as far into the lateral connection as possible. Pan the circumference of the tap, recording all defects found in the service connection. Where lateral flow is observed, observe flows from service connections for approximately two minutes to ascertain if the flow is sanitary or extraneous flow. The video recording may be paused during observation. Record results of the flow observed on video recording and inspection logs.

3.1.11 Capture color still shots of video recordings for all defects encountered.

3.1.12 Use manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions to move the camera through the sewer line.

3.1.13 TV inspection recordings shall be continuous for each pipe segment.

3.1.14 Adjust light levels, clean fouled or fogged lens, and allow vapor to dissipate from camera lights in order to produce acceptable recordings. All TV inspection recordings that do not meet the specified requirements shall be retelevised at no additional cost to the Owner.

3.2 *Flow Control –*

3.2.1 Adequately control the flow in the section being televised. Plugging or bypassing of the flows may be used to accomplish this. Recordings made where the depths of wastewater flow shown below are exceeded will be rejected:

| **Flow Control During Television Inspection** | |
|---|---|
| **Pipe Diameter (Inches)** | **Depth of Flow (% of Pipe Diameter)** |
| 6-10 | 10 |
| 12-24 | 15 |
| Over 24 | 20 |

3.2.2 Whenever flows in a sewer line are blocked, plugged, pumped, or bypassed, take sufficient precautions to protect the sewer lines from damage that might be inflicted by excess sewer surcharging. Further, take precautions to ensure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved. No overflows are permitted. The Contractor is responsible for all damages.

3.2.3 Contractor is responsible for all damages to Contractor owned and operated equipment, Owner facilities, and privately owned facilities caused by malfunction of plugs, pumps or other Contractor equipment. In the event of a failure or malfunction of Contractor equipment, Contractor is responsible for all work necessary to restore facilities to pre-construction condition including but not limited to excavation and restoration of sewer lines and roadways required to retrieve malfunctioning or stuck cameras, plugs and hoses.

3.2.4 It is anticipated that portions of the sanitary sewer are bowed or bellied and as a result the camera will be submerged. Wherever the camera encounters a submerged condition, or where the wastewater flow depth exceeds the maximum allowable, reduce the flow depth to an acceptable level by performing the survey TV inspection during minimum flow hours, or by pulling a camera with swab, high-velocity jet nozzle or other acceptable dewatering device. Recordings made while floating the camera are not acceptable unless approved by Engineer.

3.3 *Passage of TV Camera* – If during TV inspection of a pipe segment the camera is unable to pass an obstruction even though flow is unobstructed, televise the pipe segment from the opposite direction in order to obtain a complete recording of the line. Measure the distance between the manholes (centerline to centerline) with a tape or wheel to accurately determine the total length of the manhole segment.

3.4 *Inspection Deliverables* –

3.4.1 *Written Inspection Reports* – Provide printed location records to clearly identify the location of each defect, or lateral connection, in relation to adjacent manholes, using a standard stationing system zeroed on the upstream manhole. Record all information requested using proper NASSCO PACP defect codes. The reports shall include at least the minimum amount of information required by PACP, including required PACP header information. Color still shot images of all defects encountered shall be included with each pipe segment.

3.4.2 *Electronic Inspection Reports* –

3.4.2.1 Provide a NASSCO PACP v4.2 certified database listing all PACP required data fields for each pipe segment. The provided database shall be in ".mdb" format with no password protection on the file.

3.4.2.2 For each type of CCTV deliverable (Pre-Construction, Post-Construction, Warranty), provide a single database containing all the inspections for the Project.

3.4.2.3 Post Construction deliverables will contain a single inspection for each asset, inspected upon completion of all non-warranty Work on the asset.

3.4.2.3.1 Submit two inspection records for a single asset only if the asset cannot be completely inspected from one side due to the physical condition of the pipe. Properly use the PACP "MSA" coding for each such inspection record.

3.4.3 *Inspection Recordings* –

3.4.3.1 Provide digital inspection recordings for all recordings, unless otherwise specified in paragraph 3.4.4.

3.4.3.2 Recording shall be of a quality sufficient for Engineer to evaluate the condition of the sewer, locate the sewer service connections, and verify cleaning. If Engineer determines that the quality is not sufficient, re-televise the sewer segment and provide a new recording and report at no additional compensation. Camera distortions, inadequate lighting, dirty lens, or blurred/hazy picture will be cause for rejection. Payment for televised inspection will not be made until Engineer approves the recordings and reports.

3.4.3.3 Only pipe segments from the same Project shall be included on a given hard drive. Multiple deliverable types may be included on a given hard drive, but the files must be organized in individual project folders. TV Inspection recordings shall not be edited.

3.4.3.4 Digital recordings*:* Each pipe segment must be its own electronic file. Electronic recording file must allow snap scrolling to allow easy and quick access of the entire recording.

3.4.3.5 Each hard drive must have a file index whose name contains the pipe segment reference number.

3.4.3.6 Maintain a master copy of all recordings and Inspection Reports for two years after delivery of reports and recordings.

3.4.3.7 Label each hard drive with the following information:

3.4.3.7.1 File Number

3.4.3.7.2 Contractor's Name

3.4.3.7.3 Project Name

3.4.3.7.4 Contract Number

3.4.3.7.5 Drawing Number

3.4.3.7.6 Inspection Type: Post Cleaning, Repair

3.4.3.7.7 Date Televised

3.4.3.7.8 Pipe Segment Asset Identification Number

3.4.4 *Inspection* – Inspection deliverables for different types of inspections are defined below:

3.4.4.1 *Pre-Construction Inspection* – One copy on a 400mbs USB 2.0 external hard drive of PACP formatted database including, but not limited to, digital inspection recordings, defect call-out tables, defect snapshots, notes fields and asset condition reports.

3.4.4.2 *Post-Construction Inspection* –

3.4.4.2.1 Two copies of Written Inspection Reports in bound report with project name on binder spine. Reports to be filed in ascending order by upper manhole number.

3.4.4.2.2 One copy on a 400mbs USB 2.0 external hard drive of the PACP formatted database including, but not limited to, digital inspection recordings, defect call-out tables, defect snapshots, notes fields and asset condition reports.

# Section 2830

# Fencing

## PART 1: General

1.1 *General Description of Work* – Extent of chain link fences and gates is indicated on drawings.

1.2 *Related Documents* – Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 3-“Technical Specifications” sections, apply to work of this section.

1.3 *Quality Assurance* – Provide chain link fences and gates as complete units controlled by a single source including necessary erection accessories, fittings, and fastenings.

## PART 2: Products

2.1 *General* – Dimensions indicated for pipe, roll-formed, and H-sections are outside dimensions, exclusive of coatings.

2.1.1 *Available Manufacturers* – Subject to compliance with requirements, Manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

2.1.1.1 PVC Thermal Fused Galvanized Steel Fencing and Fabric:

2.1.1.1.1 American Fence Corp.

2.1.1.1.2 Anchor Fence, Inc.

2.1.1.1.3 United States Steel

2.1.1.1.4 PVC Thermal Fused Barbed Type:

2.1.1.1.5 American Fence Corp.

2.1.1.1.6 Man Barrier Corp.

2.2 *Steel Fabric* –

2.2.1 *Fabric* – No. 9 gauge core (0.148" + 0.005") size steel wires, 2-inch mesh, with top and bottom selvages with a minimum breaking strength of 1290 pounds. Furnish one-piece fabric widths for fencing up to 12 inches high.

2.2.2 *Fabric Undercoat* – Galvanized, with not less than 0.30 ounces of zinc per square foot of surface.

2.2.3 *Fabric Finish* – Minimum 7 mil polyvinyl chloride (PVC) plastic resin thermal fusion bonded finish over galvanized steel wire. Color shall be Manufacturer's standard dark green color selection.

2.3 *Fence Framing and Accessories* –

2.3.1 *Steel Framework, General* – Galvanized steel with not less than 1.8 ounces of zinc per square foot of surface.

2.3.2 *Fittings and Accessories* – Galvanized malleable cast iron or pressed steel with the thermal fused PVC coating colored the same as the fence fabric.

2.3.3 *Steel Framework Finish* – Provide framework, fittings and accessories in accordance with Manufacturer's standard thermally bonded polyvinyl chloride (PVC) plastic resin finish over galvanizing, not less than 10-15 mils thick. Color to match chain link fabric.

2.3.4 *End, Corner and Pull Posts* – 2.875-inch O.D. (3-inch nominal) steel pipe, 5.79 pounds per linear foot, or 3.5-inch x 3.5-inch roll-formed sections, 4.85 pounds per linear foot.

2.3.5 *Line Posts* – Space 10 feet on center maximum, unless otherwise indicated, of following minimum sizes and weights. Use 6-foot fabric height, 2.375 inches O.D. (2 1/2-inch nominal) steel pipe, 3.65 pounds per linear foot or 2.25-inch x 1.875-inch H-sections, 2.64 pounds per linear foot.

2.3.6 *Gate Posts* – Use 4-inch O.D. Schedule 40 with 10-15 mils of fusion bond PVC to match fence mesh color.

2.3.7 *Top Rail* – Manufacturer's longest lengths, with expansion type couplings, approximately 6 inches long, for each joint. Provide means for attaching top rail securely to each gate corner, pull and end post. Post shall be 1.66-inch O.D. pipe, 2.27 pounds per foot or 1.625-inch x 1.25-inch roll-formed sections, 1.35 pounds per foot.

2.3.8 *Tension Wire* – 7-guage, coated coil spring wire and thermal fused PVC coated finish to match fabric. Locate at bottom of fabric.

2.3.9 *Wire Ties* – Thermal fused PVC coated 9 gauge galvanized steel or 9 gauge aluminum wire, to match fabric color.

2.3.10 *Post Brace Assembly* – Manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use same material as top rail for brace, and truss to line posts with 0.375-inch diameter rod and adjustable turnbuckle.

2.3.11 *Post Tops* – Provide weather tight closure cap with loop to receive tension wire or top rail; one cap for each post.

2.3.12 *Stretcher Bars* – One-piece lengths equal to full height of fabric, with minimum cross-section of 3/16 inch x 3/4 inch. Provide one stretcher bar for each gate and end post, and 2 for each corner and pull post, except where fabric is integrally woven into post.

2.3.13 *Stretcher Bars Bands* – Space not over 15 inches on center, to secure stretcher bars to end, corner, pull and gate posts.

2.3.14 *Concrete* – Provide concrete consisting of Portland cement, aggregates, and clean water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2500 psi using at least 4 sacks of cement per cubic yard, 1-inch maximum size aggregate, maximum 3-inch slump, and 2-4 percent entrained air.

2.4 *Aluminum Cantilever Slide Gates* – All gates shall be cantilever slide gates. Exception must be approved in writing by ECUA.

2.4.1 *Fabrication* –

2.4.1.1 Fabricate framework of gates from 6061-T6 alloy aluminum with a thermal fusion PVC coating finish to match fence framework. Assemble gate frames by welding or with special fittings and rivets, for rigid connections, providing security against removal or breakage connections. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware and accessories. Vertical stiffening members shall be of 2-inch (min.) square fabrication weighing 0.94 pounds per foot spaced to subdivide the gate into square panels. Diagonal bracing between vertical stiffeners shall be with 1.25-inch square fabrication. The gate frame shall be fabricated with 2-inch square aluminum members weighing 0.94 pounds per foot, 2-inch x 4-inch aluminum members weighing 1.71 pounds per foot and a one (1) piece aluminum track/frame member weighing a minimum of 4.338 pounds per foot and whose 2-inch square frame member has a top and bottom wall thickness of not less than 0.25 inches and vertical wall thickness of 0.141 inches, or greater. The leading 2-inch square frame member shall be fabricated with a full height internal stiffening member of at least 1.66-inch diameter, weighing 2.27 pounds per foot.

2.4.1.2 The gate truck assembly shall be a swivel type, zinc die cast with four (4) factory sealed and permanently lubricated ball bearing rollers. The rollers shall be 2-inch diameter by 9/16 inches in width equipped with two (2) side rollers to prevent lateral movement. Truck assemblies shall be mounted on the post brackets using 7/8-inch diameter ball bolts with a 1/2-inch shank.

2.4.1.3 Provide same fabric as for fence, unless otherwise indicated. Install stretched fabric continuously within the anchoring channel provided in the top and bottom track of the fabricated fate frame and secure with required hardware.

2.4.1.4 Where barbed wire is indicted above gates, extend end members of gate frames 1 foot above to member and prepare to receive 3 strands of wire. Provide necessary clips for securing wire to extensions.

2.4.2 *Gate Hardware* – Provide gate hangers, latch brackets, guide assemblies and stop hardware and accessories of aluminum, malleable iron or galvanized steel after gate fabrication.

## PART 3: Execution

3.1 *Installation* – Do not begin installation and erection before final grading is completed, unless otherwise permitted.

3.1.1 *Excavation* –

3.1.1.1 Drill or hand excavate (using post hole digger) holes for posts to diameters and spacing indicated, in firm, undistributed or compacted soil.

3.1.1.2 If not indicated on drawings, excavate holes for each post to minimum diameters as recommended by fence Manufacturer, but not less than 4 times larges cross-section of post.

3.1.1.3 Unless otherwise indicated, excavate hole depths approximately 3 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.

3.1.2 *Setting Posts* –

3.1.2.1 Center and align posts in holes 3 inches above bottom of excavation.

3.1.2.2 Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. Unless otherwise indicated, extend concrete footings 2 inches above grade and trowel to a crown to shed water.

3.1.3 *Top Rails* – Run rail continuously through post caps, bending to radius for curved runs. Provide expansion couplings as recommended by fencing Manufacturer.

3.1.4 *Center Rails* – Provide center rails where indicated. Install in one piece between posts and flush with post on fabric side, using special offset fittings where necessary.

3.1.5 *Brace Assemblies* – Install braces so posts are plumb when diagonal rod is under proper tension.

3.2 Install tension wires before stretching fabric and tie to each post cap with not less than 6 gauge PVC coated galvanized wire. Fasten fabric to tension wire using 11 gauge galvanized steel hog rings spaced 24 inches on center.

3.2.1 *Fabric* – Leave approximately 2 inches between finish grade and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.

3.2.2 *Stretcher Bars* – Thread through or clamp to fabric 4 inches on center, and secure to posts with metal bands spaced 15 inches on center.

3.2.3 *Barbed Wire* – Pull wire taut and install securely to extension arms and secure to end post or terminal arms in accordance with Manufacturer's instructions.

3.2.4 *Barbed Tape* – Install barbed tape in configurations indicated in accordance with Manufacturer's recommendations and securely fasten to fencing to prevent movement or displacement.

3.2.5 *Gates* – Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.2.6 *Tie Wires* – Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing. Tie fabric to line posts, with wire ties spaced 12 inches on center. Tie fabric to rails and braces, with wire ties spaced 24 inches on center. Tie fabric to tension wires, with hog rings spaced 24 inches on center.

3.2.7 *Fasteners* – Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.3 *Coating Repair* – Any damaged PVC coating shall be touched up with vinyl paint recommended by the fence/gate Manufacturer and applied to a cleaned and prepared surface in accordance with the Manufacturer's requirements.

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# Section 3200

## Cast-In-Place Concrete

**PART 1: General**

1.1 *General Description of Work* – Mixing, placing, finishing, and providing all related services necessary to construct all cast-in-place concrete work indicated on plans.

1.2 *Submittals* –

1.2.1 *Manufacturer's Data* – Submit Manufacturer's product data with installation instructions for proprietary materials including reinforcement and forming accessories, admixtures, joint materials, hardeners, curing materials and others as requested by Engineer.

1.2.2 *Laboratory Reports* – Submit 2 copies of laboratory test or evaluation reports for concrete materials and mix designs as requested by Engineer.

1.3 *Quality Assurance* –

1.3.1 *General* – Comply with the latest published edition of the American Concrete Institute (ACI) and American Society of Testing and Materials (ASTM) standards and codes.

1.3.2 *Mix Proportions and Design* – Proportion mixes complying with mix design procedures specified in ACI 301, Specifications for Structural Concrete for Buildings.

1.3.2.1 Submit written report to Engineer for each proposed concrete mix at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed and are acceptable to Engineer.

1.3.2.2 Mix designs may be adjusted when material characteristics, job conditions, weather, test results, or other circumstances warrant. Do not use revised concrete mixes until submitted to and accepted by Engineer.

1.3.2.3 Use air-entering admixture in all concrete, providing not less than 4 percent or more than 6 percent entrained air for concrete exposed to freezing and thawing, and from 2 percent to 4 percent for other concrete.

1.3.3 *Concrete Testing Service* – Employ acceptable ACI certified independent testing laboratory to perform materials evaluation, testing, and design of concrete mixes. (When required by Owner).

1.3.3.1 *Sampling* – Sampling procedures and frequency shall meet the requirements of ASTM C 172, Standard Practice for Sampling Freshly Mixed Concrete.

1.3.3.2 *Slump* – Slump characteristics shall be tested as specified in ASTM C 143, Standard Test Method for Slump of Hydraulic-Cement Concrete. One test shall be completed for each load at point of discharge.

1.3.3.3 *Air Content* – Air content testing shall meet the requirements of ASTM C 173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric

Method. One test shall be completed for each set of compressive strength specimens.

1.3.3.4 *Compressive Strength* – Concrete compressive strength tests shall meet the requirements of ASTM C 39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. One set of samples shall be collected for each 50 cubic yards or fraction thereof of each class of concrete; one specimen tested at 7 days, one specimen tested at 28 days, and one retained for later testing if required.

1.3.3.5 *Exceptions* – When the total quantity of a given class of concrete is less than 50 cubic yards, strength tests may be waived by Engineer if field experience indicates evidence of satisfactory strength.

1.3.3.6 *Reporting* – Test results will be reported in writing to Engineer, Contractor, and concrete producer within 24 hours after tests are made.

## PART 2: <u>Products</u>

2.1 *Concrete Materials* –

2.1.1 *Portland Cement* – Portland cement shall meet the requirements of ASTM C 150, Standard Specification for Portland Cement, type as required.

2.1.2 *Fly Ash* – Fly ash shall meet the requirements of ASTM C 618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete, Type C or F. Limit use of fly ash in concrete mix design to not exceed 25 percent of cement content by weight.

2.1.3 *Aggregates* – Aggregate shall meet the requirements of ASTM C 33; Standard Specification for Concrete Aggregates except local aggregates of proven durability may be used when acceptable to Engineer.

2.2 *Water* – Water for concrete shall be potable.

2.3 *Admixtures* –

2.3.1 *Air-Entraining Admixture* – Air entraining admixture shall meet the requirements of ASTM C 260, Standard Specification for Air-Entraining Admixtures for Concrete.

2.3.2 *Water-Reducing Admixture* – Water reducing admixture shall meet the requirements of ASTM C 494, Standard Specification for Chemical Admixtures for Concrete, as required to suit project conditions. Only use admixtures, which have been tested and accepted in mix designs, unless otherwise approved by the Engineer. Superplasticizers are not permitted without prior approval of Engineer.

2.4 *Related Materials* –

2.4.1 *Waterstops* – Flat dumbbell or centerbulb type, size to suit joints, of either rubber (COE CRD C 513, Corps of Engineers Specifications for Rubber Waterstops) or PVC (COE CRD C 572, Corps of Engineers Specifications for Polyvinylchloride Waterstops)

2.4.2 *Moisture Barrier* – Clear 8-mils thick polyethylene; polyethylene-coated barrier paper; or 1/8-inch thick asphalt core membrane sheet.

2.4.3 *Membrane-Forming Curing Compound* – Membrane forming curing compounds shall meet the requirements of ASTM C 309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete, Type I.

2.4.4 *Joint Fillers* –

2.4.4.1 *Joint Sealer* – Hot poured, non-extruding, elastic joint sealer shall meet the requirements of ASTM D 6690, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

2.4.4.2 *Performed Expansion Joint Filler* – Preformed expansion joint filler shall be Non-extruding, bituminous fiber meeting the requirements of ASTM D 1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction.

2.4.5 *Stability* – Provide form materials with sufficient stability to withstand pressure of placed concrete without bow or deflection.

2.4.6 *Exposed Concrete Surfaces* – Material to suit project conditions.

2.5 *Reinforcing Materials* –

2.5.1 *Deformed Reinforcing Bars* – Reinforcing bars shall meet the requirements of ASTM A 615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement, Grade 60, unless otherwise indicated.

2.5.2 *Welded Wire Fabric* – Welded wire fabric shall meet all requirements of ASTM A 185, Standard Specification for Steel Welded Wire Reinforcement.

## PART 3: Execution

3.1 *Verification* – Verify anchors, seats, plates, reinforcements and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete.

3.2 *Preparation* – Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Bonding agent shall be approved by the Engineer prior to use. Apply Bonding agent in accordance with Manufacturer's instructions.

3.3 *Forming and Placing Concrete* –

3.3.1 *Job-Site Mixing* – Use drum type batch machine mixer, mixing not less than 1 minute for one cu. yd. or smaller capacity. Increase mixing time at least 15 seconds for each additional cubic yard or fraction thereof.

3.3.2 *Ready-Mix Concrete* – Ready-Mix concrete shall meet all requirements of ASTM C 94, Standard Specification for Ready Mix Concrete.

3.3.3 *Formwork* – Construct so that concrete members and structures are of correct size, shape, alignment, elevation, and position.

3.3.3.1 Provide openings in formwork to accommodate work of other trades. Accurately place and securely support items built into forms.

3.3.3.2 Clean and adjust forms prior to concrete placement. Apply form release agents or wet forms, as required. Retighten forms during concrete placement if required to eliminate mortar leaks.

3.3.4 *Reinforcement* – Position, support, and secure reinforcement against displacement. Locate and support with metal chairs, runners, bolsters spacers and hangers, as required. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

3.3.5 *Fabric Length* – Install welded wire fabric in as long lengths as practicable, lapping at least one mesh at both ends and sides. Tie or interlace at laps.

3.3.6 *Joints* – Provide construction, isolation, and control joints as indicated or required. Locate construction joints so as to not impair strength and appearance of structure. Locate isolation and control joints in slabs-on-ground to accommodate differential settlement and prevent random cracking.

3.3.7 *Installation of Embedded Items* – Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by cast-in-place concrete. Use setting diagrams, templates, and instructions provided by others for locating and setting.

3.3.8 *Concrete Placement* – Comply with ACI, placing concrete in a continuous operation within planned joints or sections. Do not begin placement until work of other trades affecting concrete is completed.

3.3.9 *Concrete Consolidation* – Consolidate concrete using mechanical vibrating equipment, hand rodding and tamping, so that concrete is well compacted around reinforcement and other embedded items and into forms.

3.3.10 *Concrete Protection* – Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placement and curing.

3.3.10.1 In cold weather comply with ACI 306, Specification for Cold Weather Concreting.

3.3.10.2 In hot weather comply with ACI 305, Specification for Hot Weather Concreting.

3.4 *Concrete Finishes* –

3.4.1 *Exposed-to-view Surfaces* – Provide a smooth finish for exposed concrete surfaces and surfaces that are to be covered with a coating or covering material applied directly to concrete. Remove fins and projections, patch defective areas with cement grout, and rub smooth.

3.4.2 *Slab Trowel Finish* – Apply trowel finish to monolithic slab surfaces that are exposed-to-view or are to be covered with resilient flooring, paint or other thin film coating. Consolidate concrete surfaces by floating then finish troweling, free of trowel marks, and uniform in texture and appearance.

3.4.3 *Broom Finish* – Apply broom finish to monolithic slab surfaces that are exposed to view and subject to vehicular or pedestrian traffic. Consolidate concrete surfaces by floating and troweling prior to applying broom finish.

3.4.4 *Curing* – Begin initial curing as soon as free water has disappeared from exposed surfaces. Where possible, keep continuously moist for not less than 72 hours. Continue curing by use of moisture-retaining cover or membrane-forming curing compound. Cure formed surfaces by moist curing until forms are removed. Provide protections as required to prevent damage to exposed concrete surfaces.

3.5 *Field Quality Control* –

3.5.1 *Concrete Control* – The verification and control of all concrete shall be performed by and independent testing laboratory. Cost of testing shall be paid for by the Contractor. All concrete testing shall be performed by ACI certified technicians in accordance with ASTM 94, Standard Specification for Ready Mix Concrete.

3.5.2 *Laboratory Services* – Laboratory services shall be as follows:

3.5.2.1 Make, cure, store and break test cylinders conforming to the requirements of ASTM C31, Standard Method of Making and Curing Concrete Test Specimens in the Field, ASTM C39, Standard Method of Test for Compressive Strength of Cylindrical Specimens; ASTM C143, Standard Method for Test of Slump of Portland Cement Concrete; ASTM C172 Test cylinders shall be taken at job site and under no circumstances shall they be taken at a central mixing plant.

3.5.2.2 Report on all tests conducted by laboratory shall be rendered promptly and distributed as follows:

3.5.2.2.1 ECUA: Two (2) copies

3.5.2.2.2 Engineer: One (1) copy

3.5.2.2.3 Contractor: as requested

3.5.2.3 Reports of control cylinders for job placed concrete shall conform to ASTM C94, Standard Specification for Ready Mix Concrete.

3.5.2.4 Refer to the following list of functions to be performed by Contractor.

3.5.2.4.1 Contractor shall comply with ACI 301, Specification for Structural Concrete for Buildings. Contractor shall provide assistance as necessary for cylinder sampling.

3.5.2.4.2 Contractor shall keep a daily log, recording quantities of each class used, the area of location or each quantity of concrete relating to its controlling cylinder. The Contractor shall furnish this information to the tickets, should ECUA so request.

3.5.2.5 Refer to the following list of detailed requirements:

3.5.2.5.1 Of the test cylinders taken, one shall be broken at 7 days; two shall be broken at 28 days and one held in reserve.

3.5.2.5.2 Acceptance of concrete shall be in accordance with ACI 301, Specification for Structural Concrete for Buildings.

3.6 *Patching* – Patch Imperfections

3.7 *Defective Concrete* –

3.7.1 *Levels and Lines* – Modify or replace concrete not conforming to the required levels and lines, details and elevations.

3.7.2 *Type* – Repair or replace concrete not properly placed of the specified type.

3.8 *Protection* –

3.8.1 *Temperature* – Immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures, and mechanical damage.

3.8.2 *Moisture* – Maintain concrete with minimal moisture loss at relative constant temperature for period necessary for hydration of cement and hardening of concrete.

# Section 3300

## Paving for Driveways and Parking Areas

**PART 1: General**

1.1 *General Description of Work* –

1.1.1 *Graded Aggregate Base* – Extent of base course work is shown on drawings

1.1.2 *Asphalt Concrete Paving* – Extent of Asphalt concrete paving work is shown on drawings

1.2 *Submittals* –

1.2.1 *Material Certificates* – Provide copies of material certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds specified requirements.

1.2.2 *Design Mix* – Provide design mix for each type of asphalt concrete paving course for approval by the Project Engineer.

1.3 *Quality Assurance* – Comply with FDOT Standard Specifications, latest edition, and with local governing regulations.

1.4 *Site Conditions* –

1.4.1 *Weather Limitations* –

1.4.1.1 *Graded Aggregate Base* – Graded aggregate base course may be placed when air temperature is above 30°F (-1°C) and rising.

1.4.1.2 *Asphalt Concrete* – Apply prime and tack coats when ambient temperature is above 50°F (10°C), and when temperature has not been below 35°F (1°C) for 12 hours immediately prior to application. Do not apply when base is wet or contains an excess of moisture.

1.4.1.3 Construct asphalt concrete surface course when atmospheric temperature is above 40°F (4°C), and when base is dry. Base course may be placed when air temperature is above 30°F (-1°C) and rising.

1.4.2 Establish and maintain required lines and elevations.

**PART 2: Products**

2.1 *General* – Use locally available materials and gradations which exhibit a satisfactory record of previous installations.

2.2 *Graded Aggregate Base Course* – Materials for the graded aggregate base shall meet the requirements of the FDOT Standard Specifications for Road and Bridge Construction, latest edition.

2.3 *Asphalt Concrete –*

2.3.1 *Prime Coat* – Cut-back asphalt type; AASHTO M 82 (ASTM D 2027) MC-30, MC-70 or MC-250.

2.3.2 *Tack Coat* – Emulsified asphalt; AASHTO M 140 (ASTM D 977) or M 208 (D 2397); SS-1, SS-1h, CSS-1 or CSS-1h, diluted with one part water to one part emulsified asphalt.

2.3.3 *Lane Marking Paint* – Paint shall meet or exceed Federal Specification TT-P-19528 and conform to the reflective requirements of FDOT Specifications.

## PART 3: Execution

3.1 *Graded Aggregate Base –*

3.1.1 *Subgrade Preparation –*

3.1.1.1 It is the Contractor's responsibility that the finished roadbed section meets the bearing value requirements, regardless of the quantity of stabilizing materials necessary to be added. After the roadbed grading operations have been substantially completed, the Contractor shall make his own determination as to the quantity (if any) of stabilizing material, of the type selected by him, necessary for compliance with the bearing value requirements.

3.1.1.2 Remove loose material from compacted sub-base surface immediately before applying herbicide treatment.

3.1.1.3 Proof roll prepared base surface to check for unstable areas and areas requiring additional compaction.

3.1.1.4 Notify Architect of unsatisfactory conditions. Do not begin base work until deficient subgrade areas have been corrected and are ready to receive base.

3.1.2 *Placing Base* – Place base course as directed in Section 204 of FDOT Standard Specifications. Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness, as indicated on plans.

3.1.3 *Field Quality Control –*

3.1.3.1 *General* – Test in-place base courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Architect.

3.1.3.2 *Thickness* – In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:

3.1.3.3 *Base Course* – Shall be 1/2 inch, plus or minus.

3.1.3.4 *Surface Smoothness* – The finished surface of the base course shall be checked with a template cut to the required crown and with a 15-foot straightedge laid parallel to the centerline of the road. All irregularities greater than 1/4 inch shall be corrected by scarifying, and removing or adding base material as may be required, after which the entire area shall be re-compacted to meet the specified density requirements.

3.1.3.5 *Compaction* – Graded aggregate base shall be compacted to a minimum density of 98 percent of maximum density as determined by the Modified Proctor Compaction Test. Soil-cement base (if any) shall be compacted to a minimum density of 95 percent of the Modified Proctor Test. The graded aggregate base shall be compacted at a moisture content within 1 percent of the optimum moisture content determined for the base material, by the modified Proctor compaction test; moisture contents for the base materials should be maintained, in the noted range, until completion of the pavement operations. All test results are to be submitted to the Engineer prior to beginning paving operations.

3.1.3.6 *Frequency of Field Density Test* – One test per 400 square yards of paved area.

3.2 *Asphalt Concrete* –

3.2.1 *Surface Preparation* –

3.2.1.1 Remove loose material from compacted base surface immediately before applying prime coat.

3.2.1.2 Proof roll prepared base surface to check for unstable areas and areas requiring additional compaction.

3.2.1.3 Notify Architect/Engineer of unsatisfactory conditions. Do not begin paving work until deficient base areas have been corrected and are ready to receive paving.

3.2.1.4 *Prime Coat* – Apply at rate of 0.15 to 0.20 gallons per square yard, over compacted base. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

3.2.1.5 *Tack Coat* –

3.2.1.5.1 Apply to contact surfaces of previously constructed asphalt or portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gallons per square yard of surface.

3.2.1.5.2 Allow to dry until at proper condition to receive paving.

3.2.1.5.3 Exercise care in applying bituminous materials to avoid smearing of adjoining concrete surfaces. Remove and clean damaged surfaces.

3.2.2 *Plant Mix Asphaltic Surface Course* –

3.2.2.1 *General* – This item shall consist of a wearing surface constructed of asphaltic concrete on a prepared base, in accordance with the plans and specifications.

3.2.2.2 *Materials* –

3.2.2.2.1 The materials and construction methods shall comply with those set forth for Super Pave Asphaltic Concrete in the latest edition of the FDOT Standard Specifications, Section 320, 330 and 334.

3.2.2.2.2 The asphaltic cement shall met the requirements of AASHTO Specification M-20, Viscosity Grade AC-20 (Penetration Grade 60-70).

3.2.2.3 *Job Mix Formula* –

3.2.2.3.1 The Marshall Method of testing will be used in establishing the job mix formula and for control testing throughout the work. The following parameters shall be used in determining the job mix formula:

| **Testing Parameters for Job Mix Formula** | |
|---|---|
| **Item** | **Value** |
| Number of blows each end of specimen | 75 |
| Stability | 1200 |
| Flow (maximum) 1/100 of an inch | 14 |
| Flow (minimum) 1/100 of an inch | 8 |
| Percent Voids | 3 to 5 |
| Percent Voids filled with bitumen | 75 to 85 |

3.2.2.3.2 The density of field samples shall not be less than 95 percent of the Marshall laboratory compacted mixture composed of the same materials in like proportions.

3.2.2.4 *Thickness* – The thickness of the surface shall be as shown on the construction plans. This requirement shall be checked by cores and where a deficiency of more than 1/4 inch exists, the Contractor shall be required to correct the deficiency either by replacing the full thickness or overlaying the area to the satisfaction of the Architect/Engineer.

3.2.3 *Placing Mix* –

3.2.3.1 *General* – Place asphalt concrete mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of 225°F (107°C). Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness.

3.2.3.2 *Joints* – Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

3.2.4 *Rolling* –

3.2.4.1 *General* –

3.2.4.1.1 Begin rolling when mixture will bear roller weight without excessive displacement.

3.2.4.1.2 Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

3.2.4.2 *Breakdown Rolling* – Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.

3.2.4.3 *Second Rolling* – Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

3.2.4.4 *Finish Rolling* – Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

3.2.4.5 *Patching* – Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.

3.2.4.6 *Protection* –

3.2.4.6.1 After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

3.2.4.6.2 Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.2.5 *Traffic And Lane Markings* –

3.2.5.1 *Cleaning* – Sweep and clean surface to eliminate loose material and dust.

3.2.5.2 *Striping* –

3.2.5.2.1 Paint shall meet or exceed Federal Specification ll-P-1952B and conform to the reflective requirements of FDOT Specifications. Color: White, Yellow, and Blue (whichever is required)

3.2.5.2.2 Apply paint with mechanical equipment to produce uniform straight edges. Apply in 2 coats at Manufacturer's recommended rates.

3.2.6 *Field Quality Control* –

3.2.6.1 *General* –

3.2.6.1.1 Test in-place asphalt concrete courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving as directed by Architect/Engineer. Contractor to replace asphalt removed for testing purposes.

3.2.6.1.2 Should any work or materials fail to meet the requirements set forth in the plans and specifications, Contractor shall pay for retesting of same.

3.2.6.1.3 A minimum of two cores and density test shall be made to determine pavement thickness and density. Density test and determinations shall be per FDOT Standard Specifications Section 330-10. Architect/Engineer shall determine location of cores and test.

3.2.6.2 *Thickness –*

3.2.6.2.1 In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:

3.2.6.2.1.1 Base Course: Shall be 1/2 inch, plus or minus.

3.2.6.2.1.2 Surface Course: Shall be 1/4 inch, plus or minus.

3.2.6.3 *Surface Smoothness –*

3.2.6.3.1 Test finished surface of each asphalt concrete course for smoothness, using a 10-foot straightedge applied parallel with, and at right angles to centerline of paved area.

Surfaces will not be acceptable if exceeding the following tolerances for smoothness.

3.2.6.3.1.1 Base Course Surface: Shall be 1/4 inch, plus or minus

3.2.6.3.1.2 Wearing Course Surface: Shall be 3/16 inch, plus or minus

3.2.6.3.1.3 Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template, 1/4 inch

3.2.6.3.2 Check surface areas at intervals as directed by Architect/Engineer.

## PART 4: <u>Measurement and Payment</u>

4.1 *General –*

4.1.1 Graded Aggregate Base and Asphalt Concrete shall be measured for payment either in square yards or by lump sum only for areas indicated on the plans, or as provided in the Proposal and Contract.

4.1.2 Compensation, will be for furnishing all materials, labor, equipment, tools and incidentals required for the work, all in accordance with the plans and these specifications.

# Section 4000

## Record Drawing Requirements

**PART 1: General**

1.1 *Applicability* – These requirements apply to ECUA Capital Improvement Projects (CIP) and System Extension Projects (aka developer-sponsored projects) based on the following criteria:

1.1.1 All ECUA CIP projects and System Extension Projects that include a new ECUA lift station or an existing ECUA lift station receiving major upgrades.

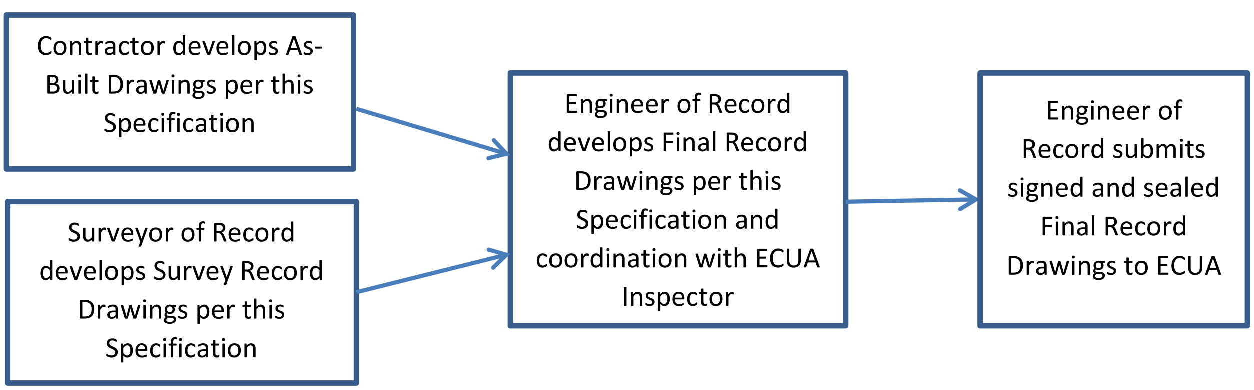
1.1.2 All ECUA CIP projects and System Extension Projects that contain a combined 500' or more of new ECUA mains shall follow this entire specification. For projects with less than 500' of mains, the Survey Record Drawings portion of this specification becomes optional.

1.1.3 If there is a question regarding the applicability of these requirements to a certain project, then the ECUA Project Engineer assigned to that project shall make the determination as early as possible in the project.

1.1.4 For CIP projects, ECUA Project Engineer will require Engineer of Record to include a specific task/fee line item for Survey Record Drawings and a specific task/fee line item for Final Record Drawings, and will provide pay item for Contractor As-Builts in the project's bid proposal form.

1.1.5 For System Extension Projects, these requirements are represented via paragraphs 7 and 8 of the Utility Service Agreement (USA).

1.2 *Overview* – The following chart represents an overview of the process required in order to develop Final Record Drawings for ECUA:




1.3 *Terms Defined* – The Record Drawing process requires various drawings to be developed by multiple parties along the way, with the following terms being defined and used as part of these requirements:

1.3.1 *Surveyor of Record* – The Florida registered PSM that performs the required surveying and then creates the Survey Record Drawings.

1.3.2 *Engineer of Record (EOR)* – The Florida registered PE that collects information from the Contractor As-Builts and Survey Record Drawings and creates the Final Record Drawings.

1.3.3 *Contractor As-Builts* – Drawings prepared by the Contractor and submitted to the EOR.

1.3.4 *Survey Record Drawings* – Drawings prepared by the Surveyor of Record and submitted to the EOR.

1.3.5 *Final Record Drawings* – Drawings prepared by the EOR and submitted to ECUA.

## PART 2: Contractor's As-Built Drawings Requirements

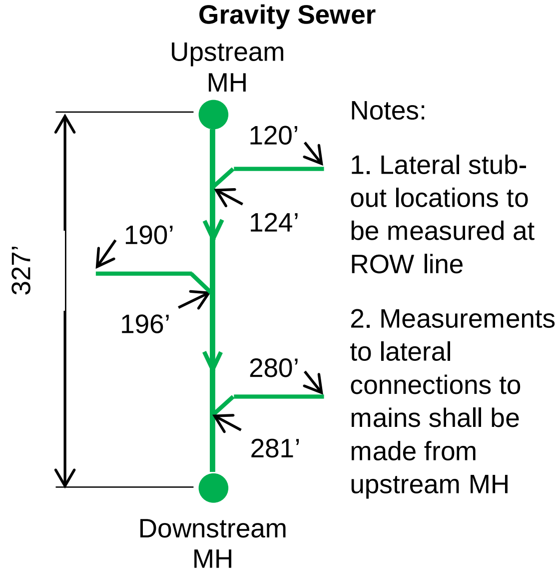
2.1 Prior to backfilling, the Contractor shall make and record measurements (recorded to nearest 1" or 0.1') to all underground features (connections to mains, fittings, etc) that the Surveyor of Record will not have access to with his post-construction survey of surface features (i.e. manhole lids, valve boxes, etc). Contractor shall assemble all of the required information in a legible format on a clean set of plans. As-Builts that are illegible will be rejected by the EOR

2.2 The following underground features shall be measured with measurements being clearly annotated on plans:

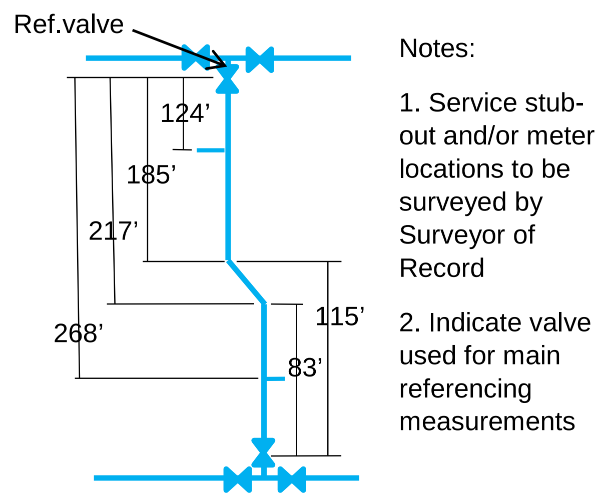
| Water System | Sewer System |
|---|---|
| Service taps | Service taps, stubouts (gravity and pressure) |
| FH taps | ARV taps |
| WM fittings (tees, bends, elbows, etc) | FM fittings (tees, bends, elbows, etc) |
| WM every 100' if WM alignment meanders | FM every 100' if FM alignment meanders |

2.3 Contractor shall take one measurement, referenced to valves, for features on straight sections of mains that are in-line with above-ground termination features such as valves. Contractor shall take two measurements, referenced to at least two above-ground features, for features on meandering sections of mains. Examples include:

**Gravity Sewer**




**Water and Force Mains**




2.4

2.5 Contractor shall provide detailed description of the feature (i.e. 6"x1" saddle tap for water service, 8" 45-degree bend for WM, 4" sewer lateral wye connection to main, etc).

2.6 Title sheet of As-Builts shall include:

2.6.1 Title *"Contractor's As-Builts"*.

2.6.2 Name of the project, and ECUA CIP project number or System Extension number.

2.6.3 Contractor's company name, address, and phone number.

2.6.4 Statement: *"These As-Built Drawings have been prepared per the ECUA Engineering Manual.",* under which shall be signature and printed name of person that prepared drawings, along with phone number and e-mail address.

2.7 Provide as separate document all available photographs, clearly labeled, that show connections to existing mains, critical utility crossings, or other pertinent areas.

2.8 Contractor shall submit As-Built Drawings to the EOR, and shall be available to answer questions related to the drawings as well as supply additional information should there be missing/incorrect information. Insufficient As-Built Drawings as determined by either the EOR or ECUA will delay ECUA payments on CIP projects, and will delay Final Acceptance on System Extension Projects.

## PART 3: Survey Record Drawings Requirements:

3.1 The Surveyor of Record is responsible for surveying property and easement boundaries as well as all at-grade and above-grade facilities per the following table:

| Water System | Sewer System |
|---|---|
| Valve boxes | Manholes |
| Fire hydrants | Lateral stub-outs |
| Water meters/boxes | Valve boxes |
| Well and tank site fence and building corners, fence gates, SCADA tower, generator pad, driveway, power service pole, aerial power lines, etc | Lift station fence corners, fence gates, SCADA tower, control panel, hatches, concrete slab corners, water service/BFP, generator pad, driveway, influent piping, power service pole, aerial power lines, etc |
| All other at- or above- grade facilities | All other at- or above- grade facilities |
| | |
| **Parcels and easements** | |
| Property corners, edge of driveways, easement boundaries, encroachments, etc | |

3.2 Survey shall be prepared utilizing the Florida North Zone of the Florida State Plane Coordinate System, with horizontal measurements and coordinates accurate to within a tenth of a foot (0.1'). All elevations (i.e. manhole rims, inverts of every gravity wastewater pipe and force main connections to manholes, lift station top of slab, bottom of wet well, influent pipe invert and control set points) will be based on the North American Vertical Datum of 1988 (NAVD88), and shall be accurate to within a hundredth of a foot (0.01').

3.3 Show and dimension all rights-of-ways, ECUA parcels, and easements. Label easements based on type (i.e. public utility, ECUA, etc) and their origination (i.e. per plat named ______ located at book ___ and page ___ ).

3.4 Provide ample measurements from right-of-way lines, parcel boundaries, and easement boundaries to surveyed facilities such that it is clearly known if a facility is in its correct location or installed outside of ECUA's property interests.

3.5 Surveyor of Record shall provide detailed description of the surveyed facility (i.e. valve box, 4" sewer lateral stub-out, etc.).

3.6 Title sheet of Survey Record Drawings shall include:

3.6.1 Title *"Survey Record Drawings"*.

3.6.2 Name of the project, and ECUA CIP project number or System Extension number.

3.6.3 Surveyor's company name, address, and phone number.

3.6.4 Statement: *"These Survey Record Drawings have been prepared per the ECUA Engineering Manual. I certify that the surveyed location information of the water and sewer facilities shown on these drawings conforms to the minimum technical standards for land surveying in the State of Florida and that said Record Drawings are true and correct to the best of my knowledge and belief."* under which shall be signature, date, and seal of Survey of Record, and printed name of Surveyor of Record, along with phone number and e-mail address.

3.7 Surveyor of Record shall submit Survey Record Drawings to the EOR, and shall be available to answer questions related to the drawings as well as supply additional information should there be missing/incorrect information. Insufficient Survey Record Drawings as determined by either the EOR or ECUA will delay ECUA payments on CIP projects, and will delay Final Acceptance on System Extension Projects.

## PART 4: <u>Final Record Drawings Requirements</u>

4.1 The EOR shall assemble the information as provided by the Contractor's As-Built Drawings and the Surveyor's Record Survey Drawings, supplement with additional information provided by the EOR and the ECUA Project Inspector, and prepare a set of *draft* Final Record Drawings. The EOR shall retain the Contractor's As-Built Drawings, the Survey Record Drawings, and a copy of the signed and sealed Final Record Drawings, all for future review by ECUA upon request.

4.2 Final Record Drawings shall be new drawings that show facilities as they are constructed, with drawings of new mains, appurtenances, labels and notes as needed. Design/construction plans with clouding, mark-outs, and strike-throughs that attempt to simply illustrate changes between design plans and record drawings will not be allowed. Any information, notes, or measurements from the design/construction plans that are no longer relevant from a Final Record Drawing perspective shall be deleted. Only installed facility information, notes, and measurements shall remain visible.

4.3 All water and sewer mains and services shall be labeled with the appropriate size, material, color, AWWA designation, pipe thickness, etc. Gravity mains shall be labeled with their diameter, pipe thickness, length, and slope. Each fitting shall be labeled with its material and size. Valves shall be labeled with their size and type. All service lines and sewer laterals shall be labeled with their diameter, material, etc.

4.4 Coordinates shall be provided for all surveyed facilities as well as measured locations of underground facilities from Contractor's As-Builts.

4.5 Incorporate project photographs per paragraph 2.6.

4.6 Show all abandoned in-place facilities including the extent and method of abandonment (i.e. capping ends of mains, grouting, etc).

4.7 Title sheet of Final Record Drawings shall include:

4.7.1 Title *"Final Record Drawings"*.

4.7.2 Name of the project, and ECUA CIP project number or System Extension number.

4.7.3 EOR's company name, address, phone number, and Certificate of Authorization number.

4.7.4 Statement: *"These Final Record Drawings have been prepared per the ECUA Engineering Manual. I certify these Final Record Drawings have been reviewed by me or by individual(s) under my direct supervision and to the best of my knowledge and belief these drawings substantially reflect the water and/or sewer facilities as constructed. Contractor's As-Builts were provided by ________, dated ______; Survey Record Drawings were provided by __________, dated _______."* under which shall be signature, date, and seal of EOR, and printed name of EOR, along with phone number and e-mail address.

