

# DEVELOPMENT MANUAL



**561 Mauldin Road  
Greenville, South Carolina 29607**

# APPROVAL REGISTER

Revision No.	Issued Date	Revision Description
0	11 / 19 / 2019	Initial Release
1	11 / 12 / 2021	Miscellaneous Updates
2	7 / 1 / 2022	Miscellaneous Updates
3	6 / 20 / 2023	Miscellaneous Updates

***Note that all references to regulations, statutes, codes, manuals and other resources are provided for reader's convenience. Reader is responsible for complying with all local, state, and federal requirements.***

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[APPENDIX VI – PUMP STATION POLICY](#)

[APPENDIX VII – LEGAL DOCUMENTS](#)

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## 1.0 INTRODUCTION

### 1.1 ABOUT REWA

Since 1925, Renewable Water Resources (ReWa) has been committed to providing high quality wastewater treatment services to the Upstate of South Carolina. ReWa's goal is to promote a cleaner environment and to protect public health and the water quality of the Upstate waterways while developing necessary sewer infrastructure. ReWa has nine water resource recovery facilities (WRRFs), 343 miles of collection lines, and provides services to Greenville County and portions of Anderson, Laurens, Pickens and Spartanburg counties (refer to [Figure 1-1: ReWa Service Area & Subdistrict Boundaries Map](#) for illustration of ReWa's Service Area).

### 1.2 OVERVIEW OF SATELLITE SEWER AGENCIES

ReWa's Service Area (Service Area) spans portions of five counties in the upstate: Anderson, Greenville, Laurens, Pickens, and Spartanburg. There are several Satellite Sewer Agencies (also referred to as "Sewer Subdistricts" or "Subdistricts") within the Service Area that provide wastewater collection and conveyance services to the residents within their boundaries. These Subdistricts convey flow to ReWa's conveyance system, and then ultimately to ReWa's WRRFs. The Subdistricts within the Service Area are shown in [Figure 1-1: ReWa Service Area & Subdistrict Boundaries Map](#).

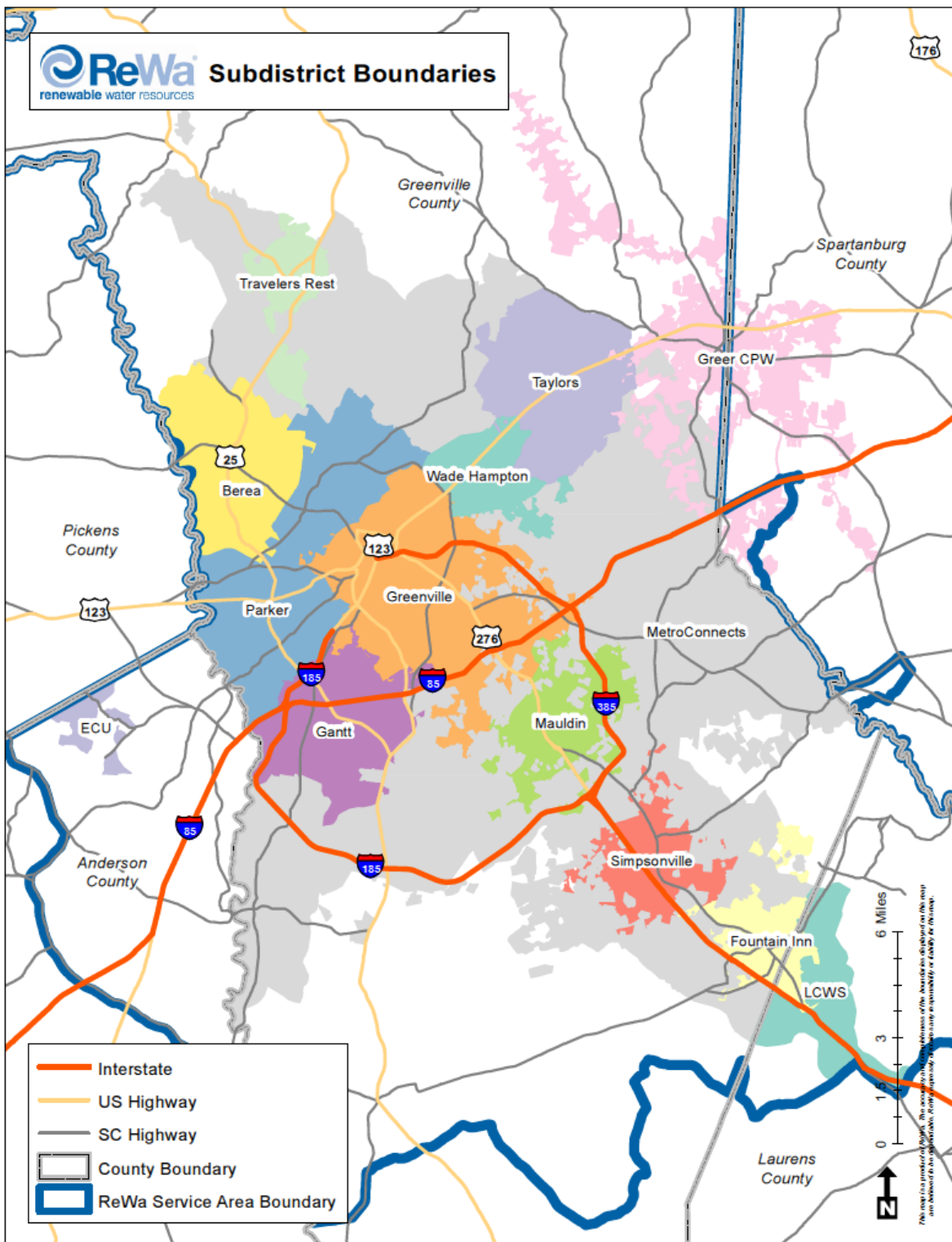
If the Applicant's sewer service request is located within the boundaries of a Subdistrict, the Applicant's Engineer is required to communicate their development efforts with that specific Subdistrict to ensure capacity is available in the Subdistrict's sewer system. In such cases, the Applicant shall adhere to the standards and protocols set forth by the Satellite Sewer Agency for the construction of new sewer infrastructure and for acceptance and/or ownership transfer. ReWa is willing to provide oversight and facilitate communication between the Applicant's Engineer and the Satellite Sewer Agency. The Applicant's Engineer is encouraged to contact ReWa for assistance throughout this process.

There are areas within ReWa's Service Area that do not have a Satellite Sewer Agency. For new construction in these areas, ReWa shall be recognized as the sole collection and treatment agency with sole authority to grant capacity acceptance.

### 1.3 STANDARDS MANUAL OVERVIEW

#### 1.3.1 Purpose

The purpose of this Manual is to provide guidelines for the planning, design and construction of new sewer infrastructure within the Service Area but not located within the boundaries of existing Satellite Sewer Agencies. This Manual is to be recognized as a working document that will be revised and updated periodically. A printed copy of this Manual is uncontrolled and may not be the most current version. All prospective Applicants are responsible for referring to the Manual on the ReWa website (refer to *ReWa Homepage* in [Section 1.5 – ReWa Online Resources](#)) to ensure that they are complying with the most current version of the Manual.



**Figure 1-1: ReWa Service Area & Subdistrict Boundaries Map**

*(As of June 2019)*

### 1.3.2 Approval and Acceptance Requirements

Applicants shall refer to [Appendix III – Process Flowcharts](#) for illustration of the processes in which to obtain capacity approval and ownership acceptance for a new sanitary sewer system. **Failure to follow the processes in the order presented and/or provide a complete submittal package as defined in this Manual will result in delays in the capacity approval and ownership acceptance processes.**

ReWa understands changed or unforeseen conditions may occur on-site and, as a result, necessitate work alterations and plan revisions to what was authorized under permit. Applicants are required to notify ReWa as soon as any of these conditions arise. Refer to [Section 4.3.2 – Changes During Construction](#) and [Section 5.3.1 – Variances During Construction](#) for further instructions on how to begin the plan modification processes for Public Main Extensions and Service Lateral Connections, respectively. **Please be aware that ReWa may require an amendment to the design if conditions arise during construction that deem it necessary.**

Applicants are authorized to begin construction of the sanitary sewer system only after receiving written approval from ReWa and all other applicable stakeholders. ReWa’s approval is subject to cancellation at any time for just causes; refer to [Section 3.6 – Project Cancellation](#) for further details on actions that can result in the termination of a capacity approval.

### 1.3.3 Development Manual Revisions

ReWa Engineering will periodically review this Manual and propose new or alternative products or installation methods to supersede old guidelines. Refer to the [Approval Register](#) for any recent changes made to the Manual.

Applicants (or any person or entity that desires to have requirements within this Manual modified or revised) must submit their requests to the ReWa Development Project Engineer via email at [development@re-wa.org](mailto:development@re-wa.org). All requests shall be submitted under the subject line: “Development Manual Revision Request”. The proposed alternative or new products shall be included in the written request. All requests will be reviewed and approved or rejected by ReWa Engineering. The person or entity proposing the request will be notified by ReWa of all decisions in writing.

If you have questions related to revisions to the Development Manual, please contact the ReWa Development Project Engineer at (864) 299-4000.

## **1.4 DEFINITIONS & ABBREVIATIONS**

### 1.4.1 Definitions

**Appurtenance** – Any accessory or other item associated with a sanitary sewer system (i.e. manhole, clean-outs, valves, etc.).

**Capital Contribution Agreement** – An agreement designed for developers to bear a portion of the cost of these capacity improvements rather than existing customers through current sewer rates.

**Easement/Right-of-Way** – A permanent non-possessory interest to use real property to construct, operate, maintain, reconstruct, or remove a public utility and appurtenances along, under, and across said easement.

**EDU** - “Equivalent Dwelling Unit” is equal to 1 single family home, or 300 gallons per day of allocated wastewater flow

**Force Main** – Any sewer piping that carries wastewater under positive pressure.

**Gravity Sewer** – A sanitary sewer pipe and manhole system that utilizes gravity to convey wastewater.

**Inflow** – Water that is dumped into the sewer system through improper connections, such as downspouts and groundwater sump pumps.

**Infiltration** – Groundwater that enters the sewer system via pipe cracks, joints, connections, or defects in piping and/or manhole structures.

**On-site Easement** – the right to use the real property of the Applicant or Owner (if they are not one and the same) for the operating and maintaining the sanitary sewer within defined limits. “On-site” shall refer any easements within the Owner’s property.

**Off-site Easement** – the right to use the real property of the Applicant or Owner (if they are not one and the same) for the operating and maintaining the sanitary sewer within defined limits. “Off-site” shall refer any easements outside of the Owner’s property.

**Peak Hourly Flow** – The design peak hour flow is the largest volume of flow to be received during a one-hour period expressed as a volume per unit time.

**Primary Satellite Sewer Agency** – a sewer collection agency within the ReWa Service Area that collects and conveys wastewater to the ReWa sewer system or a Secondary (Transport) Satellite Sewer Agency.

**Public Main Extension** – a new collection system of sewer lines and manholes typically serving new subdivisions, apartments, townhomes, etc.

**ReWa Public Main Extension** – a public main extension installed within the Service Area in locations where ReWa is the sole provider of collection and treatment (*i.e.*, outside of the Satellite Sewer Agency boundary). ReWa will own and operate the public main extension after completion of the Project Closeout phase and issuance of an ownership acceptance letter.

**ReWa Service Lateral Connection** – a service lateral connection installed within the Service Area in locations where ReWa is the sole provider of collection and treatment (*i.e.*, outside of the Satellite Sewer Agency boundary). ReWa will own and operate the service lateral connection after issuance of an ownership acceptance letter.

**Record Drawing** – Drawings that are prepared by the Applicant’s Engineer to reflect the as-constructed sewer system, including any changes to the approved construction documents.

**Satellite Sewer Agency (Sewer Subdistrict)** – an agency within the Service Area that provides sewer collection and/or conveyance to customers within their boundaries. There are two types of satellite sewer agencies: a “Primary” Satellite Sewer Agency, which provides sewer collection and conveyance services, or a “Secondary” (Transport) Satellite Sewer Agency, which receives and conveys flow from a “Primary” Satellite Sewer Agency.

**Satellite Sewer Agency (SSA) Public Main Extension** – a public main extension installed in the Service Area within the limits of Satellite Sewer Agency.

**Satellite Sewer Agency (SSA) Service Lateral Connection** – a service lateral connection installed within the limits of Satellite Sewer Agency.

**Sanitary Sewer System** – a public main extension or service lateral connection and all associated sewer infrastructure and appurtenances that are used to convey wastewater.

**Secondary (Transport) Satellite Sewer Agency** – a sewer collection agency within the ReWa Service Area that conveys wastewater to the ReWa sewer system from the Primary Satellite Sewer Agency.

**Service Area** – The geographical area within which ReWa provides sewer collection & conveyance and/or wastewater treatment. Refer to *ReWa Service Area Map* in [Section 1.5 – ReWa Online Resources](#) for illustration.

**Service Lateral Connection** – a single sewer line, typically from a re-purposed building, new commercial development, or a new building. Service Laterals may connect to a Satellite Sewer Agency sewer line or directly to a ReWa manhole.

**Structure** – Anything constructed or erected that requires permanent location on the surface of the land.

**Stub** – Short length of sewer segment tapped into existing system allowing for future connection.

**Subdistrict** – refer to definition for “Satellite Sewer Agency (Sewer Subdistrict)”.

**Tap** – Any new service lateral connection to an existing main or manhole.

**Ten State Standards** – “Recommended Standards for Wastewater Facilities of the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers.” Latest Edition.

**Upstate** – the region in the northwesternmost part of South Carolina. The region includes the following counties: Abbeville, Anderson, Cherokee, Greenville, Greenwood, Laurens, Oconee, Pickens, Spartanburg, Union.

**Wastewater/Flow** – water that has been affected by human use from any combination of domestic, industrial, commercial or agricultural activities, surface runoff, and sewer inflow and infiltration.

**Wastewater Pumping Station (Pump Station)** – Any arrangement of pumps, piping, valves, and controls which convey wastewater under pressure to a receiving sanitary sewer. The pump station facilities may include wet well structure, dry pit structure, generator, electrical control panel, valve vault structure, screening structure, and all structures and appurtenances typically located within a fenced area.

**Water Resource Recovery Facility** – a facility in which a combination of various processes (i.e. physical, chemical and biological) are used to treat municipal and/or industrial wastewater and remove pollutants.

#### 1.4.2 Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ACOG	Appalachian Council of Governments
ACI	American Concrete Institute
ANSI	American National Standards Institute
ASTM	American Society for Testing Materials
AWWA	American Water Works Association
CCTV	Closed Circuit Television Inspection
CFS	Cubic feet per second
DIA	Diameter
DIP	Ductile Iron Pipe
GIS	Geographic Information System
I&I	Inflow and Infiltration
PCR	Preliminary Capacity Request
PME	Public Main Extension
PTC	Permit to Construct
PTO	Permit to Operate
PVC	Polyvinyl Chloride Pipe
R/W	Right-of-Way, Rights-of-Way
ReWa	Renewable Water Resources
SC	South Carolina
SC DHEC	South Carolina Department of Health and Environmental Control
SC DOT	South Carolina Department of Transportation
SL	Service Lateral Connection
SSA	Satellite Sewer Agency
USACE	United States Army Corps of Engineers
WQMA	Water Quality Management Agency
WRRF	Water Resource Recovery Facility

## **1.5 REWA ONLINE RESOURCES**

### **1.5.1 *General***

[ReWa Homepage](#)

[ReWa Service Area Map](#)

[ReWa Departments & Subdistricts](#)

[Capacity Limited and Restricted Areas](#)

[ReWa Development](#)

[ReWa New Account Fees](#)

[ReWa Sewer Use Regulation](#)

[Upstate Roundtable](#)

### **1.5.2 *Permitting***

[Public Main Extension Preliminary Capacity Request Form & Instructions](#)

[Service Lateral Preliminary Capacity Request Form & Instructions](#)

[Direct Connect to ReWa Form and Process](#)

[SC DHEC Permitting: Wastewater Construction Homepage](#)

[SC DHEC Construction Permit Application: Water/Wastewater Facilities](#)

[SC DOT Encroachment Permit Homepage](#)

### **1.5.3 *Regulations***

[ReWa Sewer Use Regulation](#)

[SC DHEC Regulation 61-67: Standards for Wastewater Facility Construction](#)

[SC DHEC Regulation 61-67 Unit Contributory Loading Form](#)

[SC DOT Utilities Accommodation Manual](#)



## 2.0 ROLES & RESPONSIBILITIES

The information in this section details the roles and responsibilities of the entities involved in the initiation, production and closeout of new wastewater system extensions and associated infrastructure. The person or entity shall be solely responsible for meeting their responsibilities as described herein unless a written exception from ReWa or an approval authority is provided.

### 2.1 REWA

ReWa is the wastewater collection and treatment authority that has developed the minimum standards and guidelines written herein. ReWa owns and operates wastewater treatment facilities, pump stations and sewer collection and conveyance lines within the Service Area.

ReWa's responsibilities are as follows:

1. Review Applicant's preliminary capacity request submittal and determine wastewater service availability.
2. Confirm that all applicable fees have been paid by the Applicant and Applicant's Engineer throughout the review process.
3. Issue a preliminary capacity approval to the Satellite Sewer Agency, the Applicant and Applicant's Engineer upon completion of review of the Applicant's Preliminary Capacity Request.
4. Review design drawings prepared by the Applicant's Engineer and provide comments to plans, as necessary, for any required changes if any issues are identified and/or plans are not in for conformance with this Manual.
5. Issue a flow acceptance letter to the Satellite Sewer Agency, the Applicant and Applicant's Engineer upon approval of the Capacity Approval Process submittal package (refer to [Appendix VII – Legal Documents](#) for sample letter).

If the Applicant intends for ReWa to assume ownership of the new sanitary sewer system, ReWa shall carry the additional responsibilities below:

6. Review project closeout checklists prepared by the Applicant's Engineer and provide comments if any required information is missing or incomplete.
7. Review Closed-Circuit Television (CCTV) documentation provided by Applicant's Engineer of newly installed sanitary sewer system before it is placed into operation.
8. Issue an ownership acceptance letter to the Applicant and Applicant's Engineer (refer to [Appendix VII – Legal Documents](#) for sample letter).

ReWa will assign an inspector (ReWa Inspector) to each project to observe work and confirm compliance with the approved plans, applicable permits and the requirements within this Manual. The ReWa Inspector will be the Applicant's and the Applicant's Engineer's primary point of contact for ReWa on all questions and issues related to the construction of the new sanitary sewer system.

The ReWa Inspector’s responsibilities will include:

1. Perform periodic site visits to observe construction-related activities to determine compliance with this Manual, “approved for installation” plans from SC DHEC and applicable permits.
2. Prepare construction reports detailing the activities observed (refer to [Appendix V – Pre-Construction Meeting Agenda and Inspection & Testing Forms](#) for appropriate forms) at the end of each site visit.
3. Identify to the Applicant and the Applicant’s Engineer any work that is not in conformance with this Manual and require that the work be corrected to the satisfaction of ReWa.
4. Witness all required testing of sewer infrastructure to verify standards compliance and confirm adequacy of installation.
5. Participate in Final Inspection of newly installed sewer systems and prepare deficiency list.
6. Review project record drawings prepared by the Applicant’s Engineer to ensure accordance with the records document’s specification in [Appendix II – Standard Specifications](#) as part of project closeout checklists and provide comments, if necessary.

### 2.1.1 Basin Planning

ReWa is developing and updating comprehensive watershed master plans (or master plans) for each of the WRRF basins. ReWa will use their master plans as a planning tool for evaluating preliminary capacity requests for new developments, and as a guide for the preparation of future capital improvement projects (CIPs). Thus, ReWa’s plan review and capacity analysis will be performed with the vision of the master plans in mind.

#### 2.1.1.1 Feasibility/Restrictions/Limitations of Development

Development is a fluid process, and available capacity is changing constantly. As part of the basin planning efforts, ReWa regularly assesses the available capacity within its system to identify locations that may be potential problem areas for future service capacity. Applicants desiring preliminary capacity approval for development in these areas should anticipate extended review periods on their requests given the interceptor capacity limitations. ReWa uses two classifications to identify these areas: “Capacity Limited Areas” and “Capacity Restricted Areas”. Refer to [Section 1.5 – ReWa Online Resources](#) for an illustration depicting the areas that fall under these two categories.

A “Capacity Limited Area” is a location with limited available interceptor capacity. Capacity in these areas are not currently being denied, but Applicants should be aware that their requests may be denied depending on the size and exact location of the new development.

A “Capacity Restricted Area” is an area which has been identified as interceptor capacity restricted due to reoccurring overflows caused by excessive wet weather inflow and infiltration (I&I) into the sewer collection system. Developments may be approved in

these areas using a “checkbook” method if the applicable Satellite Sewer Agency can document a reduction of I&I in their system that is equal to or greater than the estimated flow that will be discharged from the proposed development.

**Applicants are strongly encouraged to first contact ReWa Engineering to discuss their project prior to investing time or money towards development within an area identified as a problem area.**

#### 2.1.1.2 Capital Contribution Agreements

ReWa is best served long-term by constructing conveyance systems for the foreseeable future, not just evaluating developments in these watersheds as they present themselves for approval. ReWa’s Capital Contribution agreements are designed for developers to bear a portion of the cost of these capacity improvements rather than existing customers through current sewer rates. Capital Contributions are evaluated by basin and shall not exceed \$2,500/EDU. An EDU, or “Equivalent Dwelling Unit” is equal to 1 single family home, or 300 gallons per day of allocated wastewater flow.

The map shown on the ReWa Development Website highlights areas where we currently have a Capital Contribution identified. Refer to [Section 1.5 – ReWa Online Resources](#) for a link to the *ReWa Development Website*. Note that this map is constantly updating and for the most up to date information please reach out to [development@re-wa.org](mailto:development@re-wa.org) to see if your parcel falls within an established Capital Contribution basin.

#### 2.1.1.3 Development Review Fees

ReWa strives to maintain fair and equitable rates and fees for its current and future customers. Currently, ReWa provides new development review and approval services for future customers. Therefore, fees are required to recover those costs from the future customers who receive the benefit of those services.

Refer to [Section 1.5 – ReWa Online Resources](#) for a link to the ***Sewer Use Regulation (See Appendix B)*** for our revised Engineering Development Fees which will apply to any new development within ReWa’s service area. The fees became effective on February 1st, 2023. Any new Step 1 or Step 2 requests submitted on or after February 1, 2023 will be subject to the new fees. Should you have any questions regarding our adjusted fees, please to reach out to [development@re-wa.org](mailto:development@re-wa.org).

#### 2.1.2 208 Plans

Water Quality Management Plans, otherwise known as “208 Plans”, are comprehensive regional water quality management plans required by Section 208 of the Clean Water Act. Its purpose is to protect natural water resources and improve water quality. In the upstate of South Carolina, the Appalachian Council of Governments (ACOG) is the planning agency charged with

implementing the 208 Plans and reviewing the NPDES permit applications as part of the SC DHEC permit issuance process.

As a designated Water Quality Management Agency (WQMA), ReWa is responsible for the construction, operation and maintenance of the publicly owned WRRFs in the Enoree, Reedy & Saluda Basin Planning Areas within the Appalachian Region. ReWa works with ACOG to make decisions that are consistent with the predicted and desired community growth patterns, while respecting the protection of irreplaceable natural resources. As part of the planning and acceptance processes for new development, ReWa will assess applications in accordance with the 208 Plans and will not grant approval in situations that conflict with the requirements of the 208 Plans.

### **2.1.3 Upstate Roundtable**

The Upstate Roundtable is a volunteer collaboration of community, business and governmental leaders, as well as technical experts, that are tasked with addressing challenges associated existing and future sewer infrastructure capacity needs in the Upstate. The wastewater treatment systems within those countries are served by the Enoree, Reedy & Saluda River Basins. Applicants should refer to the Upstate Roundtable website for further information on the organization’s roles and responsibilities (refer to [Section 1.5 – ReWa Online Resources](#)).

ReWa has taken responsibility for facilitating communication with Upstate Roundtable in order to better focus its resources to protect the environment and provide high quality service to its customers.

## **2.2 APPLICANT**

The “Applicant” refers to the person or entity initiating the development of a new residential, industrial, or commercial property, or connection of a new service lateral for a new property. This can be, but is not required to be, the Owner of the property or proposed development. This person or entity must have the legal authority to execute necessary permits, applications, and all other legal documents for which an Owner’s signature is required. This person or entity is responsible for the execution of all requirements detailed throughout the project unless the project is sold, and the legal authority of the development is transferred to another entity. Only at that point shall this person or entity be waived of responsibility for the execution and completion of all documents and project requirements.

The Applicant is responsible for the following:

1. Provide correct and complete information as to the person or entity responsible for the development and their contact information.
2. Paying all incurred fees (unless otherwise stated) in accordance with the fee schedule shown in the *Sewer Use Regulations* (refer to [Section 1.5 – ReWa Online Resources](#)).
3. Ensure that all contractors and subcontractors on project have the proper licensing and accreditation to perform work.

4. Ensure that construction of new development and associated sewer infrastructure is performed in accordance with this Manual.
5. Perform all required testing of new sewer infrastructure.
6. Provide ReWa with immediate notification of any changes or unforeseen conditions as shown they are presented.
7. Being financially responsible for requests for repairs that may arise during the maintenance agreement (warranty) period after ownership of new sanitary sewer system has been accepted to ReWa.

### **2.3 APPLICANT'S ENGINEER**

The "Applicant's Engineer" shall refer to the Engineer employed by the Applicant to design and prepare plans for extension of the existing wastewater piping and associated support facilities to the new building or development. This person or entity shall be the primary point of contact for ReWa during construction.