4.7.5 Contractor's name and related information as listed on the Contractor's As-Builts.

4.7.6 Surveyor of Record's name and related information as listed on the Survey Record Drawings.

4.7.7 ECUA Project Inspector's name and location for his signature granting approval of the Final Record Drawings.

4.7.8 ECUA Project Engineer's name.

4.8 Upon development of a set of *draft* Record Drawings, the EOR shall:

4.8.1 Coordinate and hold mandatory meeting at EOR's office with EOR and ECUA Project Inspector and together review the *draft* Record Drawings for completeness, accuracy, and conformance to this specification. Attendance by the Contractor or the Surveyor of Record is optional and at the discretion of the EOR.

4.8.2 Make corrections to all erroneous items as determined in meeting.

4.9 Final Record Drawings package shall include:

4.9.1 Two sets of Final Record Drawings (22" x 34" or 24" x 36" sheets), signed, dated, and sealed by the EOR

4.9.2 CD labeled with project info, containing:

- ACAD version of the Final Record Drawings
- PDF version of the Final Record Drawings (full sheet size)
- PDF version of the Contractor's As-Builts (full sheet size)
- PDF version of the Record Survey (full sheet size)

4.10 EOR shall submit Final Record Drawings package to ECUA Project Inspector per the following:

4.10.1 For CIP projects, Final Record Drawings package shall be submitted with or prior to Contractor's Final Pay Application. Final Pay Application shall not be processed without proper project closeout paperwork, to include Final Record Drawings acceptable to ECUA.

4.10.2 For System Extension projects, Final Record Drawings shall be submitted at Project Closeout along with other required documents. Final Acceptance shall not be granted without proper project closeout paperwork, to include Final Record Drawings acceptable to ECUA.

4.11 ECUA Project Inspector will perform final review and if acceptable, sign the title sheet thereby approving the documents. Insufficient Final Record Drawings as determined by either the ECUA Project Inspector or ECUA Project Engineer will delay ECUA payments on CIP projects, and will delay Final Acceptance on System Extension Projects.

## PART 5: Miscellaneous

5.1 On CIP projects, ECUA's Standard General Conditions require Record Drawings to be submitted with each monthly pay request. ECUA Project Engineer may waive this requirement based on project needs.

5.2 Occasionally, portions of partially completed projects may be required to be placed into service prior to project's end. As part of the Certification of Completion of Construction for these portions, Contractor shall submit draft As-Builts prior to placing any mains into service.

# Section 16010

# Basic Electrical Requirements

## PART 1: General

1.1 *Scope* – This scope covers the furnishing, installation, testing, adjusting and placing in operation all electrical equipment, devices, facilities, materials, and auxiliary items necessary for the complete and successful operation of all electrical equipment as herein described, shown on the plans, or deemed necessary for the completion of the electrical portion of the project. It is the intent of Sections 16010 -16950 to outline the electrical requirements of the Contract in order to provide the information necessary for the construction of a fully operational system as shown on the plans and as herein described. A comprehensive electrical scope of work is as follows:

1.1.1 Power/Electrical System

1.1.2 Lighting System

1.1.3 Control System

1.1.4 Instrumentation System

1.1.5 Utility Work

1.1.6 Connection of Electrically Powered Mechanical Equipment

1.1.7 Temporary Construction Power

1.1.8 All Incidentals Necessary for a Complete and Fully Operational Electrical System.

1.2 *Definitions* –

1.2.1 *LED* – Light Emitting Diode

1.3 *Working Clearances* –

1.3.1 Working clearances around equipment requiring electrical services shall be verified by Contractor to comply with Code requirements. Should there be apparent violations of clearances; the Contractor shall notify the Owner before proceeding with connection or placing of equipment.

1.3.2 In the case of circuit breakers, safety switches and other equipment requiring wire and cable terminations, the Contractor shall ascertain that lug sizes and wiring gutters or space allowed for proper accommodation and termination of the wires and cables are adequate.

1.4 *Workmanship* – Workmanship under this Division shall be accomplished by persons skilled in the performance of the required task. All work shall be done in keeping with conventions of the trade. Work of this Division shall be closely coordinated with work of other trades to avoid conflict and interference. Equipment and conduits shall be installed in a neat and professional manner as determined by ECUA based on certifications of the trade and NFPA. Failure to do so shall result in work being removed and reinstalled at no cost to ECUA. Conduits shall be square, level, parallel and perpendicular to each other and surrounding surfaces.

1.5 *Protection of Electrical Equipment* – Electrical equipment shall be protected from the weather, especially from water dripping or splashing upon it, at all times during shipment, storage and after installation. Follow Manufacturer's written instructions for shipment and storage.

1.6 *Utilities* – The Contractor shall provide a fully operational electrical service as described in the plans. Coordinate with the utility company for the services and install the service in accordance with their requirements, regulations and recommendations. All utilities company fees to be paid by Contractor.

1.7 *Guarantee* –

1.7.1 Contractor shall guarantee all lighting fixture drivers and LEDs for a period of five (5) years after the lift station is in service. Guarantee shall include material and labor for replacing drivers and LEDs or associated LED bar.

1.7.2 The Contractor shall guarantee all other electrical systems, materials and workmanship to be free from defects for a period of at a minimum two (2) years from the date of final acceptance. The Contractor shall correct all defects arising within this period upon notification by the Owner, without additional compensation.

1.7.3 It is understood that the rights and benefits given the Owner by the guarantees found in the technical specifications are in addition to and not in derogation of any rights or benefits found in the special and general provisions of the Contract.

1.8 *Temporary During Construction* – It shall be the responsibility of the Contractor to provide and maintain adequate temporary lighting at all times during construction, so that the various other trades can accomplish their work in a flawless manner. All utility installation costs and monthly bills shall be included as part of the responsibility.

1.9 *Material Standards* – Material shall be new and comply with standards of Underwriters' Laboratories, Inc., where standards have been established for the particular product and the various NEMA, ANSI, ASTM, IEEE, AEIC, IPCEA or other publications referenced.

1.10 *Test Equipment* – The Contractor shall provide all test equipment and supplies deemed necessary by the Owner or Engineer at no extra cost to the Owner. These supplies shall include but not be limited to the following: volt meters, amp meters, light meters, fuel, generator load banks, watt meters, harmonic distortion test equipment, thermal image camera, high pot test equipment, power quality analyzers, and oscilloscopes. Where conflict exists between specifications and plans, the most stringent requirement shall prevail unless directed otherwise in writing.

1.11 *References –*

1.11.1 See the following table for a list of related Codes and Standards:

| | |
|---|---|
| ANSI/NFPA 70 | National Electrical Code |
| ANSIC2 | National Electrical Safety Code |
| EPA | Environmental Protection Agency |
| FDEP | Florida Department of Environmental Protection |
| NFPA 820 | Standard for Fire Protection in Wastewater Treatment and Collection Facilities |
| NEMA | National Electrical Manufacturer's Association |
| NFPA | National Fire Protection Association |
| IEEE | The Institute of Electrical and Electronics Engineers |
| IESNA | The Illuminating Engineering Society of North America |
| NETA | International Electrical Testing Association |
| UL | Underwriters' Laboratories |

1.11.2 Recommended Standards for Water Works and Wastewater Facilities as published by Great Lakes – Upper Mississippi River Board of State Public Health and Environmental Managers.

1.12 *Submittal –*

1.12.1 Submit under provisions of the General Provisions.

1.12.1.1 The Contractor installing all Electrical work shall review and approve all electrical shop drawings prior to submittal to the Engineer for review. As part of the review, the installer shall certify the following:

1.12.1.1.1 I hereby certify that the equipment and devices shown and marked in this submittal are in compliance with the Contract drawing and specifications, can be installed in the allocated space, will be stored in accordance with the Manufacturer's recommendation, will be installed per NEC and ECUA standards, and is submitted for approval.

Certified by: ______________________ Date: _________________

1.12.2 Submit shop drawings and product data grouped to include complete submittal of related systems, products, and accessories in a single submittal. All material not submitted for approval may or may not be accepted after installation. If not accepted, such material shall be replaced with material acceptable to ECUA at no additional cost. No electrical work may be performed until shop drawings are approved. Submit Shop Drawings on the Following Systems as Grouped Below:

1.12.2.1 *Power/Electrical System –*

1.12.2.1.1 Conduit and Conduit Fittings

1.12.2.1.2 Wire/Conductors

1.12.2.1.3 Pull Boxes

1.12.2.1.4 Control Panel Layouts

1.12.2.1.5 Support Racks Materials

1.12.2.1.6 Conduit Support Systems

1.12.2.1.7 Transformers

1.12.2.1.8 Surge Protection Devices

1.12.2.2 *Generator Equipment –*

1.12.2.2.1 Generator

1.12.2.2.2 Generator Enclosure

1.12.2.2.3 Fuel System Tank & Piping

1.12.2.2.4 Transfer Switches

1.12.2.3 *Lighting System –*

1.12.2.3.1 All Light Fixtures

1.12.2.3.2 Site Poles & Foundations

1.12.2.4 *Control System –*

1.12.2.4.1 Control Panels

1.12.2.4.2 Generator Receptacle

1.12.2.4.3 Circuit Breakers

1.12.2.4.4 Across-The-Line Starters

1.12.2.4.5 Fuses

1.12.2.4.6 Power Distribution Blocks

1.12.2.4.7 Surge Protection Devices

1.12.2.4.8 24VDC Power Supplies

1.12.2.4.9 Batteries

1.12.2.4.10 Converters

1.12.2.4.11 PLC

1.12.2.4.12 Software

1.12.2.4.13 HMI

1.12.2.4.14 I/O Racks

1.12.2.4.15 Relays

1.12.2.4.16 Intrinsically Safe Barrier Relays

1.12.2.4.17 Seal Fail Relays

1.12.2.4.18 Pressure Transducers

1.12.2.4.19 Float Switches

1.12.2.4.20 Momentary Push Buttons

1.12.2.4.21 Hand-Off-Automatic Selectors

1.12.2.4.22 On-Off Selectors

1.12.2.4.23 Limit Switches

1.12.2.4.24 Alarm Lights

1.12.2.4.25 Wiring Devices

1.12.2.4.26 Control Point-to-Point Drawings

1.12.2.4.27 Conductors with Color Indications

1.12.2.4.28 Radio

1.12.2.4.29 Conduit Penetration Areas

1.12.2.4.30 Air Break Seal System

1.12.2.5 *Miscellaneous Electrical Equipment –*

1.12.2.5.1 Miscellaneous Electrical Parts

1.12.2.6 *Drawings –*

1.12.2.6.1 Coordination drawing of All Electrical Items in relation to Site

1.12.2.6.2 Conduit layout drawings

1.12.2.6.3 Conduit penetration locations into wet well

1.12.3 Mark dimensions and values in units to match those specified.

1.13 *Regulatory Requirements –*

1.13.1 Obtain permits, and request inspections from authority having jurisdiction.

1.13.2 References listed in section 1.11

1.14 *Final Inspection And Testing –*

1.14.1 After the electrical installation is complete, the Contractor shall deliver to the Engineer and Owner the following information with his request for final inspection. As-built drawings shall be maintained and available on site throughout construction.

1.14.1.1 One set of Contract Drawings marked to show all significant changes in equipment ratings and locations, alterations in locations of conduit runs, or of any data differing from the Contract Drawings.

1.14.1.2 Certificates of final inspection from local authority having jurisdiction.

1.14.1.3 A tabulation of all motors listing their respective Manufacturer, horsepower, nameplate voltage and current, actual running current after installation and overload heater rating.

1.14.2 The electrical work shall be thoroughly tested to demonstrate that the entire system is in proper working order and in accordance with the plans and specifications. Each motor with its control shall be run as nearly as possible under operating conditions for a sufficient length of time to demonstrate correct alignment, wiring capacity, speed and satisfactory operation. All main switches and circuit breakers shall be operated, but not necessarily at full load. Contractor may be required during final inspection, at the request of the Engineer or Owner to furnish test instruments for use during the testing.

1.15 *Staffing –*

1.15.1 The Electrical Contractor shall provide a “Master Electrician” who has been deemed a “Master Electrician” by exam through the State of Florida, or any other Florida County Permitting Authority as the Electrical Superintendent for the project. The Electrical Superintendent shall be on the project site any time any electrical work is performed by the Contractor.

1.15.2 In addition, the Contractor shall provide one Journeyman electrician for every four electrical helpers used on the project site.

1.15.3 The Electrical Contractor is required and expected to read all other equipment specifications contained in these documents and provide all required power and control conductors required by said equipment to allow them to function as described.

1.16 *As-Built Drawings –*

1.16.1 The Contractor shall provide detailed as-built drawings for the project indicating all power wiring. (All Drawings shall be delivered to the Owner in an AutoCAD 2013 Format.)

1.16.2 The As-Built drawings shall include detailed drawings of all underground conduit, above ground conduit, control panels, and control drawings.

1.16.3 The Engineer will provide electronic copies of all drawings in the plans set on a CD for use by the Contractor. Contractor shall coordinate with ECUA staff before and during conduit installation to verify sufficient size and quantities of conduits are installed.

# Section 16050

## Basic Electrical Materials and Methods

**PART 1: General**

1.1 *Summary* – This section includes:

1.1.1 Electrical equipment coordination and installation.

1.1.2 Common electrical installation requirements.

1.1.3 Concrete equipment bases.

1.1.4 Touch-up paint.

1.2 *Definitions* –

1.2.1 *EPDM* – Ethylene propylene diene monomer rubber.

1.2.2 *NBR* – Acrylonitrile-butadiene rubber.

1.3 *Submittals* –

1.3.1 *General* – Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

1.3.2 *Shop Drawings* – Shop Drawings detailing fabrication and installation of supports and anchorage for electrical items.

1.3.3 *Graphical Representation* – Samples of color, lettering style, and other graphic representation required for each identification product for Project.

1.3.4 *Coordination Drawings for Electrical Installation* –

1.3.4.1 Prepare Coordination Drawings according to "Submittals" to a 1/4-inch-equals-1-foot (1:50) scale or larger. Detail major elements, components, and systems of electrical equipment and materials in relation to each other and to other systems and installations. Indicate locations and space requirements for installation, access, and working clearance. Show where sequence and coordination of installations are important to the efficient flow of the Work. Coordinate drawing preparation with effort specified in other Specification Sections. Include the following:

1.3.4.1.1 Provisions for scheduling, sequencing, moving, and positioning equipment to the site during construction.

1.3.4.1.2 Plans, elevations, and details, including the following:

1.3.4.1.2.1 Clearances to meet safety requirements and for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.

1.3.4.1.2.2 Sizes and locations of required concrete pads and bases.

1.3.4.1.2.3 Cross section of underground ducts at all pipe crossings showing clearance.

1.4 *Coordination* – Coordinate arrangement, mounting, and support of electrical equipment:

1.4.1 To provide for ease of disconnecting the equipment with minimum interference to other installations.

1.4.2 To allow right of way for piping and conduit installed at required slope.

1.4.3 So connecting raceways, cables, and wire ways will be clear of obstructions and of the working and access space of other equipment.

1.5 *Quality Assurance* –

1.5.1 Comply with NFPA 70 for components and installation.

1.5.2 Provide products specified in this Section that are listed and labeled.

The terms "Listed and Labeled": As defined in the National Electrical Code, Article 100.

1.6 *Sequencing And Scheduling* –

1.6.1 Coordinate electrical equipment installation with other components.

1.6.2 Arrange for chases, slots, and openings in structures during progress of construction to allow for electrical installations.

1.6.3 Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

1.6.4 Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning prior to closing in the building.

1.6.5 Coordinate connecting electrical service to components furnished under other Sections. All conduits shall terminate under or over the intended enclosure whether an elevated platform or not.

## PART 2: <u>Products</u>

2.1 *Concrete Equipment Bases* –

2.1.1 *Forms and Reinforcing Materials* – As specified in Section 3200-"Cast-In-Place Concrete."

2.1.2 *Concrete* – 3000-psi, 28-day compressive strength as specified in Section 3200-"Cast-In-Place Concrete."

2.2 *Touch-Up Paint* –

2.2.1 *For Equipment* – Provided by equipment Manufacturer and selected to match equipment finish.

2.2.2 *For Non-Equipment Surfaces* – Matching type and color of undamaged, existing adjacent finish.

## PART 3: Execution

3.1 *Common Requirements for Electrical Installation* –

3.1.1 *Standards* – Comply with NECA 1.

3.1.2 *Measurements* – Measure indicated mounting heights to bottom of unit for rack mounted items and lighting fixture for pole mounted items fixtures.

3.1.3 *Equipment* – Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

3.1.4 *Installation* – Install items level, plumb, and parallel and perpendicular to each other and other systems and components, except where otherwise indicated. Follow manufacturer's instructions for installation.

3.1.5 *Right-of-Way* – Give to piping systems installed at a required slope.

3.2 *Touch-Up Painting* –

3.2.1 Thoroughly clean damaged areas and provide primer, intermediate, and finish coats to suit the degree of damage at each location.

3.2.2 Follow paint Manufacturer's written instructions for surface preparation and for timing and application of successive coats.

3.3 *Cutting And Patching* –

3.3.1 Drill slabs and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved.

3.3.2 Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.3.3 Core-drill holes or form openings.

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# Section 16055

## Overcurrent Protective Device Coordination

**PART 1: General**

1.1 *Summary* – This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study. Coordination of series-rated devices is permitted where indicated on Drawings.

1.2 *Submittals* –

1.2.1 *Product Certificates* – For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1.2.2 *Qualification Data* – For coordination-study specialist.

1.2.3 *Submittals* – Submittals shall be in paper and electronic forms.

1.2.3.1 Study input data, including completed computer program input data sheets.

1.2.3.2 Study and Equipment Evaluation Reports.

1.2.3.3 Study Report (breaker curves in color).

1.2.3.4 Provide Electronic Study for Engineer and Owner Review.

1.3 *Quality Assurance* –

1.3.1 Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

1.3.2 *Coordination-Study Specialist Qualifications* - An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices. Professional Engineer, licensed in the state of Florida, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of the Engineer.

1.3.3 *Standards* –

1.3.3.1 Comply with IEEE 242 for short-circuit currents and coordination time intervals.

1.3.3.2 Comply with IEEE 399 for general study procedures.

## PART 2: Products

2.1 *Computer Software Developers* –

2.1.1 *Product* – Subject to compliance with requirements, provide by one of the following:

2.1.1.1 SKM Systems Analysis, Inc.

## PART 3: Execution

3.1 *Examination* – Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.

Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 *Power System Data* – Gather and tabulate the following input data to support coordination study:

3.2.1 Product Data for overcurrent protective devices specified in Sections 16010 – 16950 and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

3.2.2 Impedance of utility service entrance.

3.2.3 Electrical Distribution System Diagram in hard-copy and electronic-copy formats, showing the following:

3.2.3.1 Circuit-breaker and fuse-current ratings and types.

3.2.3.2 Relays and associated power and current transformer ratings and ratios.

3.2.3.3 Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.

3.2.3.4 Generator kilovolt amperes, size, voltage, and source impedance.

3.2.3.5 Indicate conduit material, sizes of conductors, conductor material, insulation, and length.

3.2.3.6 Motor horsepower and code letter designation according to NEMA MG 1.

3.2.4 Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

3.2.4.1 Special load considerations, including starting inrush currents and frequent starting and stopping.

3.2.4.2 Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

3.2.4.3 Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.

3.2.4.4 Generator thermal-damage curve.

3.2.4.5 Ratings, types, and settings of utility company's overcurrent protective devices.

3.2.4.6 Special overcurrent protective device settings or types stipulated by utility company.

3.2.4.7 Time-current-characteristic curves of devices indicated to be coordinated.

3.2.4.8 Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

3.2.4.9 Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.

3.2.4.10 Control panel ampacity and interrupting rating in amperes rms symmetrical.

3.3 *Fault-Current Study –*

3.3.1 Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at the Control Panel.

3.3.2 Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

3.3.3 Calculate momentary and interrupting duties on the basis of maximum available fault current.

3.3.4 Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.

3.3.4.1 Transformers:

3.3.4.1.1 ANSI C57.12.10.

3.3.4.1.2 ANSI C57.12.22.

3.3.4.1.3 ANSI C57.12.40.

3.3.4.1.4 IEEE C57.12.00.

3.3.4.1.5 IEEE C57.96.

3.3.4.2 Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.

3.3.4.3 Low-Voltage Fuses: IEEE C37.46.

3.4 *Study Report* – Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

3.5 *Equipment Evaluation Report* –

3.5.1 For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.5.2 For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

3.5.3 Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.6 *Coordination Study* – Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

3.6.1 *Calculations* –

3.6.1.1 Calculate the maximum and minimum 1/2-cycle short-circuit currents.

3.6.1.2 Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.

3.6.1.3 Calculate the maximum and minimum ground-fault currents.

3.6.2 *Standards* – Comply with IEEE 141 and IEEE 242 recommendations for fault currents and time intervals.

3.6.3 *Transformer Primary Overcurrent Protective Devices* –

3.6.3.1 Device shall not operate in response to the following:

3.6.3.1.1 Inrush current when first energized.

3.6.3.1.2 Self-cooled, full-load current.

3.6.3.2 Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

3.7 *Conductor Protection* – Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

3.8 *Coordination-Study Report* – Prepare a written report indicating the following results of coordination study:

3.8.1 *Tabular Format of Settings Selected for Overcurrent Protective Devices* –

3.8.1.1 Device tag.

3.8.1.2 Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.

3.8.1.3 Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.

3.8.1.4 Fuse-current rating and type.

3.8.1.5 Ground-fault relay-pickup and time-delay settings.

3.8.2 *Coordination Curves* – Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

3.8.2.1 Device tag.

3.8.2.2 Voltage and current ratio for curves.

3.8.2.3 Three-phase and single-phase damage points for each transformer.

3.8.2.4 No damage, melting, and clearing curves for fuses.

3.8.2.5 Cable damage curves.

3.8.2.6 Transformer inrush points.

3.8.2.7 Maximum fault-current cutoff point.

3.8.3 *Data Sheets* – Completed data sheets for setting of overcurrent protective devices.

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# Section 16060

## Grounding and Bonding

**PART 1: General**

1.1 *Summary* – This Section includes methods and materials for grounding systems and equipment, plus the following special applications:

1.1.1 Grounding for overhead lines

1.1.2 Underground distribution grounding

1.1.3 Ground to grounding counterpoise

1.1.4 Grounding to piping

1.1.5 Grounding to rebar within slab/top of lift station

1.2 *Submittals* –

1.2.1 *Product Data* – For each type of product indicated

1.2.2 *Other Informational Submittals* – Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:

1.2.2.1 Ground rods

1.2.2.2 Ground counterpoise

1.2.2.3 Grounding arrangements and connections for separately derived systems

1.2.2.4 Grounding for sensitive electronic equipment

1.2.3 *Qualification Data* – For testing agency and testing agency's field supervisor.

1.2.4 *Reports* – Field quality control test reports.

1.2.5 *Operation and Maintenance Data* – For grounding to include the following in operation and maintenance manuals:

1.2.5.1 Instructions for periodic testing and inspection of grounding features at ground rings and grounding connections for separately derived systems based on NETA MTS and NFPA 70B.

1.2.5.1.1 Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.

1.2.5.1.2 Include recommended testing intervals.

1.3 *Quality Assurance* –

1.3.1 *Electrical Components, Devices, and Accessories* – Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.3.2 *Standards* – Comply with UL 467 for grounding and bonding materials and equipment.

## PART 2: Products

2.1 *Conductors* –

2.1.1 *Insulated Conductors* – Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

2.1.2 *Bare Copper Conductors* –

2.1.2.1 Solid Conductors: ASTM B 3.

2.1.2.2 Stranded Conductors: ASTM B 8.

2.1.2.3 Tinned Conductors: ASTM B 33.

2.1.2.4 Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.

2.1.2.5 Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

2.1.2.6 Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.1.3 *Bare Grounding Conductor and Conductor Protector for Wood Poles* –

2.1.3.1 Material: No. 4 AWG minimum, soft-drawn copper.

2.1.3.2 Conductor Protector: PVC conduit.

2.2 *Connectors* –

2.2.1 *Material* – Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

2.2.2 *Welded Connectors* – Exothermic-welding kits of types recommended by kit Manufacturer for materials being joined and installation conditions.

2.3 *Grounding Electrodes* –

2.3.1 Ground Rods: Copper-clad; 3/4 inch in diameter to achieve a minimum of 5 ohms.

## PART 3: Execution

3.1 *Applications* –

3.1.1 *Conductors* – Install solid conductor for overhead poles, and stranded conductors for all other conductors, unless otherwise indicated.

3.1.2 *Underground Grounding Conductors* – Install bare copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade.

3.1.3 *Conductor Terminations and Connections* –

3.1.3.1 Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

3.1.3.2 Underground Connections: Welded connectors, except as otherwise indicated.

3.1.3.3 Connections to Structural Steel: Welded connectors.

3.2 *Grounding Overhead Lines* –

3.2.1 Comply with IEEE C2 grounding requirements. ECUA staff is to inspect all welded connections before they are covered.

3.2.2 Install 2 parallel ground rods if resistance to ground by a single, ground-rod electrode exceeds 5 ohms.

3.2.3 Drive ground rods until tops are 12 inches below finished grade in undisturbed earth.

3.2.4 Install welded connectors for underground connections and connections to rods.

3.3 *Grounding Underground Distribution System Components* –

3.3.1 Comply with IEEE C2 grounding requirements.

3.3.2 Retain and edit paragraph below to exceed NFPA 70 requirements. If concrete pad is for equipment to be supplied by utility company, revise to comply with utility company's grounding standards or delete and detail on Drawings.

3.3.2.1 Pad-Mounted Transformers: Concrete pad for equipment to be supplied by utility company; grounding shall comply with utility company's grounding standards

3.4 *Equipment Grounding* –

3.4.1 *Conductors* – Install insulated equipment grounding conductors with all feeders and branch circuits.

3.4.2 *Metal Poles Supporting Outdoor Lighting Fixtures* – Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.5 *Installation* –

3.5.1 *Grounding Conductors* – Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

3.5.2 *Ground Rods* – Drive rods until tops are 1 inch below final grade, unless otherwise indicated.

3.5.2.1 Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing rod or damaging rod coating.

3.5.2.2 For grounding electrode counterpoise system, install three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

3.5.3 *Bonding Straps and Jumpers* – Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

3.5.3.1 Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

3.5.3.2 Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

3.5.4 *Grounding and Bonding for Piping* –

3.5.4.1 Install insulated copper grounding conductors, in conduit, from service equipment to main metal water service into lift station. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

3.5.4.2 Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.5.5 *Grounding for Top of Lift Station* – Install a driven ground rod at base at distances not more than 60 feet apart, as measured around perimeter. Provide a minimum of 1 for each separated slab.

3.5.6 *Grounding for Slabs* – Underground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

3.5.6.1 If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.

3.5.6.2 Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.6 *Field Quality Control* –

3.6.1 *Testing Agency* – Contractor shall perform the following field tests and inspections and prepare test reports:

3.6.2 *Tests and Inspections* – Perform the following tests and inspections and prepare test reports:

3.6.2.1 After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

3.6.2.2 Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.

3.6.2.2.1 Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

3.6.2.2.2 Perform tests by fall-of-potential method according to IEEE 81.

3.6.2.3 Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.6.3 *Resistance* – Report measured ground resistances that exceed the following values:

3.6.3.1 Control Panel: 3 ohm(s).

3.6.3.2 Pad-Mounted Equipment: 5 ohms.

3.6.4 *Excessive Ground Resistance* – If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance

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# Section 16073

# Hangers and Supports for Electrical Systems

## PART 1: General

1.1 *Summary* – This Section includes the following:

1.1.1 Hangers and supports for electrical equipment and systems.

1.1.2 Construction requirements for concrete bases.

1.2 *Definitions* –

1.2.1 *RMC* – Rigid metal conduit.

1.2.2 *RNC* – Rigid Non-metal conduit.

1.3 *Performance Requirements* –

1.3.1 Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.3.2 Supports shall be adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force. All hanger and support designs subject to ECUA and engineer approval.

1.4 *Submittals* –

1.4.1 *Product Data* – For equipment support systems.

1.4.2 *Shop Drawings* – Show fabrication and installation details and include calculations for equipment supports.

1.4.3 *Certifications* – Welding certificates.

1.5 *Quality Assurance* –

1.5.1 *Welding* – Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5.2 *Standards* – Comply with NFPA 70.

1.6 *Coordination* –

1.6.1 Coordinate size and location of concrete bases.

1.6.2 Coordinate installation of equipment supports.

## PART 2: Products

2.1 *Support, Anchorage, And Attachment Components* –

2.1.1 *Raceway and Cable Supports* – As described in NECA 1 and NECA 101.

2.1.2 *Conduit and Cable Support Devices* – Stainless Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

2.1.3 *Mounting, Anchoring, and Attachment Components* – Items for fastening electrical items or their supports to slab surfaces include the following:

2.1.3.1 *Mechanical-Expansion Anchors* – Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

2.1.3.1.1 *Manufacturers* – Subject to compliance with requirements, provide products by one of the following:

2.1.3.1.1.1 Cooper B-Line, Inc.; a division of Cooper Industries.

2.1.3.1.1.2 Empire Tool and Manufacturing Co., Inc.

2.1.3.1.1.3 Hilti Inc.

2.1.3.1.1.4 ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

2.1.3.1.1.5 MKT Fastening, LLC.

## PART 3: Execution

3.1 *Support Installation* –

3.1.1 *Standards* – Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

3.1.2 *Strength of Support Assemblies* – Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.1.3 *Mounting and Anchorage of Surface-Mounted Equipment and Components* – Anchor and fasten electrical items and their supports to rack structural elements by the following methods unless otherwise indicated by code:

3.1.3.1 To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.

3.1.3.2 To Light Steel: Sheet metal screws.

3.1.4 Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.2 *Installation of Fabricated Metal Supports –*

3.2.1 Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.2.2 Comply with AWS D1.1/D1.1M.

3.3 *Concrete Bases –*

3.3.1 Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

3.3.2 Use 3000-psi, 28-day compressive-strength concrete or better.

3.3.3 Anchor equipment to concrete base.

3.3.3.1 Place and secure anchorage devices. Use supported equipment Manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3.3.2 Install anchor bolts to elevations required for proper attachment to supported equipment.

3.3.3.3 Install anchor bolts according to anchor-bolt Manufacturer's written instructions.

3.4 *Painting –*

3.4.1 *Touchup* – Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

3.4.1.1 Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

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# Section 16075

# Electrical Identification

## PART 1: General

1.1 *Summary* – This Section includes the following:

1.1.1 Identification for raceway

1.1.2 Identification for conductors and communication and control cable

1.1.3 Underground-line warning tape

1.1.4 Warning labels and signs

1.1.5 Instruction signs

1.1.6 Equipment identification labels

1.1.7 Miscellaneous identification products

1.2 *Submittals* –

1.2.1 *Product Data* – For each electrical identification product indicated.

1.2.2 *Identification Schedule* – An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.2.3 *Samples* – For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.3 *Quality Assurance* –

1.3.1 Comply with ANSI A13.1 and ANSI C2

1.3.2 Comply with NFPA 70

1.3.3 Comply with 29 CFR 1910.145

1.4 *Coordination* –

1.4.1 Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, Manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

1.4.2 Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

1.4.3 Coordinate installation of identifying devices with location of access panels and doors.

## PART 2: Products

2.1 *Raceway Cable Identification Materials* –

2.1.1 *Standards* – Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

2.1.2 *Color for Printed Legend* –

2.1.2.1 Power Circuits: Black letters on an orange field

2.1.2.2 Legend: Indicate system or service and voltage, if applicable

2.1.3 *Self-Adhesive Vinyl Tape* – Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.2 *Conductor and Communication and Control-Cable Identification Materials* –

2.2.1 *Color-Coding Conductor Tape* – Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.2.2 *Marker Tapes* – Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 *Underground-Line Warning Tape* –

2.3.1 *Description* – Permanent, bright-colored, continuous-printed, polyethylene tape.

2.3.1.1 Not less than 6 inches wide by 4 mils thick

2.3.1.2 Compounded for permanent direct-burial service

2.3.1.3 Embedded continuous metallic strip or core

2.3.1.4 Printed legend shall indicate type of underground line

2.4 *Warning Labels and Signs* –

2.4.1 *Standards* – Comply with NFPA 70 and 29 CFR 1910.145.

2.4.2 *Self-Adhesive Warning Labels* – Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

2.4.3 *Signage* – Warning label and sign shall include, but are not limited to, the following legends:

2.4.3.1 *Multiple Power Source Warning*: "DANGER - ELECTRICAL SHOCK HAZARD – WEAR PRTOECTIVE GEAR PRIOR TO OPENING PANEL DOOR."

2.5 *Instruction Signs* –

2.5.1 Engraved, laminated acrylic or melamine plastic, minimum 1/16-inch thick for signs up to 20 square inches and 1/8-inch thick for larger sizes.

2.5.1.1 Engraved legend with black letters on white face

2.5.1.2 Punched or drilled for mechanical fasteners

2.5.1.3 Framed with mitered acrylic molding and arranged for attachment at applicable equipment

2.6 *Equipment Identification Labels* – Shall be engraved, laminated acrylic or melamine label punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.7 *Miscellaneous Identification Products* –

2.7.1 *Cable Ties* – Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

2.7.1.1 Minimum Width: 3/16 inch

2.7.1.2 Tensile Strength: 50 lb., minimum

2.7.1.3 Temperature Range: Minus 40 to plus 185°F

2.7.1.4 Color: Black, except where used for color-coding

2.7.2 *Paint* – See applicable codes and Standards for paint materials and application requirements and specifications.

2.7.2.1 *Exterior Ferrous Metal* –

2.7.2.1.1 *Semi-gloss Alkyd-Enamel Finish* – Two finish coat(s) over a primer.

2.7.2.1.1.1 Primer: Exterior ferrous-metal primer

2.7.2.1.1.2 Finish Coats: Exterior semi-gloss alkyd enamel

2.7.3 *Fasteners for Labels and Signs* – Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3: Execution

3.1 *Application* –

3.1.1 *Accessible Raceways, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30A* – Identify with weatherproof, orange self-adhesive vinyl label rated for exterior use.

3.1.2 *Accessible Raceways and Cables of Auxiliary Systems* – Identify the following systems with color-coded, weatherproof, self-adhesive vinyl label rated for exterior use:

3.1.2.1 Electrical Supervisory System: Green and blue.

3.1.2.2 Control Wiring: Green and red.

3.1.3 *Power-Circuit Conductor Identification* – For secondary conductors No. 1/0 AWG and larger in pull and junction boxes, and hand holes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

3.1.4 *Branch-Circuit Conductor Identification* – Where there are conductors for more than two branch circuits in the same junction or pull box, use. Identify each ungrounded conductor according to source and circuit number.

3.1.5 *Auxiliary Electrical Systems Conductor Identification* – Identify field-installed alarms, control, signal, and data connections.

3.1.5.1 Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

3.1.5.2 Use system of marker tape designations that is uniform and consistent with system used by Manufacturer for factory-installed connections.

3.1.5.3 Coordinate identification with Project Drawings, Manufacturer's wiring diagrams, and Operation and Maintenance Manual.

3.1.6 *Locations of Underground Lines* – Identify with underground-line warning tape for power, lighting, and control wiring. Install underground-line warning tape for both direct-buried cables and cables in raceway.

3.1.7 *Instruction Signs* –

3.1.7.1 *Operating Instructions* – Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

3.1.7.2 *Emergency Operating Instructions* – Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

3.1.8 *Equipment Identification Labels* – On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment and control panels.

3.1.8.1 *Labeling Instructions* –

3.1.8.1.1 Outdoor Equipment: Engraved, laminated acrylic or melamine label.

3.1.8.1.2 Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

3.1.8.2 *Equipment to Be Labeled* –

3.1.8.2.1 Control panel sections with access doors

3.1.8.2.2 Disconnect switches

3.1.8.2.3 Motor starters

3.1.8.2.4 Push-button stations

3.1.8.2.5 Power transfer equipment

3.1.8.2.6 Contactors

3.1.8.2.7 Power-generating units

3.1.8.2.8 Monitoring and control equipment

3.1.8.2.9 Uninterruptible power supply equipment

3.1.8.2.10 Terminals for signal and control functions

3.1.8.2.11 Miscellanies equipment and devices located within control panel

3.2 *Installation –*

3.2.1 Verification – Verify identity of each item before installing identification products.

3.2.2 *Location* – Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Apply identification devices to surfaces that require finish after completing finish work.

3.2.3 *Self-Adhesive Identification Products* – Clean surfaces before application, using materials and methods recommended by Manufacturer of identification device.

3.2.4 *Non-Adhesive Identification Products* – Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

3.2.5 *System Identification Color Banding for Raceways and Cables* – Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side.

3.2.6 *Color – Coding for Phase and Voltage Level Identification, 600 V and Less* – Use the colors listed below for ungrounded conductors.

3.2.6.1 Color – Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.

3.2.6.1.1 *Colors for 240-208/120-V Circuits –*

3.2.6.1.1.1 *Phase A:* Black

3.2.6.1.1.2 *Phase B:* Red (Orange for 240V Stinger Leg)

3.2.6.1.1.3 *Phase C:* Blue

3.2.6.1.2 *Colors for 480/277-V Circuits –*

3.2.6.1.2.1 *Phase A:* Brown

3.2.6.1.2.2 *Phase B:* Orange

3.2.6.1.2.3 *Phase C:* Yellow

3.2.6.2 *Field-Applied, Color-Coding Conductor Tape* – Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made, and for a minimum width of 2 inches. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

3.2.7 *Underground-Line Warning Tape* – During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

3.2.8 *Painted Identification* – Prepare surface and apply paint according applicable codes and standards.

# Section 16120

## Conductors and Cables

### PART 1: General

1.1 *Summary* – This Section includes the following:

1.1.1 Wires and cables rated 600 V and less

1.1.2 Connectors and terminations rated 600 V and less

1.2 *Restrictions* – All wire/cable runs of any type must be continuous. Splices are expressly prohibited. There shall be no wire nuts in panel boards.

1.3 *Definitions* –

1.3.1 *NBR* – Acrylonitrile-butadiene rubber

1.3.2 *FVR* – Full-Voltage Starter

1.3.3 *RVSS* – Reduced-Voltage Soft Starter

1.3.4 *TSP* – Twisted Shielded Pair

1.3.5 *VFD* – Variable Frequency Drive

1.4 *Submittals* – Product Data for each type of product indicated.

1.5 *Quality Assurance* –

1.5.1 *Electrical Components, Devices, and Accessories* – Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5.2 *Standards* – Comply with NFPA 70.

### PART 2: Products

2.1 *Conductors and Cables* –

2.1.1 *Manufacturers* – Subject to compliance with requirements, provide products by one of the following:

2.1.1.1 Alcan Products Corporation; Alcan Cable Division

2.1.1.2 American Insulated Wire Corp.; a Leviton Company

2.1.1.3 General Cable Corporation

2.1.1.4 Senator Wire & Cable Company

2.1.1.5 Southwire Company

2.1.1.6 The Okonite Company

2.1.2 Requirements – All conductors shall be stranded. No solid conductors shall be allowed.

2.1.3 *Copper Conductors* – Comply with NEMA WC 70

2.1.4 *Conductor Insulation* – Comply with NEMA WC 70 for Types THHN-2/THWN-2

2.1.5 *Multi-conductor Cable* – Comply with NEMA WC 70 for Types SOOW

2.1.6 *Instrumentation Cable* – Comply with NEMA WC 70 for TSP

2.2 *Connectors* –

2.2.1 *Manufacturers* – Subject to compliance with requirements, provide products by one of the following:

2.2.1.1 AFC Cable Systems, Inc.

2.2.1.2 Hubbell Power Systems, Inc.

2.2.1.3 O-Z/Gedney; EGS Electrical Group LLC

2.2.1.4 3M; Electrical Products Division

2.2.1.5 Tyco Electronics Corp

2.2.2 *Description* – Factory-fabricated connectors of size, ampacity rating, material, type, and class for application and service indicated.

## PART 3: <u>Execution</u>

3.1 *Conductor Material Applications* –

3.1.1 Feeders: Copper

3.1.2 Branch Circuits: Copper

3.2 *Conductor Insulation and Multi-conductor Cable Applications and Wiring Methods* –

3.2.1 *Service Entrance* – Type THHN-2/THWN-2, single conductors in raceway.

3.2.2 *Feeders Concealed in Concrete, Below Slabs-on-Grade, and Underground (not into wet well)* – Type THHN-2/THWN-2, single conductors in raceway.

3.2.3 *Branch Circuits, into Wet Well* – Type SOOW, multi-conductor hard service cord.

3.2.3.1 Shall be supported by means of a stainless steel, wire mesh, strain relief device located in an accessible location from the wet well access door.

3.2.3.2 Be routed with wet well to not cause damage to cord during operation or removal of serving mechanical equipment or control device for maintenance purposes.

3.2.3.3 Be connected to serving mechanical equipment or control device in such manner as to be rated for a Class I, Division I rated assembly.

3.2.4 *Class 1 & 2 Control Circuits* – Type THHN-2/THWN-2, in raceway or Type SOOW as applicable.

3.2.5 *Analog Instrumentation Circuits* – Type TSP (in raceway-Type TC) shield Flexible Tray Cable.

3.3 *Installation of Conductors and Cables* –

3.3.1 Use Manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed Manufacturer's recommended maximum pulling tensions and sidewall pressure values.

3.3.2 Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

3.3.3 Identify and color-code conductors and cables according to Section 16075-"Electrical Identification."

3.4 *Connections* – Tighten electrical connectors and terminals according to Manufacturer's published torque-tightening values. If Manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

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# Section 16130

## Raceways and Boxes

**PART 1: General**

1.1 *Summary* – This Section includes raceways, fittings, boxes, enclosures, accessories for direct buried duct, and cabinets for electrical wiring.

1.2 *Definitions* –

1.2.1 *EPDM* – Ethylene-propylene-diene terpolymer rubber

1.2.2 *LFNC* – Liquid-tight flexible non-metallic conduit

1.2.3 *NBR* – Acrylonitrile-butadiene rubber

1.2.4 *RMC* – Rigid metal conduit

1.2.5 *RNC* – Rigid nonmetallic conduit

1.3 *Submittals* –

1.3.1 *Product Data* – For raceways, wire ways and fittings, hinged-cover enclosures, and cabinets.

1.3.2 *Shop Drawings* – For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1.3.2.1 Custom enclosures and cabinets.

1.3.2.2 For hand holes and boxes for underground wiring, including the following:

1.3.2.2.1 Duct entry provisions, including locations and duct sizes

1.3.2.2.2 Frame and cover design

1.3.2.2.3 Grounding details

1.3.2.2.4 Joint details

1.3.2.2.5 Bell ends

1.3.2.2.6 Bends

1.3.2.2.7 Fittings

1.3.2.2.8 Solvent cement

1.4 *Quality Assurance* –

1.4.1 *Electrical Components, Devices, and Accessories* – Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4.2 *Standards* – Comply with NFPA 70.

1.5 *Delivery, Storage, and Handling* – Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

1.6 *Coordination* –

1.6.1 Coordinate layout and installation of ducts and hand holes with final arrangement of other utilities, site grading, and surface features as determined in the field.

1.6.2 Coordinate elevations of ducts entrances into hand holes with final locations and profiles of ducts as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to hand holes.

## PART 2: Products

2.1 *Metal Conduit* –

2.1.1 *Manufacturers* – Subject to compliance with requirements, provide products by one of the following:

2.1.1.1 AFC Cable Systems, Inc.

2.1.1.2 Alflex Inc.

2.1.1.3 Allied Tube & Conduit; a Tyco International Ltd. Co.

2.1.1.4 Anamet Electrical, Inc.; Anaconda Metal Hose.

2.1.1.5 Electri-Flex Co.

2.1.1.6 Manhattan/CDT/Cole-Flex.

2.1.1.7 Maverick Tube Corporation.

2.1.1.8 O-Z Gedney; a unit of General Signal.

2.1.1.9 Wheatland Tube Company.

2.1.2 *Aluminum Rigid Conduit* – ANSI C80.5.

2.1.3 *IMC* – ANSI C80.6.

2.1.4 *Fittings for Conduit (Including all Types and Flexible and Liquid-Tight) and Cable* – NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

2.1.4.1 Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.

2.1.4.2 Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.100 inch, with overlapping sleeves protecting threaded joints.

2.1.5 *Joint Compound for Rigid Aluminum Conduit* – Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity. All conduit bodies shall be Form 7.

2.2 *Nonmetallic Conduit* –

2.2.1 *Manufacturers* – Subject to compliance with requirements, provide products by one of the following:

2.2.1.1 AFC Cable Systems, Inc.

2.2.1.2 Anamet Electrical, Inc.; Anaconda Metal Hose.

2.2.1.3 Arnco Corporation.

2.2.1.4 CANTEX Inc.

2.2.1.5 CertainTeed Corp.; Pipe & Plastics Group.

2.2.1.6 Condux International, Inc.

2.2.1.7 ElecSYS, Inc.

2.2.1.8 Electri-Flex Co.

2.2.1.9 Lamson & Sessions; Carlon Electrical Products.

2.2.1.10 Manhattan/CDT/Cole-Flex.

2.2.1.11 RACO; a Hubbell Company.

2.2.1.12 Thomas & Betts Corporation.

2.2.2 *RNC* – NEMA TC 2, Type EPC-80-PVC, UL 651, unless otherwise indicated.

2.2.3 *Fittings for RNC* – NEMA TC 3 and UL 514B; match to conduit or tubing type and material.

2.2.4 *LFNC* – Flexible PVC core with PCV jacket, smooth inner surface with integral reinforcement within the conduit wall.

2.3 *Custom-Built Metal Wire Ways* –

2.3.1 *Description* – Custom-built stainless steel framing with open ventilated stainless steel mesh sides. Mesh sides shall consist of individual framing, and bolted on with stainless steel (316L) bolts for removable access panels to cable within wire way.

2.3.2 *Fittings and Accessories* – Include stainless steel (316L) couplings, adapters, hold-down straps, strain relief, and other fittings to match and mate with wire ways as required for complete system.

2.3.3 *Wire Way Covers* – Bolt-on type, unless otherwise indicated.

2.3.4 *Additional Requirements* – Refer to Drawings for additional requirements.

2.4 *Hand Holes for Exterior Underground Wiring* –

2.4.1 *Polymer-Concrete Hand Holes* – Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

2.4.1.1 *Available Manufacturers* – Subject to compliance with requirements, Manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2.4.1.1.1 Hubble Power Systems, Quazite

2.4.1.1.2 Armorcast Products Company

2.4.1.1.3 Carson Industries LLC

2.4.1.1.4 CDR Systems Corporation

2.4.1.2 *Basis-of-Design Product* – Subject to compliance with requirements, provide the product size indicated on Drawings.

## PART 3: <u>Execution</u>

3.1 *Raceway Application* –

3.1.1 *Outdoors* – Apply raceway products as specified below, unless otherwise indicated:

3.1.1.1 *Above-Grade Conduit* – Rigid aluminum conduit

3.1.1.2 *Underground Conduit* –

3.1.1.2.1 Wet well to control panel conduit routing: Rigid aluminum conduit schedule 80 shall be used when transitioning through a concrete slab from below grade PVC conduit.

3.1.1.2.2 All underground conduit shall be RNC, Type EPC-80-PVC direct buried, unless noted otherwise on the drawings.

3.1.1.3 *Connection to Vibrating Equipment (Including Transformers, HVAC Units)* – LFNC.

3.1.1.4 *Boxes and Enclosures, Above-Ground* – NEMA 250. Boxes shall be Appleton FS Series or equal.

3.1.1.5 *Hand holes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles* – Polymer concrete, SCTE 77, Tier 15 structural load rating.

3.1.1.6 *Conduit Unilet Bodies* – Conduit unilet bodies shall be Appleton form 35 or equal.

3.1.2 *Minimum Raceway Size* – Use a 1-inch trade size.

3.1.3 *Raceway Fittings* – Compatible with raceways and suitable for use and location.

3.1.3.1 Rigid Aluminum Conduit: Use threaded rigid aluminum conduit fittings, unless otherwise indicated.

3.1.3.2 Corrosion Prevention: Aluminum conduits in contact with concrete or earth shall be wrapped with 2 wraps of anti-corrosion tape, suited for use of protecting metal from corrosion. Tape shall be half-wrapped in one direction, and then back in the opposite direction for a total of 2 half wraps.

3.2 *Installation* –

3.2.1 *Standards* – Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

3.2.2 General –

3.2.2.1 Complete raceway installation before starting conductor installation.

3.2.2.2 Support raceways as specified in Section 16073-"Hangers and Supports for Electrical Systems."

3.2.2.3 Arrange stub-ups so curved portions of bends are not visible above the finished slab.

3.2.2.4 Install no more than the equivalent of three 90-degree bends in any conduit run.

3.2.2.5 Contractor shall allow for 5 conduits (minimum) per pump from control panel or J-box to wet well. Contractor shall allow for 5 conduits 1 inch (minimum) to Instrument/float hatch from control panel or J-Box.

3.2.3 *Raceways Embedded in Slabs* – Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

3.2.4 *Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions* – Apply listed compound to threads of raceway and fittings before making up joints. Follow compound Manufacturer's written instructions.