The Applicant's Engineer will be responsible for the following:

1. Communicate development plans with the appropriate Satellite Sewer Agency, Stakeholders and regulatory agencies, and preparing and submitting all permits and required documentation, if necessary.
2. Obtain preliminary capacity approval from the required Satellite Sewer Agency, if required, and submit the appropriate Preliminary Capacity Request Forms to ReWa for review.
3. Request a Design Concept meeting with ReWa Engineering, if deemed necessary.
4. Obtain all required permit from applicable stakeholders.
5. Prepare, stamp and seal plans for the proposed sanitary sewer system by a licensed Professional Engineer in the State of South Carolina and submit to ReWa for review.
6. **For Public Main Extension projects**, prepare and submit all required documents and completing all required procedures as part of the Permit to Construct Submittal Process.

For Public Main Extension projects where the Applicant intends to transfer ownership of the new sanitary sewer system to ReWa, the Applicant's Engineer shall carry the additional responsibilities below:

1. Schedule a Pre-Construction Meeting with the ReWa Inspector, the Applicant, and other appropriate parties (i.e., general contractor (if different than the Applicant), sub-contractors, etc.) prior to commencement of construction.
2. Provide oversight of the construction of the proposed sanitary sewer system.
3. Provide construction progress reports upon request from ReWa.
4. Prepare any requests for changes to the "approved for install" plans and submit them to ReWa.
5. Witness, record and certify all testing of newly installed sewer infrastructure and provide ReWa Inspector with sufficient notice to observe testing. Certification shall include completing the appropriate performance testing described in this Manual and

documenting results on the appropriate forms (refer to [Appendix V – Pre-Construction Meeting Agenda and Inspection & Testing Forms](#)).

6. Prepare requests for Final Inspection and submit CCTV inspection records to ReWa.
7. Preparing and submitting all required documentation for project closeout and ownership acceptance.
8. Prepare and submit all required documents and completing all required procedures as part of the Permit to Operate Submittal Process for Public Main Extension project (refer to [Appendix III – Process Flowcharts](#) for illustration of the process).

## 2.4 PUBLIC-PRIVATE PARTNERSHIP PROJECTS

Flow from new developments may necessitate substantial extension or expansion of the existing sewer infrastructure to effectively handle its expected capacity. ReWa recognizes there are scenarios where the opportunity for the total construction cost of the proposed sanitary sewer system construction to be shared between the Applicant and ReWa, depending on need and the initiating party. In such cases, the ReWa Development Project Engineer and the Applicant shall meet to discuss how potential credits or debits may be handled, and the responsibilities of each party going forward in the project.

## 2.5 OTHER STAKEHOLDERS

It is the sole responsibility of the Applicant’s Engineer to obtain all required permits prior to construction. During construction, the Applicant shall make sure copies of all obtained permits are always on-site. The Applicant and the Applicant’s Engineer shall adhere to all requirements and special conditions of all permits. The Applicant shall continually protect the environment during construction which includes but is not limited to: protecting trees that remain, protecting streams and other water bodies, and considering air & noise pollution.

In addition to approvals from ReWa and Satellite Sewer Agencies, the following stakeholders may require review and approval of the Applicant’s proposed project. **The Applicant shall be aware that this may not be a complete listing:**

- ReWa
- U.S. Army Corps of Engineers
- Duke Energy
- State 401 Water Quality
- Local Floodplain Development
- SC Department of Health and Environmental Commission (SC DHEC)
- SC Budget and Control Board
- Anderson County Planning & Community Development
- Greenville County Subdivision Advisory Committee (SAC)
- Spartanburg County Planning and Development Commission
- Laurens County Planning & Department
- SC Department of Transportation (SC DOT)
- Individual Property Owners
- Railroad Entities
- SC Wildlife Dept. Non-Game and Heritage Trust Section

### 3.0 PROJECT CATEGORIES AND POLICIES

The following information provides an overview of the two types of wastewater service extensions and general information related to wastewater service construction. The information is applicable to all new developments in the Service Area. Deviations from these standards will not be allowed without the express written consent of Renewable Water Resources.

#### 3.1 GENERAL INFORMATION

The standards and procedures written herein apply to the design, construction, and connection of public main extensions and/or service lateral connections to the sanitary sewer collection systems located within the boundaries of the Service Area that convey flow to WRRFs owned, operated and maintained by ReWa.

There are two classifications of sewer service for new development that require ReWa’s approval: “Public Main Extensions” and “Service Lateral Connections”. The Applicant shall refer to [Section 4.0 – Public Main Extensions](#) or [Section 5.0 – Service Lateral Connections](#) for detailed explanation of the guidelines and approval process for their appropriate sewer service.

#### 3.2 PUBLIC MAIN EXTENSION

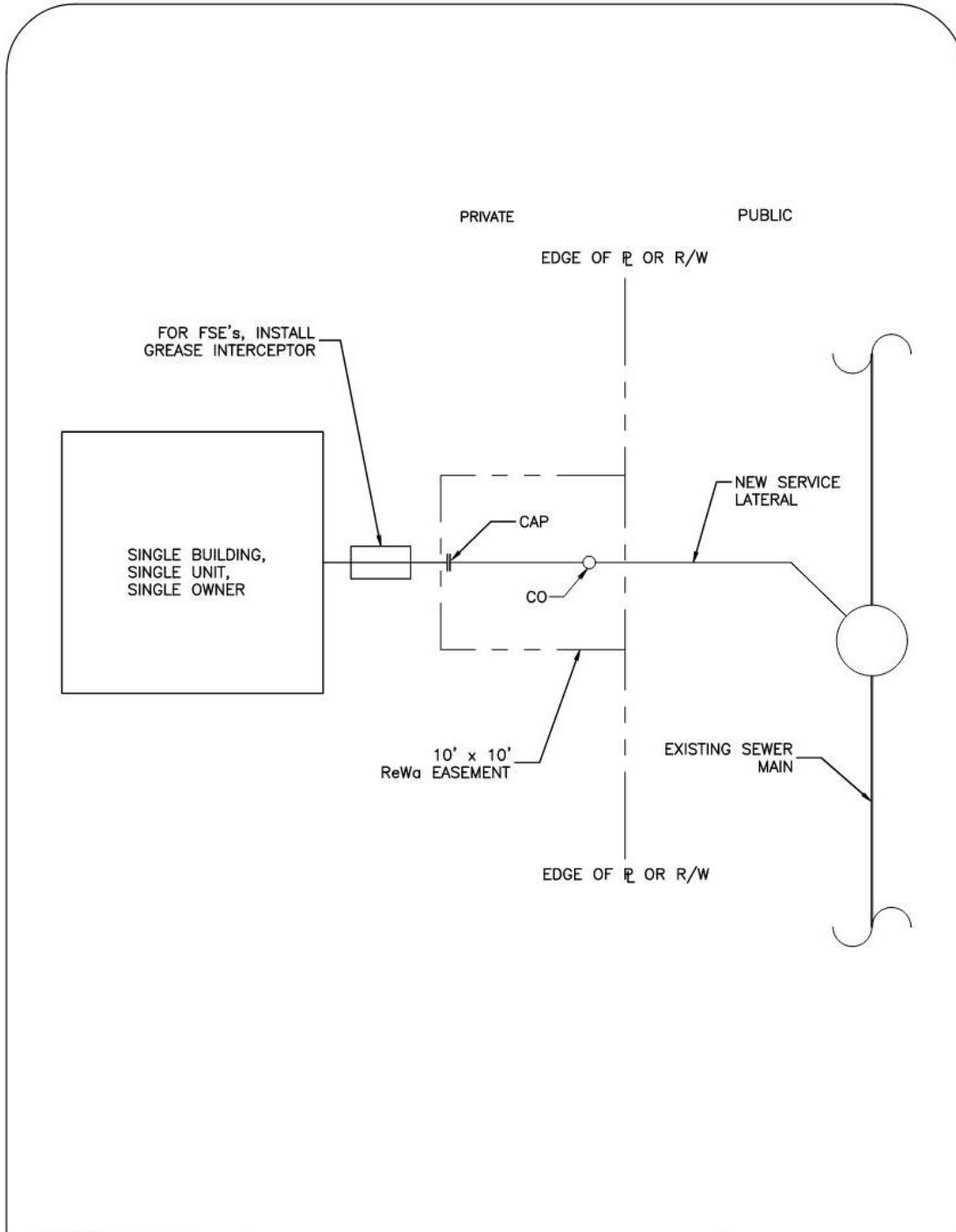
A “Public Main Extension” refers to a new collection system of sewer lines and manholes typically serving new developments, subdivisions, apartment, townhomes, etc. All new sanitary sewer collection systems defined as ‘Public Main Extensions’ must be permitted for construction and operation by South Carolina Department of Health & Environmental Commission (SC DHEC).

#### 3.3 SERVICE LATERAL CONNECTIONS

A “Service Lateral Connection” refers to a single sewer line, typically from a re-purposed building, new commercial development, or new building. Service laterals may connect to a Satellite Sewer Agency sewer line, or directly to a manhole that is owned and maintained by ReWa. Please note that the service laterals for individual homes or buildings associated with a Public Main Extension would not go through ReWa’s service lateral connection permitting process; they would receive approval with the rest of the sanitary under ReWa’s public main extension permitting process.

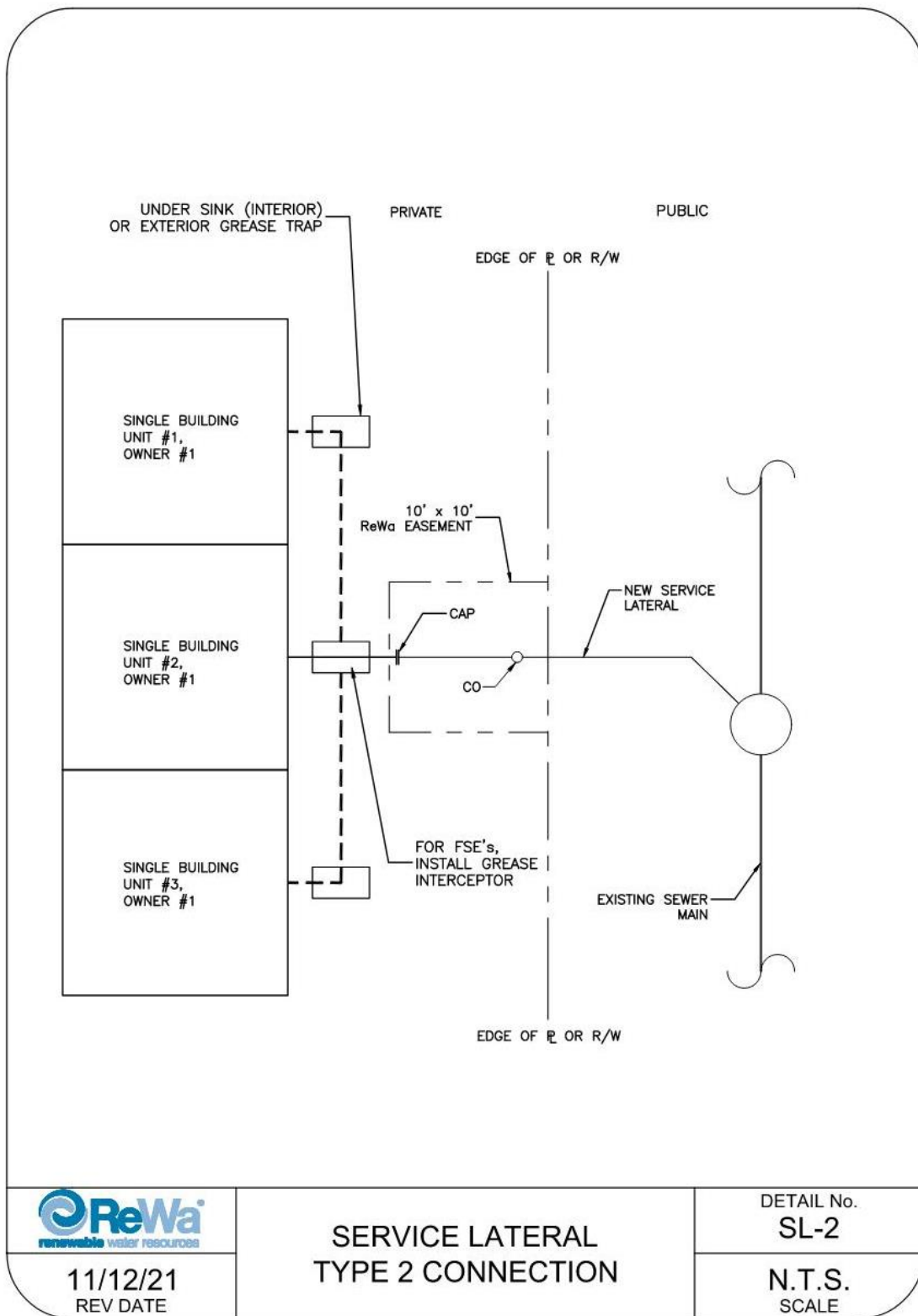
SERVICE LATERAL CONNECTION EXAMPLES	
<b>Type 1:</b> Single Owner, Single Structure, Single Unit, Single Service Connection	Individual Household, Individual Commercial Development, Food Service Establishment (FSE)
<b>Type 2:</b> Single Owner, Single Structure, Multiple Units, Single Service Connection	Apartment Complex, Retail Shops, FSE





	<b>SERVICE LATERAL TYPE 1 CONNECTION</b>	DETAIL No. <b>SL-1</b>
		<b>N.T.S.</b> SCALE
<b>11/12/21</b> REV DATE		





### 3.4 PUMP STATION POLICY

In the past, smaller-sized wastewater pumping stations were owned, operated, and maintained private utility providers, homeowners' associations (HOAs) and similar groups. Some municipalities and Satellite Sewer Agencies were responsible for the operation and maintenance of the smaller- to moderately-sized pump stations that conveyed flow into the ReWa sewer system. ReWa has historically owned, operated, and maintained moderately- to larger-sized wastewater pumping station within its Service Area.