3.2.5 *Raceway Terminations at Locations Subject to Moisture or Vibration* – Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

3.2.6 *Flexible Conduit Connections* – Use maximum of 36 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers.

3.2.6.1 Use LFNC in damp or wet locations.

3.3 *Installation of Underground Conduit* –

3.3.1 *Direct-Buried Conduit* –

3.3.1.1 Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 2100-"Earthwork" for pipe less than 6 inches in nominal diameter.

3.3.1.2 Install backfill as specified in Section 2100-"Earthwork."

3.3.1.3 After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.

3.3.1.4 Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

3.3.1.5 Install manufactured duct elbows for stub-ups at poles and equipment, unless otherwise indicated.

3.3.1.6 Install manufactured rigid aluminum conduit elbows for stub-ups at poles and equipment. Couple aluminum conduits to ducts with adapters designed for this purpose.

3.3.1.7 Bury warning tape approximately 12 inches above direct-buried conduits.

3.3.2 *Slope* – Pitch ducts a minimum slope of 1:300 down toward hand holes or wet well and away from equipment. Slope ducts from a high point in runs between two hand holes to drain in both directions.

3.3.3 *Curves and Bends* – Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.

3.3.4 *Duct Entrances to Polymer Concrete Hand Holes* – Use end bells, spaced approximately 10 inches on center for 5-inch ducts, and vary proportionately for other duct sizes.

3.3.4.1 Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.

3.3.4.2 Grout end bells into structure walls from both sides to provide watertight entrances.

3.3.5 *Clean Prior to Pulling Conductors or Cables* – Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

3.4 *Installation of Underground Hand holes* –

3.4.1 Install hand holes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

3.4.2 Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

3.4.3 Field-cut openings for conduits according to enclosure Manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 *Grounding* – Ground underground ducts and utility structures according and NFPA 70.

3.6 *Protection* – Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

3.6.1 Repair damage to stainless steel finishes in accordance with Manufacturer recommendations.

3.6.2 Repair damage to PVC finishes with matching touchup coating recommended by Manufacturer.

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# Section 16211

## Electricity Metering

### PART 1: General

1.1 *Summary* – This Section includes equipment for utility company's electricity metering.

1.2 *Submittals* –

1.2.1 *Product Data* – Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Describe electrical characteristics, features, and operating sequences. Include Electricity-metering equipment.

1.2.2 *Shop Drawings for Electricity-Metering Equipment* –

1.2.2.1 Dimensioned plans and sections or elevation layouts.

1.2.2.2 Wiring Diagrams: Power, signal, and control wiring specific to this Project. Identify terminals and wiring designations and color codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.2.2.3 Mounting and anchoring devices recommended by the Manufacturer.

1.2.3 *Operation and Maintenance Data* – For electricity-metering equipment to include in operation and maintenance manuals.

1.3 *Quality Assurance* –

1.3.1 *Electrical Components, Devices, and Accessories* – Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 *Coordination* –

1.4.1 *Electrical Service Connections* – Coordinate with utility companies and components they furnish as follows:

1.4.1.1 Comply with requirements of utilities providing electrical power services.

1.4.1.2 Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

**PART 2: Products**

2.1 *Manufacturers* – In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

2.1.1 *Available Manufacturers* – Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, Manufacturers specified.

2.2 *Equipment for Electricity Metering by Utility Company* –

2.2.1 *Current-Transformer Cabinets* – Comply with requirements of electrical power utility company.

2.2.2 *Meter Sockets* – Comply with requirements of electrical power utility company.

2.3 *Equipment for Electricity Metering by Owner* – For MCC or panel board.

2.3.1 *Available Manufacturers* –

2.3.1.1 Siemens Company

2.3.1.2 Allen-Bradley Company

2.3.1.3 Square D; Schneider Electric.

2.3.2 *Kilowatt-Hour Meter Feed-Through Socket Enclosure* – Electronic three-phase, 5-jaw, measuring electricity used.

2.3.2.1 Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated on the Drawings for its application.

2.3.2.2 Ampacity: Meter ampacity shall be size based upon, and not rated lower, the serving main overcurrent device ampacity rating.

2.3.2.3 NEMA 4X stainless steel (316L) enclosure.

2.3.2.3.1 UL Listed

2.3.2.4 Coordinate additional requirements with utility company standards.

2.3.3 *Kilowatt-Hour Meter Socket Enclosure and CT Cabinet* – Electronic three-phase, measuring electricity used.

2.3.3.1 Voltage and Phase Configuration: Meter shall be designed for use on circuits with voltage rating and phase configuration indicated on the Drawings for its application.

2.3.3.2 NEMA 4X stainless steel (316L) enclosure and CT cabinet.

2.3.3.2.1 UL Listed.

2.3.3.3 Current-Transformer Cabinet: Listed or recommended by metering equipment Manufacturer for use with sensors indicated.

2.3.3.3.1 Provide

2.3.3.3.2 Current-Transformers provide by utility company.

2.3.3.4 Coordinate additional requirements with utility company standards.

2.3.4 *Kilowatt-Hour Meter* – Provided by utility company.

**PART 3: <u>Execution</u>**

3.1 *Installation* –

3.1.1 Comply with equipment installation requirements in NECA 1.

3.1.2 Install equipment for utility company metering. Install raceways and equipment according to utility company's written requirements. Extend grounding connections as required by utility company.

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# Section 16410

# Enclosed Circuit Breakers

## PART 1: General

1.1 *Summary* – This Section includes the following individually mounted, enclosed circuit breakers:

1.1.1 Enclosed molded-case circuit breakers.

1.1.2 Enclosures.

1.2 *Definitions* –

1.2.1 *HD* – Heavy duty.

1.2.2 *RMS* – Root mean square.

1.3 *Submittals* –

1.3.1 *Product Data* – For each type of enclosed circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and Manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

1.3.1.1 Enclosure types and details

1.3.1.2 Current and voltage ratings

1.3.1.3 Short-circuit current rating

1.3.1.4 UL listing for series rating of installed devices

1.3.2 *Shop Drawings* – Diagram power wiring

1.3.3 *Operation and Maintenance Data* – For enclosed circuit breakers to include in operation and maintenance manuals. Include the Manufacturer's written instructions for testing and adjusting enclosed circuit breakers.

1.4 *Quality Assurance* –

1.4.1 *Electrical Components, Devices, and Accessories* – Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4.2 *Standards* – Comply with NFPA 70.

1.4.3 *Product Selection for Restricted Space* – Drawings indicate maximum dimensions for enclosed circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.5 *Project Conditions* –

1.5.1 Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1.5.2 Ambient Temperature: Not less than minus 22°F and not exceeding 104°F.

1.5.3 Altitude: Not exceeding 6600 feet.

1.6 *Coordination* – Coordinate layout and installation of enclosed circuit breakers and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2: <u>Products</u>

2.1 *Manufacturers* – In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

2.1.1 Subject to compliance with requirements, provide products by one of the Manufacturers specified.

2.2 *Molded-Case Circuit Breakers* –

2.2.1 *Available Manufacturers* –

2.2.1.1 Allen-Bradley; Industrial Products

2.2.1.2 Square D/Group Schneider Electric

2.2.1.3 General Electric Co.; Electrical Distribution & Control Division

2.2.2 *Molded-Case Circuit Breaker* – NEA AB 1, with interrupting capacity to meet available fault currents.

2.2.2.1 *Thermal-Magnetic Circuit Breakers* – Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2.2.3 *Molded-Case Circuit-Breaker Features and Accessories* –

2.2.3.1 Standard frame sizes, trip ratings, and number of poles.

2.2.3.2 Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.

2.2.3.3 Under Voltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1 to 0.6-second time delay.

2.3 *Ratings* – UL listed as suitable for service entrance application.

2.4 *Enclosures –*

2.4.1 NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

2.4.1.1 NEMA 250, Type 4X, stainless steel (316L)

2.4.2 Operating handle shall be capable of being pad-locked in the Off/Open position, and interlocked to prevent the door from opening when the breaker is in the On/Closed position.

2.4.3 Complies with NEC gutter space requirements.

2.4.4 Provide the following factory installed items:

2.4.4.1 Engraved nameplate with white letters on black background

2.4.4.2 Ground lugs

2.4.4.3 Rain-tight hubs

## PART 3: Execution

3.1 *Examination –*

3.1.1 Examine elements and surfaces to receive enclosed circuit breakers for compliance with installation tolerances and other conditions affecting performance.

3.1.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 *Installation –*

3.2.1 Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed circuit breakers.

3.2.2 Mount enclosed circuit breaker with top at no more than 6 feet - 6 inches, unless otherwise indicated.

3.3 *Identification –*

3.3.1 Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 16075-"Electrical Identification."

3.3.2 Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Section 16075-"Electrical Identification."

3.4 *Field Quality Control –*

3.4.1 Prepare for acceptance testing as follows:

3.4.1.1 Inspect mechanical and electrical connections.

3.4.1.2 Verify circuit breaker type and labeling.

3.4.1.3 Verify rating of installed overcurrent protection.

3.4.1.4 Inspect proper installation of type, size, and arrangement of mounting or anchorage devices complying with Manufacturer's certification.

3.4.2 Perform the following field tests and inspections and prepare test reports:

3.4.2.1 *Infrared Scanning* –

3.4.2.1.1 *Initial Infrared Scanning* – After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.

3.4.2.1.2 *Instruments, Equipment and Reports* –

3.4.2.1.2.1 Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3.4.2.1.2.2 Prepare a certified report that identifies enclosed circuit breaker and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 *Adjusting* – Set field-adjustable enclosed circuit-breaker trip ranges.

3.6 *Cleaning* –

3.6.1 On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

3.6.2 Inspect exposed surfaces and repair damaged finishes.

# Section 16521

# Exterior Lighting

## PART 1: General

1.1 *Summary* – This Section includes the following:

1.1.1 Exterior luminaires with lamps and drivers.

1.1.2 Poles and accessories.

1.2 *Definitions* –

1.2.1 CRI – Color-rendering index.

1.2.2 Luminaire – Complete lighting fixture, including driver housing if provided.

1.2.3 LED – Light Emitting Diode.

1.2.4 Pole – Luminaire support structure, including tower used for large area illumination.

1.3 *Structural Analysis for Pole and Foundation* –

1.3.1 *Delegated Engineering Design* – Contractor shall provide design performed by Professional Engineer licensed in Florida as part of required Delegated Engineering Document. Design for wind speed of 164 mph, exposure D, per ASCE 7-10/FBC 2010, and assume sandy soils. Design shall also include mounting hardware type, size, material, spacing, number, etc. Supply shop drawings, product info, Delegated Engineering Document, etc per ECUA Technical Specification 2575- Lift Stations, Section 1.4-Pre-construction Submittals.

1.4 *Submittals* –

1.4.1 *Product Data* – For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1.4.1.1 Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.

1.4.1.2 Details of attaching luminaires and accessories.

1.4.1.3 Details of installation and construction.

1.4.1.4 Luminaire materials.

1.4.1.5 Photoelectric relays.

1.4.1.6 Drivers, including energy-efficiency data.

1.4.1.7 LEDs/LED bars, including life, output, and energy-efficiency data.

1.4.1.8 Materials, dimensions, and finishes of poles.

1.4.1.9 Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

1.4.1.10 Anchor bolts for poles.

1.4.1.11 Manufactured pole foundations.

1.4.2 *Pole and Support Component Certificates* – Signed by Manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.

1.4.3 *Operation and Maintenance Data* – For luminaires and poles to include in emergency, operation, and maintenance manuals.

1.4.4 *Warranty* – Special warranty specified in this Section.

1.5 *Quality Assurance* –

1.5.1 *Electrical Components, Devices, and Accessories* – Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5.2 *Standards* – Comply with IEEE C2, "National Electrical Safety Code" and NFPA 70.

1.6 *Delivery, Storage, And Handling* –

1.6.1 Package poles for shipping according to ASTM B 660.

1.6.2 Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

1.6.3 Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.7 *Warranty* –

1.7.1 *Special Warranty* – Manufacturer's standard form in which Manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, or abuse.

1.7.1.1 Warranty Period for Luminaires: Five years from date of Substantial Completion.

1.7.1.2 Warranty Period for Metal Corrosion: Ten years from date of Substantial Completion.

1.7.1.3 Warranty Period for Color Retention: Five years from date of Substantial Completion.

1.7.1.4 Warranty Period for LEDs: Replace LEDs and fuses that fail within 5 years from date of Substantial Completion.

1.7.1.5 Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within Manufacturer's standard warranty period, but not less than five years from date of Substantial Completion.

1.8 *Extra Materials* –

1.8.1 Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8.1.1 *Drivers*: Furnish at least one of each type.

## PART 2: <u>Products</u>

2.1 *Manufacturers* – In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

2.1.1 *Luminaire* – Refer to Drawings for fixture manufacture and model number.

2.1.2 *Pole* – Provide pole by one of the available manufacturers, unless noted otherwise on the Drawings:

2.2 *Luminaires,*

2.2.1 *General Requirements* –

2.2.1.1 Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

2.2.1.2 Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

2.2.2 *Metal Parts* – Free of burrs and sharp corners and edges.

2.2.3 *Housings* – Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use.

2.2.4 *Doors, Frames, and Other Internal Access* – Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

2.2.5 *Exposed Hardware Material* – Able to withstand corrosive environment exposure. Color shall match luminaire color.

2.2.6 *Light Shields* – Factory installed in LEDs, arranged to block light distribution to indicated portion of normally illuminated area or field.

2.2.7 *Factory-Applied Finish for Luminaire* – Durable finish, able to withstand corrosive environment exposure. Color shall match luminaire color.

2.3 *Luminaire-Mounted Photoelectric Relays* –

2.3.1 Standards – Comply with UL 773 or UL 773A.

2.3.2 *Contact Relays* – Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

2.3.2.1 Relay with locking-type receptacle shall comply with NEMA C136.10.

2.3.2.2 Adjustable window slide for adjusting on-off set points.

2.4 *Drivers* –

2.4.1 *Low-Temperature Driver Capability* – Rated by its Manufacturer for reliable starting and operation of indicated LED(s) at temperatures 0°F and higher.

2.4.2 *Driver Characteristics* –

2.4.2.1 Power Factor: 90 percent, minimum.

2.4.2.2 Sound Rating: A.

2.4.2.3 Total Harmonic Distortion Rating: Less than 10 percent.

2.4.2.4 Driver: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.

2.4.2.5 Case Temperature for Compact Lamp Ballasts: 65°C, maximum.

2.4.2.6 Transient-Voltage Protection: Comply with IEEE C62.41 Category A or better.

2.4.3 *Low-Temperature LED Capability* – Rated for reliable starting and operation with ballast provided at temperatures 0°F and higher.

2.4.3.1 Average rated life of 100,000 hours (at a base point of 25°C), minimum

2.5 *LEDs* – ANSI C78.42, CRI 21 (minimum), color temperature 4000 K, and average rated life of 100,000 hours, minimum.

2.6 *Poles and Support Components, General Requirements* –

2.6.1 *Luminaire Attachment Provisions* – Comply with luminaire Manufacturers' mounting requirements. Use stainless-steel (316L) fasteners and mounting bolts, unless otherwise indicated.

2.6.2 *Mountings, Fasteners, and Appurtenances* – Corrosion-resistant items compatible with support components.

2.6.2.1 Materials: Shall not cause galvanic action at contact points.

2.6.2.2 Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.

2.6.2.3 Anchor-Bolt Template: Plywood or steel.

2.6.3 *Concrete Pole Foundations* – Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Section 3300-"Paving for Driveways and Parking Areas."

2.7 *Aluminum Poles* –

2.7.1 *Poles* – Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access hand hole in pole wall.

2.7.2 *Poles* – ATM B 209, 5052-H34 marine sheet alloy with access hand hole in pole wall.

2.7.2.1 Shape: Round, tapered or Square, tapered.

2.7.2.2 Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

2.7.3 *Grounding and Bonding Lugs* – Welded 1/2-inch threaded lug, complying with requirements in Section 16060-"Grounding and Bonding," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through hand hole.

2.7.4 *Brackets for Luminaires* – Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel (316L) bolts.

2.7.4.1 Tapered oval cross section, with straight tubular end section to accommodate luminaire.

2.7.5 *Finish* – Durable polyester power-coated finish, utilizing a 5-stage pre-treatment and painting process, able to withstand corrosive environment exposure. Color shall match luminaire color.

## PART 3: Execution

3.1 *Luminaire Installation* –

3.1.1 Install LEDs in each luminaire.

3.1.2 Fasten luminaire to indicate structural supports. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by Manufacturer.

3.1.3 Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources.

3.2 *Pole Installation –*

3.2.1 *Alignment* – Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

3.2.2 *Clearances* – Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

3.2.2.1 Fire Hydrants and Storm Drainage Piping: 60 inches.

3.2.2.2 Water, Gas, Electric, Communication, and Sewer Lines: 60 inches.

3.2.2.3 Trees: 10 feet

3.2.3 *Raising and Setting* – Raise and set poles using web fabric slings (not chain or cable).

3.3 *Corrosion Prevention* – When in direct contact with earth or concrete, protect aluminum by wrapping the conduit with 0.010-inch- thick, anti-corrosion plastic tape applied twice, with a 50 percent overlap for each wrap application.

3.4 *Grounding –*

3.4.1 Metal Poles – Ground metal poles and support structures according to Section 16060-"Grounding and Bonding."

3.4.1.1 Install grounding electrode for each pole, unless otherwise indicated.

3.4.1.2 Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.4.2 *Nonmetallic Poles* – Ground nonmetallic poles and support structures according to Section 16060-"Grounding and Bonding."

3.4.2.1 Install grounding electrode for each pole.

3.4.2.2 Install grounding conductor and conductor protector.

3.4.2.3 Ground metallic components of pole accessories and foundations.

3.5 *Field Quality Control –*

3.5.1 *Damage Inspection* – Inspect each installed fixture for damage. Replace damaged fixtures and components.

3.5.2 *Illumination Observations* – Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source. Verify operation of photoelectric controls.

3.5.3 *Illumination Tests* – Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Ensure measured light intensities meet the required levels as indicated on the drawings.

# Section 16900

# Systems Integration

## PART 1: General

1.1 *Summary* – This Section includes the following:

1.1.1 The System Integrators shall be responsible for integrating the furnished equipment, material, and software into a fully operational control system.

1.1.2 The System Integrator shall work directly for the Contractor.

1.1.3 The Systems Integrator shall be responsible for supplying the following products and services:

1.1.3.1 Field Instruments

1.1.3.2 Control Panel

1.1.3.3 All Components within Control Panel, as indicated on drawings.

1.1.3.4 All SCADA / HMI programming updates to interface new Lift Station into the overall SCADA / HMI system

1.1.3.5 All CAT 5e patch cables

1.1.3.6 All miscellaneous items required for a fully operational control system integrated with the Owner's existing SCADA / HMI system

1.1.4 The Contractor shall be responsible for supplying the following products and services:

1.1.4.1 Coordinating with the Electrical Utility Company for providing service to the site location

1.1.4.2 Coordinating the location of the Electrical Equipment and Control Panel, and installing it

1.1.4.3 Coordinate installation requirements with the Systems Integrator

1.1.4.4 Installing all field instruments

1.1.4.5 Providing all conduit and conductors associated with a complete and operational control system

1.1.5 The System Integrators shall provide all software for this project, to be installed by the Integrator. This software shall include but not be limited to the following:

1.1.5.1 PLC code

1.1.5.2 HMI screens

1.1.6 The Systems Integrator shall provide the following drawings for the control and electrical system (Each of these drawings shall be submitted and approved as a shop drawing):

1.1.6.1 Block interconnection drawings for the control system and associated electrical equipment (including connections to process control panels).

1.1.6.2 Point to Point wiring diagrams for all equipment connected to the control system.

1.1.6.3 Control Panel Drawing for any panel being built by the Integrator.

1.1.6.4 Equipment specification sheets.

1.1.6.5 Flow charts and control narratives for all control system logic to be approved by the Owner prior to implementation.

1.1.7 The Systems Integrator shall provide the following Operation and Maintenance Manuals for the control system (Each of these shall be custom written by the Integrator. In addition, each manual shall be submitted and approved as a shop drawing.):

1.1.7.1 Control System Operations Manual

1.1.7.2 Control System Maintenance Manual

1.1.7.3 Laminated Trouble Shooting Guides for both the Operators and the Maintenance Staff

1.1.8 The Contractor shall furnish and install all wiring, piping, conduits and necessary mounting and accessory equipment to provide a complete and fully operational instrumentation and control system.

1.2 *System Integrator Qualifications –*

1.2.1 *General –*

1.2.1.1 The following is a pre-approved list for Systems Integrators to be used for the project:

1.2.1.1.1 Automation Control Service, LLC.

1.2.1.1.2 Revere Control Systems.

1.2.1.1.3 Custom Control Solutions.

1.2.1.1.4 Elemech, Inc.

1.2.1.2 Systems Integrators wanting pre-approval shall submit documentation indicating they meet the requirements of this specification to the Owner for review and approval. Pre-approval written acceptance from the Owner shall be in writing and shall be turned in and attached with bid documentation forms.

1.2.1.3 The Integrator shall be engaged full time in the design and manufacturer of PLC based control systems. The Integrator shall have documented experience in the municipal water and wastewater market.

1.2.1.4 The Control Systems Integrator shall maintain a service representative within 100 driving miles of the project site.

1.2.1.5 The control system Integrator shall have a panel shop located at their main facility and shall be able to obtain a UL listing for control panels.

1.2.1.6 The System Integrators shall perform a factory acceptance test for the control system at their local office, and notify the Owner of such time so the Owner has the opportunity to attend. During this test, the Systems Integrator shall demonstrate the complete operation of the control system including any field I/O and network connections. The test shall also have actual dynamic loads provided for each Across-the-Line Starter circuit connected to the control system.

1.2.2 *Project Staffing –*

1.2.2.1 *Project Manager –*

1.2.2.1.1 The Project Manager shall be a registered Professional Engineer licensed in the State of Florida and shall oversee all aspects of the control system project.

1.2.2.1.2 The Project Manager shall have documented experience in the design and construction management of instrumentation / control and electrical systems. This experience shall include emergency power systems, variable frequency drive systems, harmonic correction, voltage drop and load flow analysis, breaker coordination, motor starters, conduit & conductor installation, and PLC / HMI programming.

1.2.2.1.3 The Project Manager shall be the primary contact for the Owner and Engineer.

1.2.2.1.4 The Project Manager or his designee shall be on site during the start-up and testing period for the proposed control system.

1.2.2.2 *Programmers* – All Programmers shall at a minimum have five (5) years of experience in PLC / SCADA / HMI programming.

1.2.3 *Service Technicians –*

1.2.3.1 All Service Technicians shall have a minimum of five (5) years of experience in electrical maintenance.

1.2.3.2 All Service Technicians shall have a minimum of two (2) years of experience in PLC /SCADA / HMI systems.

1.2.3.3 All Service Technicians shall have experience troubleshooting: motor starters, PLC, SCADA, and HMI systems.

1.2.3.4 Service Technicians shall have proficiency in using the following equipment: volt meters, oscilloscopes, PLC programming software, HMI configuration tools

1.3 *PLC / HMI Programming –*

1.3.1 All PLC code shall be written in “Function Block” and “Ladder Logic” style. The System Integrator may use “Ladder Logic” for simple logic functions with the Owner’s approval prior to programming.

1.3.2 All PLC / HMI code shall be supplied to the Owner with fully descriptive comments. All HMI code shall be supplied to the Owner with fully descriptive screen and tag data.

1.3.3 The Integrator shall provide the Owner with a flow chart of all PLC code as well as a written algorithm of the codes functions.

1.3.4 The graphic standards to be used for all HMI equipment shall be coordinated with the Owner and the existing HMI system. All control panel screens will be custom.

1.3.5 The Systems Integrator shall provide the Owner with an I/O map of all process variables in the PLC.

1.3.6 All PLC code shall be the property of the Owner.

1.3.7 The Contractor shall provide three copies of all commented PLC, SCADA, and HMI, code/script/screen layouts to the Owner in electronic format prior to acceptance by the Owner. Any documentation not containing symbol information or comments will not be considered acceptable.

1.4 *Submittals* – Verification indicating compliance with the all aspects listed under the Systems Integrator Qualifications.

## PART 2: <u>Human-Machine Interface (HMI)</u>

2.1 The Human-Machine Interface software for the SCADA HMI shall be based upon the existing installation, which shall be field verified. The Systems Integrator shall be responsible for providing all necessary licenses, drivers, and required network and software packages as required, for the configuration as detailed in the project plans. The Systems Integrator shall be required to provide the necessary HMI screens to monitor and control the equipment installed in this project. The Integrator shall be required to submit the proposed HMI screens to the Engineer and Owner for approval a minimum of one (1) week prior to the factory testing.

2.2 All alarms generated by equipment installed on the project shall be displayed in the alarm summary page. The Integrator shall coordinate with the Owner when configuring the system alarms and subsequent actions. The use of HMI alarm tags will not be allowed unless sufficient reason is submitted and approved.

## PART 3: <u>Execution</u>

3.1 *Contractor’s Responsibility* – The Contractor shall coordinate the System Integrators during construction, testing, start-up, calibration and acceptance of the instrumentation and control system. The Contractor is responsible for a complete and fully operational instrumentation and control system.

3.2 *General Installation –*

3.2.1 The instrumentation and control system, peripherals, and accessory equipment shall be installed in accordance with the equipment Manufacturer's instructions and located as shown on the Contract Drawings or as approved by the Owner and Engineer.

3.2.2 The Contractor shall coordinate the installation, placing and location of system components, their connections to the process components, panels, cabinets and devices, as required to complete the work subject to the Engineer's approval. The Contractor shall be responsible to insure that all field wiring for power and signal circuits between existing devices, the proposed control system are correctly done in accordance with best industry practice to insure a satisfactory functioning installation

3.3 *Test and Acceptance* – The Owner shall witness On-site Operability Tests, and have the option to have 1 representative present during the Factory Acceptance Tests.

3.4 *Installation* – All equipment and devices for the instrumentation and control system shall be installed in the locations shown on the drawings, in accordance with the Manufacturer's recommendations, and in compliance with the requirements of these specifications. Any alterations to equipment type and locations shall be indicated in the submittal package with a listed reason(s) as to why the change occurred.

3.5 *Field Acceptance Tests –*

3.5.1 No power shall be activated to any part of the instrumentation and control system until the Owner or Engineer receive a written certified statement by the system supplier that the installation is complete and ready for energizing. The Contractor is responsible for proper coordination and scheduling, and any damage to the instrumentation and control system.

3.5.2 After the installation is completed, the Contractor, through the System Integrator, shall test each component of the instrumentation and control system. After all systems are operating properly, the Contractor shall notify the Owner and demonstrate the full operation of the system. The Contractor shall make all necessary adjustments and correct or replace faulty equipment to the satisfaction of the Engineer.

3.5.3 The control system integrator shall be required to provide all test equipment necessary to test the control system and computer networks (radio) per industry standards.

3.6 *Field Calibration –*

3.6.1 All instrumentation and controls shall be calibrated in the presence of the Owner in accordance with the Manufacturer's instructions to the accuracy specified.

3.6.2 The Contractor shall provide field calibration as necessary until the project is considered Substantially Complete by the Engineer.

3.7 *Maintenance and Calibration Period* – During the first year of operation after substantial completion of the project, the Contractor shall provide maintenance and calibration services for the newly installed instrumentation and control systems. All maintenance and calibration activities shall conform to the Manufacturer's requirements and shall be provided by a certified technician. This work shall include all labor, tools, equipment, materials and all other expenses at no additional cost to the Owner. Calibration and maintenance shall be performed a minimum of every 4 months.

3.8 *Start-Up Services –*

3.8.1 The System Integrator shall include 8 man-hours for start-up in their bids. These hours will be on the site hours and exclude travel.

3.8.1.1 Any hours not used for Start-up shall be used for Owner Directed Field Programming Changes.

3.8.1.2 Contractor and Integrator shall plan and be prepared for the start-up. Any additional hours required to complete the start-up shall not result additional compensation by the Owner.

3.8.2 Coordinate the start-up time and location with the Owner at least 1 week prior to scheduled start-up. Owner shall have the opportunity to have representation present during the entire start-up. In the event that the Owner chooses not have representation present for start-up, the Systems Integrator shall obtain written documentation from the Owner indicating they will not require representation during the start-up and it may proceed as scheduled. A copy of this written documentation shall be provided to the Contractor at least 1 day prior to start-up.

## PART 4: <u>As-Built Documentation</u>

4.1 The Contractor shall coordinate with the Systems Integrators and provide the Owner with a complete set of AutoCAD 2013 control drawings for the project. These drawings shall include site electrical, control panel schematic/layout drawings, programming code, etc. The drawings shall indicate all wiring numbers.

4.2 The Systems Integrator shall provide detailed documentation of all computer code developed for this project. This documentation shall include but not be limited to: written descriptions, comments in PLC code, and HMI scripting. All software and code developed for this project shall be considered property of the Owner.

4.3 All As-Built documentation shall be provided in both paper and electronic formats

# Section 16910

# Control Panel Construction

## PART 1: General

1.1 *Designs –*

1.1.1 *Design Plans* - The EOR shall be responsible for determining panel configuration and location per the ECUA Engineering Manual and coordination with ECUA staff.

1.1.2 *Delegated Engineering Document* - The Contractor shall provide engineered designs, signed and sealed by a Florida Professional Engineer, in the form of a Delegated Engineering Document for control panel related components and systems. See Section 1.3 below.

1.2 *Approved Fabricators* – See Section 16900 – Systems Integration.

1.3 *Submittals* – Supply shop drawings, product info, Delegated Engineering Document, etc per ECUA Technical Specification 2575- Lift Stations, Section 1.4-Pre-construction Submittals.

1.4 *Scope –*

1.4.1 The Systems Integrator shall furnish, test, and startup all furnished electrical control panels and control system components related to their furnished equipment per control panel design in Delegated Engineering Document.

## PART 2: Products

2.1 *General Requirements for Control Panels –*

2.1.1 All control panels shall be constructed in accordance with the following standards: National Electrical Manufacturers Association (NEMA), Institute of Electrical and Electronics Engineers (IEEE), Underwriter Laboratories (UL), Nation Fire Protection Association (NFPA), and Instrumentation Systems and Automation Society (ISA)

2.1.2 All control panels shall be constructed in a UL approved production facility and bare all applicable UL labels for panel construction.

2.1.3 The completed panel shall be factory tested prior to shipment. Field installation by the Contractor shall consist only of setting the panel in place and making necessary pneumatic and/or electrical connections.

2.1.4 All control panels shall be designed to operate at the service voltage as indicated in the project plans.

2.1.5 Refer to Equipment List on drawings for product data to be provided with control panel.

2.1.6 The main utility breaker within the panel shall be rated for service entrance, as required per NFPA 70.

2.2 *Control Panel Enclosures –*

2.2.1 The entire Control Panel Enclosure and assembly shall be rated NEMA 4X.

2.2.2 All enclosures, control panels, and associated hardware interior and exterior hardware shall be constructed of stainless steel (304L). Enclosures to have door swing operated internal LED lights.

2.2.3 All interior components shall be clearly identified with plastic identification nametags. The tags shall be white with black lettering.

2.3 *Control Panel Wiring –*

2.3.1 Wiring, where required, shall be general-purpose open type, neatly bundled and laced or installed in plastic wiring troughs. Wire shall be stranded No. 14 AWG minimum, with thermoplastic insulation rated for 600V and 90°C.

2.3.2 Wiring colors shall be as follows:

2.3.2.1 All ungrounded AC conductors operating at the supply voltage shall be “Black”

2.3.2.2 All ungrounded AC control conductors operating at voltage less than supply shall be “RED”

2.3.2.3 All ungrounded DC control conductors shall be “Blue”

2.3.2.4 All ungrounded AC control conductors or wires that remain energized when the main disconnect is in the “OFF” position shall be “Yellow”

2.3.2.5 All grounded AC current carrying conductors shall be “White”

2.3.2.6 All grounded DC current carrying conductors shall be “White with a Blue stripe”

2.3.2.7 All grounded AC current carrying conductors that remain energized when the main disconnect is in the “OFF” position shall be “White with a Yellow stripe”

2.3.2.8 All ground conductors shall be “Green”

2.3.2.9 A wiring color code legend shall be mounted inside the control panel door.

2.3.3 No terminal strip may be located closer than 8 inches from any side or bottom of the control panel. This is designed to allow for adequate wire bending radius for field terminations.

2.3.4 All wiring shall be clearly marked with an identification number consistent with the wiring schematic.

2.3.5 Devices mounted on the enclosure door or interior dead front panel shall be run in spiral wrap to avoid pinch points when opening and closing the enclosure door(s) or interior panels

2.4 *Miscellaneous* – Engraved laminated plastic nameplates shall be furnished for each front panel section of the Control Panel assembly. The Contractor shall coordinate with the Owner for nameplate color and naming conventions. All instruments and components shall be tagged on rear with embossed plastic tape labels.

## PART 3: <u>Execution</u>

3.1 *Contractor's Responsibility* –

3.1.1 The Contractor shall coordinate the work of the service personnel during construction, testing, and acceptance of the work.

3.1.2 The Contractor shall receive final approval on all panel, enclosure, and equipment layouts by the Engineer and Owner prior to fabrication or installation.

3.2 *Quality Assurance* –

3.2.1 All control panels shall be factory tested and certified prior to releasing for shipment. The testing shall consist of but not limited to the following:

3.2.1.1 Point to point testing of all wiring prior to application of power

3.2.1.2 The intended supply voltage shall be applied to the control panel and all components shall be tested for proper operation and calibration.

3.2.1.3 The programmable logic controller and operator interface code shall be loaded, and each shall be tested for functionality.

3.2.1.4 All components shall be checked to confirm that each device has been installed per the plans and specifications as well as the Manufacturer's recommendations.

3.2.1.5 The enclosure shall be inspected for defects and shall be repaired or replaced if necessary.

3.2.1.6 All labeling and identification tags shall be verified and be clean and visible.

3.2.2 Prior to shipment one copy of the control panel drawings shall be placed in the drawing pocket of the enclosure.

3.3 *Installation* –

3.3.1 All equipment and devices for the work shall be installed in the locations shown on the drawings, in accordance with the Manufacturer's recommendations, and in compliance with the requirements of these specifications.

3.3.2 The Contractor shall be responsible for coordinating the installation of all equipment in the proposed locations with all other trades performing work on the project that may be affected.

3.4 *Final Inspection* –

3.4.1 Include all changes and/or alterations in the control panels prior to final inspection and acceptance by the Owner.

3.4.2 Any changes and/or alterations in the Control Panels shall be reflected/updated in all Control Panel Schematics prior to acceptance by the Owner. This includes all electronic copies delivered to the Owner.

# Section 16950

## Field Instruments

**PART 1: General**

1.1 *Related Documents* – Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 3-“Technical Specifications” Sections, apply to this Section.

1.2 *Summary* – This section includes the storage, installation, calibration, and warranty of the instrumentation.

1.3 *Delivery, Storage and Handling* –

1.3.1 Deliver units as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

1.3.2 Lift and support units with the Manufacturer’s designated lifting and covering.

1.4 *Project Conditions* –

1.4.1 Field Measurements: Verify dimensions by field measurements. Verify clearances for installation.

1.5 *Coordination and Scheduling* – Coordinate with the Owner for the equipment shop drawings (including wiring schematics) and location of mounting areas.

1.6 *Instrument Quantities for Biding Purposes* – Refer to drawings and equipment list.

**PART 2: Products**

2.1 *Manufacture and Model* – As indicated on Equipment List, located on the drawings.

2.2 *Warranty* –

2.2.1 The equipment shall be warranted for a period of two years after startup.

2.2.2 Components failing to perform as specified by the Engineers, or as represented by the manufacturer, or proven defective in service during the warranty period, shall be replaced, repaired or satisfactorily modified by the manufacturer without cost to the Owner when returned to the Manufacturer.

2.3 *Workmanship* – All materials and equipment shall be installed in accordance with the approved recommendations of the Manufacturer to conform within the Contract Documents. The installation shall be accomplished by workmen skilled in this type of work.

## PART 3: Execution

3.1 *Demonstration* –

3.1.1 Review data in the operation and maintenance manuals.

3.1.2 Demonstrate operation of products specified in this Section. Briefly identify location and describe function, operation, and maintenance of each product.

3.2 *Installation* –

3.2.1 Install according to the Manufacturer's written instructions.

3.2.2 Install units with clearances for service and maintenance.

3.2.3 Contractor shall install required electric conduit and cables for all field instruments. Each field instrument shall be supplied with 2#18 AWG twisted-shielded pair of signal wire in a 1"C to the terminal block location indicated within the control panel.

3.3 *Connections* –

3.3.1 *Electrical* – Conform to applicable requirements in Sections 16010-16950.

3.3.2 *Grounding* – Tighten electrical connectors and terminals, including grounding connections, according to the Manufacturer's published torque-tightening values. Where Manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 *Field Quality Control* –

3.4.1 *Manufacturer's Field Service* – Provide services of a factory-authorized service representative to supervise the field assembly of components and installation and electrical connections, and to report results in writing.

3.4.2 *Contractor's Responsibility* – Contractor shall install all equipment and related accessories before having the Manufacturer's field service. If additional trips are required due to incorrect installation, Contractor shall pay for the costs for the field services.

3.5 *Documentation* – Provide the Owner with original copies of the installation, operation, maintenance, and calibration manuals as provided with the equipment. In addition provide the original warranty cards and product literature. Copies of this information shall not be accepted.

# Division 4 – Construction Details

*Gravity Sewer/Manholes*

D-1 – Sewer Lateral Connection
D-2 – New Cleanout Installation on Existing Lateral
D-3 – Lateral Connection to CIPP-Lined Pipe
D-10 – Standard Manhole
D-11 – Manhole Frame and Cover
D-12 – Shallow Manhole
D-13 – Drop Manhole
D-14 – Sanitary Sewer Grade Tolerance/Acceptable SAG Limits
D-19 – Manhole Adjustment

*Force Mains/Air Release Valves*

D-20 – Low Pressure Residential Sewer Service
D-21 – Force Main Connection to Manhole
D-22 – Low Pressure Flushing Connections
D-23 – Sewer Check Valve Vault Detail
D-30 – Air Release Valve – Manual
D-31 – Air Release/Vacuum Valve – Automatic for 10” and Smaller Mains
D-32 – Air Release/Vacuum Valve – Automatic for 12” and Larger Mains

*Water/Hydrants*

D-40 – Water Service for 5/8”, 1”, and 1 ½” Meters
D-41 – Typical Chlorine Disinfection
D-42 – Chlorine and Calcium Hypochlorite Required for Disinfection
D-43 – Typical Valve and Box Installation
D-44 – 2”, 3” and 4” Meter Vault
D-45 – 6”, 8” and 10” Meter Vault
D-46 – Existing Water Main Shutdown Best Management Practices
D-47 – Typical Multiple Water Service Installation
D-48 – Multiple Water Meter Service
D-50 – Typical Fire Hydrant Installation
D-51 – Typical 2” Flush Hydrant
D-52 – Typical Thrust Block Installation
D-59 – Valve Box Adjustment

*Pipe/Miscellaneous*

D-60 – Pipe Envelope Requirements
D-61 – Flexible Pipe Bedding
D-62 – Pipe Joint Restraint Tabulation
D-63 – Pipe Joint Restraint Reducers and Reducing Tees
D-64 – Water/Sewer Separation
D-65 – Typical Jack and Bore
D-66 – Storm Sewer Vertical Separation
D-67 – Pig/Swab Launch Pit
D-68 – Exposed Piping and Equipment Master Color Chart
D-70 – Regional Services Map and Personnel

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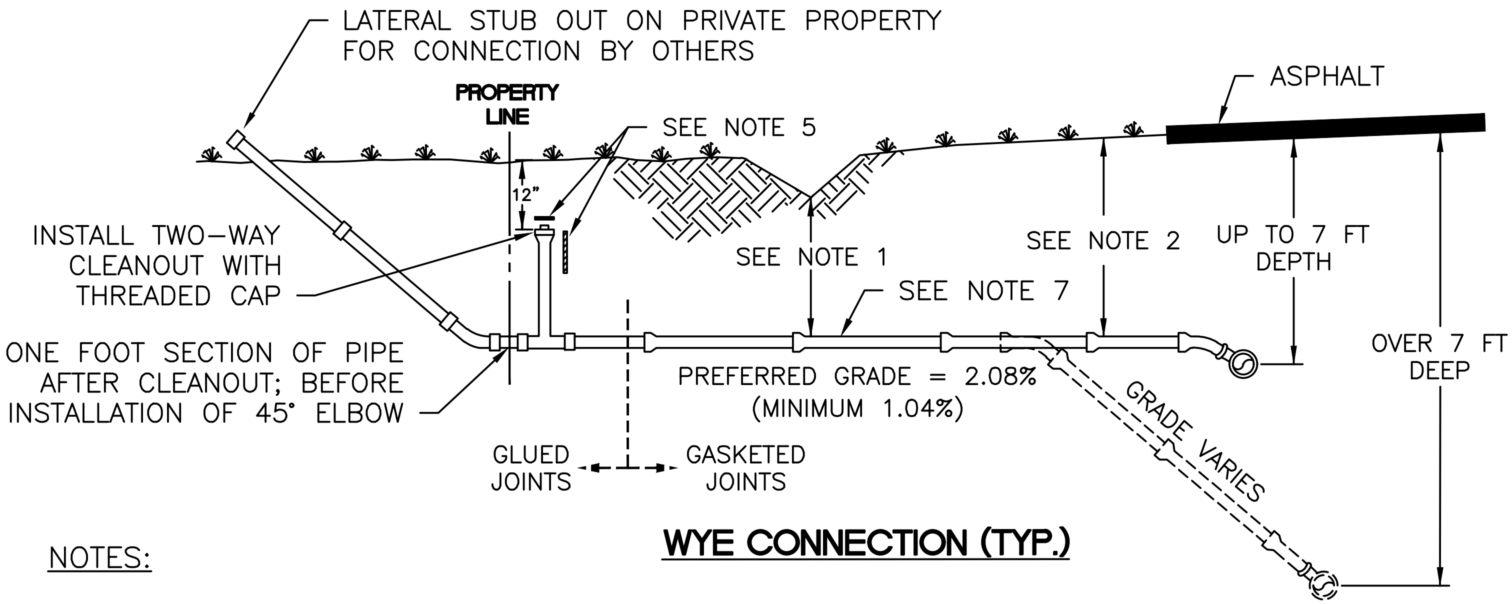
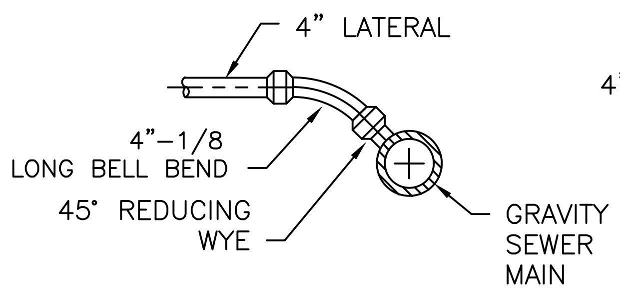


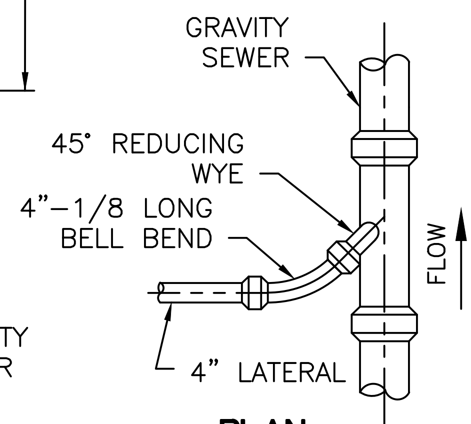

**WYE CONNECTION (TYP.)**

NOTES:

1. MAINTAIN 18" MINIMUM IF DITCH IS PRESENT.
2. MAINTAIN 36" MINIMUM IF NO DITCH IS PRESENT.
3. ALL LATERALS TO BE 4" ø UNLESS PLANS SHOW LARGER DIAMETER.
4. SEWER LATERAL SHALL BE INSTALLED FOR EACH LOT UNLESS OTHERWISE INDICATED ON CONSTRUCTION PLANS.
5. INSTALL #4 REBAR, 12" LONG, 12" COVER, NEXT TO CLEANOUT. PLACE TEMPO UNIMARKER MODEL 172 DISC DIRECTLY ABOVE CLEANOUT CAP.
6. PLUMBERS SHALL CONNECT TO LATERAL PIPING UPSTREAM OF CLEANOUT AND NOT TO CLEANOUT.
7. ASTM D3034 DR 26 PIPE (SDR 35 SHALL NOT BE USED)




**SECTION**




**PLAN**

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# SEWER LATERAL CONNECTION

DETAIL

D-1

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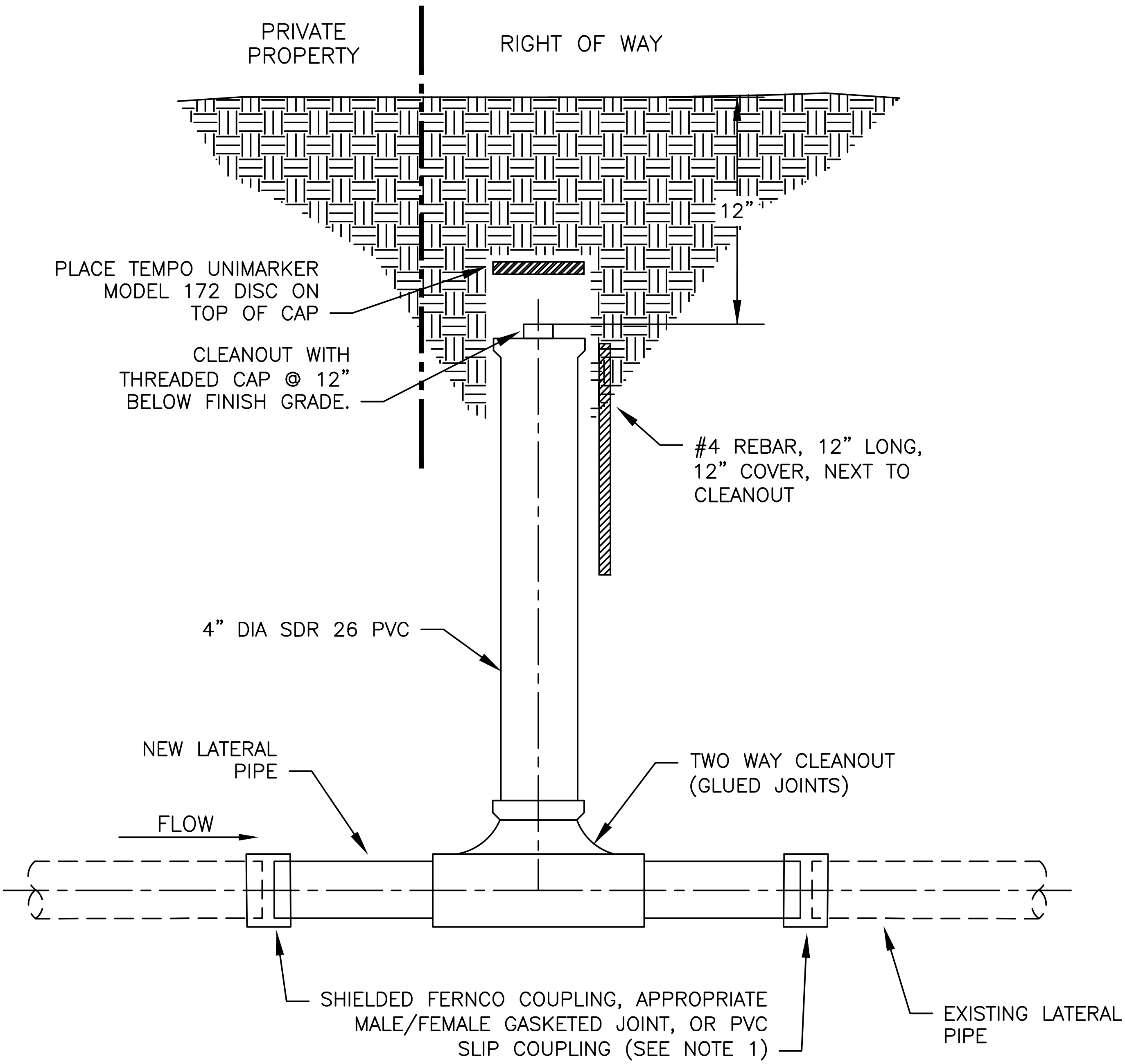


NOTES:

1. MAKE CONNECTION TO EXISTING JOINTS USING NEW GASKETS OR CONNECT TO CLEANLY CUT EXISTING PIPE USING APPROVED REINFORCED FERNCO COUPLING. WHEN COUPLING PVC TO PVC OF THE SAME OUTSIDE DIAMETER, USE A PVC SLIP COUPLING INSTEAD OF A FERNCO.

2. WHERE PRACTICAL, INSTALL CLEANOUTS AS CLOSE TO PROPERTY LINE WHILE REMAINING IN ROW.

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# NEW CLEANOUT INSTALLATION ON EXISTING LATERAL

DETAIL
D-2

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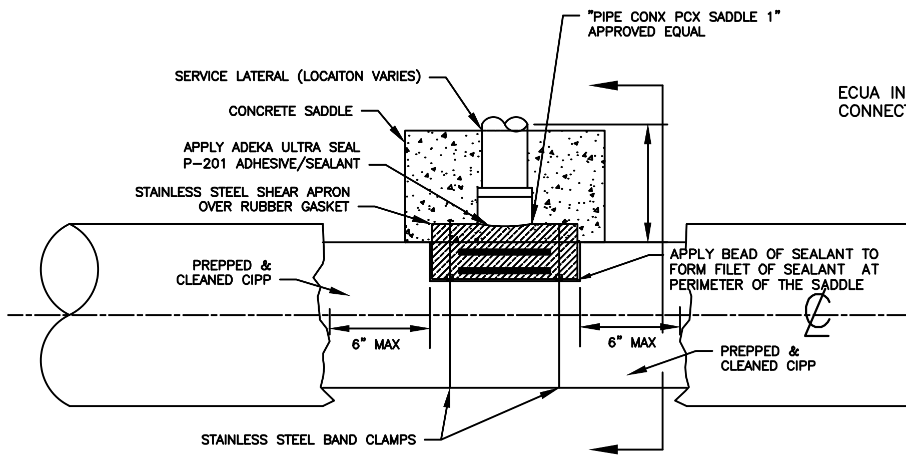
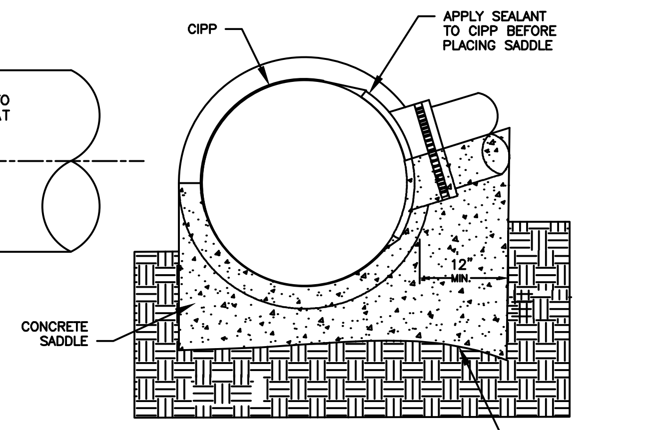



**SERVICE CONNECTION TO CIPP LINED S.S. MAINS**

ECUA INSPECTOR MUST APPROVE CONNECTION PRIOR TO BACKFILLING




**SECTION A-A**

SERVICE CONNECTION NOTES:

1. REMOVE HOST PIPE FROM CIPP WITHOUT DAMAGING CIPP LINER.
2. THE LENGTH OF THE REMOVED HOST PIPE SHALL NOT EXCEED 6" BEYOND THE PERIMETER OF THE SADDLE. rEMOVEAL OF SOIL BENEATH THE PIPE SHALL BE MINIMAL.
3. FOR A NEW SERVICE INSTALLATION, A HOLE SAW OF PROPER DIAMETER FOR THE SADDLE SHALL BE USED TO CUT THE LINER. SEE SADDLE INSTALLATION DIRECTIONS FROM SADDLE MANUFACTURER TO IDENTIFY PROPER HOLE SIZE. IF THE LINER HAS A EXISTING CUT-OUT BY THE CIPP INSTALLER, MAKE THE CUT-OUT AS CIRCULAR AS POSSIBLE. THE EDGES OF ANY CUT IN THE LINER SHALL NOT BE JAGGED AND SHALL BE SANDED FREE OF BURRS OR ANY OTHER EXTRANEOUS MATERIAL. IF THE EXISTING CUT-OUT IN THE CIPP IS FOR WYE, IS OBLONG OR EXCEEDS 6.5" IN DIAMETER, A FITTING MUST BE CUT INTO THE CIPP FOR THE LATERAL INSTALLATION. DO NOT USE A SADDLE.
4. ALL SOIL, DEBRIS, OILS, LOOSE MATERIAL AND OTHER CONTAMINANTS SHALL BE REMOVED FROM THE CIPP LINER TO ENSURE PROPER ADHESION OF SEALANT. THE CIPP SHALL BE DRY WHEN SEALANT IS APPLIED.
5. PLACE THE SADDLE ON THE CIPP WITH THE SADDLE OPENING PROPERLY POSITIONED OVER THE CUT-OUT IN THE CIPP. ENSURE THE SADDLE IS CLEAN OF SOIL, DEBRIS, OILS, LOOSE MATERIAL, ETC. THE PROTRUDING RIDGE AROUND THE INSIDE OF THE SADDLE HOLE SHALL BE PLACED WITHIN THE CIPP CUT-OUT. THE RIDGE SHALL BE BEARING AGAINST THE BOTTOM OF THE CUT-OUT TO HELP PREVENT THE SADDLE FROM SLIPPING DOWNWARD. ONCE THE SADDLE IS POSITIONED, MARD ON THE CIPP THE OUTER PERIMETER OF THE SADDLE. REMOVE THE SADDLE.
6. APPLY ADEKA ULTRA SEAL P-201 ADHESIVE SEALANT (OR ENGINEER APPROVED EQUAL) TO THE SURFACE OF THE CIPP WITHIN THE MARKED PERIMETER ON THE PIPE. USE A TROWEL OR SOME OTHER TOOL TO COVER THE ENTIRE SURFACE WITHIN THE MARKED PERIMETER WITH ADHESIVE/SEALANT TO A THICKNESS NOT EXEEDING A QUARTER OF AN INCH ($\frac{1}{4}$").
7. PLACE THE SADDLE ON THE CIPP IN THE LOCATION IDENTIFIED BY THE MARKED PERIMETER. INSTALL STIFFENER PLATE AND STAINLESS STEEL STRAPS. ENSURE STAINLESS STEEL STRAPS MEET TORQUE REQUIREMENTS FO SADDLE MANUFACTURER.
8. APPLY A BEAD OF ADHESIVE/SEALANT TO PERIMETER OF SADDLE TO FROM A FILLET AROUND THE PERIMETER OF THE SADDLE.
9. APPLY ADEKA ULTRA SEAL P-201 ADHESIVE/SEALANT TO THE OUTSIDE OF THE SPICKET END OF THE LATERAL, THEN INSERT THE LATERAL INTO THE BELL OF THE TEE-SADDLE.
10. AFTER LATERAL PIPE IS CONNCETED TO SADDLE AND ON PROPER GRADE, POUR A CONCRETE SADDLE UNDER THE MAIN PIPE AND THE LATERAL CONNECTION AS SHOWN. CONCRETE SHALL BE THOROUGHLY MIXED WITH WATER BEFORE PLACEMENT. POURING DRY MIX INTO EXCAVATION AND WETTING WITH WATER AFTERWARD IS UNACCEPTABLE.
11. ALLOW ADEQUATE TIME, PER MANUFACTURER'S RECOMMENDATION, FOR SEALANT TO CURE AND CONCRETE SET BEFORE BACKFILLING EXCAVATION.

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# LATERAL CONNECTION TO CIPP-LINED PIPE

DETAIL
D-3

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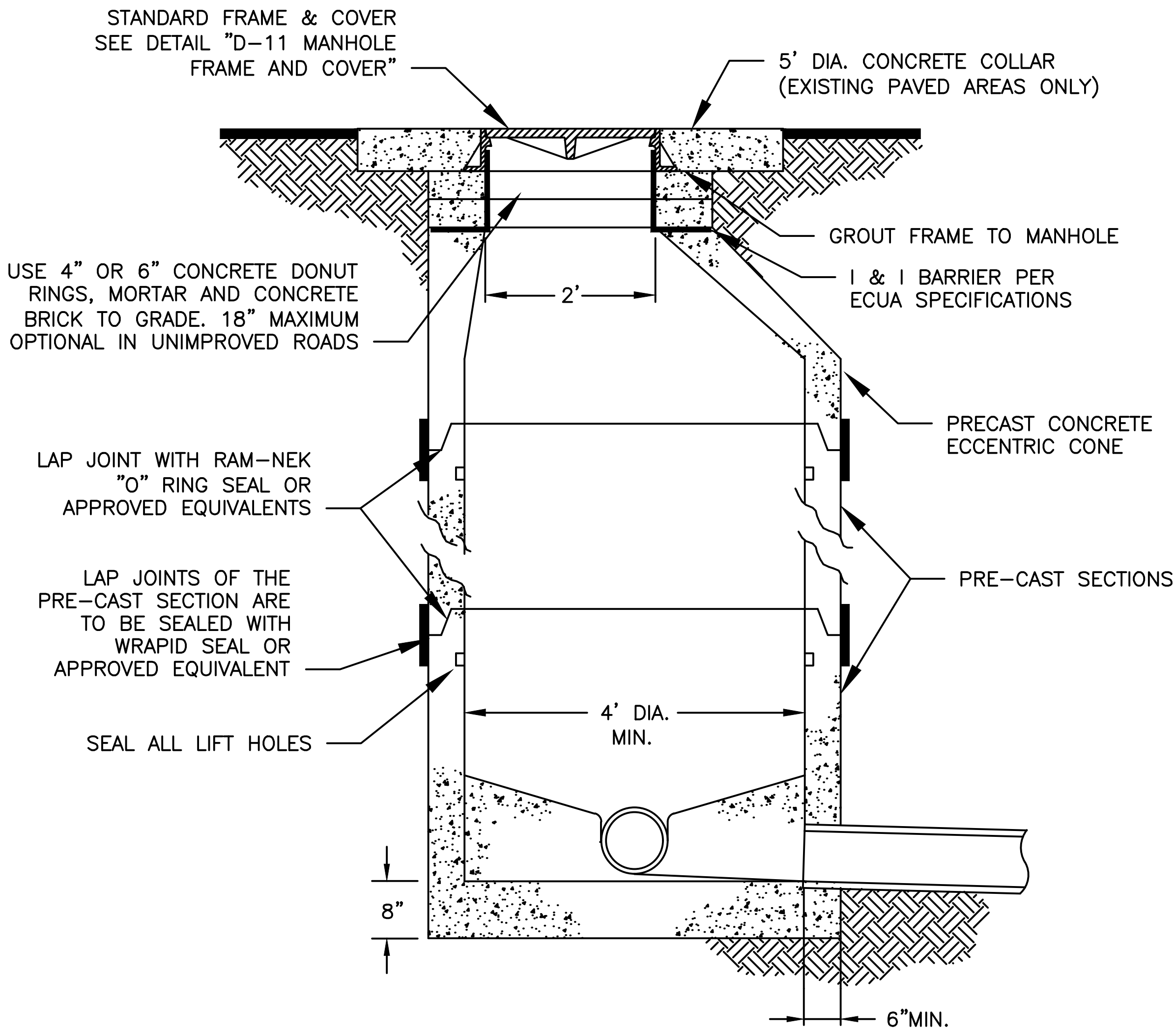
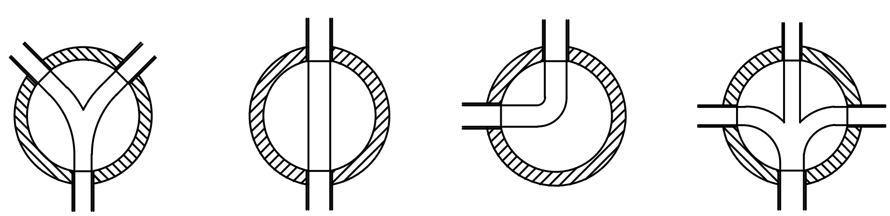



NOTES:

1. SEE SECTION 2570 FOR COMPLETE SPECIFICATIONS.
2. VACUUM TEST TO BE COMPLETED IN ACCORDANCE WITH ASTM C-1244 AND PERFORMED PRIOR TO BACKFILLING.
3. SUPPORTING SOILS UNDER THE BASE OF THE MANHOLE SHALL BE COMPACTED TO AT LEAST 98% OF MAXIMUM DENSITY.
4. JOINT SEALING WRAP SHALL BE INSTALLED ON ALL NEW MANHOLES. RISER SECTION SHALL ONLY BE WRAPPED WHEN MANHOLE IS LOCATED IN LOW AREAS OR AS DEEMED NECESSARY BY ENGINEER.



**TYPICAL INVERT CHANNELS**

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# STANDARD MANHOLE

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DETAIL
D-10

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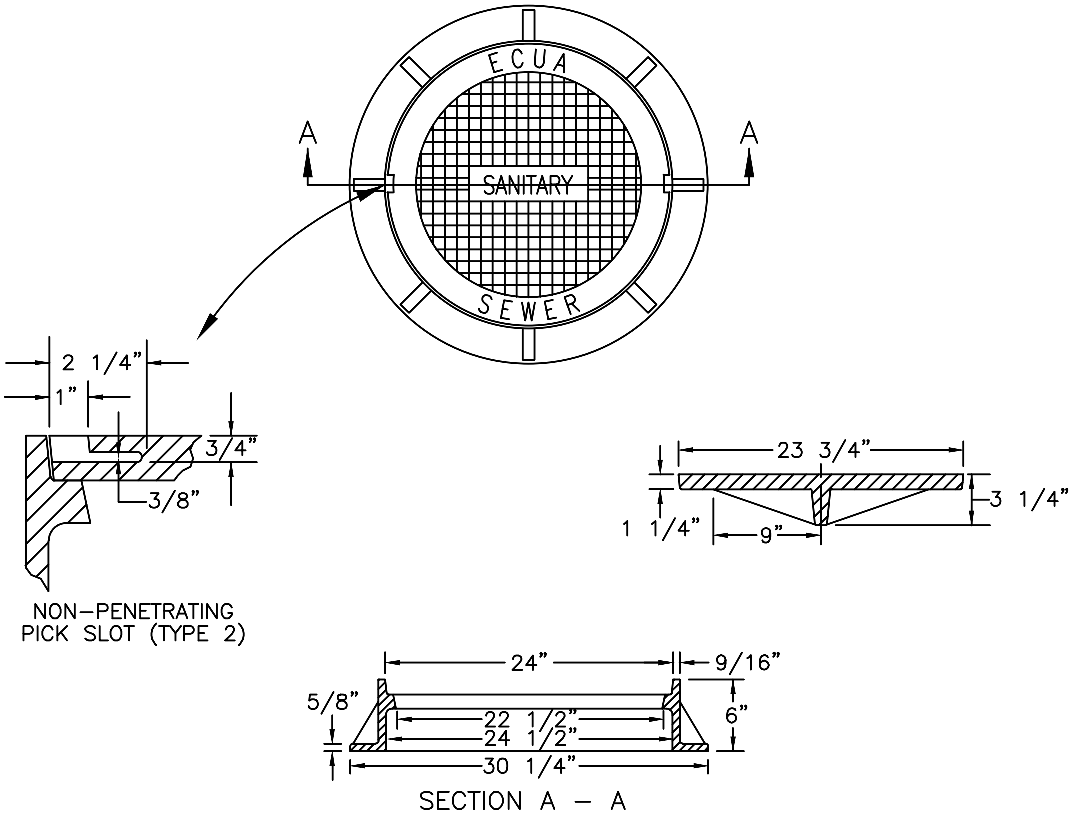


NOTES:

1. FRAME AND COVER SHALL BE U.S. FOUNDRY USF170E, BOLTING FEATURES NOT REQUIRED.
2. FRAME AND COVER SHALL CONFORM TO ASTM SPEC. A–48, CLASS 30 CAST IRON.
3. MANHOLE COVER IS TO BE NON–VENTING, EXCEPT WHEN USED ON A RECEIVING MANHOLE FOR A FORCE MAIN, A MANHOLE THAT HAS A DROP MAIN OR LATERAL ENTERING IT, OR A MANHOLE THAT HOUSES AN ARV (SEE DETAIL D–31).

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# MANHOLE FRAME & COVER

DETAIL

D-11

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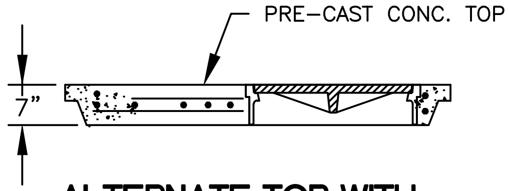
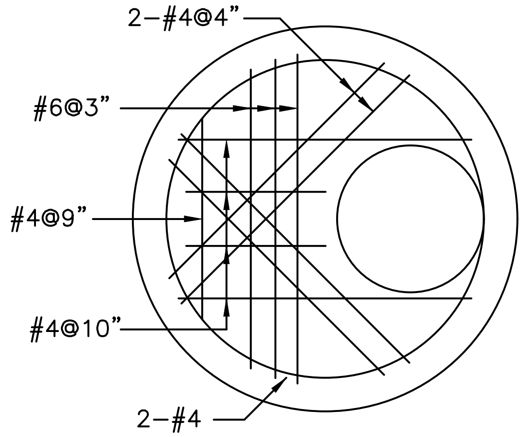
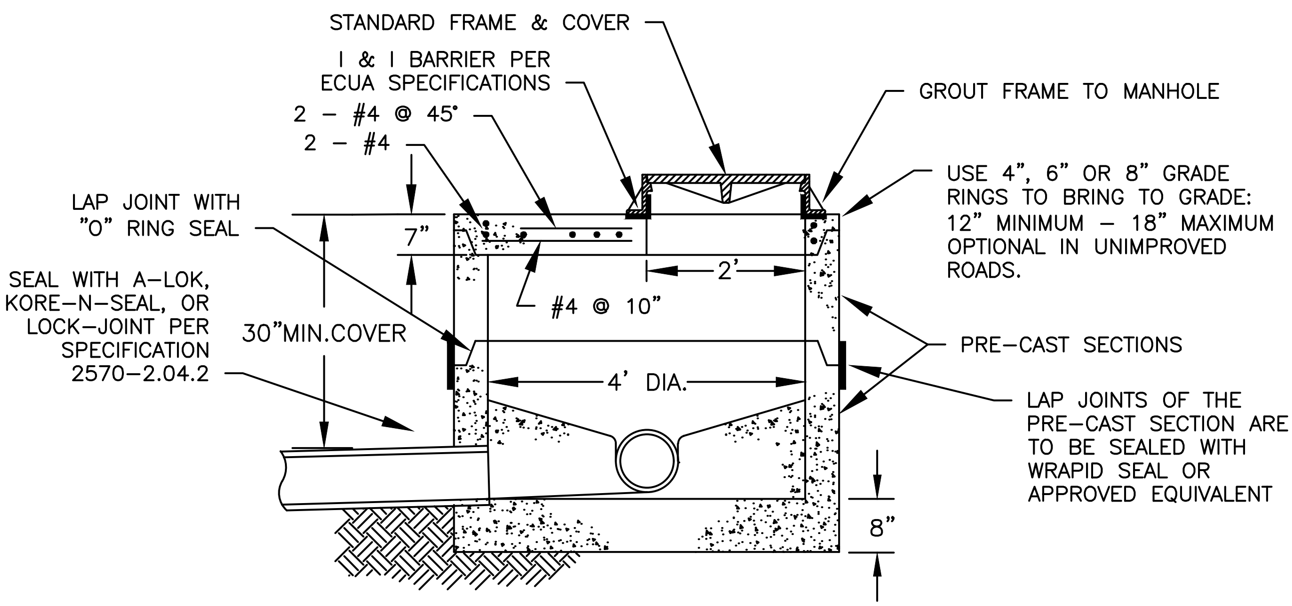



ALTERNATE TOP WITH INVERTED RING




TOP REINFORCING




NOTES:

1. SEE SECTION 2570 FOR COMPLETE SPECIFICATIONS.
2. VACUUM TEST TO BE COMPLETED IN ACCORDANCE WITH ASTM C-1244 AND PERFORMED PRIOR TO BACKFILLING.
3. SUPPORTING SOILS UNDER THE BASE OF THE MANHOLE SHALL BE COMPACTED TO AT LEAST 98% OF MAXIMUM DENSITY.
4. JOINT SEALING WRAP SHALL BE INSTALLED ON ALL NEW MANHOLES. RISER SECTION SHALL ONLY BE WRAPPED WHEN MANHOLE IS LOCATED IN LOW AREAS OR AS DEEMED NECESSARY BY ENGINEER.

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# SHALLOW MANHOLE

DETAIL
D-12

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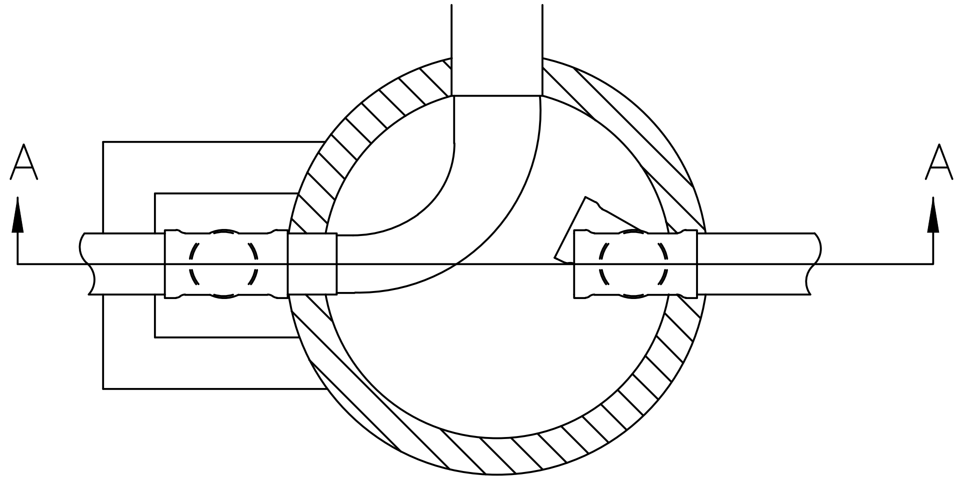
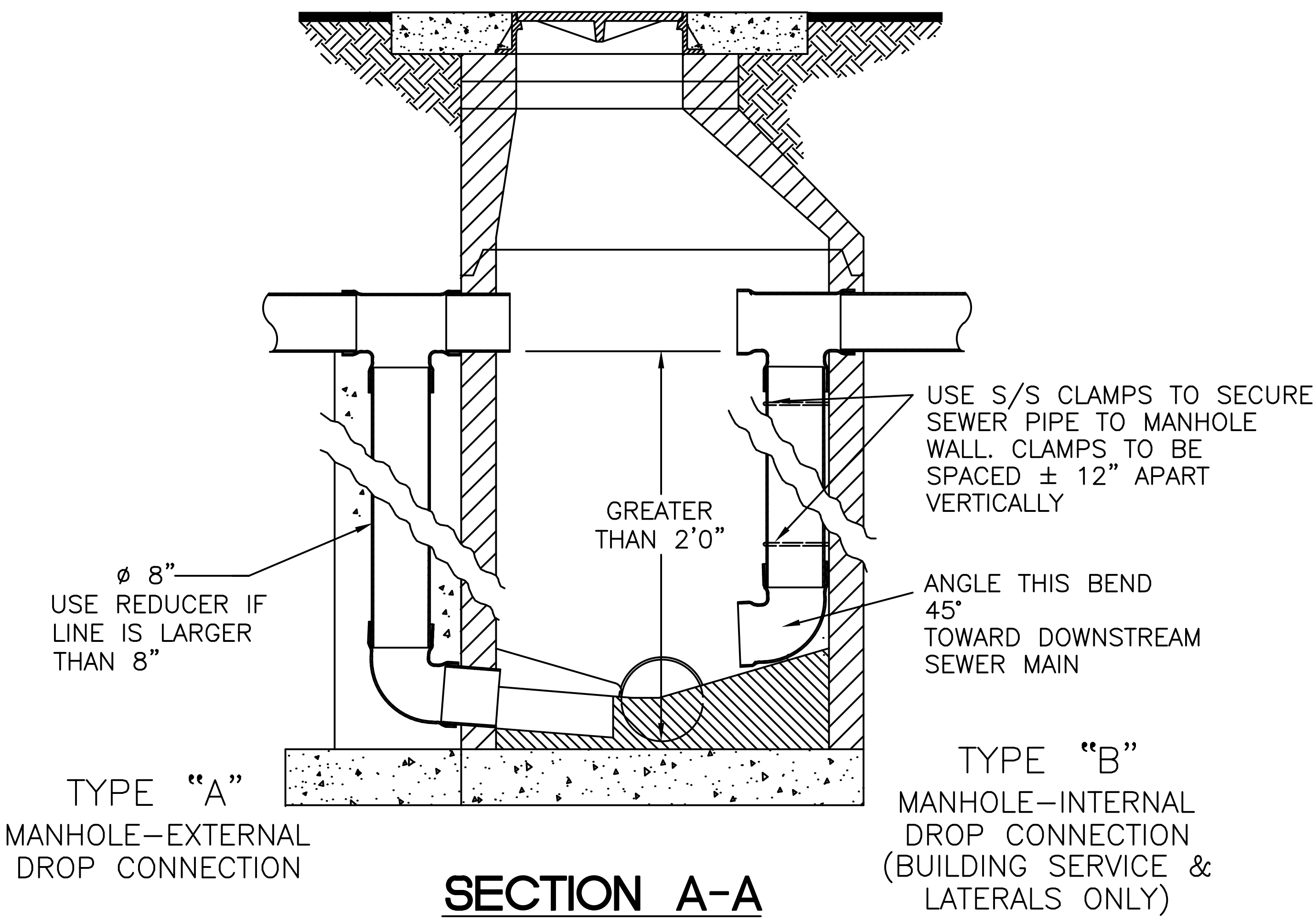



NOTE:
REFER TO SPECIFICATIONS AND DETAILS D-10 &
D-11 FOR NOTES PERTAINING TO MANHOLE CONSTRUCTION.




**SECTION A-A**

EMERALD COAST UTILITIES AUTHORITY

# DROP MANHOLE

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DETAIL
D-13

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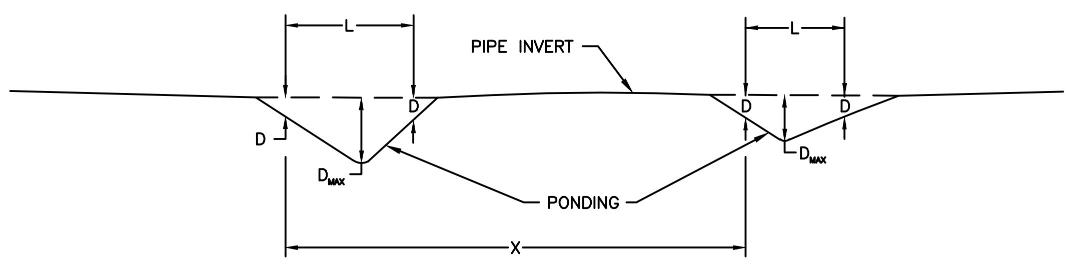
| NOMINAL PIPE DIAMETER (INCHES) | MINIMUM GRADE (%) | ACCEPTABLE SAG DEPTH (D)* IN INCHES OF WATER | | | | ABSOLUTE MAXIMUM DEPTH ($D_{MAX}$ IN INCHES OF WATER) | | MAXIMUM SAG LENGTH (L)** | MINIMUM ALLOWABLE DISTANCE BETWEEN SAGS WITH 10% OR GREATER DEPTH (X)*** |
|---|---|---|---|---|---|---|---|---|---|
| | | EQUAL OR LESS THAN MINIMUM GRADE | | GREATER THAN MINIMUM GRADE | | EQUAL OR LESS THAN MINIMUM GRADE | GREATER THAN MINIMUM GRADE | | |
| | | PVC PIPE | D. IRON PIPE | PVC PIPE | D. IRON PIPE | | | | |
| 8 | 0.400 | 0.8" | 0.8" | 1" | 1" | 1.2 | 1.5 | 6 FT | 36 FT |
| 10 | 0.280 | 1" | 1" | 1.1" | 1.1" | 1.5 | 1.65 | 6 FT | 36 FT |
| 12 | 0.220 | 1.1" | 1.1" | 1.2" | 1.2" | 1.65 | 1.8 | 9 FT | 54 FT |
| 15 | 0.150 | 1.5" | 1.5" | 1.5" | 1.5" | 2.25 | 2.25 | 9 FT | 54 FT |
| 16 | 0.140 | | 1.5" | | 1.6" | 2.25 | 2.4 | 9 FT | 54 FT |
| 18 | 0.120 | | 1.5" | | 1.8" | 2.25 | 2.7 | 9 FT | 72 FT |
| 21 | 0.100 | | 1.5" | | 2" | 2.25 | 3.0 | 9 FT | 72 FT |
| 24 | 0.080 | | 1.5" | | 2.4" | 2.25 | 3.6 | 9 FT | 72 FT |
| 27 | 0.067 | | 2" | | 2.7" | 3.0 | 4.0 | 9 FT | 72 FT |
| 30 | 0.058 | | 2" | | 3" | 3.0 | 4.5 | 9 FT | 72 FT |
| 36 | 0.046 | | 2" | | 3" | 3.0 | 4.5 | 9 FT | 72 FT |
| 42 | 0.037 | | 2" | | 3" | 3.0 | 4.5 | 9 FT | 72 FT |

*D = ALLOWABLE SAG DEPTH = ALLOWABLE DEPTH OF POOLED WATER IN PIPE AS MEASURED FROM WATER SURFACE TO INVERT OF PIPE BY USE OF SAG GAUGE.

$D_{MAX}$ = ABSOLUTE MAXIMUM DEPTH. ANY SAG DEPTH GREATER THAN $D_{MAX}$ CONSTITUTES FAILURE.

**L = SAGE LENGTH = LENGTH OF POOLED WATER SURFACE AS MEASURED FROM UPSTREAM EDGE OF POOLED WATER SURFACE TO DOWNSTREAM EDGE OF POOLED WATER SURFACE. (PROVIDED $D_{MAX}$ IS NOT EXCEEDED.)

***X = DISTANCE BETWEEN SAGS, AS MEASURED FROM UPSTREAM EDGE OF POOLED WATER SURFACES BETWEEN CONSECUTIVE SAGS.

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# SANITARY SEWER GRADE TOLERANCE/ ACCEPTABLE SAG LIMITS

DETAIL

D-14

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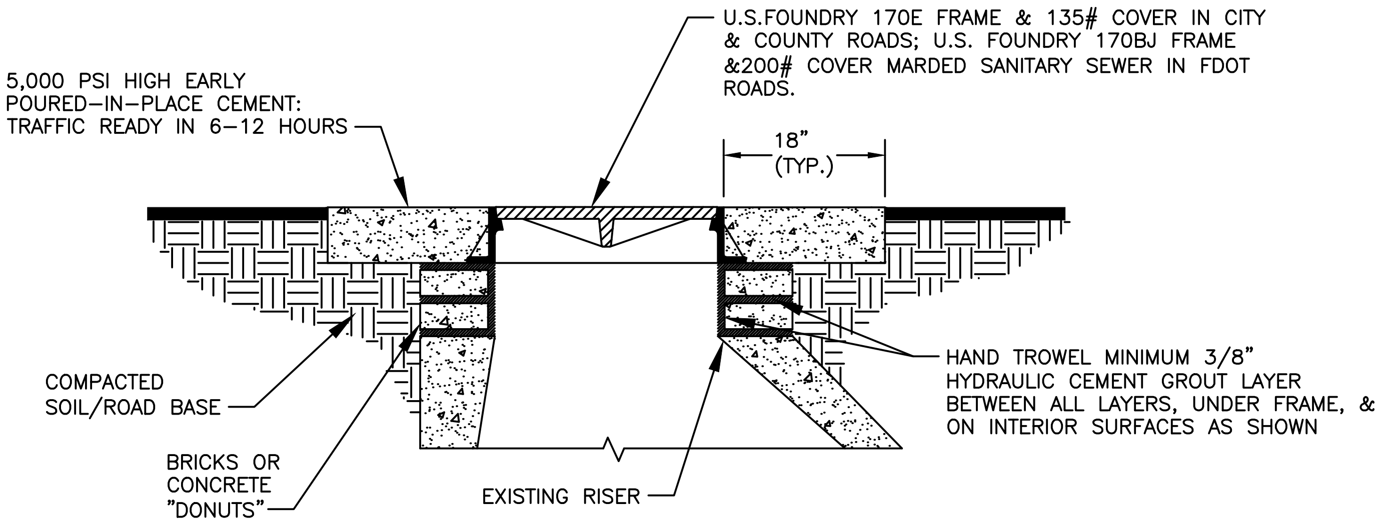


**MANHOLE (MH) ADJUSTMENT PROCEDURES:**

**Pre-milling coordination:** Contractor shall contact ECUA's Manhole Coordinator, Mr. Eddie Carter, at 476-5110 (x5824) or 698-9272, at least 2 weeks prior to milling operations to coordinate location of MHs requiring adjustment (visible MHs and those under asphalt). ECUA will then make decision to either allow adjustment of existing frames and covers or to supply new frames and covers to contractor (at ECUA expense).

**Pre-milling procedures:** Contractor shall make a list of all MH locations (station and offset or GPS coordinates to sub-meter accuracy), and submit list to Mr. Carter. Contractor can then remove frame and cover and if required brick/risers and install minimum 1/2" thick steel plate (or thicker if needed) over MH at a depth to avoid milling operations. Contractor shall paint solid green circle, two feet in diameter, directly over plated manholes onto milled asphalt surfaces and leveling course surfaces and shall maintain painted mark for the duration of the project. Due to ECUA emergency access needs, MHs shall not be plated more than 1 month, with 2 weeks or less being preferred.

**Post-resurfacing procedures:** Contractor shall determine location of MHs using list created in pre-milling stage and shall remove circular area of asphalt approximately 5' in diameter (equal to typical 2' ring diameter and 18" wide concrete collar), centered over MH. Remove plate. For changes in grade of 2" or less, place minimum 3/8" layer, maximum 2" layer, of hydraulic cement grout over top of existing brick/concrete donut/riser. For changes in grade more than 2", add bricks (clay for City and County, concrete for FDOT) or concrete donuts, with 3/8" layer of hydraulic cement grout in between each layer of bricks/donuts. Coat all inside surfaces with 3/8" thick layer of hydraulic cement grout. Maximum height of vertical adjustment (including existing and new brick/donut) shall be 12" as measured from bottom of frame to top of riser; adjustments more than 12" shall require installation of concrete riser sections. Frame shall be set so that elevation and slope of lid matches finished road surface. Pour 5000 psi concrete around frame to form 18" wide concrete collar that matches elevation and slope of finished road surface.

**Post-resurfacing coordination:** Roadway inspector shall confirm all MHs have been adjusted and done so according to this detail. Contractor shall then contact Mr. Carter for ECUA's final inspection. MHs not meeting this detail, or with construction debris in bottom of MH, or not matching roadway elevation and slope, will be corrected as required prior to payment. Contractor shall provide 2 years warranty (1 year if performed on FDOT project) beginning on ECUA's date of acceptance.

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# MANHOLE ADJUSTMENT

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DETAIL

D-19

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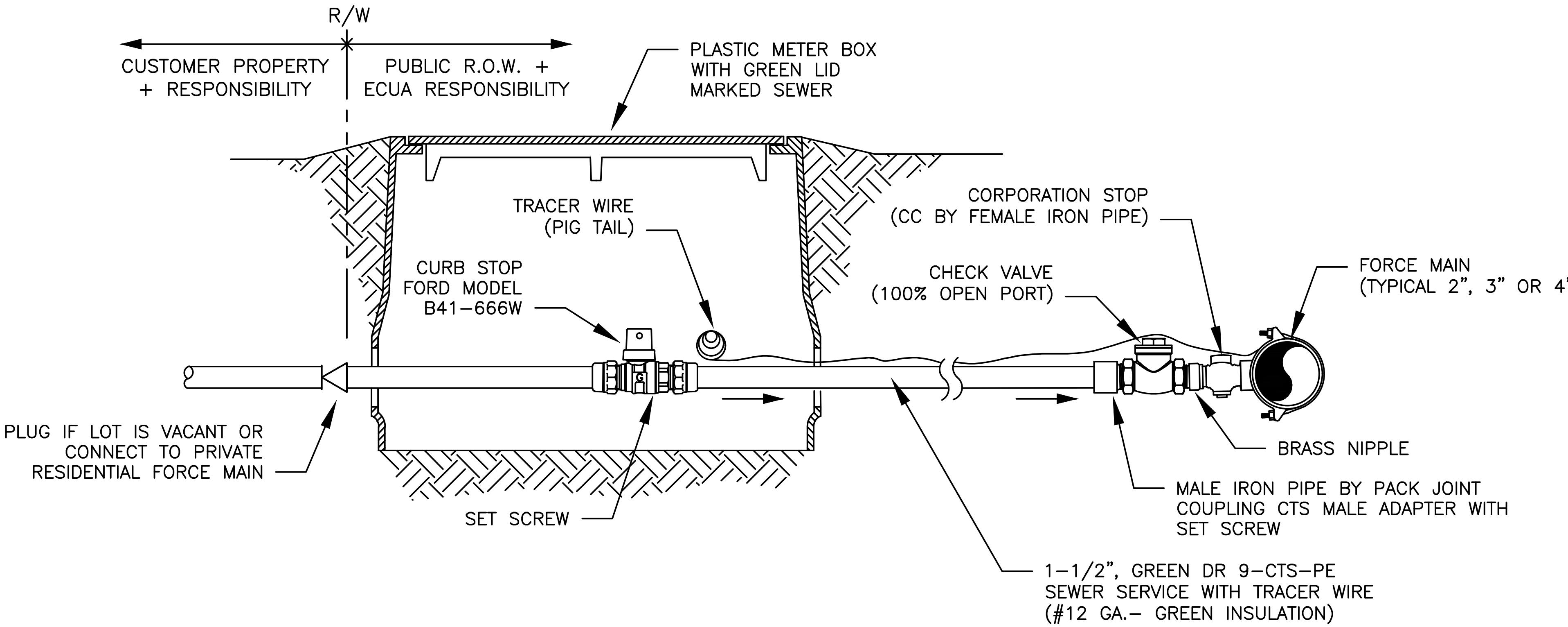


NOTES:

1. RESIDENTIAL GRINDER PUMP STATION SHALL BE MAINTAINED BY THE CUSTOMER. IT IS RECOMMENDED THAT ALL PUMP STATIONS BE A SEMI-POSITIVE DISPLACEMENT TYPE. A CHECK VALVE AND BALL VALVE SHALL BE PROVIDED AT THE PUMP STATION AND MAINTAINED BY THE CUSTOMER.

2. EACH CUSTOMER SHALL HAVE A SEPARATE "LOW PRESSURE RESIDENTIAL SEWER SERVICE" (SEE ABOVE DETAIL). ALL COMPONENTS ON CUSTOMER SIDE OF VALVE BOX ARE RESPONSIBILITY OF CUSTOMER.

3. IF LONG SERVICE (UNDER ROAD), PROVIDE 3" GREEN PE CASING, MIN. 24" COVER UNDER ROADWAY AND/OR DITCH.

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# LOW PRESSURE RESIDENTIAL SEWER SERVICE

DETAIL
D-20

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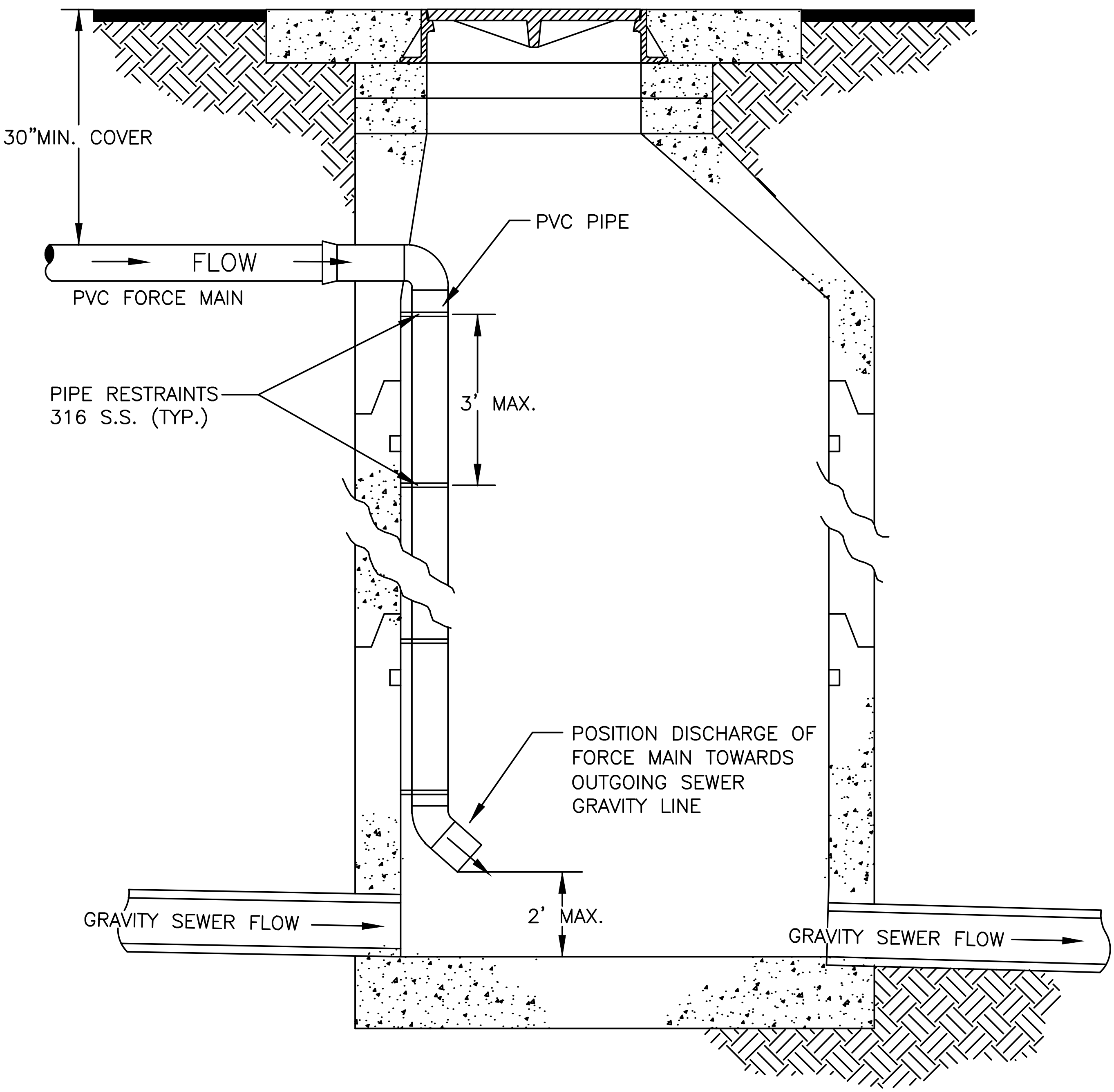


NOTES:

1– FORCEMAIN UP TO 4".