Over time, the entities which typically operated and maintained smaller pump stations have sought to transfer ownership responsibilities to those with greater resources for the operation and maintenance of these pump stations. Thus, ReWa created a Pump Station Policy as a means of establishing guidelines for determining acceptance of a given wastewater pump station.

Please refer to [Appendix VI – Pump Station Policy](#) for further explanation on the requirements for installing a pump station in the Service Area and the guidelines that must be met for ReWa to accept ownership of an installed pump station.

### **3.5 EASEMENT REQUIREMENTS**

Permanent sewer easements shall be established for all gravity sewer and force mains not installed in a dedicated road R/W.

#### **3.5.1 General Easement Requirements**

1. Sanitary sewer installations shall be located within a public R/W or within an established or recorded permanent easement adjacent to a public R/W.
2. When a new sanitary sewer line is installed within an existing public easement or R/W and there is less than half of the width available (refer to [Section 3.5.3 – Easement Width](#)), the Applicant is required to acquire additional easement (or R/W) to obtain the full required easement width.
3. Maximum grade along an access easement shall be 10:1 (both horizontally and vertically, respectively).
4. Easements shall be grassed and clear of trees and debris.
5. Asphalt paths, concrete sidewalks, roads, parking lots, grass, shrubs and other types of plants whose natural height does not exceed three (3) feet are permitted within the easement limits. Maintenance for these items is the responsibility of the property owner or homeowner's association.
6. Obstructions within, below, or above any easement (i.e. trees, buildings, building overhangs, building footers, lighting, signage, etc.) which may limit access to or use of the entire easement are not permitted within the easement limits. If installed improperly, such obstructions (including, but not limited to, those described above) are at risk of damage and subject to removal as required to perform maintenance.
7. If trees are planted in close proximity to the sewer easement, ReWa will require root barrier protection to be located.
8. Sewer infrastructure installed in road R/W's must be approved by SC DOT and/or the appropriate City/County, in addition to ReWa.

9. New sanitary sewer systems are not allowed to parallel an SC DOT road within the SC DOT road R/W.
10. Within the sanitary sewer easement, fences are not permitted to be parallel to the sanitary sewer line. Fences are not permitted to be perpendicular to the sanitary sewer line without written consent from ReWa.
11. If ReWa allows fencing to be placed within the sanitary sewer easement, two (2) – (8') eight-foot wide gates are required. The center of the gates shall match the center of the sanitary sewer easement. Refer to *Detail No. SS-37, Steel Gate – Double Gate Installation* in [Appendix I – Standard Drawings](#).

**Please note that ReWa will not assume any responsibility for damage to utilities or other items placed within the easement. Once the easement is turned over to ReWa, ReWa has the legal authority to have any obstruction removed without advanced notice to the property owner. All costs incurred to remove the obstruction will be transferred to the property owner.**

### 3.5.2 Existing Easements

Any existing easement or R/W's shall be shown on the plans or exhibits prepared by the Applicant's Engineer for the Project Closeout submittal package. The easement shall include the Deed Book and page number of the recorded instrument. Any restrictive clauses as to the use of the easement shall be noted on the plan adjacent to the specific easement. Examples of restrictive clauses may include but are not limited to:

- Utility purposes (gas, electric, telephone, water) only;
- Drainage purposes only;
- Sanitary sewer purposes only.

### 3.5.3 Easement Width

1. Gravity Sewer and Force Main
  - a. Refer to *Detail No. SS-29, Typical Right-of-Way Detail* in [Appendix I – Standard Drawings](#) for general easement or right-of-way dimensions.
  - b. Exhibits and record drawings prepared for the Project Closeout submittal package must show permanent easements along the sanitary sewer line as constructed. This includes easements that extend outside of a road R/W. (Refer to [Appendix II – Standard Specifications](#) for Record Documents Specifications).
  - c. Width of temporary construction easements shall not be less than fifty (50) feet.
  - d. Drawings prepared for ReWa's Capacity Approval Process review must show temporary construction easements.
  - e. Edge of easement should not be less than ten (10) feet from any building, building footer, permanent structure or stormwater impoundments.
  - f. Wastewater gravity lines and force mains may be placed in the same easement. Each respective line must be laid with a minimum of ten (10) feet of horizontal separation between the inside edge of the pipes. The width of the easement shall

be increased such that there is no less than 10 feet of separation between the centerline of the pipe and the edge of the easement.

- g. ReWa reserves the right to increase the width of any easement during the dedication process if conditions requiring such changes arise (refer to [Section 4.4.3.1 – Dedication and Conveyance of Sewer Line](#)).

#### 3.5.4 Easement Agreement

The Applicant's Engineer shall be responsible for completing the Easement Agreement which will serve as a transfer of the easement from the Applicant to ReWa. The Applicant shall fill out the agreement using the ReWa standard Easement Agreement document (refer to [Appendix VII – Legal Documents](#)). The Applicant's Engineer shall communicate all questions regarding how to respond to certain portions of the agreement to the ReWa Development Project Engineer.

### 3.6 PROJECT CANCELLATION

Any approved project (*i.e.*, projects that have been issued a flow acceptance letter from ReWa) may have their approval rescinded if either of the following occurs:

- A SC DHEC Permit to Construct for the proposed sanitary sewer system has not been issued within 120 days of the date listed on the flow acceptance letter.
- A SC DHEC Permit to Operate for the proposed sanitary sewer system has not been issued within 3 years of the issue date of the SC DHEC Permit to Construct.

## 4.0 PUBLIC MAIN EXTENSIONS

The information in this section covers the submittal and approval requirements for Public Main Extensions as defined in Section 3.0. The guidelines set forth shall apply to all public main extensions installed in the Service Area. No deviations from these requirements are allowed without the express written consent of Renewable Water Resources.

ReWa requires that all plans prepared for a public main extension are stamped, sealed and signed by a Professional Engineer licensed in the State of South Carolina. Thus, the Applicant is required to employ an engineer (Applicant's Engineer) to prepare the design of the public main extension and its associated support facilities, and all documentation required to receive a flow acceptance and ownership transfer letters (if required).

### 4.1 PRELIMINARY CAPACITY REQUEST (STEP 1 OF CAPACITY REQUEST APPLICATION)

A capacity analysis must be performed for all proposed sanitary sewer systems prior to construction. At the Applicant's request, a capacity analysis will be performed by ReWa to determine if the ReWa sewer system has the available capacity to accept the estimated sewer flow from the new development. The Applicant shall be aware that developments located in areas identified as "Capacity Limited" or "Capacity Restricted" may experience difficulties in acquiring a preliminary capacity approval from ReWa (refer to *Capacity Limited and Restricted Areas Map* in [Section 1.5 – ReWa Online Resources](#) for illustration and [Section 2.1.1.1 – Feasibility/Restrictions/Limitations of Development](#) for further description).

**ReWa strongly encourages Applicants to first contact ReWa Engineering to discuss their project prior to investing time or money towards any development, especially those within identified problem areas.**

The Applicant's Engineer shall refer to [Appendix III – Process Flowcharts](#) for illustration of the capacity approval submittal process for ReWa and Satellite Sewer Agency public main extensions, respectively. The Applicant's Engineer shall refer to the appropriate flowchart depending on whether connection will be made to the Satellite Sewer Agency's or directly to ReWa's sewer systems.

#### 4.1.1 Communication with Satellite Sewer Agencies

If the new development is located within the boundaries of a Satellite Sewer Agency (refer to [Figure 1-1: ReWa Service Area & Subdistrict Boundaries Map](#)), the Applicant's Engineer must receive preliminary approval from the primary Satellite Sewer Agency (and secondary/transport, if applicable) before ReWa will grant its preliminary capacity approval.

If the new development falls within the Service Area boundaries, but not within the boundaries of a Satellite Sewer Agency, ReWa shall be recognized as the primary sewer provider and the

Applicant will tie directly in the ReWa sewer system. Thus, the Applicant's Engineer will only need to receive preliminary approval from ReWa.

#### 4.1.2 Preliminary Capacity Forms & Instructions

For all Public Main Extension projects, the Applicant's Engineer shall refer to the *Public Main Extension Preliminary Capacity Request Form* in [Section 1.5 – ReWa Online Resources](#) and follow the instructions for the preliminary capacity approval process. Completing the *Public Main Extension Preliminary Capacity Request Form* and submitting the form to ReWa shall initiate the preliminary capacity request process.

##### 4.1.2.1 Estimated Total Sewer Flow

The estimated total daily sewer flow using SC DHEC Unit Contributory Loadings shall be provided on the *Public Main Extension Preliminary Capacity Request Form* prepared by the Applicant's Engineer. The provided flow shall be based on the average daily flow projection. Refer to [Section 6.1.2 – Sanitary Sewer Sizing](#) as for the basis for average daily flow projection.

Upon review of the preliminary capacity request by all required parties, ReWa will provide the Applicant's Engineer with an approval (Preliminary Capacity Request Approval) or denial to proceed with the capacity approval process.

**Applicants should be aware that all information provided prior to the issuance of the flow acceptance letter is for informational purposes only. A preliminary capacity request approval does not constitute a contract or guarantee that the project flow will be approved.**

#### 4.2 CAPACITY APPROVAL PROCESS & PLAN REVIEW (STEP 2 OF CAPACITY REQUEST APPLICATION)

To receive a flow acceptance letter from ReWa, the Applicant's Engineer must prepare and submit a submittal package including all of the items listed in the *ReWa Capacity Approval Process Checklist (Public Main Extension)* (refer to [Section 1.5 – ReWa Online Resources](#)). **Capacity is allocated based on a “first-come-first-serve basis”, so it is incumbent upon the Applicant's Engineer to prepare the submittal package in a timely manner.**

##### 4.2.1 Capacity Approval Process Checklist & Submittal Package

The *ReWa Capacity Approval Process Checklist (Public Main Extension)* form (refer to [Section 1.5 – ReWa Online Resources](#)) lists all of the required items for the Capacity Approval Process submittal package. The capacity approval package shall also include cut sheets for all materials, equipment and other appurtenances that are to be installed on this project to verify conformance with this Manual.

Any submittal packages that are incomplete and/or do not fully comply with the guidelines set forth in this Manual shall be returned to the Applicant's Engineer for revisions. Depending on the

nature and extent of the comments, ReWa may request a Comment Review Meeting to discuss the issues with the design and what modifications are needed for ReWa to grant its approval.

#### 4.2.1.1 Additional Stakeholder Approval

The Applicant's Engineer is required to identify all additional stakeholders (*i.e.*, other entities whose properties will be encroached upon by the Applicant's construction or who have jurisdiction over the affected area) and receive their approval to perform work within their jurisdiction. For examples of possible stakeholders from which the Applicant's Engineer would need to obtain approval, the Applicant's Engineer shall refer to [Section 2.5 – Other Stakeholders](#). ReWa can aid the Applicant's Engineer in determining all applicable stakeholders upon request.

ReWa requires the Applicant's Engineer to provide copies of any stakeholder approvals or encroachment permits that may have impacts, special conditions or statutes that would be conveyed to ReWa upon ownership transfer as part of their submittal package. Some examples of permits that would be required are as follows (**please note that the examples below should not be recognized as a complete list**):

- Floodplain Encroachment
- SC DOT R/W Encroachment
- Utility (gas, electric, etc.) Easement Encroachment
- Railroad R/W Encroachment
- USACE Jurisdictional Wetlands Encroachment

#### 4.2.2 Flow Acceptance Letter

Once the technical review of the submittal package is complete and the proposed work is deemed satisfactory, ReWa will generate and distribute a flow acceptance letter to the Applicant, the Applicant's Engineer and the Satellite Sewer Agency (if applicable). This letter serves as confirmation that the capacity has been allocated in the ReWa sewer system for the proposed development. **Please note that ReWa reserves the right to withhold distribution of the flow acceptance letter until all appropriate review fees have been paid by the Applicant (refer to ReWa New Account Fees in Section 1.5 – ReWa Online Resources).**

#### 4.2.3 SC DHEC Permit to Construct

The Applicant's Engineer shall be responsible for submitting the SC DHEC Construction Permit application. Please note that State law and regulations require the submission of plans and specifications to obtain a written SC DHEC Permit to Construct. This permit is required before a public main extension can be constructed, relocated or modified.