2– LARGER FORCEMAIN: OUTSIDE DROP CONNECTION

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# FORCE MAIN CONNECTION TO MANHOLE

DETAIL

D-21

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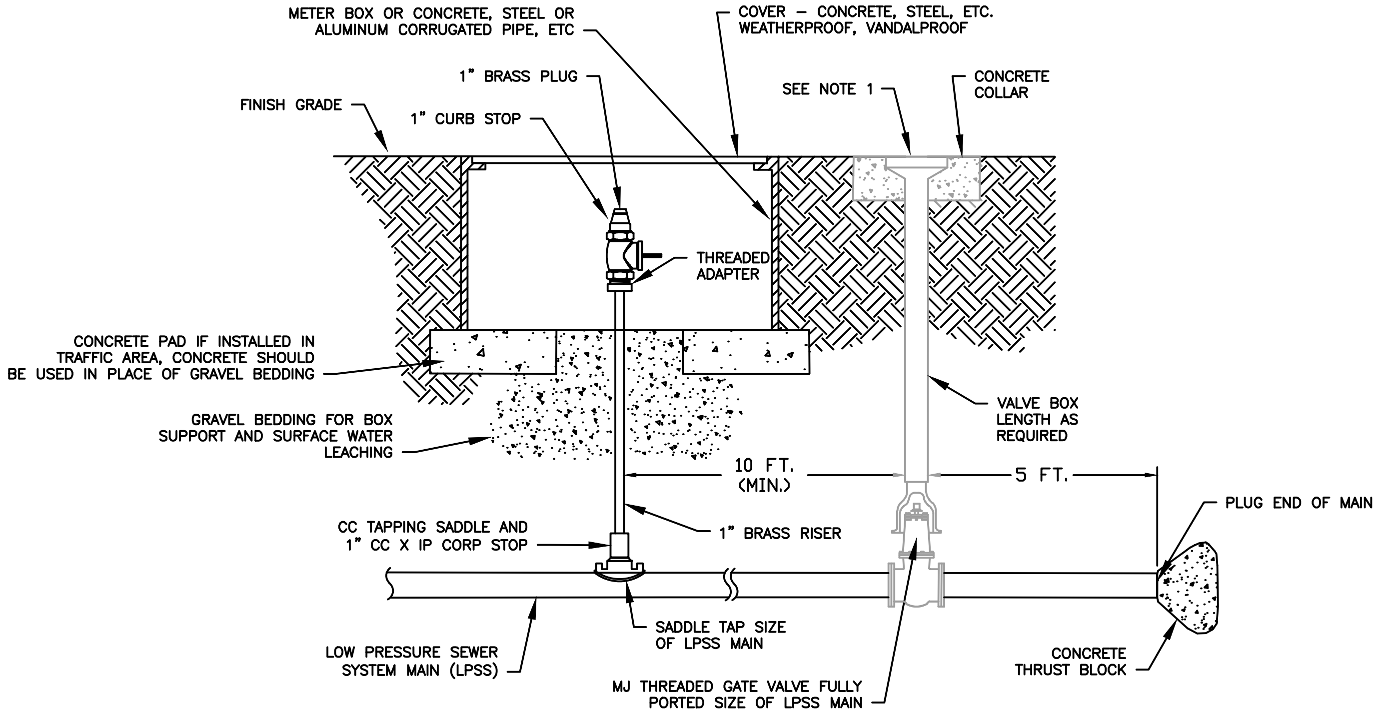
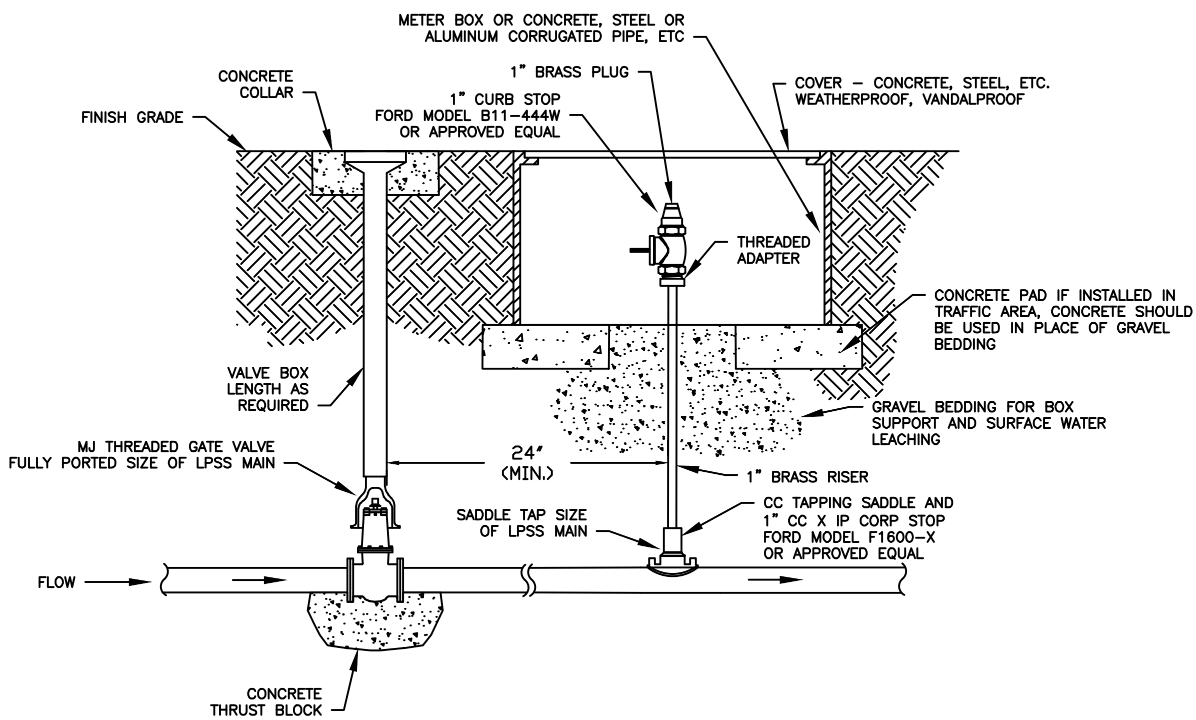



NOTES:

1. TERMINAL FLUSHING CONNECTIONS OF 2" WILL NOT REQUIRE THE VALVE AND PIPING FOR FUTURE EXPANSION.

## TERMINAL FLUSHING CONNECTION




## INLINE FLUSHING CONNECTION

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# LOW PRESSURE FLUSHING CONNECTIONS

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DETAIL
D-22

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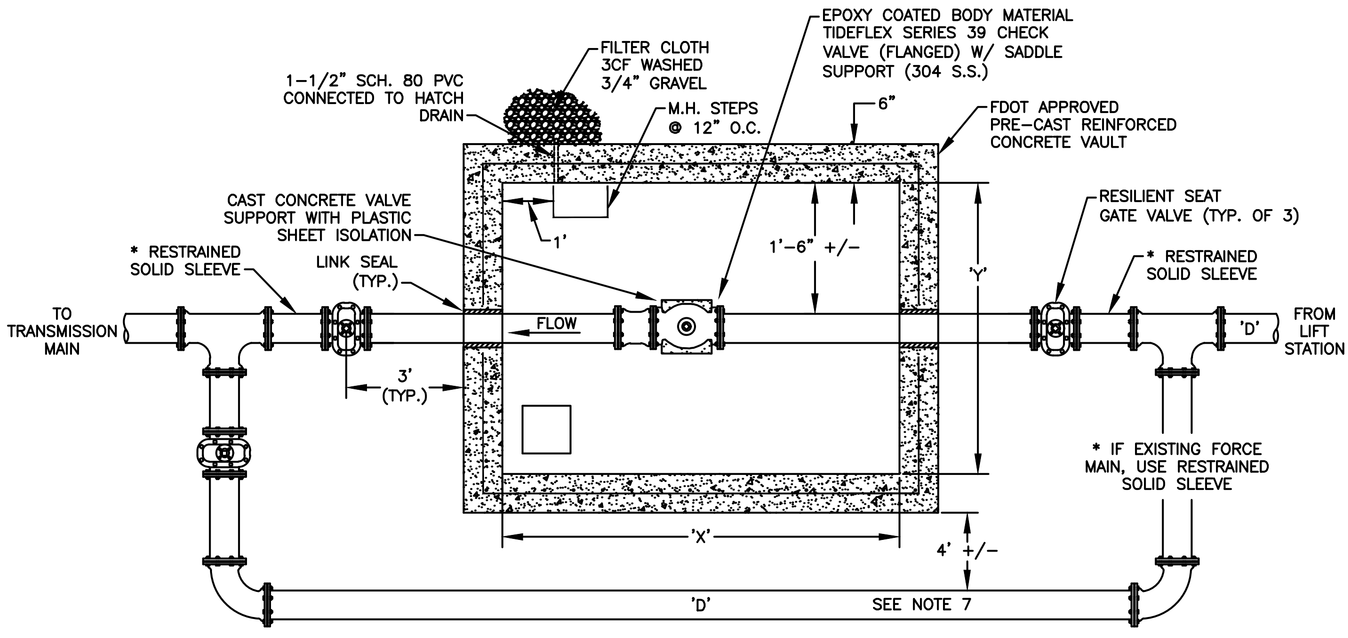
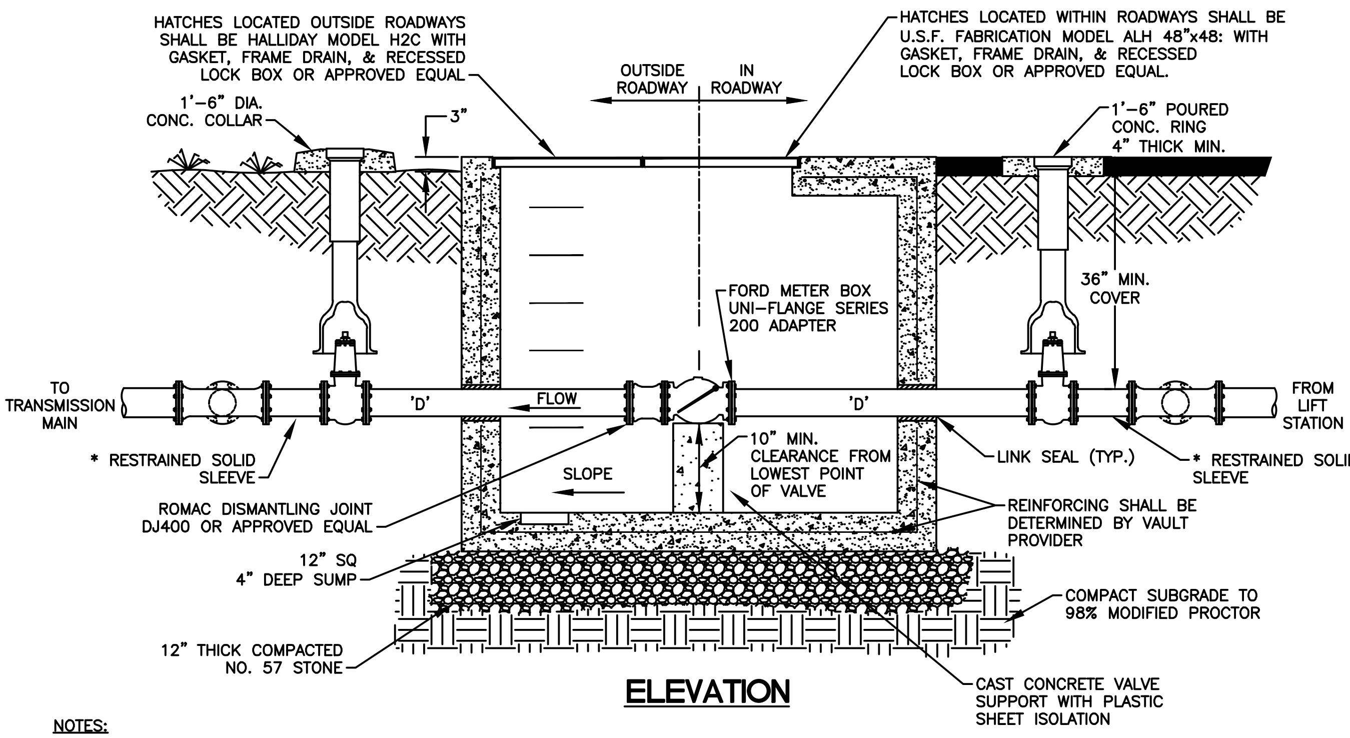



## PLAN




## ELEVATION

NOTES:

1. VAULT & HINGED HATCH DESIGNED FOR H-20 LOAD RATING. (CONTINUOUS LOADING IN ROADWAYS, OCCASIONAL LOADING OUTSIDE ROADWAYS).
2. HINGED HATCH FOR OUTSIDE ROADWAY TO MATCH 'X' & 'Y' DIMENSIONS UNLESS OTHERWISE INDICATED.
3. ALL EXPOSED FASTENING HARDWARE & TIE RODS SHALL BE 316 S.S.
4. EARTH UNDER FLANGE OF VALVE BOX & COLLAR TO BE FIRM AND WELL TAMPED TO ENSURE AGAINST VALVE BOX SETTLING.
5. CHECK VALVE DESIGN PRESSURES:
   A. OPERATING = ____PSI
   B. MAXIMUM BACK PRESSURE = ____PSI
6. MANHOLE STEPS SHALL NOT BE LOCATED ON THE SAME SIDE AS HATCH HINGE.
7. IN SPECIAL CASES, THE BYPASS PIPING MAY BE ELIMINATED ON 4" AND 6" FORCE MAINS, SUBJECT TO APPROVAL BY ECUA.
8. PIPE PENETRATIONS SHALL BE MADE USING A LINK-SEAL MODULAR SEAL SYSTEM AS MANUFACTURED BY GPT INDUSTRIES OR APPROVED EQUAL.

| LINE SIZE ('D') | LENGTH ('X') | WIDTH ('Y') |
|---|---|---|
| 4" & 6" | 54" | 48" |
| 8" | 60" | 48" |
| 10" | 72" | 48" |
| 12" | 72" | 60" |
| 16" | 84" | 60" |
| 20" | 84" | 78" |

EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.

DATE: 9/01/2016

# SEWER CHECK VALVE VAULT DETAIL

DETAIL

D-23

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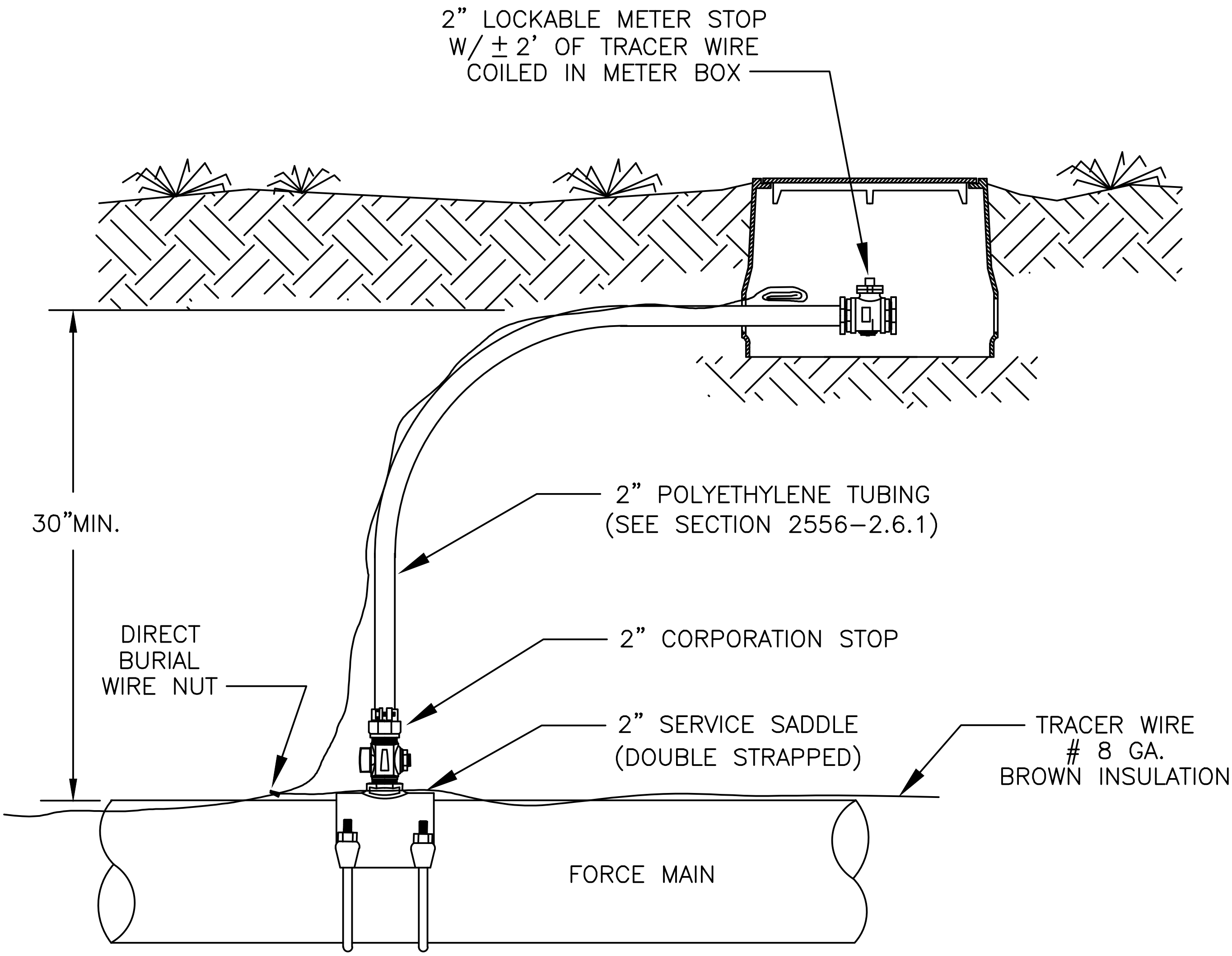


NOTE:
USE OF MANUAL ARV REQUIRES E.C.U.A. APPROVAL.

ECUA
EMERALD COAST
UTILITIES AUTHORITY

# AIR RELEASE VALVE - MANUAL

SCALE: N.T.S.
DATE: 9/01/2016

DETAIL
D-30

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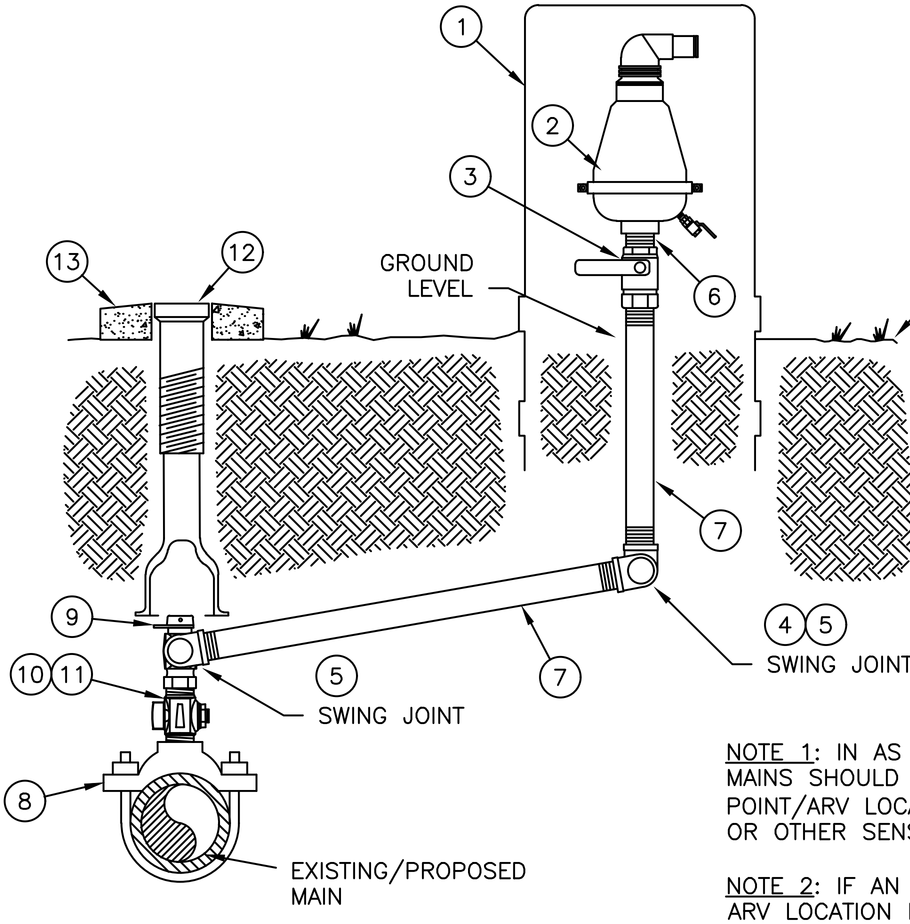


NOTE 1: IN AS MUCH IS PRACTICAL, NEW FORCE MAINS SHOULD BE INSTALLED SUCH THAT HIGH POINT/ARV LOCATION IS AWAY FROM RESIDENCES OR OTHER SENSITIVE AREAS.

NOTE 2: IF AN EXISTING HIGH POINT/PROPOSED ARV LOCATION IS IN FRONT OF A RESIDENCE OR IN A SENSITIVE AREA, THEN CONSULT WITH THE ECUA INSPECTOR AS TO THE BEST ALTERNATIVE LOCATION, PREFERABLY DOWNSTREAM FROM THE HIGH POINT.

## MATERIALS

| | | |
|---|---|---|
| 1 | 1 | ENCLOSURE, WATER PLUS CORPORATION, MODEL #131632 GREEN, WITH PIN ALLEN LOCK |
| 2 | 1 | AIR RELEASE VALVE 2" NPT, ARI MODEL D–025P |
| 3 | 1 | 2" BALL VALVE, 316 S.S. |
| 4 | 1 | 2" STANDARD 90° ELBOW, 316 S.S. |
| 5 | 2 | 2" STREET 90° ELBOW, 316 S.S. |
| 6 | 3 | 2" SHORT NIPPLE, 316 S.S. |
| 7 | 2 | 2" PIPE, 316 S.S. LENGTH AS REQUIRED, 2° ANGLE MIN. (3.5% SLOPE) |
| 8 | 1 | MAIN SIZE x 2" DOUBLE STRAP TAPPING SADDLE, IRON SADDLE WITH 316 S.S. STRAPS |
| 9 | 1 | 2" x 90° FIPxFIP ANGLE BALL VALVE FORD PART No. BA11777W |
| 10 | 1 | 2" CLOSE NIPPLE, 316 S.S. (EXISTING 2" BRASS CORPORATION STOP) (EXISTING AIR RELEASE VALVE ASSEMBLY INSTALLATION) |
| 11 | 1 | 2" BRASS CORPORATION STOP FORD PART FB400–7–NL (NEW AIR RELEASE VALVE ASSEMBLY INSTALLATION) |
| 12 | 1 | VALVE BOX WITH LID LABELED "SEWER" |
| 13 | 1 | CONCRETE VALVE BOX COLLAR |

EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.
DATE: 9/01/2016

# AIR RELEASE/VACUUM VALVE - AUTOMATIC FOR 10" AND SMALLER MAINS

DETAIL
D-31

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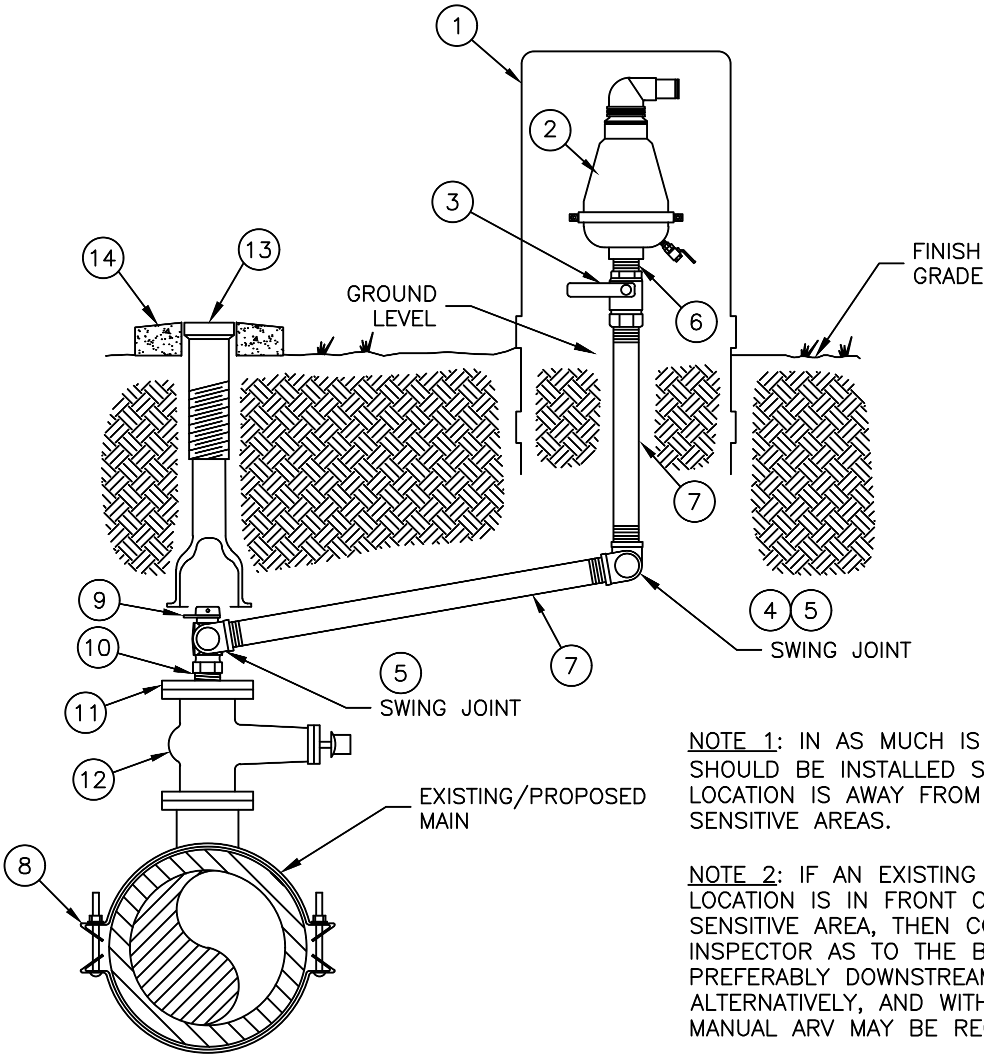


NOTE 1: IN AS MUCH IS PRACTICAL, NEW FORCE MAINS SHOULD BE INSTALLED SUCH THAT HIGH POINT/ARV LOCATION IS AWAY FROM RESIDENCES OR OTHER SENSITIVE AREAS.

NOTE 2: IF AN EXISTING HIGH POINT/PROPOSED ARV LOCATION IS IN FRONT OF A RESIDENCE OR IN A SENSITIVE AREA, THEN CONSULT WITH THE ECUA INSPECTOR AS TO THE BEST ALTERNATIVE LOCATION, PREFERABLY DOWNSTREAM FROM THE HIGH POINT; ALTERNATIVELY, AND WITH PERMISSION FROM ECUA, A MANUAL ARV MAY BE REQUIRED.

## MATERIALS

| | | |
|---|---|---|
| 1 | 1 | ENCLOSURE, WATER PLUS CORPORATION, MODEL #131632 GREEN, WITH PIN ALLEN LOCK |
| 2 | 1 | AIR RELEASE VALVE 2" NPT, ARI MODEL D–025P |
| 3 | 1 | 2" BALL VALVE, 316 S.S. |
| 4 | 1 | 2" STANDARD 90° ELBOW, 316 S.S. |
| 5 | 2 | 2" STREET 90° ELBOW, 316 S.S. |
| 6 | 3 | 2" SHORT NIPPLE, 316 S.S. |
| 7 | 2 | 2" PIPE, 316 S.S. LENGTH AS REQUIRED, 2° ANGLE MIN. (3.5% SLOPE) |
| 8 | 1 | MAIN SIZE x 4" DOUBLE STRAP TAPPING SLEEVE (12"–16" MAINS), OR MAIN SIZE x 6" DOUBLE STRAP TAPPING SLEEVE (18"–LARGER MAINS), WITH IRON SADDLE & 316 S.S. STRAPS |
| 9 | 1 | 2" x 90° FIPxFIP ANGLE BALL VALVE FORD PART No. BA11777W |
| 10 | 1 | 2" CLOSE NIPPLE, 316 S.S. |
| 11 | 1 | 4" X 2" M.J. PLUG, EPOXY COATED |
| 12 | 1 | 4" FLANGE x M.J. TAPPING VALVE |
| 13 | 1 | VALVE BOX WITH LID LABELED "SEWER" |
| 14 | 1 | CONCRETE VALVE BOX COLLAR |

ECUA
EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.
DATE: 9/01/2016

# AIR RELEASE/VACUUM VALVE - AUTOMATIC FOR 12" AND LARGER MAINS

DETAIL
D-32

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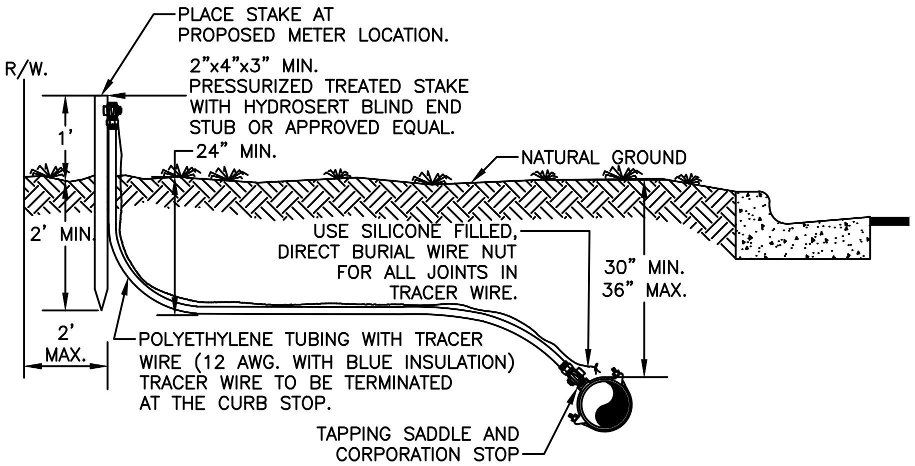
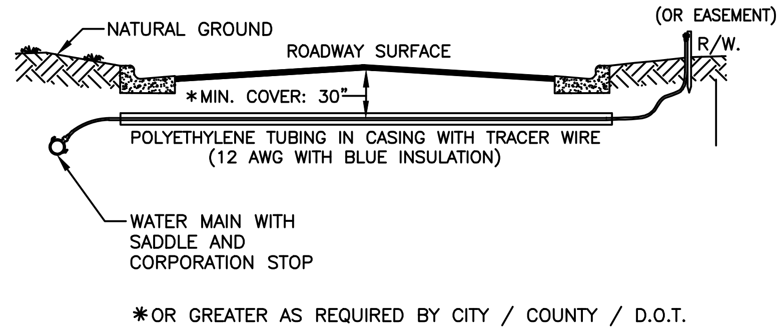



## TYPICAL SHORT SERVICE




## TYPICAL LONG SERVICE - STREET CROSSING

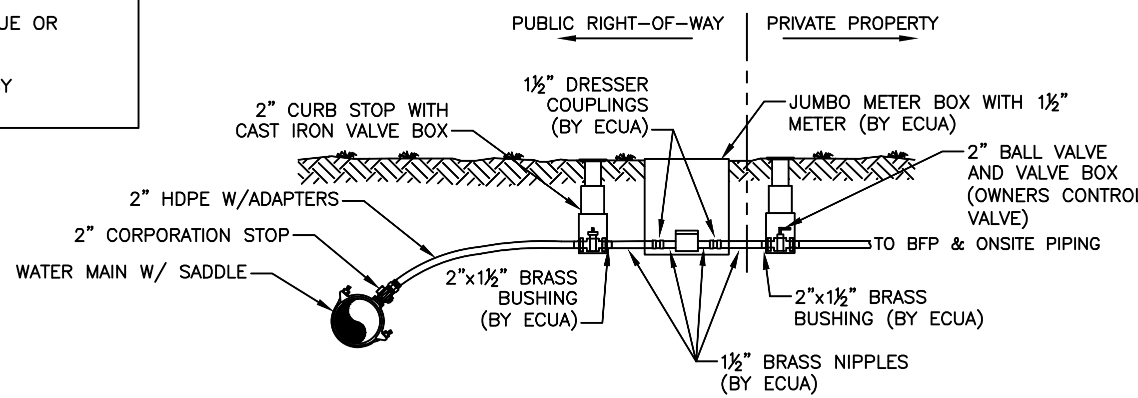
GENERAL NOTES:

- SERVICE LINES TO BE TERMINATED WITHIN 2 FEET OF THE R/W LINE BUT NOT UNDER ANY TYPE OF PAVEMENT.
- ALL WATER SERVICES SHALL BE INSTALLED 1 FOOT OFF THE COMMON PROPERTY LINE, ON THE OPPOSITE PROPERTY LINE FROM THE PROPOSED ELECTRICAL TRANSFORMERS. THE OWNER/DEVELOPER SHALL COORDINATE THE LOCATION OF THE WATER METER WITH THE POWER COMPANY PRIOR TO INSTALLATION.
- CASING SHALL BE PVC OR HDPE AND SHALL BE COLOR CODED BLUE OR BLACK WITH BLUE STRIPING.
- ALL METER BOXES AND PLUMBING SHALL BE INSTALLED BY THE OWNER/DEVELOPER. ALL METERS SHALL BE INSTALLED BY ECUA BY CONNECTING METER TO CURB-STOP.

RECOMMENDED TUBING SIZES FOR WATER SERVICES

| SIZE OF METER | DESIGN FLOW (GPM) | MAX. LENGTH OF TUBING FOR SIZE INDICATED | |
|---|---|---|---|
| | | 1" | 2" |
| 5/8" | 20 | 92 | 2679 |
| 1" | 50 | 17 | 492 |
| 1½" | 100 | | 136 |
| SIZE OF CASING (LONG SERVICE ONLY) | | 2" | 4" |

## 1 1/2" WATER METER ASSEMBLY




EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.
DATE: 9/01/2016

# WATER SERVICE FOR 5/8", 1", & 1 1/2" METERS

DETAIL
D-40

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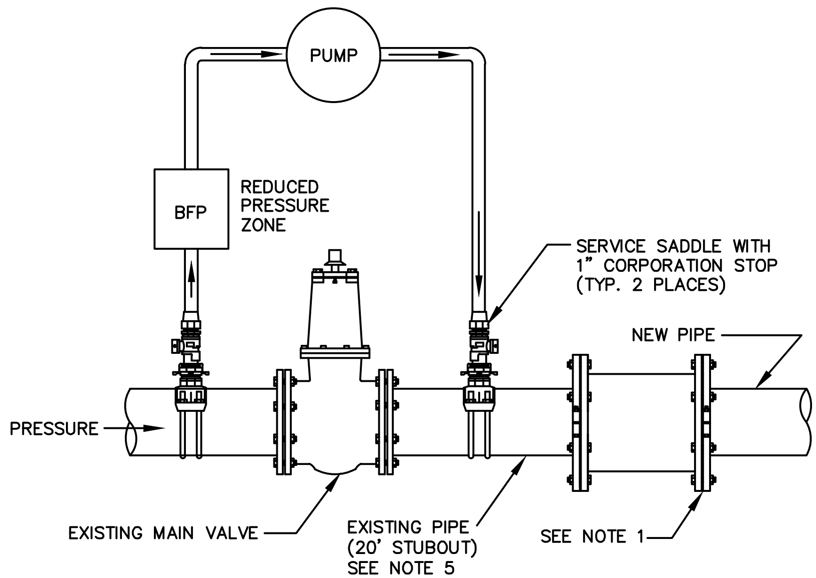
NOTES:

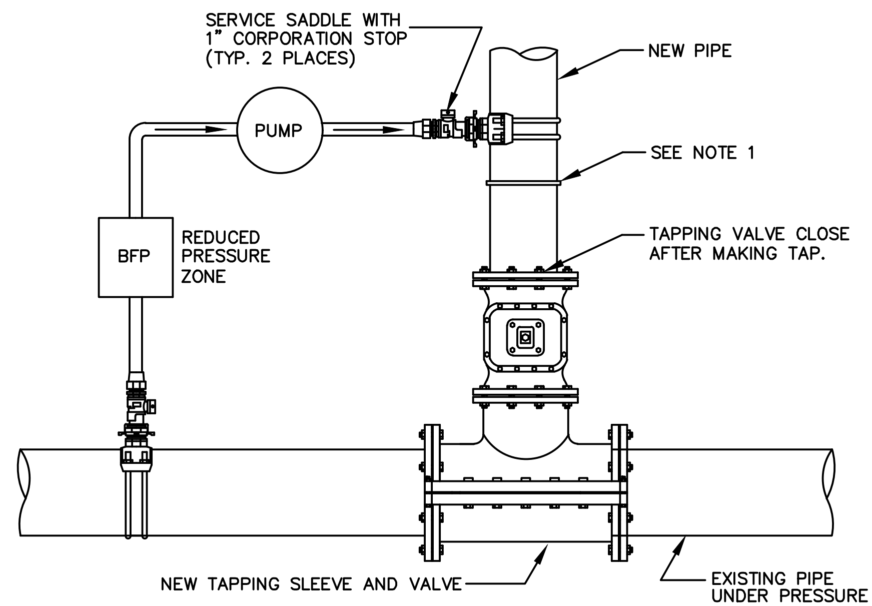
1. NEW PIPE SHALL BE CAPPED OR PLUGGED FOR PRESSURE TEST. ONCE TEST IS SATISFACTORILY COMPLETED NEW MAIN IS TO BE CONNECTED TO EXISTING MAIN IN A MANNER ACCEPTABLE TO E.C.U.A.
2. THE CONTRACTOR SHALL FLUSH LINE PRIOR TO STARTING THE CHLORINATION PROCEDURE. ALL FLUSHING SHALL BE DONE THROUGH THE EXISTING VALVE WITH ALL HYDRANTS AND SERVICE LINES OPEN. E.C.U.A. INSPECTOR SHALL BE THE ONLY PERSON ALLOWED TO OPERATE THE VALVE AND SHALL BE PRESENT DURING FLUSHING OPERATION.
3. ONCE SATISFACTORY BACTERIOLOGICAL SAMPLES ARE OBTAINED THE CONTRACTOR SHALL CLOSE BOTH CORPORATION STOPS AND REMOVE SERVICE TUBING, PUMP AND BACK FLOW PREVENTER; CAP CORPORATION STOPS WITH BRASS CAPS.
4. CONTRACTOR SHALL FURNISH ALL MATERIALS, EQUIPMENT AND LABOR NECESSARY FOR FILLING, CHLORINATING AND TESTING PROCEDURES. CONTRACTOR SHALL PROVIDE SAMPLING TAPS AT THOSE LOCATIONS APPROVED BY THE E.C.U.A. INSPECTOR. E.C.U.A. SHALL COLLECT TEST SAMPLES. CONTRACTOR IS RESPONSIBLE FOR PROPER DISPOSAL OF CHLORINATED WATER.
5. IF 20' STUB OUT IS NOT PRESENT, SPECIAL ARRANGEMENTS WILL HAVE TO BE MADE TO DEPRESSURIZE THE EXISTING MAIN TO MAKE CONNECTION TO THE EXISTING VALVE.




**TYPICAL CONNECTION FOR NEW LINE FILLING, PRESSURE TESTING, FLUSHING AND CHLORINATION. (EXISTING STUBOUT)**

NOTES:

1. NEW PIPE SHALL BE CAPPED OR PLUGGED FOR PRESSURE TEST. ONCE TEST IS SATISFACTORILY COMPLETED NEW MAIN IS TO BE CONNECTED TO TAPPING VALVE. TAPPING VALVE IS TO REMAIN CLOSED.
2. THE CONTRACTOR SHALL FLUSH LINE PRIOR TO STARTING THE CHLORINATION PROCEDURE. ALL FLUSHING SHALL BE DONE THROUGH THE TAPPING VALVE WITH ALL HYDRANTS AND SERVICE LINES OPEN. E.C.U.A. INSPECTOR SHALL BE THE ONLY PERSON ALLOWED TO OPERATE THE VALVE AND SHALL BE PRESENT DURING FLUSHING OPERATION. ONCE FLUSHING IS COMPLETE THE INSPECTOR SHALL CLOSE THE VALVE.
3. ONCE SATISFACTORY BACTERIOLOGICAL SAMPLES ARE OBTAINED THE CONTRACTOR SHALL CLOSE BOTH CORPORATION STOPS AND REMOVE SERVICE TUBING, PUMP AND BACK FLOW PREVENTER; CAP CORPORATION STOPS WITH BRASS CAPS.
4. CONTRACTOR SHALL FURNISH ALL MATERIALS, EQUIPMENT AND LABOR NECESSARY FOR FILLING, CHLORINATING AND TESTING PROCEDURES. CONTRACTOR SHALL PROVIDE SAMPLING TAPS AT THOSE LOCATIONS APPROVED BY THE E.C.U.A. INSPECTOR. E.C.U.A. SHALL COLLECT TEST SAMPLES. CONTRACTOR IS RESPONSIBLE FOR PROPER DISPOSAL OF CHLORINATED WATER.




**TYPICAL CONNECTION FOR NEW LINE FILLING, PRESSURE TESTING, FLUSHING AND CHLORINATION. (TAPPING SLEEVE AND VALVE)**

EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.
DATE: 9/01/2016

# TYPICAL CHLORINE DISINFECTION

DETAIL
D-41

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| PIPE SIZE (INCHES) | SPECIFICATION | GALLONS PER 100' | CHLORINE REQUIRED PER 100' FOR 25ppm (OUNCES) | HTH REQUIRED PER 100' FOR 25ppm (OUNCES) | CHLORINE REQUIRED PER 100' FOR 50ppm (OUNCES) | HTH REQUIRED PER 100' FOR 50ppm (OUNCES) |
|---|---|---|---|---|---|---|
| 2 | C-901 DR9 | 16.3 | 0.05 | 0.08 | 0.11 | 0.17 |
| 3 | C-901 DR11 | 36.7 | 0.12 | 0.19 | 0.24 | 0.38 |
| 4 | C-900 DR18<br>C-906 DR11 | 65.3 | 0.22 | 0.34 | 0.44 | 0.67 |
| 6 | C-900 DR18<br>C-906 DR11 | 146.9 | 0.49 | 0.75 | 0.98 | 1.51 |
| 8 | C-900 DR18<br>C-906 DR11 | 261.1 | 0.87 | 1.34 | 1.74 | 2.68 |
| 10 | C-900 DR18<br>C-906 DR11 | 408.0 | 1.36 | 2.09 | 2.72 | 4.19 |
| 12 | C-900 DR18<br>C-906 DR11 | 587.5 | 1.96 | 3.02 | 3.92 | 6.03 |
| 14 | C-905 DR18<br>C-906 DR11 | 799.6 | 2.67 | 4.10 | 5.34 | 8.21 |
| 16 | C-905 DR18<br>C-906 DR11 | 1044.4 | 3.48 | 5.36 | 6.97 | 10.72 |
| 18 | C-905 DR18<br>C-906 DR11 | 1321.8 | 4.41 | 6.78 | 8.82 | 13.57 |
| 20 | C-905 DR18<br>C-906 DR11 | 1631.9 | 5.44 | 8.38 | 10.89 | 16.57 |
| 22 | C-905 DR18<br>C-906 DR11 | 1974.6 | 6.59 | 10.13 | 13.17 | 20.27 |
| 24 | C-905 DR18<br>C-906 DR11 | 2349.9 | 7.84 | 12.06 | 15.68 | 24.12 |

NOTE:

1. DISINFECTION SHOULD CONFORM TO THE CURRENT VERSION OF AWWA STANDARD C-651.
2. CALCIUM HYPOCHLORITE (HTH) WITH 65% AVAILABLE CHLORINE BY WEIGHT.
3. FORMULAS ARE AS FOLLOWS:

$Cl_2$ REQUIRED FOR DISINFECTION (OZ.) = VOLUME (MG) X $Cl_2$ DOSAGE (PPM) X (8.34 LB/GAL) X (16 OZ/LB)

CALCIUM HYPOCHLORITE REQUIRED FOR DISINFECTION (OZ.) = $Cl_2$ REQUIRED FOR DISINFECTION (OZ.) / (% AVAILABLE $CL_2$/100)

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EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.
DATE: 9/01/2016

# CHLORINE AND CALCIUM HYPOCHLORITE REQUIRED FOR DISINFECTION

DETAIL
D-42

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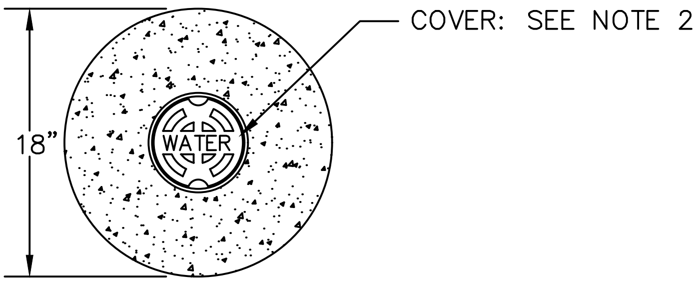
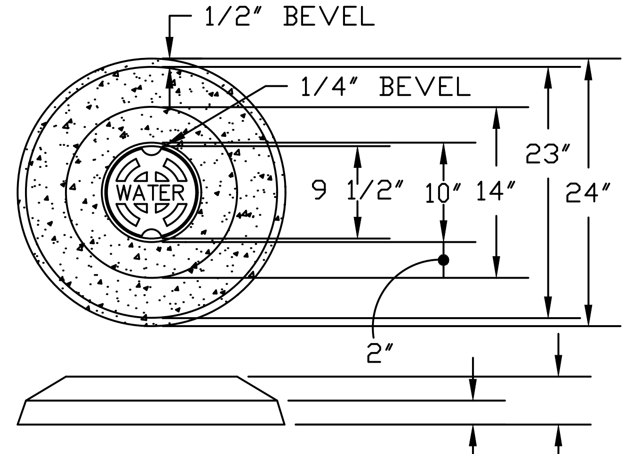
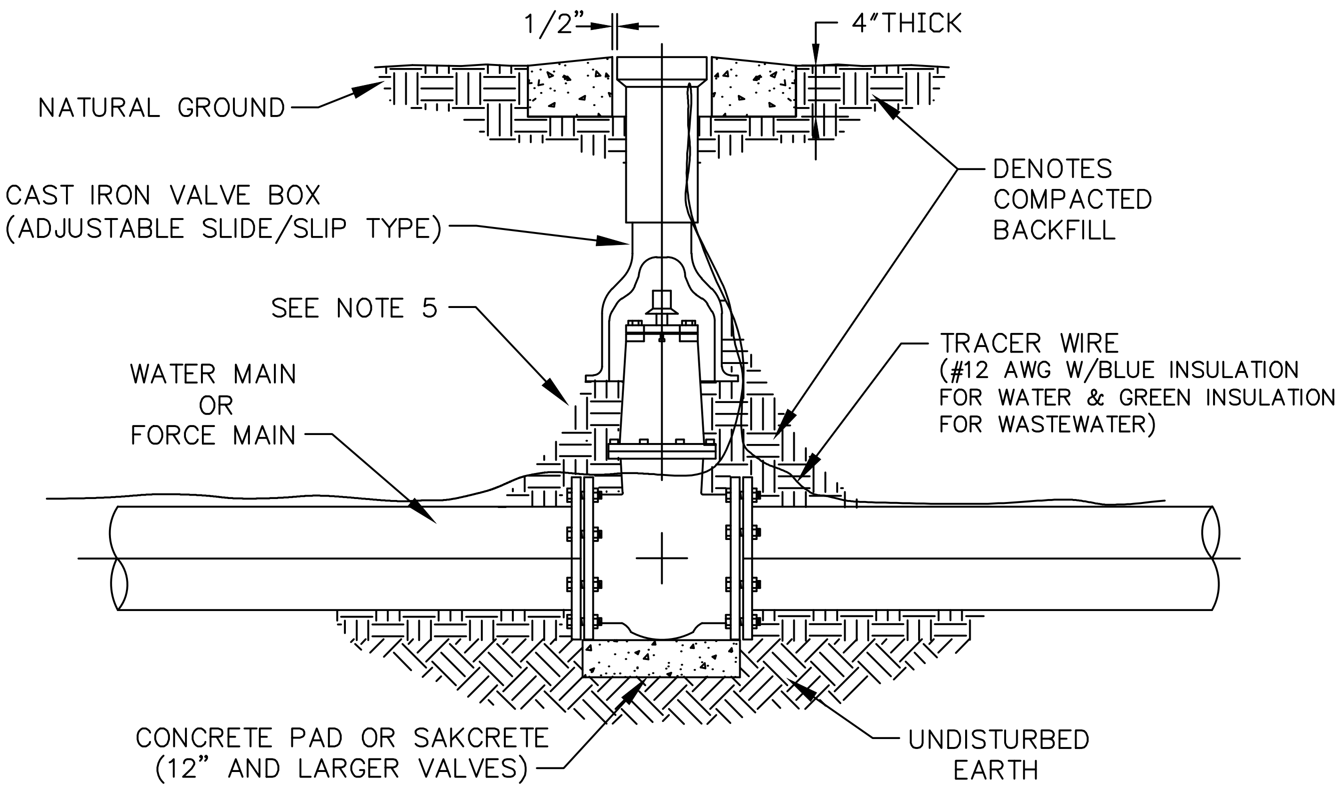



**CAST-IN-PLACE COLLAR**




**24' PRE-CAST VALVE PAD**




NOTES:

1. VALVE BOX AND BOOT SHALL BE CAST IRON.
2. VALVE COVER SHALL BE MARKED "WATER" OR "SEWER" AS APPLICABLE
3. VALVE BOX TOP & COLLAR SHALL BE FLUSH WITH FINISHED GRADE OR ½" ABOVE NATURAL GROUND LEVEL.
4. GATE VALVE SHALL BE RESILIENT SEAT WITH MECHANICAL JOINT ENDS.
5. EARTH UNDER FLANGE OF VALVE BOX & COLLAR TO BE FIRM AND WELL TAMPED TO ENSURE AGAINST VALVE BOX SETTLING.

ECUA
EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.
DATE: 9/01/2016

# TYPICAL VALVE & BOX INSTALLATION

DETAIL
D-43

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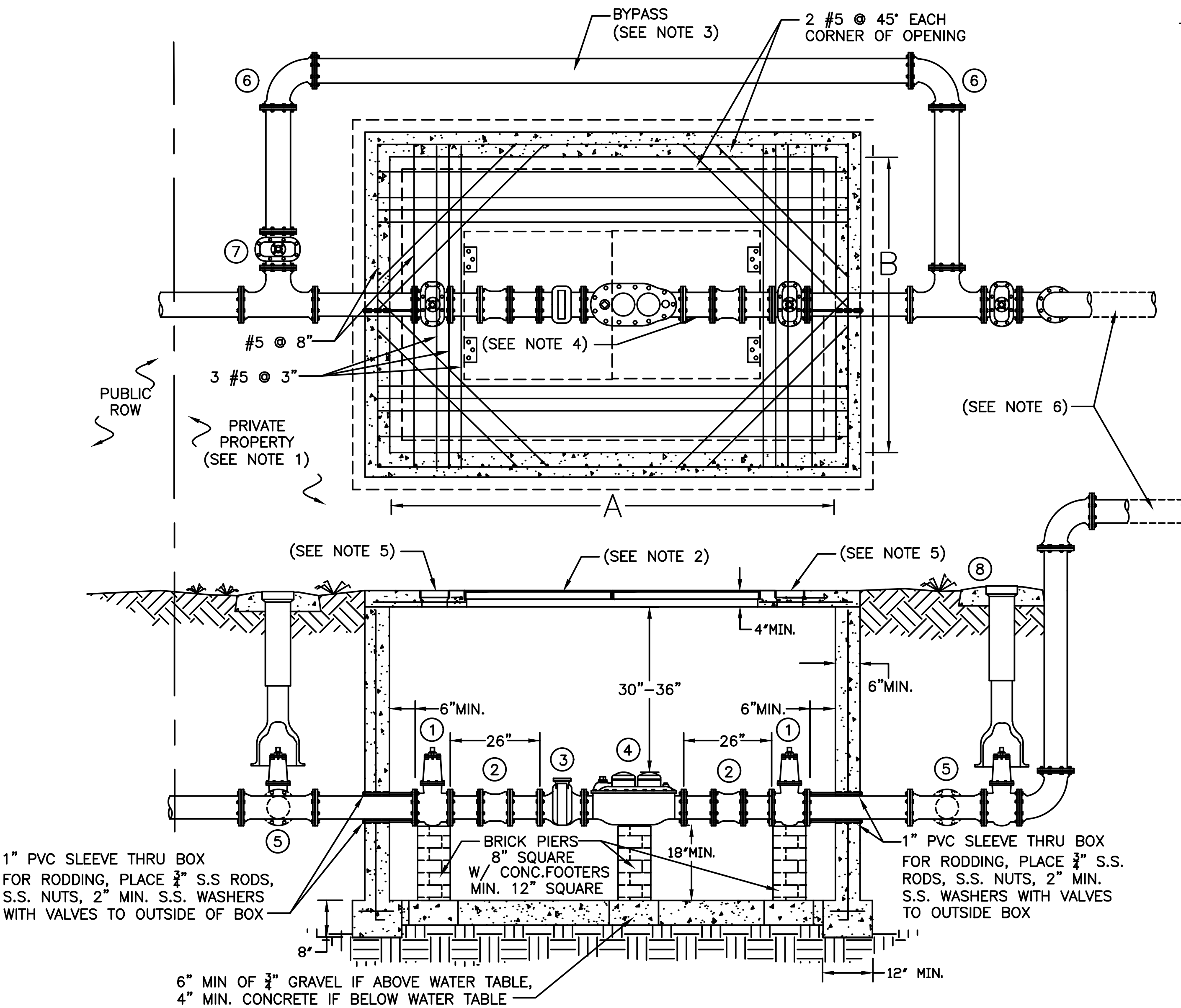


## NOTES:

1.) METER VAULTS ARE TYPICALLY PLACED IN AN EASEMENT ON PRIVATE PROPERTY ABUTTING ROW LINE (SEE ECUA ENGINEERING FOR INFORMATION). METER SHALL NOT BE FENCED IN.

2.) ALUMINUM OR GALVANIZED STEEL ANGLE FRAME HATCH WITH ALUMINUM DOUBLE COVER. SIZE 36" X 48" FOR 2" METER VAULTS OR 36" X 72" FOR 3" AND LARGER METER VAULTS. NO CENTER BAR, DOORS HINGED ON OPPOSITE SHORT SIDE AND OPEN TO 90 DEGREES OR MORE. TYPE AHD FOR INCIDENTAL H20 RATED TRAFFIC, OR TYPE APD FOR 300 POUND RATED PEDESTRIAN USE.

3.) BYPASS PIPING FOR 2" METERS MAY BE INTERNAL. INTERNAL 2" BYPASS PIPING SHALL BE BRASS. BYPASS PIPING FOR 3" AND 4" METERS SHALL BE EXTERNAL. ALL EXTERNAL BYPASS PIPING SHALL BE PVC OR DUCTILE IRON. HDPE BYPASS PIPING NOT ALLOWED.

4.) METER RUN PIPING SHALL BE BRASS FOR 2" METERS AND SHALL BE DUCTILE IRON FOR 3" AND 4' METERS.

5.) VALVE BOXES ARE REQUIRED FOR 3" AND 4" METERS; VALVE BOXES ARE NOT REQUIRED FOR 2" METERS.

6.) TO BACKFLOW PREVENTION DEVICE (NOT SHOWN) AS INSTALLED BY OWNER.

| METER SIZE | METER BOX (INSIDE DIMENSIONS) | |
|---|---|---|
| | A | B |
| 2" | 6'6" | 4'6" |
| 3" & 4" | 9'0" | 5'0" |

## LEGEND

1. M.J. GATE VALVE (3" OR LARGER) OR WHEEL VALVE (2" ONLY)
2. 12" SOLID SLEEVE (3" & LARGER) OR DRESSER COUPLING (2" ONLY)
3. STRAINER (BY ECUA)
4. METER (BY ECUA)
5. M.J. TEE
6. M.J. ELBOW 90°
7. M.J. GATE VALVE & BOX
8. OWNER CONTROL GATE VALVE

EMERALD COAST UTILITIES AUTHORITY

# 2", 3" & 4" METER VAULT

SCALE: N.T.S.

DATE: 9/01/2016

DETAIL

D-44

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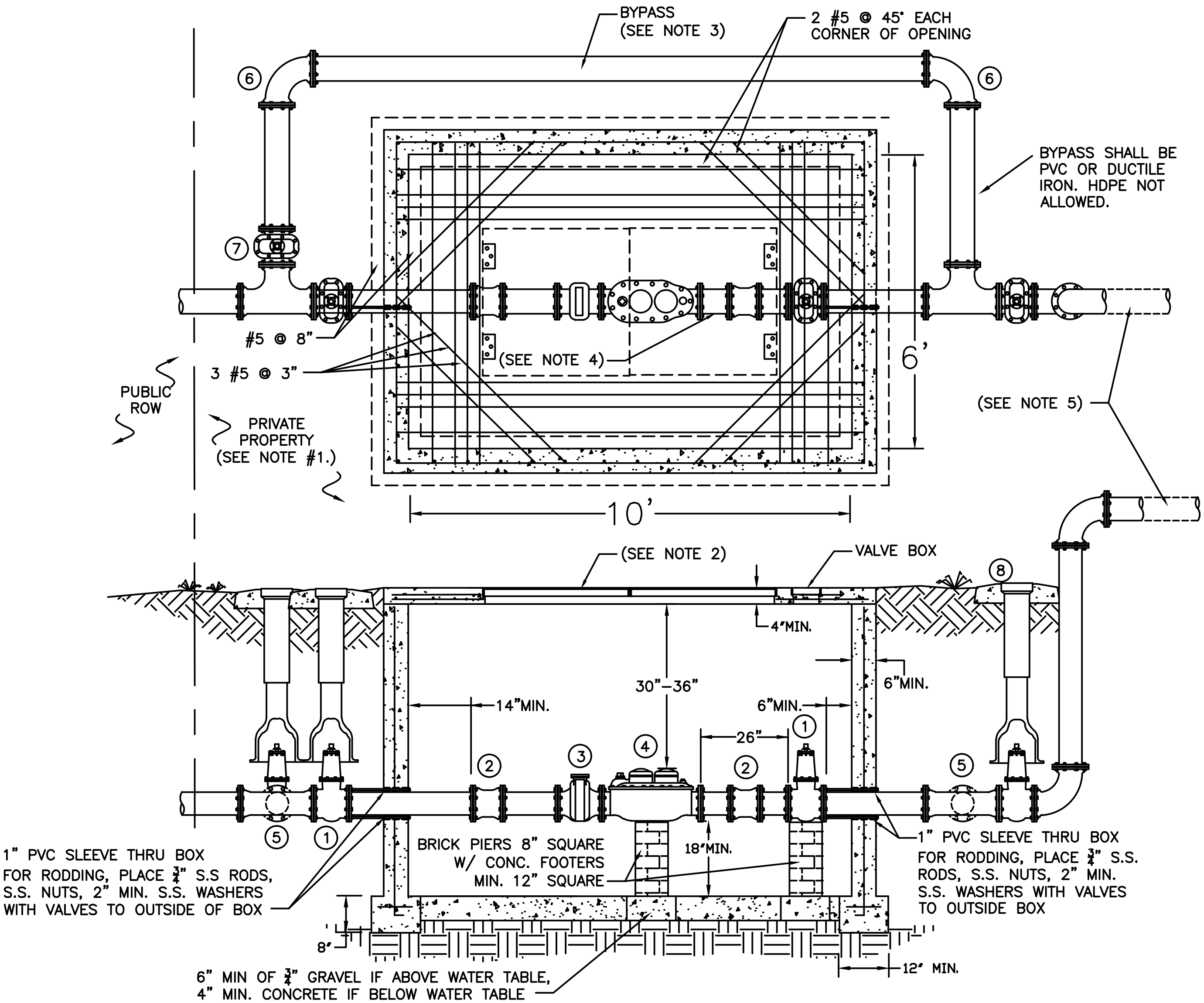


NOTES:

1.) METER VAULTS ARE TYPICALLY PLACED IN AN EASEMENT ON PRIVATE PROPERTY ABUTTING ROW LINE (SEE ECUA ENGINEERING FOR INFORMATION), METER SHALL NOT BE FENCED IN.

2.) ALUMINUM OR GALVANIZED STEEL ANGLE FRAME HATCH WITH ALUMINUM DOUBLE COVER, SIZE 36" X 72". NO CENTER BAR, DOORS HINGED ON OPPOSITE SHORT SIDE AND OPEN TO 90 DEGREES OR MORE. TYPE AHD FOR INCIDENTAL H20 RATED TRAFFIC, OR TYPE APD FOR 300 POUND RATED PEDESTRIAN USE.

3.) BYPASS PIPING SHALL BE EXTERNAL AND BE PVC OR DUCTILE IRON. HDPE NOT ALLOWED.

4.) METER RUN PIPING SHALL BE DUCTILE IRON.

5.) TO BACKFLOW PREVENTION DEVICE (NOT SHOWN) AS INSTALLED BY OWNER.

6.) METERS LARGER THAN 10" SHALL HAVE METER VAULT ENGINEERED FOR CORRECT SIZING.

LEGEND

1 M.J. GATE VALVE
2 12" SOLID SLEEVE
3 STRAINER (BY ECUA)
4 METER (BY ECUA)
5 TEE
6 ELBOW 90°
7 M.J. GATE VALVE & BOX
8 OWNER CONTROL GATE VALVE

EMERALD COAST UTILITIES AUTHORITY

# 6", 8" & 10" METER VAULT

SCALE: N.T.S.
DATE: 9/01/2016

DETAIL
D-45

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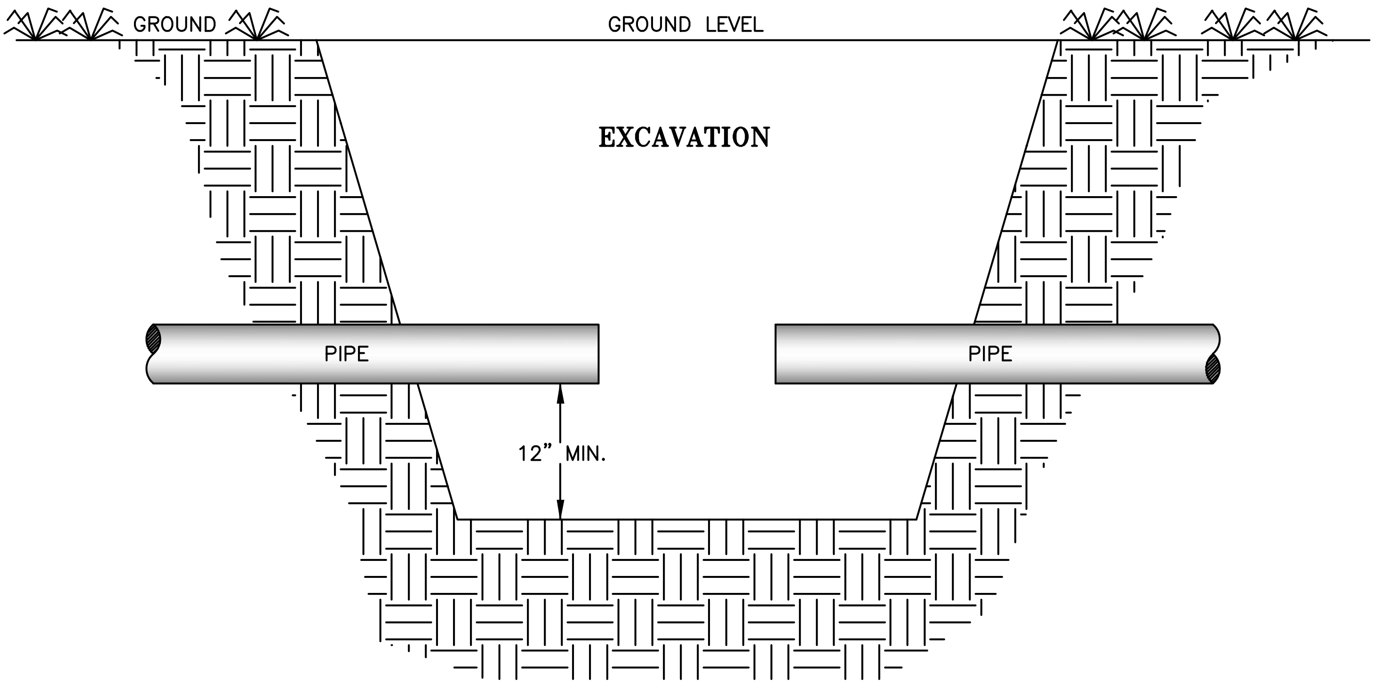


NOTES:

1. A CONTINUOUS OUTFLOW OF WATER FROM THE PIPE ON EACH SIDE OF THE REPAIR MUST BE MAINTAINED.

2. STANDING SURFACE, GROUND OR POTABLE WATER IN THE PIT (EXCAVATION) IS NOT ALLOWED TO REMAIN DURING PERIODS OF UNPRESSURIZED PIPE CONDITIONS, LESS THAN FULL PIPE FLOW OR WHENEVER FLOW IS NOT BEING MAINTAINED. ADDITIONALLY, SOIL SHOULD BE EXCAVATED TO A MINIMUM DEPTH OF 12 INCHES BELOW THE PIPE INVERTS.

3. PRECAUTIONARY BOIL WATER NOTICES SHALL BE ISSUED WHEN THE CONDITIONS OUTLINED IN NOTES 1 AND 2 ABOVE ARE NOT MAINTAINED.

4. ALL REPAIR OR CONNECTION ITEMS, PIPING AND APPURTENANCES SHALL BE PROPERLY DISINFECTED OR SWABBED IN ACCORDANCE WITH RULE 62–555.340, F.A.C., AND AWWA STANDARD C651. AS A RECORD OF PROCEDURAL BMP EFFECTIVENESS, A MINIMUM OF ONE BACTERIOLOGICAL SAMPLE SHALL BE COLLECTED ON EITHER SIDE OF THE REPAIR AREA FOR TWO CONSECUTIVE DAYS. IF THE ANALYTICAL RESULTS ARE POSITIVE, A PBWM SHALL BE ISSUED AND TWO DAYS OF SATISFACTORY WATER QUALITY ANALYSIS ARE REQUIRED TO RESCIND THE BOIL WATER NOTICE.

| | | | |
|---|---|---|---|
| EMERALD COAST UTILITIES AUTHORITY | SCALE: N.T.S.<br>DATE: 9/01/2016 | EXISTING WATER MAIN SHUTDOWN BEST MANAGEMENT PRACTICES | DETAIL<br>D-46 |

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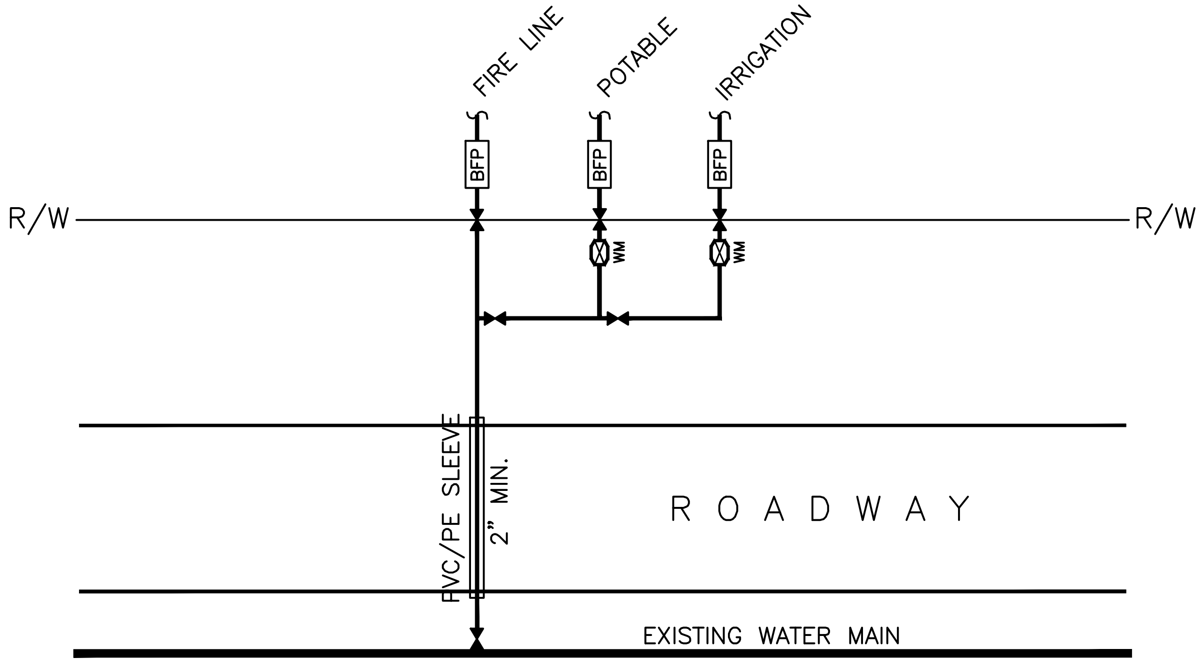
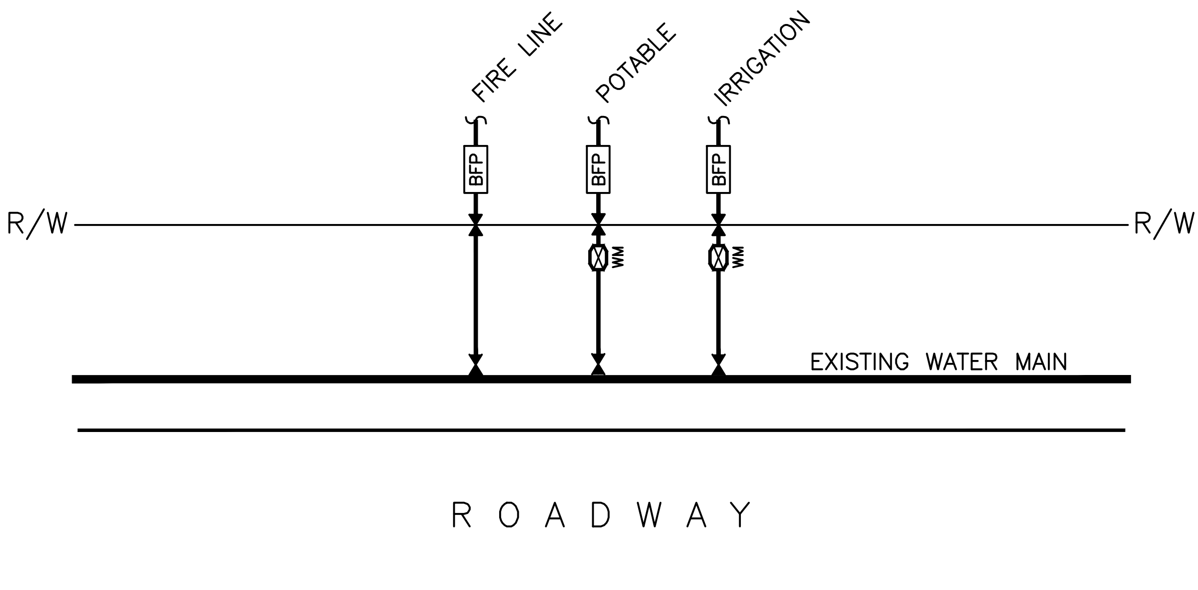



## TYPICAL MULTIPLE LONG SERVICES FOR ONE PROPERTY




NOTE: IF THE WATER MAIN IS UNDER ASPHALT, ECUA WILL CONSIDER USING ONE TAP ON THE SHORT SERVICE.

## TYPICAL MULTIPLE SHORT SERVICES FOR ONE PROPERTY

EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.

DATE: 9/01/2016

# TYPICAL MULTIPLE WATER SERVICE INSTALLATION

DETAIL

D-47

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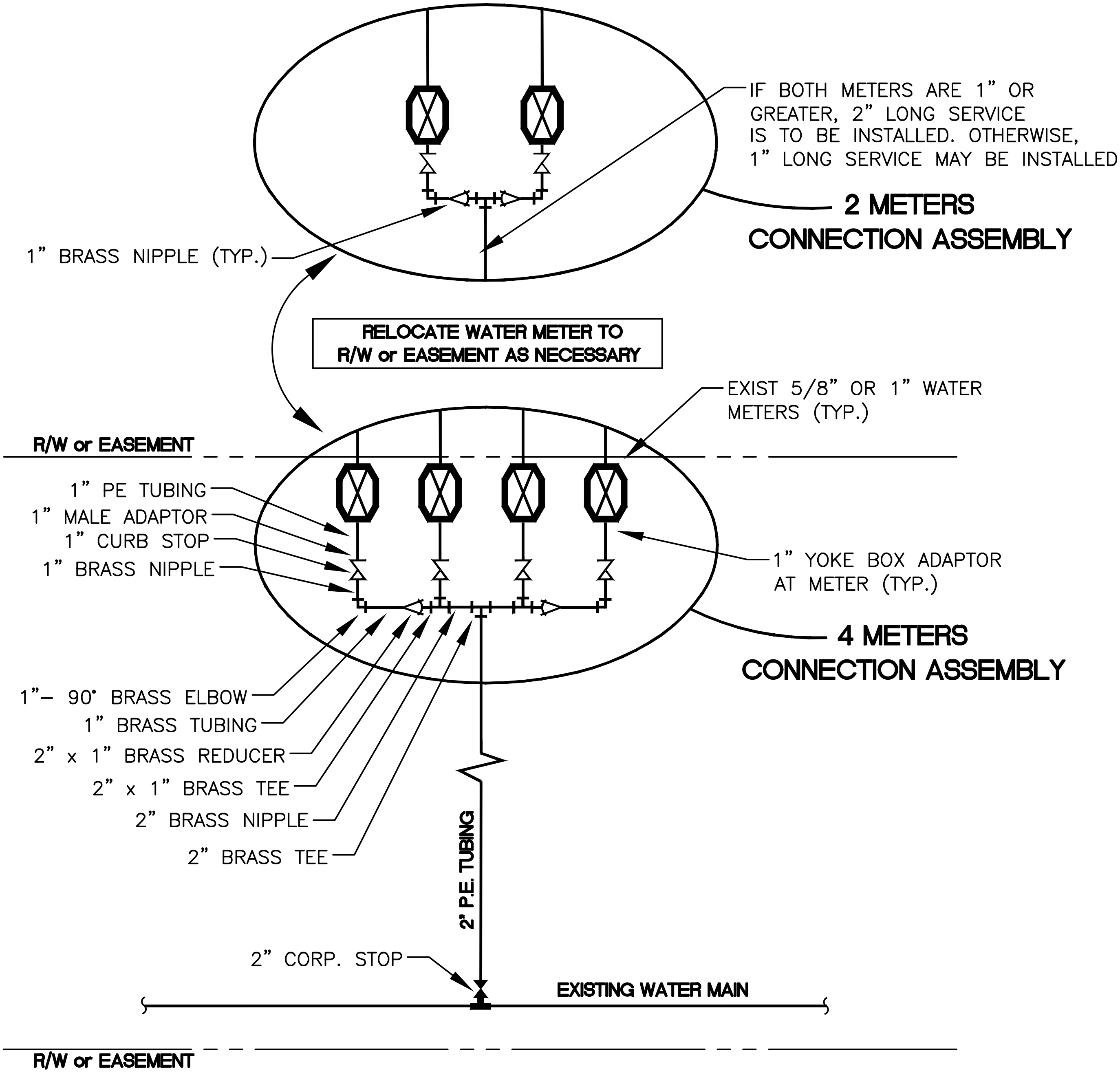


## 2" LONG WATER SERVICE (MULTI-METER) DETAIL

EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.

DATE: 9/01/2016

# MULTIPLE WATER METER SERVICE

DETAIL

D-48

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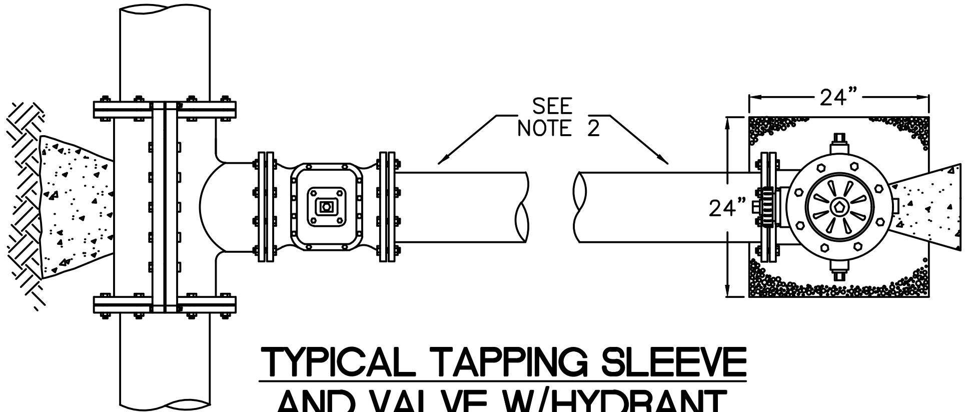
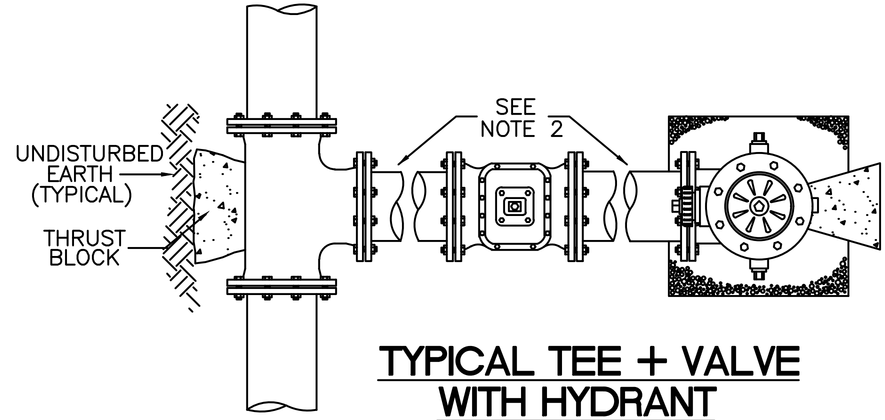
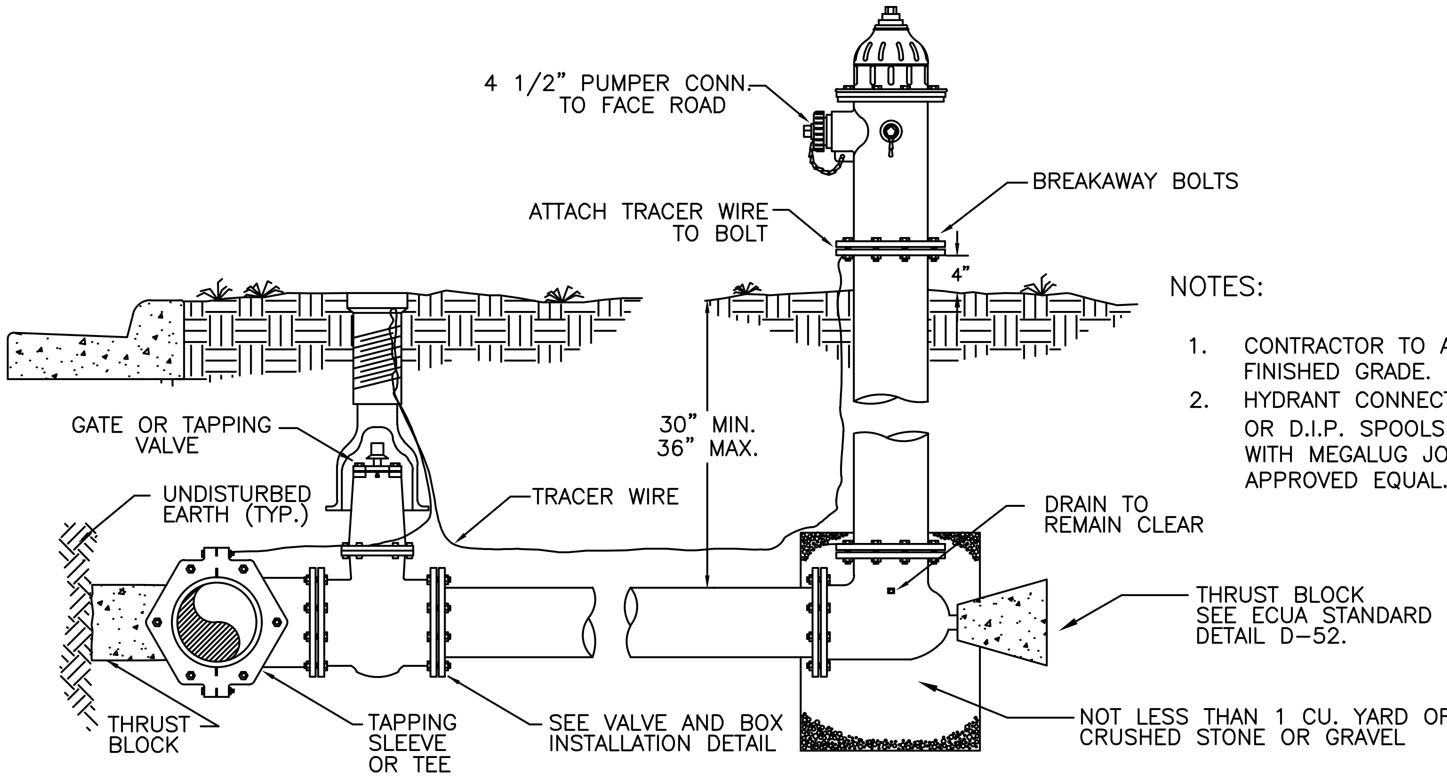



## TYPICAL TAPPING SLEEVE AND VALVE W/HYDRANT




## TYPICAL TEE + VALVE WITH HYDRANT




NOTES:

1. CONTRACTOR TO ADJUST FIRE HYDRANT TO FINISHED GRADE.
2. HYDRANT CONNECTORS (MIN3' IN LENGTH) OR D.I.P. SPOOLS (MIN 3" IN LENGTH) WITH MEGALUG JOINT RESTRAINTS OR APPROVED EQUAL.

EMERALD COAST UTILITIES AUTHORITY

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| SCALE: | N.T.S. |
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# TYPICAL FIRE HYDRANT INSTALLATION

DETAIL

D-50

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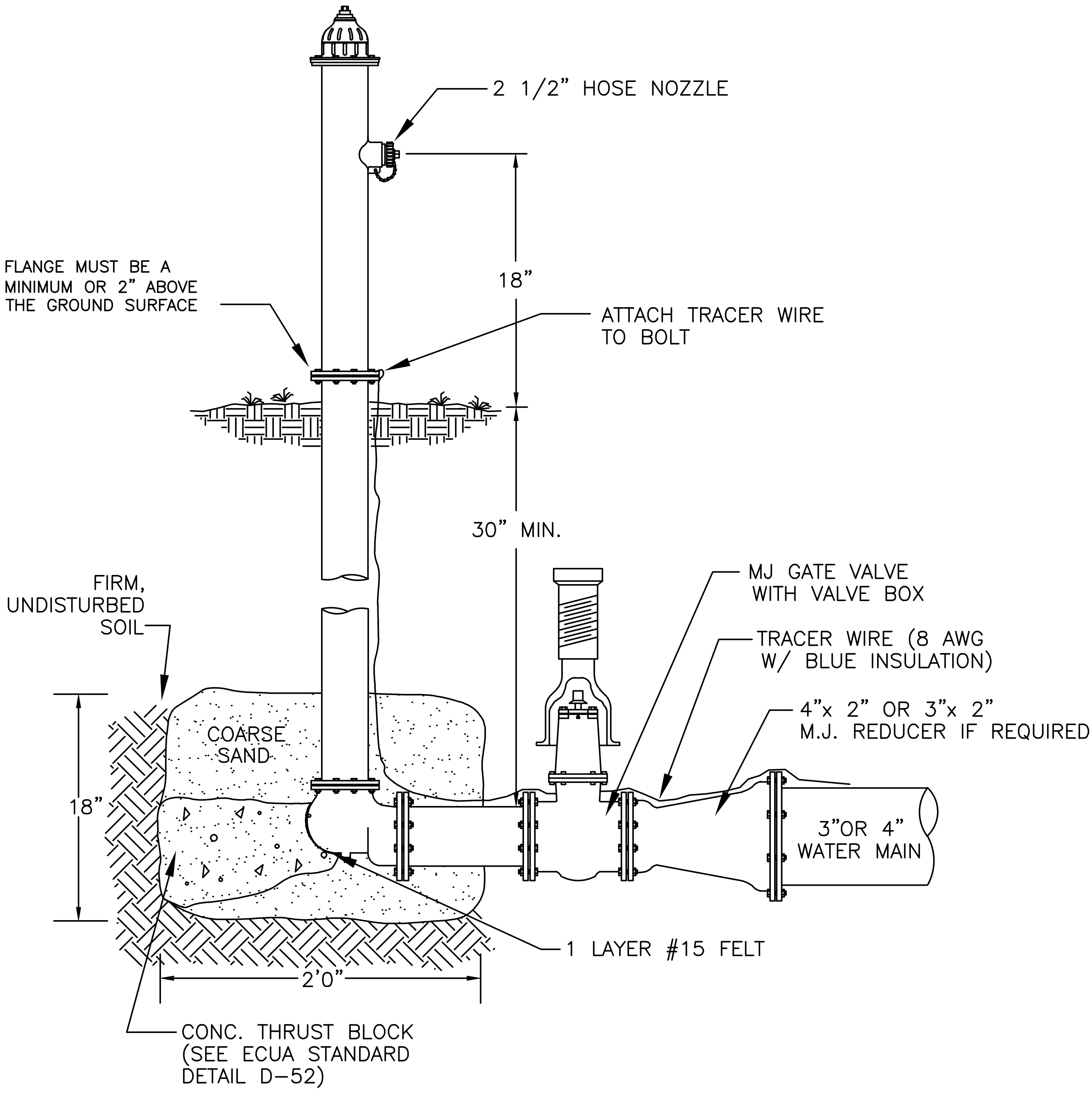


EMERALD COAST UTILITIES AUTHORITY

# TYPICAL 2" FLUSH HYDRANT

SCALE: N.T.S.

DATE: 9/01/2016

DETAIL

D-51

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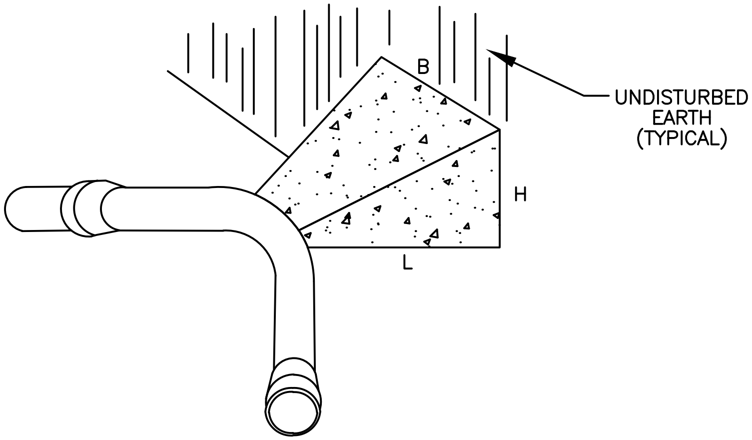
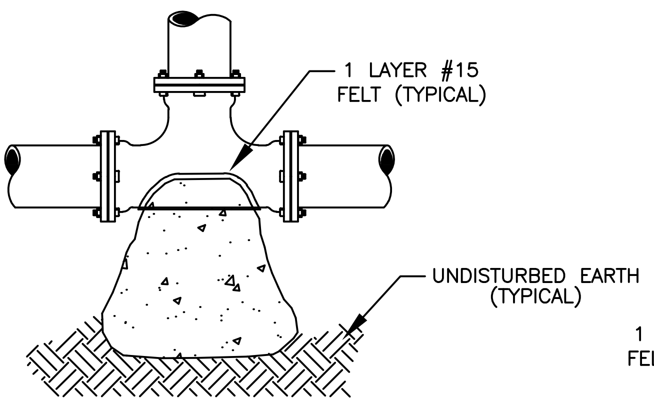



## 11.25°, 22.5°, 45° + 90° BEND

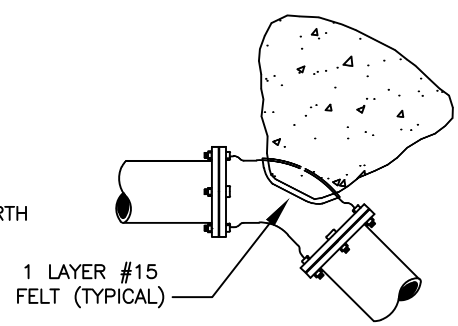
| | BEARING AREA DIMENSIONS OF THRUST BLOCK, H X B (FT) | | | | |
|---|---|---|---|---|---|
| PIPE SIZE | DEAD END OR TEE | 90° BEND | 45° BEND | 22.5° BEND | 11.25° BEND |
| 4" | 1.0 X 1.5 | 1.5 X 1.5 | 1.0 X 1.0 | 1.0 X 1.0 | 1.0 X 1.0 |
| 6" | 1.5 X 2.0 | 1.5 X 2.5 | 1.0 X 2.0 | 1.0 X 1.5 | 1.0 X 1.0 |
| 8" | 2.0 X 2.5 | 2.0 X 3.5 | 1.5 X 2.5 | 1.0 X 2.0 | 1.0 X 1.0 |
| 10" | 2.5 X 3.5 | 3.0 X 4.0 | 2.0 X 3.0 | 1.5 X 2.0 | 1.0 X 1.5 |
| 12" | 3.0 X 4.0 | 3.5 X 5.0 | 2.5 X 3.5 | 2.0 X 2.5 | 1.0 X 2.0 |
| 16" | 4.0 X 5.5 | 4.5 X 6.5 | 3.0 X 5.0 | 2.5 X 3.5 | 1.5 X 2.5 |

NOTES:

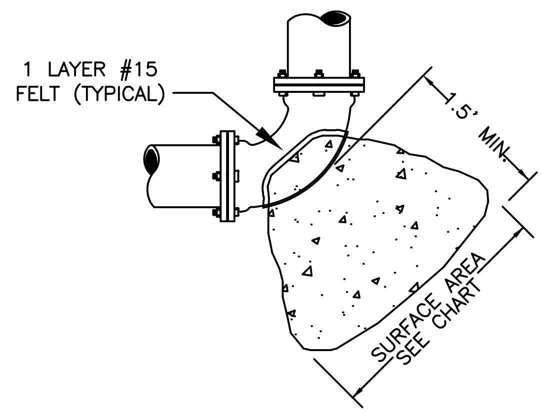
1. ONE LAYER OF #15 FELT TO BE USED TO PREVENT ADHESION OF CONCRETE TO FITTING.
2. ALL THRUST BLOCKS TO BE BACKED BY UNDISTURBED SOIL
3. THRUST BLOCK DIMENSIONS BASED ON SM SOIL CLASSIFICATION WITH A SOIL BEARING PRESSURE OF 3000 LB/FT$^2$
4. CONCRETE MIN. 2,500 PSI.
5. BEARING AREAS SHALL BE MINIMUM 1.0 FT$^2$
6. JOINT RESTRAINTS ARE TO BE USED ON ALL FITTINGS. THRUST BLOCKS REQUIRED ON 90° BENDS, 45° BENDS, 22.5° BENDS, 11.25° BENDS, TEES, TAPPING SLEEVES AND DEAD ENDS.




## TEE - M.J.




## 11.25°, 22.5° + 45° BENDS - M.J.




## 90° BEND - M.J.

EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.
DATE: 9/01/2016

# TYPICAL THRUST BLOCK INSTALLATION

DETAIL
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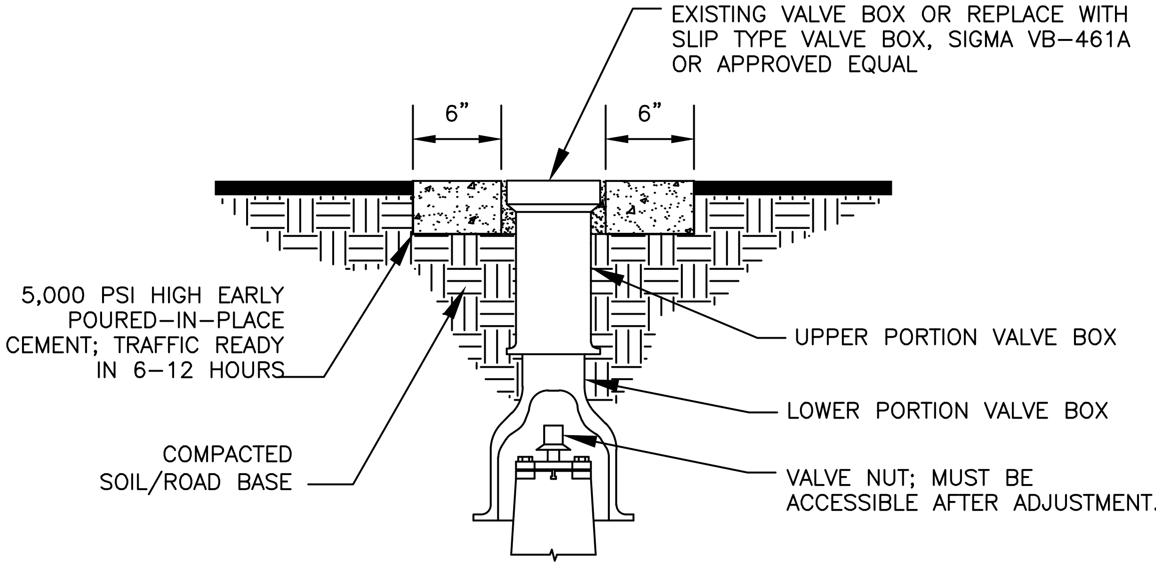


## VALVE BOX (VB) ADJUSTMENT PROCEDURES:

**Pre-milling coordination:** Contractor shall contact ECUA's Manhole Coordinator, Mr. Eddie Carter (see D-83 ECUA Regional Services Map) at least 2 weeks prior to milling operations to coordinate location of VBs requiring adjustment (visible VBs and those under asphalt). ECUA will then make decision to either allow adjustment of existing VBs or to supply new VBs to contractor (at ECUA expense).

**Pre-milling procedures:** Contractor shall make a list of all VB locations (station and offset or GPS coordinates to sub-meter accuracy), and submit list to ECUA's Manhole Coordinator. If upper portion of VB is removable, then Contractor can remove upper portion of VB and install minimum ½" thick steel plate (or thicker if needed) over lower portion of VB at a depth to avoid milling operations. If upper portion of VB is not removable, then entire VB shall be removed, and new lower portion of VB shall be installed prior to plating. Contractor shall coordinate with ECUA's Manhole Coordinator on the supply of new valve boxes as needed. Contractor shall paint solid blue circle, one foot in diameter, directly over plated valve onto milled asphalt surfaces and leveling course surfaces and shall maintain painted mark for the duration of the project. Due to ECUA emergency access needs, VBs shall not be plated more than 1 month, with 2 weeks or less being preferred.

**Post-resurfacing procedures:** Contractor shall determine location of VBs using list created in pre-milling stage and shall remove circular area of asphalt approximately 18" in diameter (equal to typical 6" lid and 12" wide concrete collar), centered over VB. Remove plate. Align lower portion of VB to be centered over valve nut and remove all material from VB to make nut free and clear from obstructions. For minor changes in grade, adjust upper portion of VB to match finished grade. Request from ECUA's Manhole Coordinator either extra-long lower sections or extra lower sections for deeper than normal installations (PVC pipe will not be allowed). VB and lid shall be set so that elevation and slope of lid matches finished road surface. Pour 5,000 psi concrete around VB to form 6" wide concrete collar that matches elevation and slope of finished road surface.

**Post-resurfacing coordination:** Roadway Inspector shall confirm all VBs have been adjusted and done so according to this detail. Contractor shall then contact ECUA's Manhole Coordinator for final ECUA inspection. VBs not meeting this detail, with valve nuts not accessible due to poor alignment of valve box or construction debris/dirt in bottom of VB, or not matching roadway elevation and slope, will be corrected as required prior to payment. Contractor shall provide 2 years warranty (1 year if performed on FDOT project) beginning on ECUA's date of acceptance.

EMERALD COAST UTILITIES AUTHORITY

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|---|---|
| SCALE: | N.T.S. |
| DATE: | 9/01/2016 |

# VALVE BOX ADJUSTMENT

DETAIL

D-59

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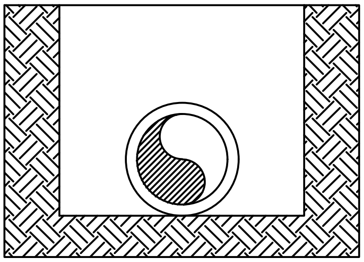
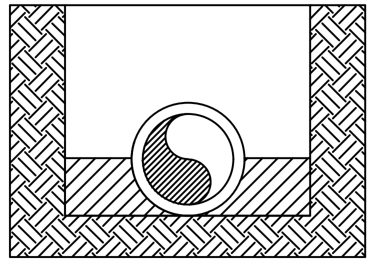


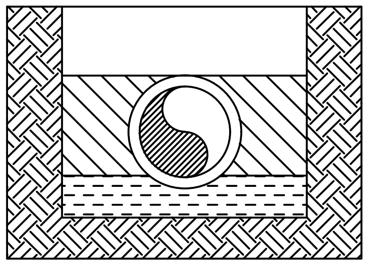
**TYPE 1**

FLAT–BOTTOM* TRENCH, LOOSE EMBEDMENT
E = 50 psi (340 kPa). K = 0.110



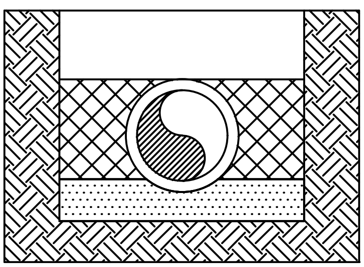
**TYPE 2**

FLAT–BOTTOM* TRENCH, EMBEDMENT LIGHTLY
CONSOLIDATED TO CENTERLINE OF PIPE.
E = 200 psi (1,380 kPa). K = 0.110



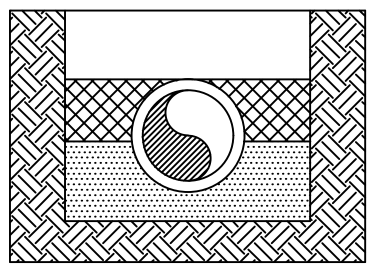
**TYPE 3**

PIPE BEDDED ON 4" (100 mm) MINIMUM
OF LOOSE SOIL.** EMBEDMENT LIGHTLY
CONSOLIDATED TO TOP OF PIPE.
E = 400 psi (2,760 kPa). K = 0.102



**TYPE 4**

PIPE BEDDED ON SAND, GRAVEL OR CRUSHED
STONE TO DEPTH OF 1/8 PIPE DIAMETER, 4"
(100 mm) MINIMUM. EMBEDMENT COMPACTED
TO TOP OF PIPE.(APPROXIMATELY 80% STANDARD
PROCTOR. AASHTO T–99 OR ASTM D 698)
E = 1,000 psi (6,900 kPa). K = 0.096



**TYPE 5**

PIPE ENBEDDED IN COMPACTED GRANULAR
MATERIAL TO CENTERLINE OF PIPE. COMPACTED
GRANULAR OR SELECT MATERIAL TO TOP OF PIPE.
(APPROXIMATELY 90% STANDARD PROCTOR.
AASHTO T–99 OR ASTM D 698)
E = 2,000 psi (13,800 kPa). K = 0.083

NOTE: REQUIRED EMBEDMENT TYPE WILL DEPEND ON THE PIPE'S DIMENSION RATIO, INTERNAL OPERATIING PRESSURE, AND EXTERNAL LOAD, AND SHALL BE SPECIFIED BY THE PURCHASER.(SEE SEC. 5.3)

* "FLAT–BOTTOM" IS DEFINED AS UNDISTURBED EARTH.
** "LOOSE SOIL" OR "SELECT MATERIAL" IS DEFINED AS NATIVE SOIL EXCAVATED FROM THE TRENCH, FREE OF ROCKS FOREIGN MATERIAL, AND FROZEN EARTH. A SOFT "LOOSE SOIL" BEDDING WILL CONTOUR TO THE PIPE BOTTOM. CAUTION MUST BE EXERCISED TO ENSURE PROPER PLACEMENT OF EMBEDMENT MATERIAL UNDER THE HAUNCHES OF THE PIPE.

From AWWA C.605
UNDERGROUND INSTALLATION OF PVC PIPE

EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.
DATE: 9/01/2016

# PIPE ENVELOPE REQUIREMENTS

DETAIL
D-60

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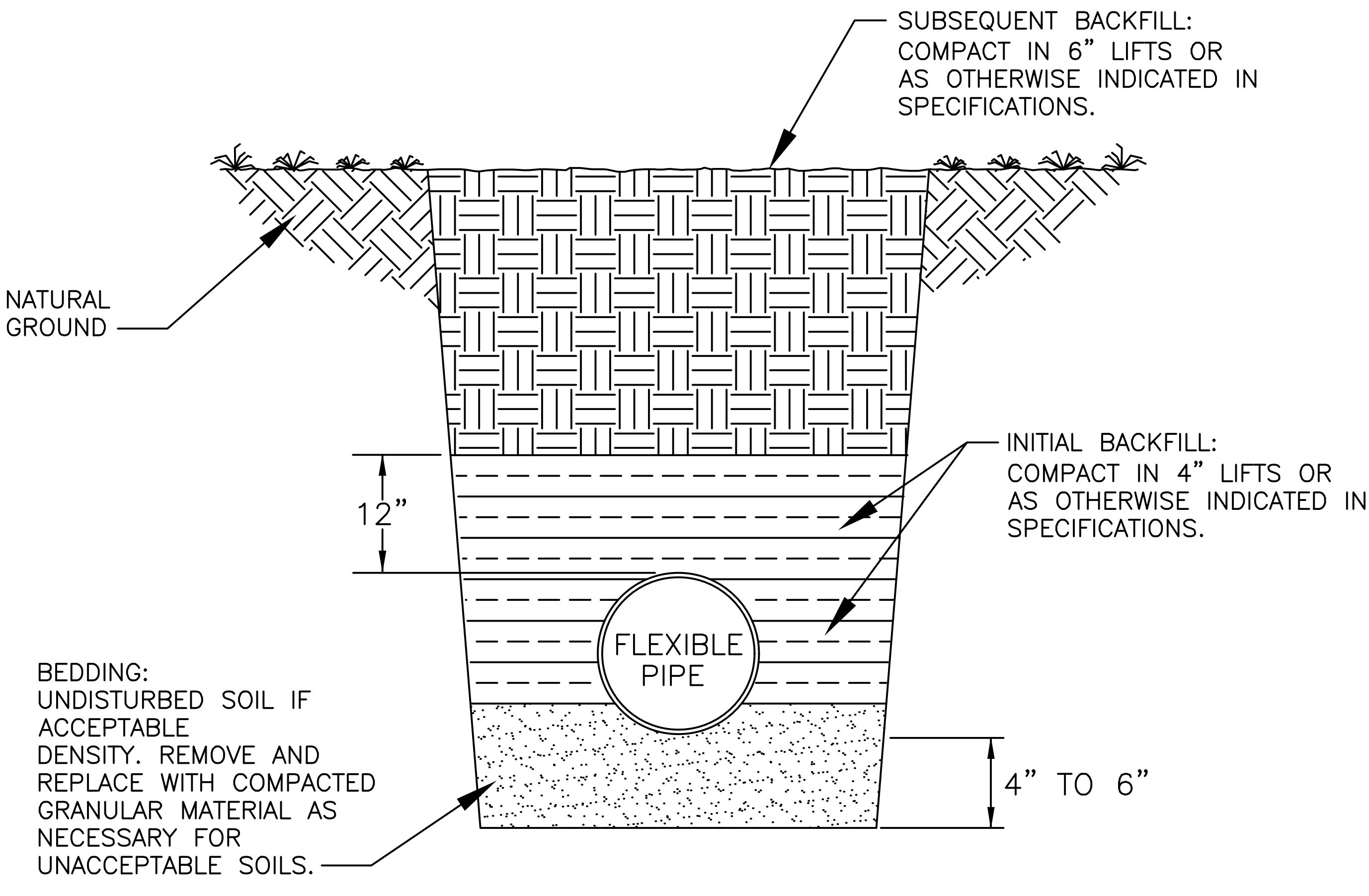



EMERALD COAST UTILITIES AUTHORITY

# FLEXIBLE PIPE BEDDING

SCALE: N.T.S.