**Sections 4.3 & 4.4 only apply to ReWa Public Main Extensions. For SSA Public Main Extensions, the Applicant shall refer to the guidelines and standards for construction, testing and closeout of public main extensions established by the appropriate Satellite Sewer Agency.**



### 4.3 CONSTRUCTION ACTIVITY & REQUIREMENTS FOR REWA PUBLIC MAIN EXTENSIONS

During construction, the Applicant's Engineer shall be the primary point of contact for ReWa and will be responsible for observing and verifying that all work is performed in accordance with this Manual, approved permits and all other applicable documents.

*ReWa Public Main Extension Construction & Permit to Operate Submittal Process* (refer to [Appendix III – Process Flowcharts](#)) details the sequence of operation for construction, closeout and ownership transfer. The Applicant's Engineer shall follow the process steps in order, unless the ReWa Development Project Engineer provides instruction otherwise. **Failure to follow the steps in the order in which they are shown may result in delays in the process.**

#### 4.3.1 Pre-Construction Meeting

A mandatory Pre-Construction meeting will take place prior to the beginning of any construction activity. The Applicant (which includes the Applicant and their general contractor, if those two are not one in the same), sub-contractors, the Applicant's Engineer and the ReWa Inspector are all required to attend. **The Applicant's Engineer must notify the ReWa Inspector of the proposed pre-construction meeting date with at least one weeks' notice (five working days, not including weekends or holidays).**

The Applicant's Engineer is required to prepare a pre-construction meeting agenda (use the template pre-construction meeting agenda in [Appendix V – Pre-Construction Meeting Agenda and Inspection & Testing Forms](#)). **The ReWa Inspector has the authority to delay of the start of construction if items are not appropriately addressed at the time of the meeting.**

An additional pre-construction meeting will be held if construction is suspended for more than 6 months or the Applicant employs a new general contractor. Work is not authorized to resume until additional pre-construction meeting is held. **Failure to comply may result in termination of flow acceptance letter.**

A copy of SC DHEC permits, and all other applicable permits shall be provided during the meeting. The Applicant shall maintain a copy of the flow acceptance letter and all permits on-site at all times.

#### 4.3.2 Changes During Construction

Any design changes that would result in a variance from the approved plans must be submitted by the Applicant's Engineer for review and approval by ReWa, SC DHEC and all other stakeholders requiring permitting prior to the construction of the variance. All revision dates shall be recorded and shown on the plans. Once the revised plans have been approved, the Applicant's Engineer is responsible for re-issuing the drawings and distributing them to the appropriate parties.



### 4.3.3 Inspections

All sewer infrastructure installed within the Service Area shall be subject to inspection and testing prior to acceptance. The ReWa Inspector must be present for construction and modifications to existing and proposed sanitary sewer mains & associated sewer infrastructure.

The Applicant's Engineer (or a representative under their direct supervision) must observe the installation techniques to determine if they are appropriate for the soil conditions and the type of pipe. The Applicant's Engineer will be responsible for verifying that all materials installed on the project comply with the standards in this Manual and shall notify the ReWa Inspector when materials are delivered onsite. The ReWa Inspector may require a field review of the materials prior to installation if there are concerns about the new materials meeting the standards set for this Manual. If the field review is insufficient in alleviating the ReWa Inspector's concerns, the ReWa Inspector may require supporting documentation to verify the standards in this Manual are being met. **Work stoppages may result if the ReWa Inspector cannot satisfactorily verify that the work is compliant with the established standards.**

#### 4.3.3.1 Pipe Inspections

The ReWa Inspector shall perform a visual inspection of all lines, regardless of pipe material. If the ReWa Inspector notices any settlement or slope loss of the sewer main as it enters and or leaves a manhole, the line shall be uncovered and raised to proper alignment. If the ReWa Inspector finds excessive misalignment of the piping between manholes, the entire line shall be removed and re-laid.

#### 4.3.3.2 Manhole Inspections

The ReWa Inspector will check all the flow channels between inverts and all benches to verify proper construction. The ReWa Inspector also shall inspect all manholes to ensure that lift holes, steps, joints and rings are mortared smooth in accordance with [Appendix I – Standard Drawings](#) and [Appendix II – Standard Specifications](#). For the work to be deemed acceptable, there shall be no signs of infiltration into the manhole. The ReWa Inspector will verify proper alignment of the ring and cover and all sections of the manhole. The ReWa Inspector will also verify that the ring and cover are at appropriate grade.

#### 4.3.3.3 Pump Station Inspections

The ReWa Inspector also shall witness all on-site assembly and construction of pump station to observe quality and progress of the work.

### 4.3.4 Performance Testing

The Applicant is responsible for performing all performance testing on new sewer infrastructure. Refer to the construction procedures in [Section 6.0 – Minimum Design Standards](#) for further information on what testing is required. The Applicant's Engineer (or a representative under their direct supervision) must witness and certify all testing of all sewer infrastructure in accordance

with SC DHEC requirements and the guidelines set forth in this Manual. The Applicant's Engineer shall refer to [Appendix V – Pre-Construction Meeting Agenda and Inspection & Testing Forms](#) for all required testing forms. The ReWa Inspector must witness all testing and sign testing forms to confirm observance and acceptance of the results. **The Applicant's Engineer must provide ReWa with no less than 48 hours of notice of any testing. Any testing performed but not witnessed by ReWa and/or not certified by the Applicant's Engineer will not be accepted.** If the ReWa Inspector and/or the Applicant's Engineer is not on-site to witness, record or certify the initial test, testing shall be re-performed in the presence of the ReWa Inspector and the Applicant's Engineer.

At the completion of construction, the Applicant's Engineer shall submit the testing forms as part of the Project Closeout submittal package (refer to [Appendix IV – Capacity Approval Process & Project Closeout Checklists](#)) to ReWa for review.

#### 4.3.5 *Connection to ReWa Sewer System*

New connections to the existing ReWa sewer system are allowed only after the construction of the proposed sewer system within the new development is complete and the required performance testing has been performed and accepted by ReWa. Applicants shall refer to [Section 6.2 – Gravity Sewer](#) for the guidelines on which types of connections are acceptable and how connections to existing laterals or main sewer trunk lines shall be performed.

##### 4.3.5.1 Tie-In Coordination Meeting

Before connection to the ReWa sewer system is made, a site meeting shall take place. The Applicant, the Applicant's Engineer and the ReWa Inspector are required to be in attendance. If the Applicant will not be performing the connection themselves, the Applicant is responsible for bringing their contractor to the meeting. The purpose of the site meeting is to finalize the location and the sequence of construction for the proposed connection. All public main extension connections must be made a water and sewer general contractor who possesses a South Carolina LLR "WL" or "WP" license. **The ReWa Inspector must be on-site to observe the connection. No part of the installation in the sewer easement shall be backfilled or covered prior to receiving written correspondence from ReWa confirming that work is satisfactory.**

ReWa prefers that all new public main extensions are connected to the existing ReWa sewer system via a new or existing manhole unless circumstances prevent these types of connection (refer to [Section 6.2.5.1 – Existing Manhole](#) and [Section 6.2.5.3 – Cut-in Manhole](#), respectively for further detail on sewer connection).

**If connection does not comply with the standards in this Manual, the ReWa Inspector will coordinate the local Building Code Division to place a hold on the Certificate of Occupancy until the connection is deemed acceptable by ReWa.**

#### 4.3.6 Final Inspection

Once construction of the sanitary sewer system and all associated work has been complete, the Applicant's Engineer shall submit a written request via email to ReWa for a final inspection of the new sewer system. The request shall be submitted to the ReWa Development Project Engineer at [development@re-wa.org](mailto:development@re-wa.org) under the subject line: "Final Inspection". Its purpose is to confirm conformance with the Approved for Installation drawings (excluding any changes approved by ReWa) and the minimum design standards set forth in this Manual.

**The Applicant shall coordinate the Final Inspection with the ReWa Inspector at least five (5) working days (not including weekends or holidays) prior to the desired final inspection date.**

The ReWa Inspector shall document and prepare a final deficiency list summarizing the remaining issues that need to be resolved. Once all outstanding deficiencies are corrected, the Applicant's Engineer notify the ReWa Inspector so a subsequent final inspection can be scheduled. If deficiencies have not been corrected to a satisfactory level, ReWa will issue subsequent deficiency lists detailing the issues that need to be resolved. The project closeout phase cannot be initiated until the issues on the deficiency list(s) have been fixed.

#### 4.4 PROJECT CLOSEOUT

##### 4.4.1 Part 1 of Project Closeout Checklist & Submittal Package

To commence the project closeout phase, the Applicant's Engineer shall begin by preparing Part 1 of Project Closeout submittal package (refer to the applicable forms in [Appendix IV – Capacity Approval Process & Project Closeout Checklists](#)) and provide to the ReWa Development Engineer at [development@re-wa.org](mailto:development@re-wa.org) under the subject line: "Project Closeout – Part 1".

##### 4.4.1.1 Record Drawings

Record drawings are expected to illustrate the as-constructed condition of the newly installed sanitary sewer system. The Applicant's Engineer shall refer to the appropriate record drawing checklist for the infrastructure installed (refer to [Appendix IV – Capacity Approval Process & Project Closeout Checklists](#)). It is the responsibility of the Applicant's Engineer to incorporate all required items on the appropriate checklist into the record drawings.

ReWa will be responsible for reviewing the record drawings against the checklists completed by the Applicant's Engineer. If any required items are considered incomplete by ReWa, they will be marked as such on the checklist, and returned to the Applicant's Engineer along with any additional comments in the record drawings. The Applicant's Engineer is responsible for making all corrections noted to the record drawings and re-submitting them to the ReWa Development Project Engineer. All corrections reflected on the drawing shall be bubbled and include a revision number. This review process will continue until all required items are considered complete by ReWa.

#### 4.4.1.2 Maintenance Agreement

If the Applicant intends to transfer ownership of the new sanitary sewer system to ReWa, the Applicant must prepare an unexecuted and unrecorded Maintenance Agreement between the Applicant and ReWa and include with the Part 1 of submittal package (refer to [Appendix VII – Legal Documents](#)). The agreement shall warrant to ReWa that all materials and equipment furnished and installed as part of the new sanitary sewer system. The Applicant is expected to install, and the Applicant is to oversee that all work is of good quality, free from faults and defects and conform to the standards set forth in this Manual.

The maintenance period shall last for **two years** and is required for all new sewer infrastructure. The warranty period will begin upon issuance of the ReWa ownership acceptance letter. ReWa reserves the right to require a longer warranty period if special circumstances necessitate an extended examination of work. During the warranty period, the Applicant is responsible for repairing, replacing and/or remedying any defects or issues that arise to the full and complete satisfaction of ReWa. **If any repairs or replacements are made by the Applicant during the maintenance period, the maintenance period shall automatically be extended for a period of two years from the date of said repair and/or replacement.**

#### 4.4.1.3 Final Pay Application

A copy of the final pay application for the labor and materials related to the new sanitary sewer system shall be provided with Part 1 of Project Closeout submittal package.

Once all required items in Part 1 of Project Closeout submittal package are considered complete by ReWa, the ReWa Development Project Engineer will notify the Applicant and Applicant's Engineer and forward a copy of ReWa's completed checklist and CCTV inspections to all parties for their records.

#### 4.4.2 CCTV Inspection & GPS Documentation

After Part 1 of Project Closeout submittal package has been accepted by ReWa and there are no further comments, the Applicant's Engineer shall perform a CCTV inspection of the new sewer system. Costs, scheduling, and documentation associated with CCTV inspections shall be the responsibility of the Applicant. CCTV Inspections shall conform to the requirements of *Section 33 01 30.11 – Television Inspection of Sewers* in [Appendix II – Standard Specifications](#). The CCTV documentation shall be submitted to the ReWa Development Project Engineer at [development@re-wa.org](mailto:development@re-wa.org) under the subject line: "CCTV Inspection – *Project Name*". ReWa will be responsible for reviewing the CCTV documentation and providing written acceptance or a list of corrective measures.

Concurrent with the CCTV inspection, Applicant will document the location of all appurtenances associated to the new sanitary sewer system via GPS and submit to ReWa for review & approval.

GPS datum and accuracy shall be in accordance with the *Field Engineering/Surveying* specification shown in [Appendix II – Standard Specifications](#).

The CCTV inspection of the new sanitary sewer system will include the public main extension and any connected service laterals. A cleanout must be installed within the new sanitary sewer system prior to performing the CCTV inspection.

**Please note that requests for review of CCTV inspections will be processed by ReWa in the order in which they are received.**

Any deficiencies observed in the CCTV inspection will be included in the CCTV review comments. The Applicant’s Engineer will be responsible for ensuring all repairs are made and any other issues detailed in the comments are corrected. The Applicant’s Engineer will be responsible for communicating to ReWa when all deficiencies identified in the report have been corrected and perform a subsequent follow-up CCTV inspection. Applicant’s Engineer shall provide final CCTV documentation for ReWa review and acceptance. Additional CCTV inspections may be required until the repairs to the new system are deemed satisfactory. Upon acceptance of the inspections, ReWa will prepare a final written acceptance and forward it to the Applicant’s Engineer.