DATE: 9/01/2016

DETAIL

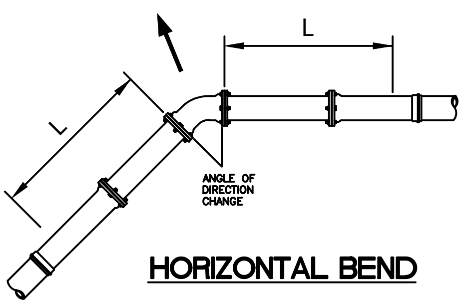
D-61

| Pipe Size (in) | DUCTILE IRON — Minimum Pipe Length to be Restrained, L (ft) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Horizontal Fittings | | | | | | 45° Vertical Offset | |
| | 90° | 45° | 22.5° | 11.25° | Dead Ends/Valves | Equal Tees | $L_{UPPER}$ | $L_{LOWER}$ |
| 3 | 22 | 10 | 5 | 3 | 46 | 1 | 19 | 10 |
| 4 | 27 | 11 | 6 | 3 | 56 | 1 | 23 | 11 |
| 6 | 38 | 16 | 8 | 4 | 79 | 1 | 33 | 16 |
| 8 | 48 | 20 | 10 | 5 | 101 | 11 | 42 | 20 |
| 10 | 58 | 24 | 12 | 6 | 123 | 32 | 51 | 24 |
| 12 | 67 | 28 | 14 | 7 | 143 | 51 | 59 | 28 |
| 14 | 76 | 32 | 15 | 8 | 164 | 70 | 68 | 32 |
| 16 | 84 | 35 | 17 | 9 | 182 | 88 | 76 | 35 |
| 18 | 92 | 38 | 19 | 10 | 202 | 106 | 84 | 38 |
| 20 | 100 | 42 | 20 | 10 | 219 | 123 | 91 | 42 |
| 24 | 114 | 48 | 23 | 12 | 255 | 156 | 106 | 48 |

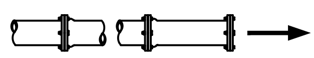
| Pipe Size (in) | PVC — Minimum Pipe Length to be Restrained, L (ft) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Horizontal Fittings | | | | | | 45° Vertical Offset | |
| | 90° | 45° | 22.5° | 11.25° | Dead Ends/Valves | Equal Tees | $L_{UPPER}$ | $L_{LOWER}$ |
| 3 | 25 | 11 | 5 | 3 | 61 | 1 | 26 | 11 |
| 4 | 30 | 13 | 6 | 3 | 73 | 1 | 31 | 13 |
| 6 | 43 | 18 | 9 | 5 | 105 | 1 | 44 | 18 |
| 8 | 54 | 23 | 11 | 6 | 133 | 14 | 55 | 23 |
| 10 | 65 | 27 | 13 | 7 | 162 | 42 | 67 | 27 |
| 12 | 75 | 31 | 15 | 8 | 189 | 67 | 78 | 31 |
| 14 | 85 | 36 | 17 | 9 | 216 | 93 | 90 | 36 |
| 16 | 94 | 39 | 19 | 10 | 241 | 116 | 100 | 39 |
| 18 | 104 | 43 | 21 | 11 | 267 | 140 | 111 | 43 |
| 20 | 112 | 47 | 23 | 11 | 290 | 162 | 120 | 47 |
| 24 | 128 | 53 | 26 | 13 | 337 | 206 | 140 | 53 |

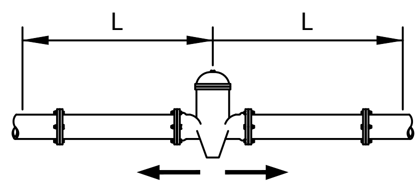
NOTES:

1. CALCULATIONS ARE BASED ON THE FOLLOWING ASSUMPTIONS:
   TEST PRESSURE = 150 PSI, SOIL GROUP = SM, TRENCH TYPE = 3, DEPTH = 2.5', SAFETY FACTOR = 2
2. WITH EQUAL TEES, THE DISTANCE OF THE RUN LENGTH IS ASSUMED TO BE 40'. FOR OTHER RUN LENGTHS, INDIVIDUAL CALCULATIONS MUST BE MADE.
3. AS A MINIMUM, PIPE RESTRAINTS ARE TO BE PLACED ON THE FIRST JOINT FROM THE FITTING.
4. FOR ALL NEW CONSTRUCTION, WHEN A PIPE MUST BE INSTALLED IN A CASING THE REQUIRED JOINT RESTRAINTS MUST ALSO BE INSTALLED INSIDE THE CASING. THE CASING IS TO BE SIZED ACCORDINGLY.
5. FOR AN EXISTING MAIN LOCATED UNDER A PAVED SURFACE, THE CONTRACTOR WILL NOT BE REQUIRED TO PLACE RESTAINTS ON THE EXISTING PIPE.
6. FOR AN EXISTING MAIN NOT LOCATED UNDER A PAVED SURFACE, THE CONTRACTOR WILL BE REQUIRED TO PLACE RESTAINTS ON THE EXISTING PIPE.
7. L IS THE CALCULATED LENGTH OF PIPE TO BE RESTRAINED.

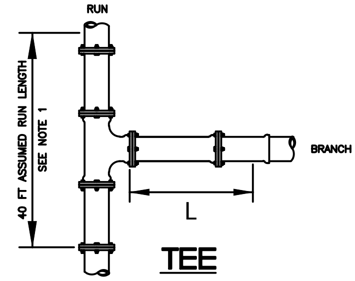


HORIZONTAL BEND


DEAD END



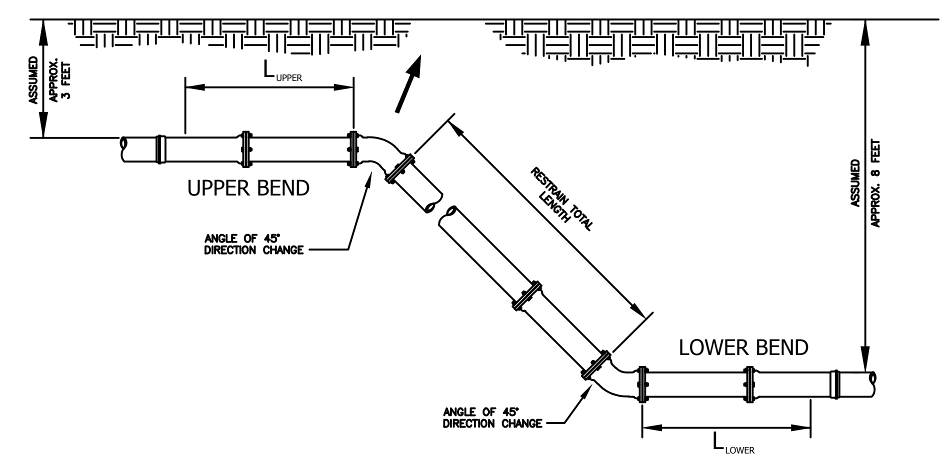
VALVE



TEE

NOTES:

1. AS A MINIMUM, RESTRAINTS SHALL BE INSTALLED ON THE FIRST JOINT ON ITHER SIDE OF THE TEE (RUN).



VERTICAL OFFSET PROFILE

EMERALD COAST UTILITIES AUTHORITY

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|---|---|
| SCALE: | N.T.S. |
| DATE: | 9/01/2016 |

# PIPE JOINT RESTRAINT TABULATION

DETAIL

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## DUCTILE IRON — STRAIGHT REDUCERS

Minimum Pipe Length to be Restrained, L (ft)

| | Pipe Diameter (in) | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SMALL SIDE | **3** | 18 | 54 | 81 | | | | | | | |
| | **4** | | 42 | 72 | 100 | 124 | | | | | |
| | **6** | | | 41 | 75 | 103 | 130 | 153 | | | |
| | **8** | | | | 43 | 77 | 108 | 133 | 159 | | |
| | **10** | | | | | 41 | 77 | 107 | 136 | 161 | |
| | **12** | | | | | | 43 | 78 | 110 | 137 | 188 |
| | **14** | | | | | | | 41 | 78 | 108 | 165 |
| | **16** | | | | | | | | 42 | 77 | 139 |
| | **18** | | | | | | | | | 40 | 109 |
| | **20** | | | | | | | | | | 77 |

## DUCTILE IRON — REDUCING TEES

Minimum Pipe Length to be Restrained, Lb (ft)

| | Pipe Diameter (in) | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BRANCH | **3** | 1 | 1 | 1 | | | | | | | |
| | **4** | | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | **6** | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | **8** | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | **10** | | | | | 12 | 1 | 1 | 1 | 1 | 1 |
| | **12** | | | | | | 32 | 14 | 1 | 1 | 1 |
| | **14** | | | | | | | 55 | 38 | 21 | 1 |
| | **16** | | | | | | | | 73 | 59 | 27 |
| | **18** | | | | | | | | | 94 | 66 |
| | **20** | | | | | | | | | | 98 |

## PVC — STRAIGHT REDUCERS

Minimum Pipe Length to be Restrained, L (ft)

| | Pipe Diameter (in) | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SMALL SIDE | **3** | 24 | 71 | 107 | | | | | | | |
| | **4** | | 55 | 95 | 132 | 164 | | | | | |
| | **6** | | | 54 | 99 | 136 | 172 | 203 | | | |
| | **8** | | | | 57 | 101 | 142 | 177 | 210 | | |
| | **10** | | | | | 54 | 102 | 142 | 180 | 213 | |
| | **12** | | | | | | 57 | 103 | 146 | 182 | 249 |
| | **14** | | | | | | | 54 | 103 | 144 | 217 |
| | **16** | | | | | | | | 56 | 102 | 184 |
| | **18** | | | | | | | | | 53 | 143 |
| | **20** | | | | | | | | | | 101 |

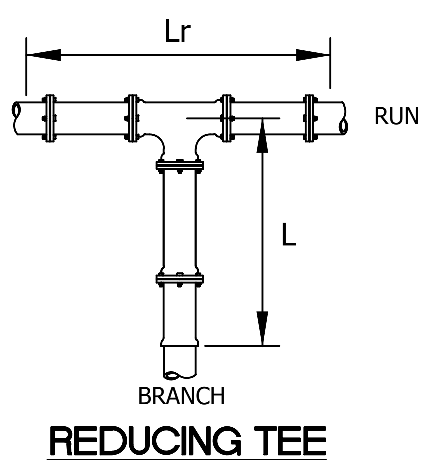
## PVC — REDUCING TEES

Minimum Pipe Length to be Restrained, Lb (ft)

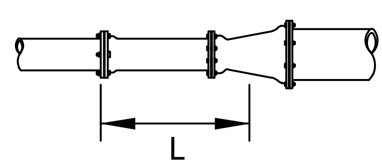
| | Pipe Diameter (in) | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| BRANCH | **3** | 1 | 1 | 1 | | | | | | | |
| | **4** | | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| | **6** | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | **8** | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | **10** | | | | | 16 | 1 | 1 | 1 | 1 | 1 |
| | **12** | | | | | | 43 | 19 | 1 | 1 | 1 |
| | **14** | | | | | | | 73 | 50 | 28 | 1 |
| | **16** | | | | | | | | 97 | 78 | 36 |
| | **18** | | | | | | | | | 124 | 87 |
| | **20** | | | | | | | | | | 130 |

NOTES:

1. CALCULATIONS ARE BASED ON THE FOLLOWING ASSUMPTIONS:
   TEST PRESSURE = 150 PSI, SORL GROUP = SM, TRENCH TYPE = 3, DEPTH = 2.5', SAFETY FACTOR = 2
2. WITH REDUCING TEES, THE DISTACE OF THE RUN LENGTH IS ASSUMED TO BE 40'. FOR OTHER RUN LENGTHS (Lr), INDIVIDUAL CALCULATIONS MUST BE MADE.
3. AS A MINIMUM, PIPE RESTRAINTS ARE TO BE PLACED ON THE FIRST JOINT FROM THE FITTING.
4. FOR ALL NEW CONSTRUCTION, WHEN A PIPE MUST BE INSTALLED IN A CASING THE REQUIRED JOINT RESTRAINTS MUST ALSO BE INSTALLED INSIDE THE CASING. THE CASING IS TO BE SIZED ACCORDINGLY.
5. FOR AN EXISTING MAIN LOCATED UNDER A PAVED SURFACE, THE CONTRACTOR WILL NOT BE REQUIRED TO PLACE RESTAINTS ON THE EXISTING PIPE.
6. FOR AN EXISTING MAIN NOT LOCATED UNDER A PAVED SURFACE, THE CONTRACTOR WILL BE REQUIRED TO PLACE RESTAINTS ON THE EXISTING PIPE.




**REDUCING TEE**




**STRAIGHT REDUCER**

EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.

DATE: 9/01/2016

# PIPE JOINT RESTRAINT REDUCERS & REDUCING TEES

DETAIL

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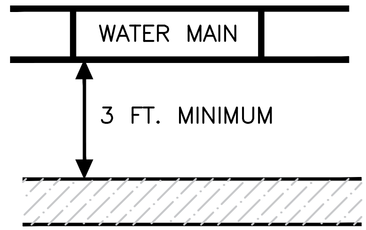
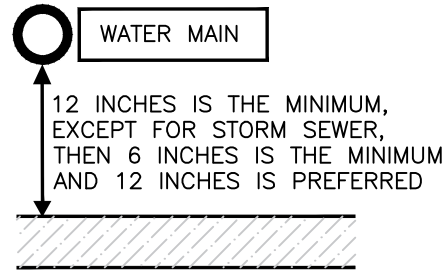
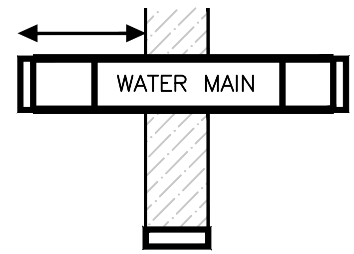
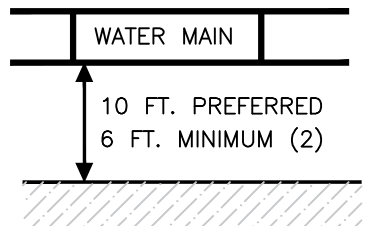
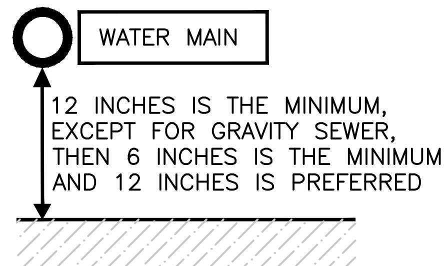
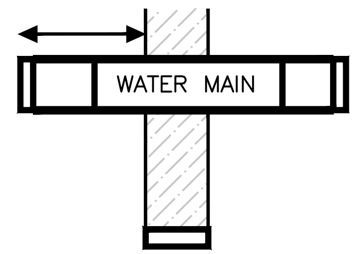
| OTHER PIPE | HORIZONTAL SEPARATION | CROSSINGS (1) | JOINT SPACING @ CROSSINGS (FULL JOINT CENTERED) |
|---|---|---|---|
| STORM SEWER,<br>STORMWATER FORCE MAIN |   |   | ALTERNATE 3 FT. MINIMUM   |
| GRAVITY OR PRESSURE<br>SANITARY SEWER,<br>SANITARY SEWER FORCE MAIN |   |   | ALTERNATE 6 FT MINIMUM   |

(1) WATER MAIN SHOULD CROSS ABOVE OTHER PIPE. WHEN WATER MAIN MUST BE BELOW OTHER PIPE, THE MINIMUM SEPARATION IS 12 INCHES.
(2) 3 FT. GRAVITY SANITARY SEWER WHERE THE BOTTOM OF THE WATER MAIN IS LAID AT LEAST 6 INCHES ABOVE THE TOP OF THE GRAVITY SANITARY SEWER.

## NOTES:

A. INFORMATION PROVIDED FROM FDEP RULE 62–555. IF OTHER FDEP RULES CONFLICT, THEN USE THE MOST STRINGENT RULE.
B. IF THERE ARE CONFLICTS IN THE SEPARATION REQUIREMENTS BETWEEN COLLECTION SYSTEMS AND DRINKING WATER FACILITIES ESTABLISHED IN FOOTNOTES (1) AND (2) ABOVE AND THOSE ESTABLISHED IN CHAPTER 62–532 OR 62–555, F.A.C., THEN THE REQUIREMENTS IN CHAPTER 62–532 OR 62–555, F.A.C., SHALL APPLY.

ECUA
EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.
DATE: 9/01/2016

# WATER / SEWER SEPARATION

DETAIL
D-64

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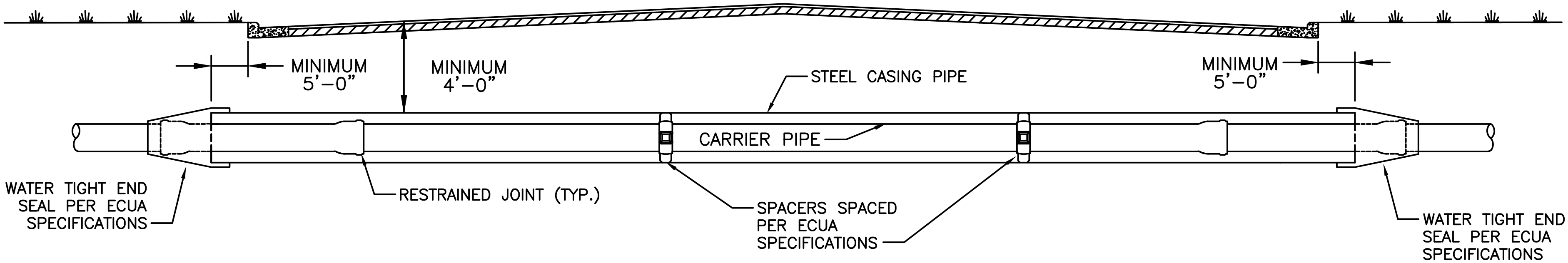


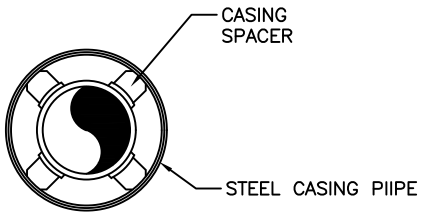


| CARRIER PIPE NOMINAL DIAMETER (IN) | CASING PIPE NOMINAL DIAMETER (IN) | CASING PIPE THICKNESS (IN) |
|---|---|---|
| 4 | 12 | 0.188 |
| 6 | 14 | 0.188 |
| 8 | 16 | 0.250 |
| 10 | 18 | 0.250 |
| 12 | 20 | 0.250 |
| 14 | 24 | 0.250 |
| 16 | 24 | 0.250 |

NOTES:

1. JOINTS INSIDE CASING PIPE SHALL BE RESTRAINED.
2. ENDS OF CASING PIPE SHALL BE SEALED WATER TIGHT DUE TO RESTRAINT SIZE IN ACCORDANCE WITH ECUA SPECIFICATIONS.
3. ALL COUNTY ROAD CROSSINGS SHALL BE INSTALLED IN ACCORDANCE WITH APPLICABLE STATE AND LOCAL STANDARDS.
4. ALL STATE HIGHWAY CROSSINGS SHALL BE INSTALLED IN ACCORDANCE WITH APPLICABLE STATE AND LOCAL STANDARDS.
5. ALL RAILROAD CROSSING SHALL BE INSTALLED IN ACCORDANCE WITH THE GOVERNING AGENCY'S REGULATIONS AND IN ACCORDANCE WITH PERMIT REQUIREMENTS.
6. CASING SPACERS TO BE INSTALLED IN ACCORDANCE WITH ECUA SPECIFICATIONS.

ECUA
EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.
DATE: 9/01/2016

# TYPICAL JACK AND BORE

DETAIL
D-65

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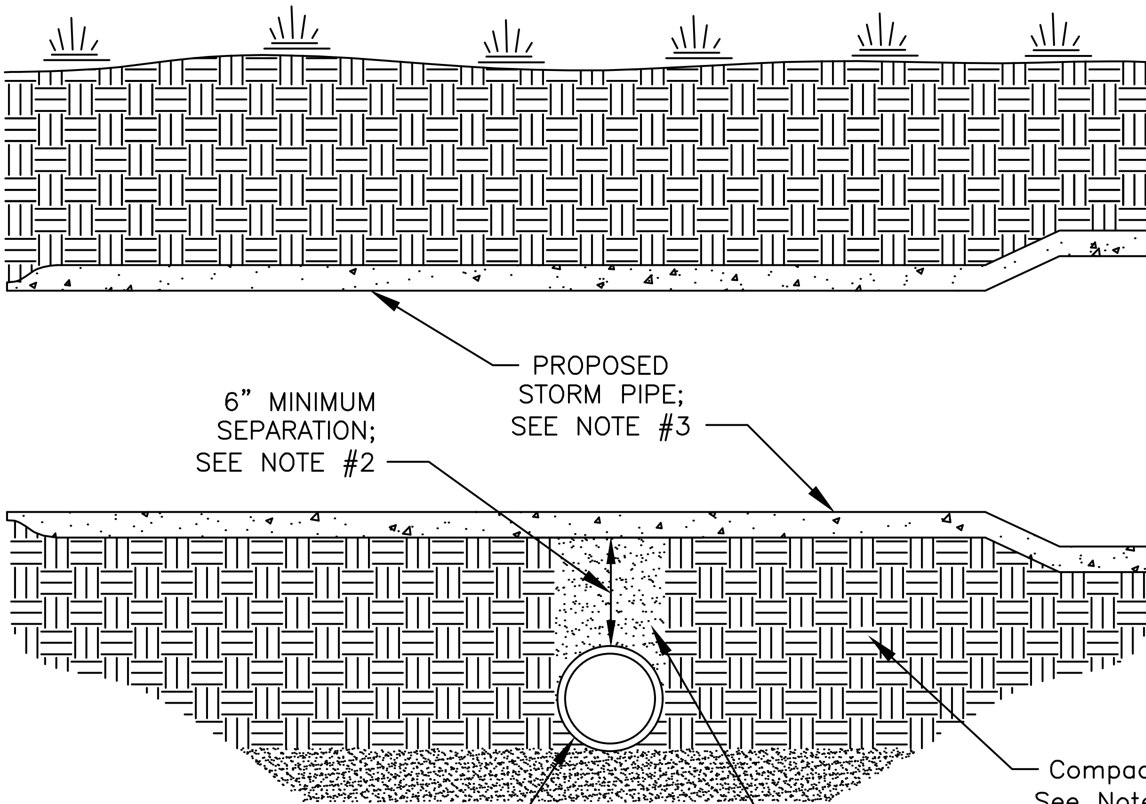


**NOTES FOR STORM SYTEM INSTALLATION:**

1. The first step in avoiding any potential conflict between a proposed storm system design and an existing utility pipe is confirmation of the exact horizontal and vertical location of the existing utility pipe. Per industry standard best management practices, the storm system designer should have the exisitng utility pipe exposed and survey the exact horizontal location and vertical elevation prior to designing the storm system, thus allowing conflicts to be avoided as much as possible, or, when needed, utility relocations designed into contract.
2. Maintain at least 6" of vertical separation as shown from the exterior of the storm pipe to the exterior of the utility pipe. In situations where 6" cannot be provided, then E.C.U.A. will determine if less than 6" will be allowed. Separations less than 3" are generally not allowed.
3. Contractor shall layout storm system piping such that midpoint of storm pipe segment is centered over utility pipe as much as practical. Bell and spigot ends of storm pipe shall be kept as far away from utility pipe as possible.
4. In order to 'bridge' utility pipe, Contractor shall compact soil under entire segment of storm pipe that is over utility pipe to 98% modified Proctor for a depth of 12" below storm pipe, while taking care not to damage utility pipe. Fill space between utility pipe and storm pipe with loose fill and hand tamp.

EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.
DATE: 9/01/2016

# STORM SEWER VERTICAL SEPARATION

DETAIL
D-66

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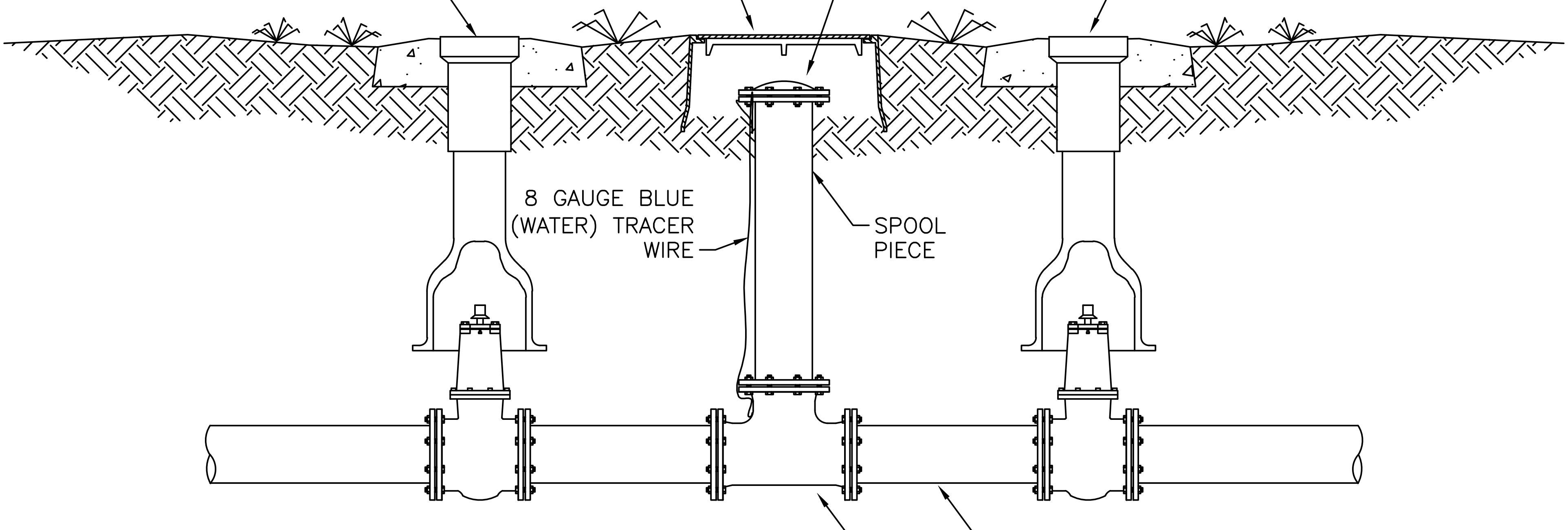


NOTES:

- MJ WITH MEGALUGS AND ALL THREADS.
- ALL PIPE AND FITTINGS TO BE VISABLY MARKED, STRIPED, LABELED AND/OR COATED WITH APWA STANDARD BLUE COLOR AS PER FDEP RULES.
- ALL HDD MAINS 12" AND LARGER SHALL HAVE PIG/SWAB LAUNCH PITS AT EACH END OF THE HDPE.

EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.

DATE: 9/01/2016

# PIG/SWAB LAUNCH PIT

DETAIL

D-67

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| SAMPLE | PIPE CONTENT | VISUAL COLOR | SHERWIN-WILLIAMS COLOR CODE | SAMPLE | PIPE CONTENT | VISUAL COLOR | SHERWIN-WILLIAMS COLOR CODE |
|---|---|---|---|---|---|---|---|
| | Potable Water | Light Blue | SW4062 Spillway | | Polymer | Orange with Light Green Band | SW4083 Safety Orange SW4076 Green Byte |
| | Reclaimed Water/ Reuse Water | Pantone Purple | SW6836 Novel Lilac | | Primary Effluent | Light Brown | SW4002 Modular Tan |
| | Final Effluent | Dark Blue | SW4056 Blueprint | | Backwash/Waste Filtrate/Centrate | Light Brown with Dark Blue Band | SW4002 Modular Tan SW4056 Blueprint |
| | Final Effluent w/Chlorine | Dark Blue with Yellow Band | SW4056 Blueprint SW4084 Safety Yellow | | Supernatant | Light Brown with Black Band | SW4002 Modular Tan SW Black |
| | Filter Effluent | Dark Blue with Light Brown Band | SW4056 Blueprint SW4002 Modular Tan | | Pretreatment Slurry | Light Brown with Light Green Band | SW4002 Modular Tan SW4076 Green Byte |
| | Secondary Effluent | Light Green with Dark Blue Band | SW4076 Green Byte SW4056 Blueprint | | Bacteria Solution | Light Brown with Red Band | SW4002 Modular Tan SW4081 Safety Red |
| | Sulfur Dioxide | Light Green with Yellow Band | SW4076 Green Byte SW4084 Safety Yellow | | Sludge | Dark Brown | SW4001 Bolt Brown |
| | Magnesium Hydroxide | Light Green with Orange Band | SW4076 Green Byte SW4083 Safety Orange | | Dried Biosolids | Dark Brown with Dark Green Band | SW4001 Bolt Brown SW4071 Rain Forest |
| | Mixed Liquor | Light Green with Dark Brown Band | SW4076 Green Byte SW4001 Bolt Brown | | Scum | Dark Brown with Dark Blue Band | SW4001 Bolt Brown SW4056 Blueprint |
| | Sodium Hydroxide (Caustic) | Light Green with Red Band | SW4076 Green Byte SW4081 Safety Red | | Grit Slurry | Dark Brown with Light Green Band | SW4001 Bolt Brown SW4076 Green Byte |
| | Mixed Liquor Recycle | Light Green with Black Band | SW4076 Green Byte SW Black | | Grease | Dark Brown with Yellow Band | SW4001 Bolt Brown SW Safety Yellow |
| | Compressed Air | Dark Green | SW4071 Rain Forest | | Gasoline/Diesel/ Natural Gas | Red | SW4081 Safety Red |
| | Off-Gases | Dark Green with Red Band | SW4071 Rain Forest SW4081 Safety Red | | Gasoline/Diesel/ Natural Gas/Vents | Red with Dark Green Band | SW4081 Safety Red SW4071 Rain Forest |
| | Sodium Hypochlorite (Bleach) | Yellow with Dark Blue Band | SW4084 Safety Yellow SW4056 Blueprint | | Electrical | Light Gray | SW4027 Galvano |
| | Methanol | Yellow with Light Green Band | SW4084 Safety Yellow SW4076 Green Byte | | Raw Sewage | Dark Gray | SW4018 Anchor Gray |
| | Muriatic Acid | Yellow with Red Band | SW4084 Safety Yellow SW4081 Safety Red | | Holding Tank | Dark Gray with Light Brown Band | SW4018 Anchor Gray SW4002 Modular Tan |
| | Alum | Orange | SW4083 Safety Orange | | Floor Drains | Dark Gray with Light Green Band | SW4018 Anchor Gray SW4076 Green Byte |
| | Odor Control Recirculation | Orange with Dark Blue Band | SW4083 Safety Orange SW4056 Blueprint | | Stormwater | Charcoal | SW4049 Camshaft |
| | | | | | Nitrogen | Black | SW Black |
| | | | | | | | |

EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.

DATE: 9/01/2016

# EXPOSED PIPING AND EQUIPMENT MASTER COLOR CHART

DETAIL

D-68

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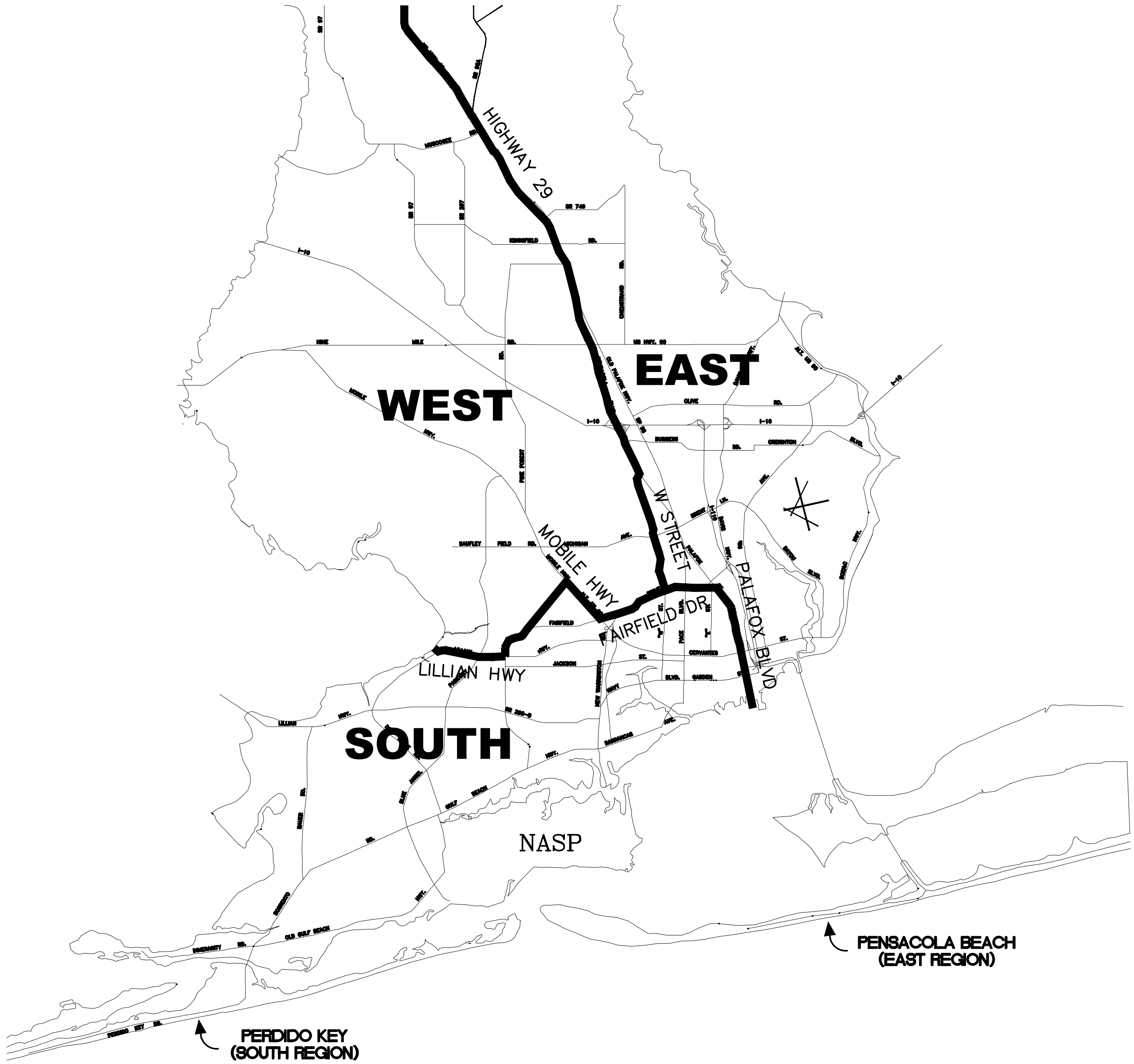
| Region | Supervisor | Office/Cell | | Assistant | Office/Cell | |
|---|---|---|---|---|---|---|
| South | Tommy Taylor | 969–6516 | 698–4677 | Calvin Gillis | 969–6515 | 698–4667 |
| West | Mike Lambert | 969–3312 | 698–4613 | Terry Golson | 969–6622 | 698–4684 |
| East | Tony Johnson | 969–6679 | 698–4619 | Perry White | 969–6680 | 698–4607 |
| MH Maint. | Doug Gibson | 969–6513 | 698–4696 | Jason Wise | 969–6514 | 698–4718 |
| FH Maint. | Todd Gudelfinger | 969–6620 | 698–4620 | NA | NA | |
| MH Coord. | Eddie Carter | 969–5824 | 698–7292 | NA | NA | |




EMERALD COAST UTILITIES AUTHORITY

SCALE: N.T.S.

DATE: 9/01/2016

# REGIONS SERVICE MAP AND PERSONNEL

DETAIL

D-70

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# Division 5 – Forms

Agreement for Residential or Commercial Grinder Pump and Application

Certification of Completion Form – Sewer

Certification of Completion Form – Water

Change Order Form

Engineering Manual Reference Note

ECUA Fire Hydrant Flow Data Form

ECUA Pay Request Form

ECUA Pipe Material Chart

ECUA Version of FDOT Utility Permit Special Instructions

Lift Station Milestone Sign-off Sheet

Lift Station Manufacturers and Sales Contacts

Lift Station Pump Overview Chart

Lift Station Pump Selection Worksheet

Notice of Intent (NOI) Permit

Notification of Commencement of Construction

Capacity Reservation Form

Request for Single Service Connection

Review of Privately-Owned Lift Station

Certification of Developer (SD-3)

System Extensions – Preliminary Submittal Form

Temporary Construction Easement

Utility Service Agreement (USA)

Water Meter Access Agreement

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# AGREEMENT FOR RESIDENTIAL OR COMMERCIAL GRINDER PUMP STATION

This agreement is made by and between __________________(the "Customer", which term includes the singular and the plural as appropriate) whose address is_______________________________________ and the Emerald Coast Utilities Authority, a local governmental body, corporate and politic ("ECUA"):

**Recitals*:***

Customer owns that certain real property commonly identified as:
______________________________ (the "Property".)

1. Customer desires ECUA to provide wastewater service for the Property by means of connection to the ECUA sewer system.

2. In order to connect to the ECUA system it will be necessary for the Customer to install, operate and maintain a grinder pump station to collect wastewater generated on the Property, grind it, and pump it to a point of connection to the ECUA sewer system.

3. Subject to the conditions stated in this Agreement, ECUA agrees to reimburse the Customer for the cost of the initial purchase of a grinder pump station for this purpose.

NOW, THEREFORE, the Customer and ECUA agree as follows:

1. The above Recitals to this Agreement are true and correct.

2. Customer shall purchase and install a grinder pump station, including any check valves and related equipment, to connect the Property to the ECUA wastewater collection and treatment system. Installation shall be performed by a plumber licensed to perform this type of work in Escambia County, Florida.

3. Following the installation and placing in service of the grinder pump station ECUA shall reimburse the Customer for the cost of purchasing the grinder pump station. The amount of such reimbursement shall be determined by ECUA but shall not exceed one thousand five hundred dollars ($1,500.00). Reimbursement shall be made only for the cost of purchase of the grinder pump station: no reimbursement shall be made for costs of installation or other expenses which may be incurred by the Customer.

4. Application for reimbursement shall be submitted on a form to be provided by ECUA, which shall include: a certification by the plumber who performed the installation that the grinder pump station has been installed in accordance with all applicable standards, including any requirements of ECUA. The application form shall be signed by the Customer and by the plumber, and all signatures shall be notarized. The application form shall be accompanied by original receipts for the purchase of all equipment for which reimbursement is sought.

5. The Customer shall own the grinder pump station and shall be solely responsible for its operation, maintenance, repair, and replacement. In no event shall ECUA have any responsibility for the operation, maintenance, repair, or replacement of the grinder pump station.

6. The Customer (jointly and severally, if more than one) hereby releases ECUA from any claims or damages arising out of or in any way related to the installation, operation, maintenance, repair, or replacement of the grinder pump station, or failure of the grinder pump station to adequately service the Property.

7. In the event of the sale or transfer of the Property the rights and responsibilities of Customer under this Agreement shall become the rights and responsibilities, respectively, of the successors and assigns of Customer. Customer shall advise any purchaser or other transferee of the Property that the Property is served by a grinder pump station which is to be operated, maintained, repaired, and replaced by the purchaser or other transferee.

Dated this ___day of __________, 20______.

| Customer(s)' Signature(s) | Emerald Coast Utilities Authority |
|---|---|
| ______________________________________ | ________________________________________ |
| ______________________________________ | Customer Service Director or Supervisor |

***Return completed forms to Customer Service.**

# Application for Reimbursement of Residential or Commercial Grinder Pump Station

The reimbursement shall be made only for the cost of the residential or commercial grinder pump station for residential or commercial customers previously served by a private disposal system; no reimbursement shall be made for costs of installation or other expenses which may be incurred by the customer. The ECUA shall determine the reimbursement, but the amount shall not exceed one thousand, five hundred dollars ($1,500.00).

The following is required and must be attached to application for reimbursement of purchase:

1. Certification of plumber who performed the installation, indicating that the grinder pump station has been installed in accordance with all applicable standards, including any requirements of ECUA.

2. **List below all parts, equipment and labor costs separately for the grinder pump station: (If the items and charges are not listed separately, there will be a delay in processing the reimbursement.)**

| Item | Cost |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| **Total Cost of Grinder Pump Station: $ ___________________________** | |

3. Owner and Plumber certify the above is true and accurate. Please attach a copy of receipts for purchase of the above listed items. Receipts are required for reimbursement.

_________________________________________ Owner Signature

___________________________________ Plumber Signature

_________________________________________ Printed name of Owner

___________________________________ Printed Name of Plumber

State of Florida
County of Escambia

The foregoing instrument was acknowledged before me this _____ day of __________________, 20_____, by ____________________________________, as owner and _____________________________________, as plumber, who are personally known to me or who have produced _________________________________________________ as identification and who did (did not) take an oath.

_________________________________ Notary Public – State of Florida

Service Address: ___________________________________

Account Number: ___________________________________

**Please Return Form To:**
Emerald Coast Utilities Authority
Customer Service Department
P. O. Drawer 15311
Pensacola, Florida 32514-0311

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# Capacity Reservation Form

Date________________ Service Requested: Water_____ Sewer_____

Name of Project__________________________________________ Area(Acres)_________

**Project Address (attach location map):**_______________________________________________

Type Development: Residential_____ Commercial_____ Industrial_____ Other_____

(Explain)_____________________________________________________________________

Number and/or Size of Units___________________________________________________________

_______________________________________________________________________________

Estimated Flow: (Average Day) Water__________ Sewer_________ Fire__________

How will water and/or sewer be provided if not from ECUA?_________________________________

_______________________________________________________________________________

Special Requirements:_______________________________________________________________

_______________________________________________________________________________

Owner of Property: (type or print)_____________________________________________________

Address:_______________________________________________Phone:________________

Developer: (type or print)____________________________________________________________

Address:_______________________________________________Phone:________________

Engineer: (type or print)_____________________________________________________________

Address: (type or print)________________________Phone:__________Email:_____________

Submitted By: (type or print)_____________________________________Title:________________

Signature of Submitter__________________________________________Title:________________

---

**FOR ECUA USE:** **MAP PAGE:**__________

Nearest Water Line of Adequate Size:___________________________________________________

Size:____________________________ Pressure:________________________

Nearest Sewer Line of Adequate Size:___________________________________________________

Size:__________ 1st L/S:___________ 2nd L/S:___________ Plant:__________

**ECUA Sanitation**?_________________________________

**Prepared By**____________________ **Date**___________ **Reviewed By**_____________________

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P.O. Box 15311 9255 Sturdevant St. Pensacola, FL 32514-0311 Phone: (850) 969-3310 Fax: (850) 969-6511

**Certification of Completion of Construction
for an Extension to Emerald Coast Utilities Authority's
Wastewater Collection/Transmission System**

**Instructions: This form is to be completed and submitted to the ECUA Engineering Department along with one (1) set of record drawings, and other supporting documentation required below, PRIOR TO PLACING THE SYSTEM INTO OPERATION. A collection/transmission system should not be placed into service without prior written ECUA approval. All applicable blanks must be filled in.**

## I. Project Information

ECUA Submittal No.: ______________________________

Project Name: ______________________________

Location: ______________________________

Date of connection to ECUA system: ______________________________

Owner/Developer: ______________________________

Address: ______________________________

Telephone No.: ____________________ Fax No.: ____________________

**Required Attachments for ECUA Acceptance of Ownership and O&M of System:**

- ❑ Letter from Engineer of Record for corrected punch list items
- ❑ Two (2) sets of as-built plans completed by Engineer of Record and one (1) set on diskette in AutoCAD format, if available
- ❑ Form SD-3 – Certification of Developer Form, with an itemized Statement of Improvement values or cost, if applicable
- ❑ Recorded plat and/or any applicable easement forms (executed and recorded by the Owner/Developer)
- ❑ Test Results (if applicable)

Substantial deviations from the approved plans and specifications:

______________________________

______________________________

______________________________

______________________________

## II. Statement by Professional Engineer:

I certify that the project has been completed substantially in accordance with the approved plans and specifications, or the deviations will not prevent the system from functioning in compliance with the requirements of Chapter 62-604, F.A.C., and/or the ECUA Engineering Manual. These determinations have been based upon on-site observation of construction, scheduled and conducted by me or by a project representative under my direct supervision, for the purpose of determining if the work proceeded in compliance with plans and specifications and application materials. I further certify that record drawings for the facilities have been reviewed by me, or by an individual(s) under my direct supervision, for completeness and adequacy. I further certify that the record drawings identify those substantial deviations noted above.

______________________________________
Signature Sealed with Embossed Seal Date

______________________________________
Printed Name Florida Registration Number

______________________________________
Company Name (Print or Type)

______________________________________
Company Address (Print or Type)

______________________________________
Telephone Number

______________________________________
Facsimile Number

## III. Approval by ECUA:

The Water Reclamation Facility serving this system will be:

☐ CWRF ☐ Bayou Marcus ☐ Pensacola Beach ☐Other (specify) ______________________

The release of these facilities for operation is hereby approved in accordance with ECUA's Memorandum of Agreement with the Florida Department of Environmental Protection for the ECUA to independently regulate the construction of water distribution and sewage collection and transmission mains and pump stations appurtenant to such force mains.

______________________________________
Signature

______________________________________
Printed Name

______________________________________
Title Date

P.O. Box 15311 9255 Sturdevant St. Pensacola, FL 32514-0311 Phone: (850) 969-3310 Fax: (850) 969-6511

# Certification of Completion of Construction for an Extension to Emerald Coast Utilities Authority's Drinking Water Distribution System

**Instructions: This form is to be completed and submitted to the ECUA Engineering Department along with one (1) set of record drawings, and other supporting documentation required below, PRIOR TO PLACING THE SYSTEM INTO OPERATION. A distribution system extension should not be placed into service without prior written ECUA approval. All applicable blanks must be filled in.**

## I. Project Information

ECUA Submittal No.: ______________________________

Project Name: ______________________________

Location: ______________________________

Date of connection to ECUA system: ______________________________

Owner/Developer: ______________________________

Address: ______________________________

Telephone No.: ____________________ Fax No.: ____________________

**Required Attachments for ECUA Acceptance of Ownership and O&M of System:**

- ❑ Bacteriological Test Results
- ❑ Letter from Engineer of Record for corrected punch list items
- ❑ Two (2) sets of as-built plans completed by Engineer of Record and one (1) set on diskette in AutoCAD format, if available
- ❑ Form SD-3 – Certification of Developer Form, with an itemized Statement of Improvement values or cost, if applicable
- ❑ Recorded plat and/or any applicable easement forms (executed and recorded by the Owner/Developer)

Substantial deviations from the approved plans and specifications:

______________________________

______________________________

______________________________

______________________________

## II. Statement by Professional Engineer:

I certify that the project has been completed substantially in accordance with the approved plans and specifications, or the deviations will not prevent the system from functioning in compliance with the requirements of Chapters 62-555 and 62-550, F.A.C., and/or the ECUA Engineering Manual. These determinations have been based upon on-site observation of construction, scheduled and conducted by me or by a project representative under my direct supervision, for the purpose of determining if the work proceeded in compliance with plans and specifications and application materials. I further certify that record drawings for the facilities have been reviewed by me, or by an individual(s) under my direct supervision, for completeness and adequacy, and have been proved to the permittee. I also certify that the new or altered water mains in this project have been disinfected and bacteriologically tested* in accordance with Chapters 62-555, F.A.C. and applicable AWWA disinfection standards. I further certify that the record drawings identify those substantial deviations noted above.

________________________________________
Signature Sealed with Embossed Seal Date

________________________________________
Printed Name Florida Registration Number

________________________________________
Company Name (Print or Type)

________________________________________
Company Address (Print or Type)

________________________________________
Telephone Number

________________________________________
Facsimile Number

**For all new and altered public drinking water facilities, bacteriological sampling shall be conducted by first reducing the total chlorine residual in the water within the facilities to no more than 4 mg/L and then collecting daily bacteriological samples (taken at least 24 hours apart) for two or more consecutive work-days until satisfactory test results are obtained. Bacteriological test results shall be considered satisfactory if two consecutive daily samples from each sample location show the absence of total coliform organisms. Bacteriological test results will be considered invalid if the results are for samples collected more than 60 days before the results are received ECUA, and if the pressure in the mains is not maintained at 20 psi or greater after the samples are collected.*

## III. Approval by ECUA:

Drinking Water Zone: ________ North; ________ South; ________ Pensacola Beach; ________ Other

The release of these facilities for operation is hereby approved in accordance with ECUA's Memorandum of Agreement with the Florida Department of Environmental Protection for the ECUA to independently regulate the construction of water distribution and sewage collection and transmission mains and pump stations appurtenant to such force mains.

________________________________________
Signature

________________________________________
Printed Name

________________________________________
Title Date

**SD-3**
**Certification of Developer**

**EMERALD COAST UTILITIES AUTHORITY**
**CERTIFICATION OF DEVELOPER**

According to the best of my knowledge and belief, I certify as official representative of the principal developer of

______________________________________________________________

that all water and/or wastewater facilities have been completed and the work performed in accordance with the State of Florida, Department of Environmental Protection's rules and the Emerald Coast Utilities Authority approved plans and specifications and/or duly authorized deviations. The total construction cost of $________________ is a true and correct statement of the final cost of all of the water and/or wastewater facilities that the developer is herewith giving the Emerald Coast Utilities Authority for public use. The undersigned official representative of the principal developer further certifies that the work covered by this statement of the final cost, including engineering, labor, material, and equipment, has been paid for by the developer as required by the Emerald Coast Utilities Authority. An itemized statement of the final cost is attached.

Submitted:

By: ________________________________________ Date ________________

Title: ________________________________________

Company: __________________________________

Subscribed and sworn before me this ________ day of ____________________,20___.

__________________________________
Notary Public

My Commission Expires: __________________________________

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# ECUA CHANGE ORDER FORM

**ECUA Project Name:** ________________________________ **ECUA Project No.:** __________ **C.O. #.** ____ **dated** ___________

The Contractor, _____________________________________________, is hereby ordered to make the following changes from the plans and specifications or do the extra work on your contract dated ___________________. The adjustment in compensation and contract time that will be due the Contractor by reason of these changes will be made on the following basis:

| **Item No.** (1) | **Item Description and Justification** (2) *(maximum 2 lines of text)* | **Unit** | **Quantity (show + or -)** | **Unit Price [$]** (1) | **Extension [$] (show + or -)** | **Days (show + or -)** |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| (1) *Must match contract item number and unit price when applicable.* (2) *Attach additional documentation if space is insufficient for proper justification* | | **TOTALS:** | | | | |

| Signatures: | | | **Contract $** | **Contract Dates/Days** |
|---|---|---|---|---|
| | | Notice to Proceed date: | N/A | ____________ |
| Contractor:____________________________ | Date: ________ | Original contract Total: | $____________ | _____ |
| EOR:___________________________________ | Date: ________ | Total +/- of all previous C.O.'s: | $____________ | _____ |
| ECUA Inspector:_________________________ | Date: ________ | Total +/- of this C.O.: | $____________ | _____ |
| ECUA PM:______________________________ | Date: ________ | Revised contract Total: | $____________ | _____ |
| ECUA Exec Dir:___________________________ | Date: ________ | Revised final completion date : | N/A | ____________ |
| | | Revised substantial completion date: | N/A | ____________ |

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# ***ECUA Engineering Manual Reference Note****

**note shall be inserted in the upper right corner of title sheet*

** applicable only to ECUA infrastructure to be constructed in public ROW or in utility easement; not to be applied to private water/sewer facilities on private property (see Building Code)*

## ***A. ECUA Engineering Manual Incorporated by Reference***

The ECUA Engineering Manual, dated December 18, 2014, along with Update # 1 dated September 1, 2016 (hereinafter "Manual"), located at www.ecua.fl.gov, is hereby incorporated by reference into this Project's official contract documents as if fully set forth therein. It is the Contractor's responsibility to be knowledgeable of the Manual's contents and to construct the Project in accordance with the Manual. The Contractor shall provide its employees access to the Manual at all times, via Project site or office, via digital or paper format. In the event of a conflict between the Manual and Plans, Contractor shall consult Engineer of Record for proper resolution.

## ***B. Additional Documents (to be completed by the Engineer of Record)***

Does this Project have additional technical specifications or construction details that supplement and/or supersede the Manual listed above? ☐YES NO☐. If yes, Contractor shall construct Project in accordance with said documents as listed and located below:

| Document Name | Document Type | | Location | |
|---|---|---|---|---|
| | Specifi-cation | Detail | Plans | Project Manual* |
| | ☐ | ☐ | ☐ | ☐ |
| | ☐ | ☐ | ☐ | ☐ |
| | ☐ | ☐ | ☐ | ☐ |
| | ☐ | ☐ | ☐ | ☐ |

**Project Manuals used only with ECUA CIP Projects*

## ***C. Engineer of Record Responsibilities***

The Engineers of Record (EORs) that have affixed their seals and signatures on these plans warrant their portions of the plans have been designed in accordance with the Manual (unless otherwise directed by the ECUA Project Engineer). The EORs shall be knowledgeable of the Manual's contents and shall assume responsibility for its use on this Project.

# SPECIAL INSTRUCTIONS

PERMIT NO:__________ SECTION NO: _______ STATE ROAD:______ COUNTY:_______________

Pursuant to Section 19 of this permit, the following Special Instructions are hereby incorporated into and made a part of this permit:

___________________________, Developer, and the EMERALD COAST UTILITIES AUTHORITY (ECUA) shall be severally liable as PERMITTEE under this permit such that Developer shall be required to comply with all obligations hereunder applicable to the construction of the facilities and the ECUA shall be required to comply with all obligations hereunder post construction, including, but not limited to those applicable to operation and maintenance. The indemnification in paragraph 11 of the Utility Permit as applied to the ECUA is limited to that allowed by law.

The ECUA shall inspect the construction of new facilities described in the Utility Permit for compliance with ECUA's utility standards, and upon ECUA's satisfaction, the FDOT shall then perform a final inspection to evaluate the Developer's compliance with the utility permit conditions. Final determination of utility permit compliance for work performed by the Developer shall remain with the FDOT. The post construction obligations of the ECUA shall commence upon final inspection by the FDOT. The FDOT shall provide the ECUA written notice of such date.

The signatures below constitute PERMITTEES' signatures on this permit and signify agreement with these terms and conditions.

---

DEVELOPER: ______________________________

Signature: __________________________________________ Date:____________

Name Printed: ______________________________ Telephone: (____) _____-________

Title: ______________________________ E-mail: ________________________

Address: ______________________________

City: __________________ State: _______ Zip: ____________

---

**EMERALD COAST UTILITIES AUTHORITY (ECUA)**

Signature: __________________________________________ Date:____________

Name Printed: William E. Johnson, PE, PLS Telephone: (850) 969-3391

Title: Director of Engineering E-mail: william.johnson@ecua.fl.gov

Address: 9255 Sturdevant Street

City: Pensacola State: FL Zip: 32514-0311

**Project Information for ECUA Use**

Project Name: ____________________________________________________________

Site Address: ____________________________________________________________

Submittal #: ______________________

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# Fire Hydrant Flow Data

# Requested Information

In response to your request for fire hydrant flow information, ECUA is able to provide the data in the table below. Additional testing or data collection may be performed with the approval and supervision of ECUA.

| ECUA Fire Hydrant # | Date Tested | Flow [gpm] | Static Pressure [psi] | Residual Pressure [psi] | Comments |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

DISCLAIMER

This Emerald Coast Utilities Authority fire hydrant flow test data is from a single test performed at an arbitrary point in time and as such is not assumed to be representative of typical water system conditions. No representation is made as to its accuracy and ECUA disclaims any and all liability with respect to any information given. It is provided as information only and is not to be used as the basis for development of construction plans or any type of engineering service. This data is not guaranteed to be accurate or suitable for any use other than that for which it was gathered. Any use of this information by any other organization for any other purpose and any conclusions drawn from the use of this data is strictly the responsibility of the user.

## Lift Station Approved Manufacturers and Sales Contacts

## (As of Sep. 1, 2016)

### Pump Manufacturers and Sales Contacts

| Pump Manufacturer | Sales Rep Company | Sales Rep | Phone # | E-mail |
|---|---|---|---|---|
| KSB | Pump and Process | Jeb Smith | Office: (850)432-0334<br>Cell: (850) 525-2560 | jeb@pumpandprocess.net |
| Fairbanks Morse | Pump and Process | Jeb Smith | Office: (850)432-0334<br>Cell: (850) 525-2560 | jeb@pumpandprocess.net |
| Grundfos | Gilbert Pump and Mechanical | Adam Bates | Office: (850) 864-4000<br>Cell: (850) 420-1392 | abates@gilbertpump.net |
| Hydro-matic | Morrow Water Technologies | Tim Maloney | Office: (205) 408-6680<br>Cell: (251) 222-1021 | tmaloney@morrowwater.com |

### Fiberglass Wetwell Manufacturers and Sales Contacts

| Wetwell Manufacturer | Sales Rep Company | Sales Rep | Phone # | E-mail |
|---|---|---|---|---|
| AFE | Hydraservice | Chad Roberts | Office: (251) 947-5006<br>Cell: (251) 747-8123 | chad@hydraservice.net |
| Edwards (with FTS piping) | Pump and Process | Jeb Smith | Office: (850)432-0334<br>Cell: (850) 525-2560 | jeb@pumpandprocess.net |
| LFM | Gilbert Pump and Mechanical | Adam Bates | Office: (850) 864-4000<br>Cell: (850) 420-1392 | abates@gilbertpump.net |

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LIFT STATION PUMP OVERVIEW CHART

| Horsepower | 15 HP and Below | 16-40 HP | 41 HP and Above |
|---|---|---|---|
| **RPM** | 1200 or 1800 | 1200 or 1800 | 900, 1200, or 1800[1] |
| **Pump Type** | Submersible Centrifugal | Submersible Centrifugal | Submersible Centrifugal |
| **Impeller Type[2]** | Non-Clog or Vortex | Non-Clog or Vortex | Non-Clog or Vortex |
| **Starter Type[3]** | FVNR Starters | FVNR Starters (< 20HP)<br>VFD/Soft Start ($\geq$ 20HP) | VFD |
| **Pump Manufacturer Warranty (100%)** | 5 year, See Spec. | 5 year, See Spec. | 5 year, See Spec. |
| **Motor Insulation Class** | Class H | Class H | Class H |
| **Mechanical Seal Type - Pump Side** | Silicon Carbide/Silicon Carbide | Silicon Carbide/Silicon Carbide | Silicon Carbide/Silicon Carbide |
| **Mechanical Seal Type - Bearing Side** | Carbon/Silicon Carbide | Carbon/Silicon Carbide | Carbon/Silicon Carbide |
| **Bearings** | 40,000 hrs. min. | 40,000 hrs. min. | 40,000 hrs. min. |
| **Impeller Wear Ring[4]** | Stainless Steel/<br>350 Series Brinnell Hardness | Stainless Steel/<br>350 Series Brinnell Hardness | Stainless Steel/<br>350 Series Brinnell Hardness |
| **Volute Wear Ring[4]** | Stainless Steel/<br>400 Series Brinnell Hardness | Stainless Steel/<br>400 Series Brinnell Hardness | Stainless Steel/<br>400 Series Brinnell Hardness |
| **Guide Rails / Material** | 2-inch diameter, Sch. 40, 316 S.S. | 2-inch diameter, Sch. 40, 316 S.S. | TBD Based on Size of Pump |
| **Seal Availability** | 2 Business Days | 5 Business Days | TBD Based on Size of Pump |
| **Impeller Availability** | 2 Business Days | 5 Business Days | TBD Based on Size of Pump |
| **Shaft** | 440 Stainless Steel | 440 Stainless Steel | 440 Stainless Steel |
| **Approved Manufacturers[5]** | KSB | KSB | KSB |
| | Fairbanks Morse | Fairbanks Morse | Fairbanks Morse |
| | Grundfos | Grundfos | |
| | Hydromatic | Hydromatic | |

**1 – 1800 rpm allowed on pump motors less than 61 horsepower only.**

**2 – Impellor type shall be chosen by ECUA Lift Station Manager or ECUA Engineering Department Project Engineer based on specific application.**

**3 – Starter type shall be chosen by ECUA I/E Manager or ECUA Engineering Department Project Engineer based on specific application.**

**4 – Hardened metallurgy may be required in some locations, primarily where high grit is anticipated (i.e. Pensacola Beach and Perdido Key).**

**5 – ECUA reserves the right to disallow any particular manufacturer from any specific project based on ECUA's judgment regarding application, prior experiences, etc.**

**NOTE: This chart is intended to provide an overview of various technical features required in specifying pumps. ECUA reserves the right to make selections that differ from the information stated in this chart and/or the specifications.**

**NOTE: Final pump selection for each project shall be selected from the chart of approved pumps as shown on the plans. Said chart shall match the pumps as shown on each project's Pump Selection Worksheet.**

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# Lift Station Pump Selection Worksheet

*This document shall be prepared by the Engineer of Record (EOR) and used to evaluate the three best pump options from ECUA's list of approved manufacturers for the project listed below. The pumps listed are not necessarily 'equal' with respect to overall performance, price, etc; however, they have been reviewed and approved by ECUA. These three pumps shall be listed on the plans in order to allow Bidders to price and use any of them on this project.*

Project Name: ______________________________ Project CIP #: ____________

EOR/Company: ______________________________________________

ECUA Project Manager: ________________ Design pump rate (gpm): ______ and TDH (feet): ______

| Pump Property | Pump 'A' | Pump 'B' | Pump 'C' |
|---|---|---|---|
| Manufacturer/Model # | | | |
| Supplier Company Name | | | |
| Sales Rep Name | | | |
| Vortex or Non-clog* | | | |
| RPM* | | | |
| Impeller diameter (in.)* | | | |
| Duty point flow, head (gpm,ft)* | | | |
| Shutoff Head (ft) | | | |
| Shutoff head – Duty point head | | | |
| Duty point efficiency (%)* | | | |
| Duty Point Motor Size (HP)* | | | |
| NOL motor size (HP)* | | | |
| NOL Motor FLA Rating (Amps) | | | |
| Voltage required (V) | | | |
| Max. Impellor Size (in.) | | | |
| Max. Motor Size (HP) | | | |
| Budget estimate for 3 pumps | | | |
| Delivery time (weeks) | | | |

*Attach copy of system curve plotted on manufacturer's pump curve. Spreadsheet curves not allowed.

***Approval of these pumps for use on this project:***

____________________________ __________
Engineer of Record (EOR) Date

____________________________ __________
ECUA Project Engineer Date

____________________________ __________
ECUA Lift Station Staff Date

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**Notice of Intent to Construct**
**an Extension to Emerald Coast Utilities Authority's**

**❑ Drinking Water Distribution System and/or**
**❑ Wastewater Collection/Transmission System**

P.O. Box 15311 9255 Sturdevant St. Pensacola, FL 32514-0311 Phone: (850) 476-5110 Fax: (850) 969-6511

**Instructions: This form is required for all System Extension projects (See Procedure 1, paragraph 8.16). This form is to be completed and submitted to the ECUA Engineering Department along with six (6) sets of engineering plans and specifications, and other supporting documentation, AT LEAST 30 DAYS PRIOR TO INITIATING CONSTRUCTION. All applicable blanks must be filled in. This form is for water and sewer lines 12 inches or less in diameter and pump stations appurtenant to such force mains.**

## I. Project Information:

Project Name: ____________________

Location: ____________________

Section: __________ Township: __________ Range: __________

Escambia County Property Appraiser's I.D. No(s).: ____________________

This project will serve:_____ Single Family Homes, _____Multifamily Units, _____ Commercial Facilities,

____Utility Relocation, Other (explain) ____________________

Estimated increase in flow/demand for water: __________MGD and/or wastewater:__________MGD

Owner/Developer: ____________________

Address: ____________________

Telephone No.: ____________________ Fax No.: ____________________

## II. Statement by Owner/Developer:

I, the undersigned owner or authorized representative of ____________________* certify that the above information is true and complete to the best of my knowledge. I acknowledge that it is my responsibility to ensure that the facilities are constructed as designed and I have retained the services of a Professional Engineer registered in the state of Florida to observe that the construction of the project is in accordance with the engineering plans as submitted and approved. I am aware that the use of this permit is not transferable and will expire after 5 years. (*Attach notarized letter of authorization.)

____________________
Signature of Owner or Owner's Representative* Date

____________________
Printed Name and Title

____________________
Company Name (Print or Type)

____________________
Company Address (Print or Type)

____________________
Telephone Number

____________________
Facsimile Number

## III. Statement by Engineer:

I certify that the engineering features of this system have been designed by me or those under my direct supervision in accordance with Chapters 62-604/62-555 FAC and the latest edition of the ECUA Engineering Manual, and any other regulatory requirements. A Certification of Completion Form, As-built Drawings, and appropriate clearances will be submitted to ECUA after completion of the facilities in order to obtain approval to place the facilities in service.

________________________________________
Signature Sealed with Embossed Seal Date

________________________________________
Printed Name Florida Registration Number

________________________________________
Company Name (Print or Type)

________________________________________
Company Address (Print or Type)

________________________________________
Telephone Number

________________________________________
Facsimile Number

## IV. Approval by ECUA:

The drinking water zone serving this system will be:

☐ North Zone ☐ South Zone ☐ Pensacola Beach ☐ Other (specify) ________________________

The Water Reclamation Facility serving this system will be:

☐ CWRF ☐ Bayou Marcus ☐ Pensacola Beach ☐ Other (specify) ____________________

The construction of these facilities is hereby approved in accordance with ECUA's Memorandum of Agreement with the Florida Department of Environmental Protection for the ECUA to independently regulate the construction of water distribution and sewage collection and transmission mains and pump stations appurtenant to such force mains.

________________________________________
Signature

________________________________________
Printed Name

________________________________________
Title Date

# CONTRACTOR'S NOTIFICATION OF COMMENCEMENT OF CONSTRUCTION

**To: EMERALD COAST UTILITIES AUTHORITY**

**ATTN:________________________________(Inspector)**
**Engineering Department**
**9255 Sturdevant Street Phone (850) 969-3310**
**Pensacola, FL 32514 FAX (850) 969-6511**

Re: ________________________________________________ ________________
(Project Name) (ECUA Submittal No.)

Phase No. (If Applicable): ___________________________

Developer: ______________________________________

Civil Engineer:_______________________________ Date Approved: _____________

**CONTRACTOR INFORMATION**

Firm Name: ______________________________________________________

Responsible Officer: ______________________________________________________

Title: ______________________________________________________

Address: ______________________________________________________

______________________________________________________

Phone:________________________________ FAX: ___________________________

The superintendent on this job will be _______________________________________

**This is to notify you that construction will begin on: ______________________________**

Printed Name: ____________________________________

Signed:__________________________________________ Date: ________________

This notice must be delivered or faxed to the ECUA Engineering Department at least three (3) ECUA business days prior to commencement of construction. Failure of the contractor to provide proper notification prior to commencement of construction is a violation of ECUA's Rules and Regulations, and is subject to fines and penalties.

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**EMERALD COAST UTILITIES AUTHORITY**
**CONTRACTOR'S PAY REQUEST**

**Project Name:** ______________________
**Project Number:** ______________________
**Pay Request No.:** ______________________
**Date:** ______________________

**Contractor Name:** ______________________
**Contractor Address:** ______________________
______________________
**Contractor Phone #:** ______________________

**Consulting Engineer:** ______________________
______________________

| ITEM | DESCRIPTION | ORGINAL CONTRACT QUANTITY | UNIT | UNIT PRICE | ORGINAL CONTRACT AMOUNT | CHANGE ORDER QTY | | | TOTAL CONTRACT QUANTITY | TOTAL CONTRACT AMOUNT | PREV QTY | PREV AMOUNT | QTY THIS PERIOD | AMOUNT THIS PERIOD | TOTAL IN PLACE QTY | TOTAL IN PLACE AMOUNT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | CO 1 | CO 2 | CO 3 | | | | | | | | |
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**Contractor's Certification:**

I hereby certify that the work covered by the above Pay Request has been performed in accordance with the Contract, that prevailing scales of wages have been paid, that all invoices for materials included in previous Pay Requests have been paid, that the above estimate is true, and that payment thereof has not been received.

Contractor: ______________________

By: ______________________

Date: ______________________

**ECUA Inspector's Approval (Quantities):**

By: ______________________

Date: ______________________

**Consulting Engineer's Approval:**

By: ______________________

Date: ______________________

**ECUA Engineer's Approval:**

By: ______________________

Date: ______________________

Previous Work Completed to Date: __________
Work Completed this Period: __________
Total Work Completed to Date: __________

Stored Materials: __________

Subtotal: __________

___ % Retainage: __________

Subtotal Less Retainage: __________

Less Previously Paid: __________

Amount Due This Pay Request: __________

## INFORMATION PAGE

### Change Order Summary

Original Contract Amount:
Change Order No. 1 :
Change Order No. 2 :
Change Order No. 3 :

Adjusted Contract Amount:

### Notes:

1. Material supplier's invoice and evidence of payment shall be attached for payment of stored materials.
2. For lump sum items, where partial payment is requested, the contractor is to provide a breakdown of the lump sum item for approval.
3. For payment of fill or other items where payment is made on the basis of truck volume and/or weight, delivery tickets verifying volume and/or weight must be provided.

## Pipe Material Summary Chart (1)

**September 1, 2016**

**(Numbers in Parentheses Indicate Footnote Number)**

| Material | Sizes | Standards | Typical Applications | Dimension Ratio | OD Class | Pressure Rating | Color | Notes |
|---|---|---|---|---|---|---|---|---|
| HDPE (PE4710 resin) | 1" | AWWA C901* | Water Services | 9 | CTS | 200 | Blue | Water only |
| | 1.5" | AWWA C901* | Sewer FM Services (2) | 9 | CTS | 200 | Green | Sewer only |
| | 2" | AWWA C901* | Water Services, Sewer FM Services, FM via HDD | 9 | CTS | 200 | (3) | |
| | 3" | AWWA C901 | Water Services, Sewer FM Services, FM via HDD | 11 | IPS | 200 | (3) | |
| | 4" + | AWWA C906 | WMs, Sewer FMs via HDD | 11 | DIPS | 200 | (3)* or (4) | |
| | | | | | | | | |
| | | | | | | | | |
| PVC & fPVC(9) | 2" and 3" | ASTM D2241* | Low pressure FMs (6) | 21 | IPS | 200 | Green | Sewer only |
| | 4" + | ASTM D3034* | Gravity Sewer Laterals and Mains | 26 | N/A | N/A | Green | Sewer only |
| | 4" to 12" | AWWA C900* | FMs, WMs | 25/18 (7) | DIPS | 165/200 (7) | (3) | DR25 for all Water Mains |
| | 14" + | AWWA C905* | FMs, WMs | 25/18 (7) | DIPS | 165/200 (7) | (3) | DR25 for all Water Mains |
| | | | | | | | | |
| | | | | | | | | |
| Ductile Iron | 3" - 12" | AWWA C151 | FMs, WMs, Gravity Sewer (8) | NA | DIPS | 350 | (5) and (3) | |
| | 14" - 20" | AWWA C151 | FMs, WMs, Gravity Sewer (8) | NA | DIPS | 250 | (5) and (3) | |
| | 24" - 64" | AWWA C151 | FMs, WMs, Gravity Sewer (8) | NA | DIPS | 200 | (5) and (3) | |
| | | | | | | | | |

| Footnotes: | |
|---|---|
| 1-See applicable specifications for all applicable pipe info (i.e. markings, etc) | FMs = sewer force mains; WMs = water mains |
| 2-Sewer FM service for grinder pumps up to 25 gpm shall be 1.5" | N/A = Not Applicable |
| 3-Blue for water services/pipe, green for sewer services/pipe | * = Standard application |
| 4-Black pipe with factory applied striping per ECUA specifications | |
| 5-Asphaltic coated pipe with field applied striping per ECUA specifications | |
| 6-Low pressure force mains intended for use with grinder pump systems | |
| 7-DR25 when FM connects to manhole; DR 18 when connects to manifold FM | |
| 8-Interior lined per ECUA specifications in FM and gravity applications | |
| 9-fPVC for trenchless applications only | |

# Request for Single Service Connection Information Sheet

**Note:** Commercial customers using a private lift station must apply for a System Extension via Procedure 2 in order to connect to ECUA's system (See Procedure 1, paragraph 8.16).

Date______________________

Name of Project_____________________________________________________ Area(Acres)_________________

**Project Address (attach location map):** ___________________________________________________________________

Type Development: Commercial_______ Industrial_______ Other_______

(Explain)______________________________________________________________________________

Number and/or Size of Units_____________________________________________________________________

_______________________________________________________________________________________________

Owner of Property: (type or print)_________________________________________________________________________

Address:______________________________City_________________State______Zip________Phone:______________

Signature of Submitter_______________________________________________Title:______________________________

Name Printed or Typed_________________________Phone______________Fax___________Email:_______________

## SERVICE REQUESTED

*Meters sized 1.5" and larger require a large meter contract. Estimated flow shall be a minimum of 1000 GPD.

**Sewer charges are based on potable water usage. Potable water used for irrigation will incur sewer charges. A separate meter used specifically for irrigation is recommended to avoid unnecessary sewer charges.

☐ **Potable (Drinking) Water**

Size Service___________________________ Size Meter Requested______________

Estimated Flow (Average Day) ___________________ Gallons per Day

☐ **Irrigation**

Size Service___________________________ Size Meter Requested______________

Estimated Flow (Average Day) ___________________ Gallons per Day

☐ **Fire**

Size Service___________________________

☐ **Sanitary Sewer**

Size Lateral___________________________

Estimated Flow (Average Day)___________________ Gallons per Day

How will water and sewer be provided if not from ECUA?

_______________________________________________________________________________________________

**FOR ECUA USE:** **MAP PAGE:**_______________

**ECUA Sanitation**?__________________________________________

**Prepared By**___________________________ **Date**_____________ **Reviewed By**___________________________

# REVIEW OF PRIVATELY OWNED LIFT STATIONS

This form must be completed and submitted to ECUA for use in reviewing all lift stations intended to remain privately owned, other than single family residential. Privately owned lift stations must meet all applicable FDEP requirements. Duplex pumps are required for most establishments.

Establishments may use a simplex pump if and only if the establishment meets all of the following criteria:

1. Establishment for which the total estimated wastewater production is 500 GPD or less.
2. Establishment does not provide food service or preparation for the general public.
3. Establishment contains less than 100 seats for public assembly.
4. Establishment does not house medical facilities
5. Use of a simplex pump will not pose a significant public health or environmental hazard.
6. ECUA engineer agrees that establishment conforms to the five criteria listed above

Please provide the following information:

I. Flow Calculations

Average Daily Flow:

Peak Hour Flow:

Basis for Daily/Peak Flow Criteria (e.g. number of employees/customers, fixture count, etc.)
________________________________________________________

Force Main Size: ____________________

Minimum Flow needed to meet Minimum Velocity of 2.5 FPS=_________________GPM

Design/Controlling Flow: __________________________________________GPM

II. Total Dynamic Head Calculations

Does the proposed force main connect to another force main? Yes No
If yes, provide Manifold Pressure______________________________
(Indicate Source of Manifold Pressure Information and provide any calculations used to determine manifold pressure)

For System Curve provide 3 points

| Flow | Static | +Hf | Manifold Pressure | Total |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

**Provide a graph showing the performance curve for the selected pump with the system curve plotted over it**.

Identify operating point (Intersection of pump curve and system curve):
_______gpm @ _______ ft.
Velocity at operating point: ________ fps.
Is Operating Point > Design Point? __________

III. Wet Well Calculations

a. Cycle Volume Calculation

Calculate required cycle volume by the following equation: $V = \frac{TP}{4}$

V – Volume in the wet well between pumps off and the first pump on
P – Pump Rate, gpm (operating point)
T – Cycle Time, Cycle time (T) should not be less than 10 minutes.

Cycle volume = ___________

b. Required Height between pump on and pumps off in wet well

Wet well diameter ___________ feet

Gallons per vertical foot of wet well ________ gallons

Cycle Depth required = $\frac{\text{Cycle Volume Required (gallons)}}{\text{Gallon per vertical foot}}$ =

IV. Emergency Storage Calculations

A minimum of 30 minutes storage volume between high level alarm and influent invert is required at average daily flow.

Required Emergency Volume = (Average Daily Flow) (30 minutes) = ____________

Emergency Depth required = $\frac{\text{Emergency Volume}}{\text{Gallons per vertical foot}}$ = _______________________

## V. <u>Buoyancy Calculations</u>

Provide soil boring to substantiate ground water depth shown in calculations. Or assume ground is saturated and provide calculations to show that the total weight is greater than the buoyancy force.

VI. Are the following items provided?

| | | |
|---|---|---|
| Emergency Pump-Out | Yes | No |
| Emergency Generator Receptacle | Yes | No |
| High Water Alarm (Audio & Visual w/battery backup) | Yes | No |
| Site Security | Yes | No |

(Minimum requirement of locking control panel, wet well, and valve box)
Describe how security will be provided:

| | | |
|---|---|---|
| Lightning Arrestor and Surge Protection | Yes | No |
| Wet Well Ventilation | Yes | No |
| Run Time Meter | Yes | No |
| Phase Protection for 3-Phase | Yes | No |

Provide explanations if any of the above items are not provided.

VII. Flood

What is the 100-year flood elevation at the lift station site? ___________________________

What is elevation of the bottom of the electrical controls/panel s? ______________________

What is the 25-year flood (storm) elevation at the lift station site? ______________________

What is the top of the wet well elevation? ________________________________________

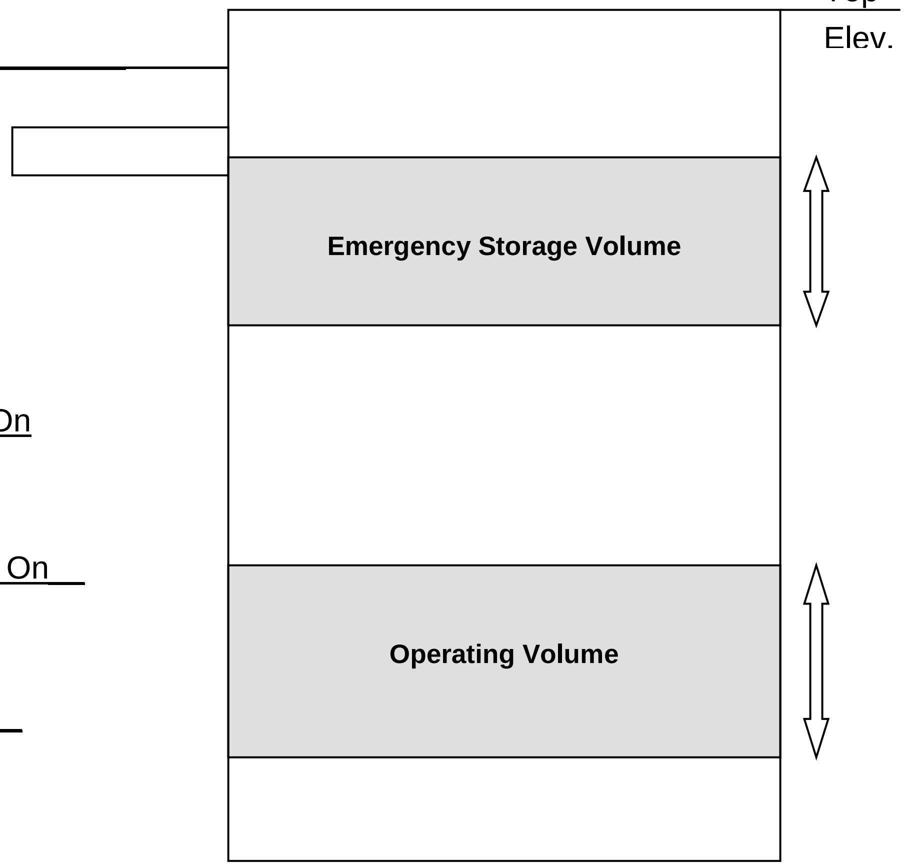
Is station designed to remain fully operational and accessible during a 25-year storm?

Diameter of Wet well _______________

Top
Elev. =

Ground ____________________
Elev. =

Inv. In:
Elev. =




Alarm
Elev. =

Lag Pump On
Elev. =

Lead Pump On__
Elev. =

Pump Off___
Elev. =

Bottom______
Elev. =

Provide elevations for each of the points above.

Note:  Elevation for Lag Pump On and Alarm may be the same.

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# System Extensions – Project Information Form

**Instructions:** Project's Engineer of Record shall complete the top portion of this form and submit along with Preliminary Engineering Report as outlined in ECUA Engineering Manual, Procedure 2, Section 2.1.

Project Name: ______________________________________________

Project Address/Location: ______________________________________

Applicant/Owner: ______________________________ ______________________________
Contact Name Company Name

______________________________ ______________________________
E-Mail Phone #

Engineer of Record: ______________________________ ______________________________
Name Company Name

______________________________ ______________________________
E-Mail Phone #

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*(Bottom Portion of Form for ECUA use **ONLY)***

ECUA Reviewer: ______________________________ ______________________________
Name Project #

______________________________ ______________________________
Project Name E-Mail

Preliminary Meeting Date: __________ Time: ________

Check sets needed? ☐ Yes ☐ No

Lift station included? ☐ No ☐ ECUA Owned ☐ Privately Owned (commercial only)

Oversizing expected? ☐ Yes ☐ No

Meeting Notes: ______________________________________________

______________________________________________

______________________________________________

______________________________________________
(Attach additional pages if necessary)

ECUA Reviewer is satisfied with PER and Pre-application meeting coordination and recommends EOR provide Formal Submittal.

ECUA Reviewer Signature: _________________________ Date: ___________

(Provide Engineer of Record with copy of signed form) Rev. 9/1/16

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# TEMPORARY CONSTRUCTION EASEMENT

THE PARTIES identified below enter into this Temporary Construction Easement ("Easement") for the following property (“Property”) at the following location:

Property address: ______________________________________________________________________

Escambia County Property ID: ______________________________________________________________

Property owner (“GRANTOR”) name(s): ______________________________________________________

Mailing address of property owner(s): ____________________________________________________

KNOW ALL MEN BY THESE PRESENTS that GRANTOR, for and in consideration of $1.00 and other good and valuable consideration, in hand paid by ____________________________________________ (name of GRANTEE), whose mailing address _________________________________________________________, the receipt of which is hereby acknowledged, does hereby grant, bargain, sell and convey unto GRANTEE, its successors and assigns, the temporary right and easement to enter upon with men, equipment and supplies, occupy and use the following described real property for the purpose of utility construction requiring a temporary construction easement of the following size and for the following specific purpose:

___________________________________________________________________________________________

_________________________________________________________________________________________

In executing the above easement, the GRANTOR and the GRANTEE hereby covenant and agree that the above described property shall not be used for any purpose inconsistent with the construction of said utility, until such construction has been completed. This easement shall automatically become null and void ninety (90) days after completion of contemplated construction, but no later than 12 months from the date of execution.

The GRANTEE for itself, its successors and assigns, hereby covenants and agrees restore the GRANTOR’S property to a condition equal to or exceeding its current condition and to pay the cost of restoration and clean-up of the area which may be required as a result of GRANTEE’s construction of its utility or exercising any of the other rights granted.

TO HAVE AND TO HOLD the same rights and easements unto the GRANTEE, its successors and assigns, as herein granted.

| | |
|---|---|
| ______________________________________ | By: _________________________________ |
| Witness #1 Signature | GRANTOR signature |
| ______________________________________ | ___________________________________ |
| Witness #1 Name (print or type) | GRANTOR Name (print or type) |
| ______________________________________ | ___________________________________ |
| Witness #2 Signature | GRANTOR Title |
| ______________________________________ | |
| Witness #2 Name (print or type) | |

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# UTILITY SERVICE AGREEMENT
# FOR CONSTRUCTION OF
# WATER AND WASTEWATER SYSTEM EXTENSIONS

This AGREEMENT is made and entered into by and between the EMERALD COAST UTILITIES AUTHORITY, a governmental body, corporate and politic, (“ECUA”) and
(Name of Company or Individual):____________________________________
(Business Address):_________________________________________________
(Business Tax I.D. No.): _____________________________________________
(the “Developer”). This Agreement shall be effective as of the date on which both the Developer and ECUA or their representatives, as indicated below have signed it.

WHEREAS, the Developer owns or otherwise controls a development interest in certain land (the “Property”) in Escambia County, Florida, more particularly described in Exhibit “A” to this Agreement and intends to construct on the Property a (Describe the type of project, i.e. subdivision, apartments, commercial, etc.):
______________________________________________________________
______________________________________________________________
______________________________________________________________,
to be known as (Name of Project):
___________________________________________________ (the “Project”); and

WHEREAS, the Developer desires ECUA to provide to the Project:

A. Water service –
Projected average daily demand of _________ gallons per day;
B. Wastewater service –
Projected average daily flow of __________ gallons per day; and

WHEREAS, ECUA is willing to provide such service upon the terms and conditions hereinafter set forth;

NOW, THEREFORE, in consideration of the premises and the mutual covenants herein contained the Developer and ECUA hereby agree as follows:

1. The Developer shall, at the sole cost and expense of the Developer:

A. Construct or cause to be constructed such mains, services, laterals, lift stations, force mains, fire hydrants and other facilities as may be necessary for ECUA to provide such service to the Project.

B. Construct or cause to be constructed such other facilities outside the Property as are generally described in Exhibit “B” to this Agreement.

C. Provide any and all documents as ECUA may request related to the transfer of ownership or operation of the facilities which are the subject of this Agreement.

2. The Developer shall pay all Project costs of any kind, including the cost of any necessary relocation of existing utilities, and shall secure all documentation such as permits, warranty deeds and easements as may be required. However, ECUA may elect to modify the intended design and participate financially in certain system extensions as necessary to meet other current or future needs of the system. Such participation by ECUA shall be described in Exhibit “D” to this Agreement.

3. All such design and construction shall be done in accordance with the requirements of the ECUA Engineering Manual, latest edition.

4. No such construction shall be commenced until plans and specifications therefor have been submitted to and approved in writing by ECUA and other agencies or permitting authorities having jurisdiction.

5. In accordance with the requirements and conditions of the Plan Approval process the Developer or his representative shall notify ECUA in writing before commencing construction. Failure of the Developer or his Contractor to provide timely notice before commencement of construction, as required, may be considered as a breach of this Agreement. The Developer will be responsible for payment of penalties and other costs associated with such failure to notify.

6. All work related to the construction of extensions to ECUA water or wastewater facilities shall be subject to inspection by ECUA. Employees and agents of ECUA may at any reasonable time during or after construction enter upon the Property for the purpose of inspecting such facilities. Any work done prior to proper notification or without appropriate inspection is subject to rejection. Work requiring repeated inspections, failure to properly prepare work for inspection, or other actions which result in excessive use of inspection services, shall be cause for assessment of additional inspection fees payable prior to final completion or acceptance of the project.

7. Upon completion of construction the engineer that prepared the approved plans and specifications shall at the Developer’s expense certify such facilities as to conformity with the approved plans and specifications and provide copies of the project plan drawings indicating the final, as-built record of construction including location references. Also prior to the facilities being placed into service the Developer shall provide or cause to be provided additional documentation including but not limited to easements, warranties, dedications, etc.

8. Ownership and maintenance responsibility for the completed facilities shall be defined by ECUA and outlined in Exhibit “C” to this Agreement. Prior to completion of the project, the Developer shall provide a survey from a third party

acceptable to ECUA which details the location and provides the legal description of any and all facilities for which ECUA is to take ownership. Any underground facilities shall be field spotted and located, verifying the location such that the facilities can be adequately surveyed.

9. Prior to completion of the project, the developer shall provide appropriate warranty deeds, easements, or other documents necessary to effectuate the transfer of the appropriate property interests to ECUA. All such documents transferring any property interest to ECUA shall contain the appropriate legal description as verified by survey.

10. Upon determination by ECUA that the facilities have been properly located and constructed by the Developer in accordance with the approved plans and specifications and all applicable requirements of ECUA and other agencies having jurisdiction, ECUA shall accept ownership and maintenance responsibility or acknowledge satisfactory completion of construction of the facilities as appropriate. For facilities not being accepted by ECUA the Developer shall provide the name, address, phone number and other contact information for the person or agency responsible for the maintenance of the facilities.

11. No building or similar facility shall be connected to any new or existing water or wastewater facilities until such time as ECUA acknowledges satisfactory completion of construction, and until all applicable rates, fees and charges have been paid to ECUA. If for any reason service is established to the Project prior to the receipt of all documentation necessary to meet the requirements of the completion or acceptance process, such service shall be considered temporary and limited to a period of ninety days. Failure of the Developer to provide the necessary documentation within this period may result in discontinuance of service until such documentation is provided.

12. Upon acceptance of any facility by ECUA, such facility, together with all permits, easements, warranties, engineering drawings, and other matters owned by the Developer in connection therewith shall be delivered to and owned by ECUA. The Developer shall execute such instruments of conveyance as ECUA may require, and shall provide ECUA with all surveys and as-built records of construction in a format suitable to ECUA.

13. The Developer hereby warrants the new facilities to be free of defects in material, workmanship and design for two (2) years after the acceptance or acknowledgment of completion thereof. Any such defect appearing within two (2) years after acceptance shall be corrected by the Developer or, at the option of ECUA, shall be corrected by ECUA and the Developer shall reimburse ECUA for the cost of such correction within 30 days after receipt of a statement for the same.

14. The Developer shall not engage, directly or indirectly, in the ownership or operation of a water or wastewater system within or serving the Property or the Project. This provision does not preclude the submetering of water for purposes

of allocating cost to individual dwelling units such as in apartment complexes in accordance with Florida laws.

15. The Developer agrees to operate and maintain any completed water or wastewater facilities in compliance with all federal, state, local and ECUA codes and requirements, and agrees to allow ECUA access as required to inspect the facilities for compliance with those requirements.

16. The Developer hereby releases and agrees to hold harmless, indemnify, protect, and defend ECUA, its members, officers, employees and agents from any and all claims, damages, actions or causes of action relating to the planning, design, location, and construction of such facilities, or relating to any denial by the Florida Department of Environmental Protection or other authority of any permit to provide utility service to the Property, or any failure by the Developer to construct such facilities or develop the Property. This provision shall survive the acceptance and transfer of facilities to ECUA.

17. This Agreement may not be amended except by a writing executed by the Developer and by ECUA. All documents necessary for the implementation of this Agreement, including all permits, engineering design and construction contracts, plans and specifications for the facilities as and when approved and filed with the ECUA are a part of this Agreement and incorporated herein by reference.

18. The laws of the State of Florida shall govern this Agreement.

EXECUTED by the Developer or its representative this ______ day of ________________, 20____.

DEVELOPER

_______________________________ BY:____________________________

Witness

Printed Name & Title:______________

EXECUTED by the undersigned representative of ECUA this ______ day of ____________________, 20_____.

EMERALD COAST UTILITIES AUTHORITY

__________________________

BY:____________________________

Witness

Title:___________________________

EXHIBIT “A” – DESCRIPTION OF PROPERTY

The Escambia County Property Appraiser’s Parcel I.D. No. for the Property is

The legal description of the Property on which the proposed Project is to be constructed is as follows:

.

(Description may be attached. If so, please note).

EXHIBIT “B” – OFFSITE IMPROVEMENTS

The Developer intends to construct the following water or wastewater facilities outside the boundaries of the Property. The Developer or his engineer has confirmed that the proposed facilities are located in public rights-of-way or, if not, the Developer shall prior to construction acquire a permanent easement in ECUA’s favor sufficient for the long term operation, maintenance and repair of the facilities.  The legal description for any such easement shall be confirmed by use of a third party surveyor acceptable to ECUA.

Description of Offsite Facilities:

EXHIBIT “C” – OWNERSHIP & MAINTENANCE RESPONSIBILITY

It is the intent of the Developer and of ECUA that the ownership and maintenance responsibility for the water or wastewater facilities to be constructed for this Project will be as follows after final completion or acceptance.

ECUA

Upon satisfactory completion of construction and provision by the Developer of all properties, easements, and appropriate completion documents the following described facilities will be accepted for ownership, maintenance and operation by ECUA:

____ All facilities as shown on the approved Plans, or

Those facilities as shown on the approved Plans as described below:

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

Developer

Upon completion of construction and provision by the Developer of all appropriate completion documents the following described facilities will be retained for ownership, maintenance and operation by the Developer or his successor:

____ All facilities as shown on the approved Plans, or

Those facilities as shown on the approved Plans as described below:

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

______________________________________________________________________

Ownership and contact information for these facilities will be as follows:

Owner’s Name: ________________________________________________________

Owner’s Address: ______________________________________________________

Contact Person: _______________________________________________________

Daytime Phone No. _____________________________________________________

Emergency Contact No: _________________________________________________

EXHIBIT “D” – ECUA PARTICIPATION

The ECUA requires the Developer to modify the design of the Project as outlined below. ECUA will pay the difference in cost between the Developer’s desired Project and ECUA’s required modifications. The differential cost of design and construction related to the modification shall be in the estimated amount listed below or as otherwise approved by ECUA’s Executive Director or the ECUA Board. Payments shall be made after completion or acceptance based on documented actual costs, satisfactory to ECUA, in an amount not to exceed the estimated cost without prior written approval by ECUA.

Required Modifications:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
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________________________________________________________________________
________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Estimated Original Cost of Project (portion affected by modification): $ ________

Estimated Revised Cost of Project (portion affected by modification): $________

Estimated Differential Cost: $________

## WATER METER VAULT ACCESS AGREEMENT

THE PARTIES identified below hereby enter into this Water Meter Vault Access Agreement (hereinafter "Agreement"), as follows:

This Agreement pertains to the property (hereinafter “Property”) at the following location:

Property address: ______________________________________________

Escambia County Property ID: _____________________________________

A formal request is hereby made by Property Owner of ECUA to place a water meter vault(s) and all public utilities related thereto (hereinafter collectively “Facilities”) at the location on the Property which ECUA, in the exercise of its discretion, deems best to serve the Property.

It is acknowledged that ECUA requires access to these Facilities, and accordingly ECUA's access shall not be hindered by fencing, pavement, locked gates, or any other structure which in ECUA’s opinion impedes ECUA's reasonable access to the Facilities.

Additionally, ECUA is hereby granted a right-of-way for and access to the Facilities on the Property for any and all purposes regarding those Facilities, including but not limited to reading, maintaining, testing, repairing, replacing, or otherwise working on its water meter(s) and related Facilities. It is understood that ECUA does not own or maintain any lines or appurtenances (i.e. backflow prevention devices) on the Owner’s side of the ECUA meter vault.

It is further understood by the Parties that water service to the Property is conditioned on the above-referenced right-of-way and access and that subsequent revocation or alteration thereof may lead to the termination of any or all services provided to the Property by ECUA.

The Property Owner further represents and warrants that should ownership of the Property change subsequent to the date reflected below, the Property Owner shall provide a copy of this Agreement to the prospective new Owner prior to closing and otherwise inform that prospective new Owner of ECUA's right-of-way and right of access.

This Agreement is entered into on this _____ day of ________________, 20___, and is agreed upon by the following:

| | |
|---|---|
| ___________________________ | _____________________________ |
| ECUA Representative Printed Name | Owner or Representative Printed Name |
| ___________________________ | _____________________________ |
| ECUA Representative Signature | Owner or Representative Signature |