#### 4.4.3 Part 2 of Project Closeout Checklist & Submittal Package

After the CCTV inspections have been accepted by ReWa, the Applicant’s Engineer may submit Part 2 of Project Closeout submittal package (refer to the applicable forms in [Appendix IV – Capacity Approval Process & Project Closeout Checklists](#) and [Appendix VII – Legal Documents](#)) and provide to the ReWa Development Engineer at [development@re-wa.org](mailto:development@re-wa.org) under the subject line: “Project Closeout – Part 2”.

##### 4.4.3.1 Dedication and Conveyance of Sewer Line

An electronic copy of the Dedication and Conveyance of Sewer Line and its associated exhibit shall be submitted electronically as part of the Part 2 of Project Closeout submittal package. ReWa’s attorney will conduct a title search before reviewing the Dedication and Conveyance document and exhibit. Once all comments from the attorney have been addressed, a signed and notarized hard copy of the Dedication and Conveyance document (refer to [Appendix VII – Legal Documents](#)) and exhibit shall be submitted to the attorney for recording. ReWa’s attorney will record the document.

##### 4.4.3.2 Easements

Refer to [Section 3.5 – Easement Requirements](#).

#### 4.4.4 Ownership Acceptance

Upon acceptance of the CCTV inspections and Project Closeout submittal package, ReWa shall issue a copy of the ownership acceptance letter to the Applicant and the Applicant’s Engineer (refer to [Appendix VII – Legal Documents](#) for a sample ownership acceptance letter). The letter will serve as confirmation that all ReWa’s requirements have been met and the new sanitary sewer system has been accepted for ownership, operation and maintenance by ReWa.

#### 4.4.4.1 Transfer of Utilities

The ownership acceptance letter only applies to the new sanitary sewer system and does not include a transfer of utilities (i.e., gas, electric, water, etc.). Utilities will not be transferred over to ReWa until the PTO has been issued by SC DHEC. At that point, ReWa and the Applicant shall meet to discuss the transfer of utilities required to operate and maintain the new sanitary sewer system.

#### 4.4.5 SC DHEC Permit to Operate

The Applicant's Engineer shall use the ownership acceptance letter to confirm ReWa's acceptance of operation & maintain of the new sanitary sewer system. The Applicant's Engineer shall include the letter along with their Permit to Operate (PTO) submittal package to SC DHEC for the new sanitary sewer system. Once the approved PTO has been received, the Applicant's Engineer is responsible for forwarding a copy of the permit to ReWa.

**The Applicant is not permitted to discharge flow into the newly construction sanitary sewer system until a PTO has been officially issued by SC DHEC and ReWa has received a copy.**

## 5.0 SERVICE LATERAL CONNECTIONS

The information in this section covers the submittal and approval requirements for service lateral connections as defined in Section 3.0. The guidelines set forth shall apply to all service lateral connections installed in the Service Area. No deviations to these requirements are allowed without the express written consent of Renewable Water Resources.

### 5.1 NEW SERVICE LATERAL

All capacity requests to extend sewer service for a re-purposed building, new commercial development, or new building shall follow the instructions in the order described in this section for 'Service Lateral Connection'. Per SC DHEC R.61-67, permitting through SC DHEC is not required if the following conditions are met:

1. Individual connections, at the time of connection, have design flow contribution no greater than five (5) percent of the existing wastewater treatment facility's design capacity or have no generated flows greater than fifty thousand (50,000) gallons per day.
2. Individual connections are to a gravity sewer main.
3. Individual connections only serving a single house, single mobile home, single building, or multiple-building complex under single ownership with no rental units (e.g., schools or industry).
4. Individual connections are not serving a shopping mall, multiple-building complex where there will be several owners or renters (e.g., apartment complex, condominium complex, mobile home park, campground, industrial park, or business park), or marina.
5. Individual connections that do not have the reasonable ability to serve any additional projects and/or buildings in the future that are not part of a multiple-building complex under single ownership with no rental units (e.g., schools or industry).

If the new building or development requiring sewer service does not meet the SC DHEC requirements listed above, the new sanitary sewer system falls under 'Public Main Extension'. The Applicant shall refer to [Section 4.0 – Public Main Extensions](#) and follow the guidelines therein for obtaining capacity approval.

Upon receipt of approval from the appropriate entities, Applicants are allowed to connect their service laterals to an existing gravity sewer line or manhole owned and maintained by a Satellite Sewer Agency, or directly to a manhole that owned and maintained by ReWa (refer to [Section 5.2.2.2 – Direct Connect to ReWa Manhole](#)).



## 5.2 CAPACITY APPROVAL PROCESS

Applicants shall refer to [Appendix III – Process Flowcharts](#) for illustration of the capacity approval submittal process for ReWa and Satellite Sewer Agency service lateral connections, respectively.

For all ReWa Service Lateral Connections, the Applicant shall refer to the Service Lateral Capacity Request Form and Process which provides explicit detail into the steps required for obtaining capacity approval (refer to *ReWa Service Lateral Capacity Request Form and Process* in [Section 1.5 – ReWa Online Resources](#)). The Applicant are encouraged to familiarize themselves with the process and documentation required for approval. **Failure to provide required information in order in which it is listed may result in delays in the approval process.**

### 5.2.1 *Communication with Satellite Sewer Agencies (SSA)*

For all SSA Service Lateral Connections, the Applicant shall communicate their development plans with the appropriate SSA (refer to [Figure 1-1: ReWa Service Area & Subdistrict Boundaries Map](#)). The Applicant must receive capacity approval from the primary SSA (and secondary/transport, if applicable) before ReWa will grant approval of the Applicant’s Capacity Request.

If the new or re-purposed building or development falls within the Service Area boundaries, but outside of the limits of any SSAs, then ReWa is recognized as the primary sewer provider. Thus, the Applicant will only need to receive approval from ReWa.

### 5.2.2 *ReWa Capacity Approval Request*

Once the Applicant has received capacity approval from the Satellite Sewer Agencies (if required), the Applicant shall begin their formal capacity approval request with ReWa (refer to Capacity Approval Process in *ReWa Preliminary Service Lateral Capacity Request Process & Form* in [Section 1.5 – ReWa Online Resources](#)). The Applicant shall complete the form and provide all the information listed on the form.

**ReWa will not review any capacity request forms that do not include preliminary approval from the appropriate Satellite Sewer Agencies.**

#### 5.2.2.1 Estimated Total Sewer Flow

The estimated total daily sewer flow using SC DHEC Unit Contributory Loadings shall be provided on the *Service Lateral Preliminary Capacity Request Form* prepared by the Applicant. The provided flow shall be based on the average daily flow projection. Refer to [Section 6.1.2 – Sanitary Sewer Sizing](#) as for the basis for average daily flow projection.

As part of the capacity approval request, the Applicant is expected to identify how they intend to connect their proposed service lateral to the existing sewer system. ReWa prefers service lateral connections to be made at a manhole (refer to [Sections 6.2.5 – Manholes](#) for acceptable manhole connection methods via manhole). Connections at an existing sewer main by direct tap or



doghouse manhole may be allowed but will be reviewed on a case-by-case basis and must be approved by ReWa.

#### 5.2.2.2 Direct Connect to ReWa Manhole

If the service lateral will be directly connected to a ReWa manhole, the Applicant will be required to complete the *Direct Connect to ReWa Form* (refer to *Direct Connect to ReWa Form and Process* in [Section 1.5 – ReWa Online Resources](#)). Please note that the Applicant shall be responsible for paying ReWa’s New Account Fee (refer to *ReWa New Account Fees* in [Section 1.5 – ReWa Online Resources](#)) from approval is granted by ReWa.

If the connection point will be made at a Satellite Sewer manhole, the Applicant is responsible for communicating development plans and adhering to any details or standards set forth by the Satellite Sewer Agency to receive approval for new service lateral installation to existing manholes.

Once the capacity request has been reviewed and approved, ReWa Engineering will distribute the approved Service Lateral Connection Capacity Request Form to the Applicant and Satellite Sewer Agency (if applicable).

#### 5.2.3 Additional Requests

In special circumstances, ReWa may request that the Applicant provide additional information prior to issuance of the capacity approval letter.

##### 5.2.3.1 Food Service Establishments

New or renovated (requiring a building permit) Food Service Establishments (FSE’s) shall submit grease trap design for review and approval by the ReWa Pre-Treatment Department. See ReWa Sewer Use Regulation Attachment B for FSE Fees.

#### 5.2.4 Withdrawal of ReWa’s Capacity Approval

ReWa’s Capacity Approval for a Service Lateral Connection is contingent upon the Applicant adhering to the guidelines set forth in this Manual. In addition to criteria provided in [Section 3.6 – Project Cancellation](#), a Capacity Approval may be rescinded by ReWa if either of the following issues occur:

1. The development is not completed within two years of the ReWa Representative’s signed date of the Service Lateral Connection Capacity Request Form.
2. The plans for the development change and the previously requested flow is no longer applicable. In such cases, a new capacity request will be required.
3. Any variances in construction that are performed prior to receiving approval from ReWa or the appropriate stakeholders.

### 5.2.5 Additional Stakeholders

After receiving capacity approval from ReWa, the Applicant is required to identify all other stakeholders, communicate development plans with those entities, and determine which permits are required prior to commencement of construction (refer to [Section 2.5 – Other Stakeholders](#)).

**Sections 5.3, 5.4 & 5.5 only apply to ReWa Service Lateral Connections. For SSA Service Lateral Connections, the Applicant shall refer to the guidelines and standards for construction, testing and closeout of Service Lateral Connections established by the appropriate Satellite Sewer Agency.**

## 5.3 CONSTRUCTION ACTIVITY & REQUIREMENTS FOR REWA SERVICE LATERAL CONNECTIONS

### 5.3.1 Variance During Construction

Any request to perform construction activity that would necessitate a variance from the guidelines written in this Manual must be submitted to ReWa and all other applicable stakeholders by the Applicant prior to the construction of the variance. **Any variances in construction that are performed prior to receiving approval from ReWa or the appropriate stakeholders may result in a withdrawal of ReWa’s Capacity Approval.**

If drawings were provided to ReWa as part of an additional request, all revision dates shall be recorded and shown on those drawings. Once the revised drawings have been approved, the Applicant’s Engineer is responsible for re-issuing the drawings and distributing them to the appropriate parties.

**If the requested changes invalidate the estimated total sewer flow provided in the capacity request, then ReWa’s capacity approval shall be withdrawn. A new capacity request form will be required, and the capacity process must start all over again.**

### 5.3.2 Inspections

All gravity sewer mains, force mains, manholes, and other sewer infrastructure installed within the Service Area shall be subject to inspection prior to backfilling and testing by the ReWa Inspector. The ReWa Inspector shall be present for all new construction and modifications to sanitary sewer main & associated sewer infrastructure.

The Applicant is responsible for verifying that all materials installed on the project comply with the standards in this Manual and shall notify the ReWa Inspector when materials are delivered onsite. The ReWa Inspector may require a field review of the materials prior to installation if there are concerns about the new materials meeting the standards set for this Manual. If the field review is insufficient in alleviating the ReWa Inspector’s concerns, the ReWa Inspector may require supporting documentation to verify the standards in this Manual are being met. **Work stoppages may result if the ReWa Inspector cannot satisfactorily verify that the work is compliant with the standards established in this Manual.**

### 5.3.2.1 Pipe Inspections

The ReWa Inspector shall perform a visual inspection of all lines, regardless of pipe material. If the ReWa Inspector notices any settlement or slope loss of the sewer main as it enters and or leaves a manhole, the line shall be uncovered and raised to proper alignment. If the ReWa Inspector finds excessive misalignment of the piping between manholes, the entire line shall be removed and re-laid.

### 5.3.2.2 Manhole Inspections

The ReWa Inspector will check all the flow channels between inverts and all benches to verify proper construction. The ReWa Inspector also shall inspect all manholes to ensure that lift holes, steps, joints and rings are mortared smooth in accordance with [Appendix I – Standard Drawings](#) and [Appendix II – Standard Specifications](#). For the work to be deemed acceptable, there shall be no signs of infiltration into the manhole. The ReWa Inspector will verify proper alignment of the ring and cover and all sections of the manhole. The ReWa Inspector will also verify that the ring and cover are at appropriate grade.

### 5.3.3 Performance Testing

All service laterals and other sewer infrastructure installed as part of the Service Lateral Connection shall be subject to testing. ReWa’s inspector must witness all testing. **The Applicant must provide the ReWa Inspector with no less than 48 hours of notice of any testing.** Any testing performed but not witnessed by ReWa will not be accepted. In this event, testing shall be re-performed in the presence of ReWa. **If the new sewer is backfilled prior to testing being witnessed by ReWa, the Applicant will be required to uncover the new service lateral and associated sewer infrastructure and re-perform testing at ReWa’s request.**

The Applicant shall refer to [Appendix V – Pre-Construction Meeting Agenda and Inspection & Testing Forms](#) for the appropriate testing forms. The Applicant is responsible for certifying that each test has been performed in conformance with the standards, and the ReWa Inspector will sign the forms to confirm observance of the results.

### 5.3.4 Connection to Existing Sewer System

New connections to the ReWa sewer system are allowed only after the construction of the proposed sewer system within the new development is complete and the required performance testing has been performed and accepted by ReWa. Applicants shall refer to [Section 6.2 – Gravity Sewer](#) for the guidelines on which types of connections are acceptable and how connections to existing laterals or main sewer trunk lines shall be performed.

ReWa prefers service lateral connections to be made at a manhole. If the Applicant wishes to tie into an existing ReWa manhole, the Applicant shall refer to [Section 6.2.5.2 – Existing Manhole](#) for further instructions.

Connections to an existing gravity sewer main via direct connection or tap are allowed for service lateral connections only. The Applicant shall refer to *Detail No. SS-22, Service Lateral Saddle Connection to Existing Sewer Main* in [Appendix I – Standard Drawings](#) for installation instruction for direct connection to existing sewer mains and the guidelines depending the type of service lateral connection (refer to [Section 3.3 – Service Lateral Connections](#)).

#### 5.3.4.1 Tie-In Coordination Meeting

Before connection to the ReWa sewer system is made, a site meeting shall take place. The Applicant and the ReWa Inspector are required to be in attendance. If the Applicant will not be performing the connection themselves, the Applicant is responsible for bringing their contractor to the meeting. The purpose of the site meeting is to finalize the location and the sequence of construction for the proposed connection. All service lateral connections must be made a mechanical contractor (with a specialization in plumbing) that is licensed to perform water and sewer work. **The ReWa Inspector must be on-site to observe the connection. No part of the installation in the sewer easement shall be backfilled or covered prior to receiving written correspondence from ReWa confirming that work is satisfactory.**

**If the service connection does not comply with the standards in this Manual, the ReWa inspector will coordinate the local Building Code Division to place a hold on the Certificate of Occupancy until the connection is deemed acceptable by ReWa.**

## 5.4 PROJECT CLOSEOUT

### 5.4.1 *CCTV Inspection*

Upon completion of the installation of the new service lateral connection, the Applicant's Engineer shall perform a CCTV inspection of the new sewer system. Costs, scheduling, and documentation associated with CCTV inspections shall be the responsibility of the Applicant. CCTV Inspections shall conform to the requirements of *Section 33 01 30.11 – Television Inspection of Sewers* in [Appendix I – Standard Drawings](#). The CCTV documentation shall be submitted to the ReWa Development Project Engineer at [development@re-wa.org](mailto:development@re-wa.org) under the subject line: "CCTV Inspection – *Project Name*". ReWa will be responsible for reviewing the CCTV documentation and providing written acceptance or a list of corrective measures.

Concurrent with the CCTV inspection, Applicant will document the location of all appurtenances associated to the new sanitary sewer system via GPS and submit to ReWa for review & approval. GPS datum and accuracy shall be in accordance with the *Field Engineering/Surveying* specification shown in [Appendix II – Standard Specifications](#).

The CCTV inspection of the new sanitary sewer system will include the public main extension and any connected service laterals. A cleanout must be installed within the new sanitary sewer system prior to performing the CCTV inspection.

**Please note that requests for review of CCTV inspections will be processed by ReWa in the order in which they are received.**

The CCTV inspection shall terminate at the cap of the new cleanout on the property owner's side (refer to *Detail No. SS-18, Service Lateral Cleanout* in [Appendix I – Standard Drawings](#)). Any deficiencies observed in the CCTV inspection will be included in the CCTV review comments. The Applicant's Engineer will be responsible for ensuring all repairs are made and any other issues detailed in the comments are corrected. The Applicant's Engineer will be responsible for communicating to ReWa when all deficiencies identified in the report have been corrected and perform a subsequent follow-up CCTV inspection. Applicant's Engineer shall provide final CCTV documentation for ReWa review and acceptance. Additional CCTV inspections may be required until the repairs to the new system are deemed satisfactory. Upon acceptance of the inspections, ReWa will prepare a final written acceptance and forward it to the Applicant's Engineer.

#### **5.4.2 Ownership Acceptance**

Once all of the deficiency list items from the CCTV inspection have been addressed and outstanding invoices and fees have been paid by the Applicant, ReWa shall issue an ownership acceptance letter to the Applicant (refer to [Appendix VII – Legal Documents](#) for a sample ownership acceptance letter). The letter will serve as confirmation that all ReWa's requirements have been met and the new sanitary sewer system has been accepted for ownership, operation and maintenance by ReWa.

## 6.0 MINIMUM DESIGN STANDARDS

The information detailed in this section covers general requirements for construction of wastewater collection and conveyance systems. This is applicable to all developments requiring wastewater service. Deviations from the procedures and guidelines listed in this section WILL NOT be allowed the express written consent of Renewable Water Resources.

### 6.1 GENERAL

#### 6.1.1 General

1. These design standards shall be used to compliment the requirements set forth by all applicable federal, state and local requirements. In instances where information between separate guidelines conflict, the more stringent guideline will prevail.
2. Design of all sanitary sewer systems shall be performed, stamped and sealed by a Professional Engineer registered in the State of South Carolina.
3. These design standards shall apply to all developments requiring wastewater service and connection to the ReWa sewer system.
4. There shall be enough area cleared around the new sanitary sewer system (i.e. gravity sewer, force main, pump stations) such that access for maintenance is not inhibited.
5. The submittal package to ReWa shall include system-head capacity curves for the proposed pumping station and force main with the selected pump characteristic curve superimposed to demonstrate that all pump design operating points comply with the pump capacity and performance requirements stated in the ReWa Development Manual.
6. For pump stations employing parallel pump operation (i.e., pump stations with three or more pumps), the pump characteristic curves for multiple pumps in parallel operation shall also be shown on the system-head capacity curves. For pump stations that include variable frequency drives, the pump characteristic curves for maximum and minimum speeds shall also be shown on the system-head capacity curves.
7. The submittal package to ReWa shall include the pump manufacturer's pump performance curve depicting head, efficiency (whole pump, not just impeller), brake horsepower, and NPSHr as a function of flow rate as well as the boundaries of the preferred operating range, allowable operating range, and the minimum continuous stable flow rate.

### 6.1.2 Sanitary Sewer Sizing

New sanitary sewers shall be sized to accommodate peak hourly flow projections. Peak hourly flow shall be the average daily flow times the appropriate peaking factor. The guidelines shall be followed to determine the average daily flow and the appropriate peaking factor for design:

1. Use 75 gallons per day (gpd) per person as the basis for determining average daily flow.
2. Use actual data (where available) to determine a peaking factor.
3. In the absence of actual data, multiply the estimated average daily flow by a calculated peaking factor, which is a function of the estimated population within the new development (see formula below):

$$\text{Peaking Factor} = \frac{18 + \sqrt{P}}{4 + \sqrt{P}}, \text{ where } P = \text{population}^1$$

- a. Population, in peaking factor equation, shall be based on a minimum of 3 persons per residential unit.
4. A minimum peaking factor of 2.5 will be used when the calculated peaking factor is less than 2.5.

### 6.1.3 Relation to Water Mains

#### 6.1.3.1 Conflicts

The safety and protection of public and private water utilities is paramount to ReWa and the people residing in the upstate of South Carolina. No physical connections shall be made between a public or private potable water supply system and any sanitary sewer or appurtenances which would allow passage of any sewage or polluted water into the potable water supply. Under no circumstances shall any sanitary sewer construction come into contact or conflict with any components of a potable water supply system.

#### 6.1.3.2 Horizontal and Vertical Clearances

Sanitary sewers shall be separated from potable water main shall be installed based on the following separation requirements:

1. Horizontal separation of ten (10) feet (measured from edge to edge of respective pipes)

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<sup>1</sup> "Figure 1 – Ratio of Peak Hourly Flow to Design Average Flow". *Recommended Standards for Wastewater Facilities*, 2014 Edition.

2. Vertical separation of eighteen (18) inches (measured from edge to edge of respective pipes)

If the separations as described above are not feasible due to site conditions and constrictions, the new sanitary sewer must be installed in a separate trench where the elevation of the top of sewer is at least 18 inches below the bottom of the water main. For all other scenarios, deviations will not be allowed without permission from ReWa. ReWa may allow deviations from the design criteria set forth if supported by data from the Applicant's Engineer. Requests for deviation will be reviewed on a case-by-case and additional measures (beyond the minimum standards) may be required to receive approval.

If the new sanitary sewer system will be installed in SC DOT R/W, the Applicant's Engineer shall refer to latest SC DOT Utility Accommodation Controls and Standards (refer to *SC DOT Utility Accommodation Controls and Standards* in [Section 1.5 – ReWa Online Resources](#)). The most stringent regulations shall govern the required horizontal and vertical clearances.

#### 6.1.3.3 Crossings

Proposed sanitary sewers crossing potable water mains shall be laid such that there is a minimum vertical separation of eighteen (18) inches between the outside pipe walls of the potable water main and sanitary sewer.

Proposed sanitary sewers shall be laid below potable water mains, when possible. Installation of sanitary sewers shall be such that its joints are as far from the point of crossing as possible. When it is not possible for the potable water main to be laid above the proposed sewer line, the Applicant shall ensure that adequate structural support is provided for the sewer line to prevent damage to the potable water main while maintain line and adequate cover.

#### 6.1.3.4 Special Circumstances

1. When it is not possible to obtain the distance specified in [Section 6.1.3.2](#) and [Section 6.1.3.3](#) above, ReWa may allow an alternate layout if the following criteria is met:
  1. Distance between the proposed sewer line and water main and the joints of each are maximized.
  2. Allow for enough room to make repairs to one line without damaging the other.

Applicants shall be aware that approval for alternate layout will provided on a case-by-case basis. Applicants are encouraged to provide all relevant documentation to confirm the requirements in in [Section 6.1.3.2](#) and [Section 6.1.3.3](#) have been achieved.



#### 6.1.4 Relation to Storm Drains

##### 6.1.4.1 Conflicts

Sanitary sewer pipes are not allowed through a storm water pipe, catch basin or any other type of storm water conveyance structure unless ReWa has determined there to be no other feasible alternatives and granted approval to proceed.

##### 6.1.4.2 Vertical Clearance

Sanitary sewer piping shall be installed using DIP when proposed sewer will be located underneath a storm drain. For sewers over top of or below storm drains, DIP shall be used when clearance is less than 1 foot, outside-to-outside.

Structural design may be required given the weight of the structure clearance to sewer piping if deemed necessary by ReWa. Each design will be reviewed on a case-by-case basis.

If the new gravity sewer main will be installed in SC DOT R/W, the Applicant's Engineer shall refer to latest SC DOT Utility Accommodation Controls and Standards (refer to SC DOT *Utility Accommodation Controls and Standards* in [Section 1.5 – ReWa Online Resources](#)). The most stringent regulations shall govern the required vertical clearance.

The above guidelines set forth for installation above for storm sewer infrastructure shall apply to underground conduit banks for telephone, cable TV and power lines.

#### 6.1.5 Surveying Standards

All surveying for new gravity sewers, force mains and pump stations shall be performed by a Registered Land Surveyor registered in the State of South Carolina. All surveying shall be performed in accordance with the Minimum Standards Manual for the Practice of Land Surveying in South Carolina, Code of Regulations Chapter 49, Article 4. Surveying shall be based on the State Plane Coordinate System and in accordance with the Field Engineering/Surveying specification in [Appendix II – Standard Specifications](#).

#### 6.1.6 Bypass Pumping

Where intermittent or long-term (continuous) bypass pumping are required to bypass flows in existing gravity sewer or force mains, Applicant's Engineer's design documents shall reference Section 33 01 30.45 - *Temporary Bypass Pumping* in [Appendix II – Standard Specifications](#).

Standard specification shall be edited by Applicant Engineer to reflect project specific requirements. Bid documents shall also include provisions for long-term (continuous) bypass pumping as base-bid items, with bid alternates for intermittent (non-continuous) pumping if project conditions warrant only intermittent pumping.

## 6.2 GRAVITY SEWER

### 6.2.1 General

The design standards presented in this section shall be enforced for new gravity sewer mains designed and constructed directly for ReWa, for new systems that are installed by others and subsequently owned by ReWa, and for service laterals installed to serve residential and commercial customers that will tie into the ReWa sewer system.

### 6.2.2 Design Criteria

1. Gravity sewer mains shall be constructed of the following materials:
  - a. Polyvinyl Chloride (PVC): Preferred material for 48" diameter or smaller. Where special loadings or depths require additional structural integrity, C900 PVC pressure pipe may be utilized.
  - b. Ductile Iron (DIP): Use only in special circumstances where required for utility crossings, excessively deep installations, aerial creek crossings or otherwise authorized by ReWa.
  - c. Fiber Reinforced Plastic (FRP): Preferred for pipelines larger than 48" diameter. Bedding shall be specifically designed for the soil conditions, loadings, depth of bury, and pipe thickness.
  - d. Refer to *Section 33 31 11 – Public Sanitary Sewerage Gravity Piping* in [Appendix II – Standard Specifications](#) for further detail on the acceptable material for gravity sewer piping.
2. The minimum size for a public main extension, excluding service lateral connections, shall be 8-inch.
3. Minimum bury depth from top of pipe to finished grade shall be 3 feet (or 42" if located in SC DOT R/W), and maximum bury depth shall be 18 ft. Reduced cover or installations deeper than 18 feet may be approved if justification is provided. The presence or unsuitable soil conditions is not justification for reduced cover. In these scenarios, the primary alternative will be to install DIP. For shallow, or excessively deep applications, The Applicant's Engineer shall submit design calculations detailing loads on pipe and bedding design to ReWa for review and consideration.
4. When a smaller gravity sewer is connected to a larger gravity sewer main 30" in diameter or smaller through a manhole, the smaller gravity sewer shall be installed such that the crowns of both pipes match. When the larger gravity sewer is larger than 30", the smaller gravity sewer shall be installed such that their crowns match if the difference in elevation between the incoming pipe and the manhole invert is less than 24". If the difference in inverts is greater than 24", a drop pipe is required for the smaller gravity sewer entering the manhole to meet SCDHEC regulations.

5. Manhole spacing shall adhere to the maximum spacing requirements set forth below or the latest SC DHEC standards, whichever spacing is shorter.
  - a. Pipe diameters up to 15": 400 ft.
  - b. Pipe diameters from 18" – 30": 500 ft.

\* For pipe sizes greater than 30", manhole spacing shall be evaluated by ReWa on a case-by-case basis.
6. Manholes shall have a minimum 0.2-foot drop in elevation from the lowest upstream inlet invert to the invert of the outlet.
7. Gravity sewer mains shall be laid with a straight alignment and uniform slope between manholes.
8. Horizontal alignment should consider property lines, topography, environmental damage (i.e., tree removal) and existing property owner wishes.
9. The minimum downstream angle between gravity sewer mains intersecting at manhole is 90 degrees or greater. Manholes shall be sized so that at least 12" of the manhole wall remains between cored or formed openings.
10. Cleanouts shall be installed for all service laterals in accordance with the details in [Appendix I – Standard Drawings](#).

### 6.2.3 Capacity Design

#### 6.2.3.1 Minimum Slope

Under no scenario shall the slope of a gravity sewer main values fall under the minimum values listed in Table 6-1 below:

**Table 6-1: Minimum Slope Requirements for Gravity Sewer Piping**

Nominal Sewer Size (inches)	Minimum Slope (feet per 100 feet)
4	1.00
6	1.00
8	0.50
10	0.32
12	0.25
14	0.20
15	0.18

Nominal Sewer Size (inches)	Minimum Slope (feet per 100 feet)
16	0.17
18	0.12
21	0.10
24	0.08
30 & Larger	*

\* Minimum slope will be determined based on velocity calculations using actual data or flow projections.

### 6.2.3.2 Pipe Size Determination

The Applicant’s Engineer shall use the Manning’s Equation to determine the appropriate pipe size for all gravity sewer mains:

$$Q = 1.486 * A * (R^{2/3}) * (S^{1/2})$$

where

- Q, flow in cubic feet per second (cfs)
- n, Manning’s coefficient = 0.013
- A, cross-sectional area of pipe in square feet
- R, hydraulic radius = D/4 for pipe flowing full
- S, pipe slope in ft/ft

All gravity sewer mains shall be sized such that peak hourly flow does not exceed the maximum percent (%) full at peak flow values (i.e., depth of flow relative to the diameter of the pipe ( $d/D$ )) shown in Table 6-2 below:

**Table 6-2: Maximum Allowable Flow Depths for Gravity Sewer Piping**

Nominal Sewer Size (inches)	Maximum % Full at Peak Flow ( $d/D$ )
8	0.50
10	0.60
12	0.60
14	0.65
15	0.65
16	0.70
18 & Larger	0.75

### 6.2.3.1 Velocities

Gravity sewer mains shall be designed for a minimum velocity of two (2) feet per second (fps) when pipe is flowing full.

### 6.2.4 Service Laterals

The Applicant must adhere to the following guidelines for installing service laterals:

1. Refer to service lateral details for installation requirements in [Appendix I – Standard Drawings](#).
2. In plan view, service laterals shall be installed perpendicular to the gravity sewer and connected to a manhole (preferred) or connected using a wye fitting to the main pipe.
3. Minimum spacing between service lateral connections shall be 10 feet.
4. Service laterals shall be generally located 10 feet from the property corner.
5. A minimum size of 6-inch diameter shall be used for the service laterals in the following applications:
  - a. Multi-family family building with up to 4 units
  - b. Up to two individual residential units connected via double wye.
  - c. A single commercial building with a single occupant.
6. Slope of service laterals shall meet or exceed the minimum slope requirements identified in [Section 6.2.3 – Capacity Design](#).
7. Cleanouts for service laterals shall be installed prior to CCTV inspection. Refer to *Detail No. SS-18, Service Lateral Cleanout* in [Appendix I – Standard Drawings](#).

### 6.2.5 Manholes

#### 6.2.5.1 New Manhole:

Manholes shall be installed along a gravity sewer main line at the following locations:

1. At the end of each gravity sewer main.
2. At all changes in line size, slope, or alignment.
3. Installed at intervals that do not exceed 350 feet.

Precast manholes are preferred for new manholes. In unique circumstances where the installation of precast manholes is not feasible, other construction materials/methods may be considered upon approval from ReWa. Refer to *Detail Nos. SS-2 through SS-6* in [Appendix I – Standard Drawings](#).

For all manhole installations, the horizontal centerline of the pipe opening in the manholes shall match the centerline of incoming flow. Connection of gravity sewer main to an existing sanitary sewer system under ReWa’s jurisdiction shall be made at an existing manhole or constructing a cut-in manhole.

Drop manholes may only be used to meet local, state or federal requirements, and shall be minimized. Where practical, pipe slope adjustments are preferred to drop connections. If the difference in inverts is greater than 24", a drop pipe connection is required for the sewer line entering the manhole to meet SCDHEC regulations. Refer to *Detail No. SS-7.1, External DIP Drop Connection at Manhole* in [Appendix I – Standard Drawings](#) for proper configuration.

#### 6.2.5.2 Existing Precast Manhole:

If the Applicant wishes to tie into an existing manhole with their new service lateral or public main, the following requirements must be adhered to:

1. Refer to *Detail No. SS-20, New Pipe Connection at Manhole* in [Appendix I – Standard Drawings](#).
2. Connection to existing manhole shall be made in the presence of the ReWa Inspector.
3. New holes in manholes shall be core drilled, as long as work does not compromise the integrity of the manhole.
4. Provide appropriate bypass pumping methods to temporarily block and/or divert sewage flows in accordance with *33 01 30.45 - Temporary Bypass Pumping* in [Appendix II – Standard Specifications](#).
5. Seal around new pipe with boot and grout as detailed in [Appendix I – Standard Drawings](#).

#### 6.2.5.3 Brick Manholes

1. New gravity sewer connections to existing brick manholes is not allowed. Existing manholes shall be removed and replaced with new precast concrete manholes. Refer to *Detail Nos. SS-2 through SS-6* in [Appendix I – Standard Drawings](#).
2. Refer to *Detail No. SS-21, Connection of Existing Sewer to New Manhole* in [Appendix I – Standard Drawings](#).
3. Provide appropriate bypass pumping methods to temporarily block and/or divert sewage flows in accordance with *33 01 30.45 - Temporary Bypass Pumping* in [Appendix II – Standard Specifications](#). Cut out length of existing pipe to accept new manhole.
4. Connections to new manhole shall be made in the presence of the ReWa Inspector.

#### 6.2.5.4 Cut-in Manhole:

If the Applicant wishes to install a cut-in manhole along an existing gravity sewer to accommodate their new service lateral, the following requirement must be adhered to:

1. Refer to *Detail No. SS-21, Connection of Existing Sewer to New Manhole* in [Appendix I – Standard Drawings](#).

2. New manhole inverts shall match slope along existing gravity sewer. If it is not feasible to match existing slope, a doghouse manhole shall be used.
3. Provide appropriate bypass pumping methods to temporarily block and/or divert sewage flows in accordance with *33 01 30.45 - Temporary Bypass Pumping* in [Appendix II – Standard Specifications](#). Cut out length of existing pipe to accept new pipe in manhole.
4. If benches are pre-formed, insert short section of PVC pipe in the existing holes and seal. Lower bottom section of manhole into hole and sleeve to existing piping.
5. If benches are not pre-formed, cut the PVC pipe to form the channel and insert the required length of pipe through the holes in the bottom section of the manhole, set to match existing slope, and seal. Lower the assembly into the hole, sleeve to existing piping, and unblock sewage flows. Using high early strength cement, form benches as in typical manholes.

#### 6.2.6 Materials of Construction

Refer to *Section 33 31 11 – Public Sanitary Sewerage Gravity Piping* in [Appendix II – Standard Specifications](#) for all required materials of construction and standards for gravity sewer main and service lateral piping, fittings, joints and associated appurtenances.

#### 6.2.7 Construction Procedures

Refer to *Section 33 31 11 – Public Sanitary Sewerage Gravity Piping* in [Appendix II – Standard Specifications](#) for all gravity sewer main and service lateral construction procedures, required installation methods and testing standards.

##### 6.2.7.1 Metallic Detection Tape

1. Provide 2” wide metallic detection tape on all buried piping that meets the following guidelines:
  - a. Provide 5.0 mil overall thickness with no less than a 50-gauge solid aluminum foil core.
  - b. Foil to be visible from both sides.
  - c. No inks or printing extended to the edges of the tape.
  - d. Encase printing to avoid ink rub-off.
  - e. Tensile shall be meet or exceed 28 lbs./inch.
  - f. Use heat set Mylar inks.
2. Locate tape 12” below ground surface in pipe trench.
3. Color of tape shall be green.
4. Wording on tap shall read as follows: “CAUTION SEWER LINE BURIED BELOW” at a spacing no greater than 24” on center.

### 6.2.7.2 Tracer Wire

1. Tracer wire must be installed on all force mains. Applicants shall follow the installation guidelines as specified in *Section 33 05 97, Identification and Signage for Utilities* in [Appendix II – Standard Specifications](#).
2. Tracer wire boxes shall be placed at than 500’ maximum spacing intervals. See Tracer Wire Box detail in [Appendix I – Standard Drawings](#).

### 6.2.7.3 Low Pressure Air Testing

Low pressure air testing is required for all gravity sewer mains. Refer to *Section 33 01 32 – Sewer and Manhole Testing* in [Appendix II – Standard Specifications](#) for further instructions on how to perform testing.

### 6.2.7.4 Exfiltration Testing

Exfiltration testing is required for all gravity sewer mains larger than 36” in diameter. Refer to *Section 33 01 32 – Sewer and Manhole Testing* in [Appendix II – Standard Specifications](#) for further instructions on how to perform testing.

### 6.2.7.5 Infiltration Testing

Infiltration testing is required for all gravity sewer piping with a minimum 4’-0” of submergence above crown of pipe. Refer to *Section 33 01 32 – Sewer and Manhole Testing* in [Appendix II – Standard Specifications](#) for further instructions on how to perform testing.

### 6.2.7.6 Deflection Testing of Plastic Piping

All PVC gravity sewer piping shall be tested for initial diametric deflections using a 5% mandrel after the piping has been in place for at least 30 days. Refer to *Section 33 01 32 – Sewer and Manhole Testing* in [Appendix II – Standard Specifications](#) for further instructions on how to perform testing.

### 6.2.7.7 Vacuum Testing

All manholes shall be vacuum tested in accordance with *Section 33 01 32 – Sewer and Manhole Testing* in [Appendix II – Standard Specifications](#).

## 6.3 WASTEWATER PUMPING STATIONS

### 6.3.1 General

It is ReWa’s policy to minimize the need for wastewater pumping stations, or simply pump stations, and to limit their construction and use within the sanitary sewer system. The basis for this general policy is that pump stations can cause disproportionate expense in order to provide service to a limited customer base. The operation and maintenance costs and time for maintaining the pump stations represents a continuing cost and maintenance issue that may stretch available resources and ultimately result in further cost increases, and failure to address issues of pump stations would pose significant environmental risks. Please refer to [Appendix VI](#)



– [Pump Station Policy](#) for further explanation on the factors that will be considered in ReWa’s review as it relates to the potential transfer of ownership of wastewater pumping stations.

However, it is recognized, that there are situations where pump stations are required because gravity service is not available or possible. Unless otherwise authorized by ReWa, pump stations shall meet the following minimum design criteria.

**ReWa will only consider approval of pump stations when installation of gravity sewer mains is not possible.**

### 6.3.2 General Design Criteria

1. The layouts of the pump station and force mains shall match details shown in [Appendix I – Standard Drawings](#).
2. Pump station piping shall be designed in compliance with Hydraulics Institute standard ANSI/HI 9.6.6 (latest edition).
3. The pump station wet well, and dry well shall be ventilated, excluding the valve pit. The vent shall be a screen inverted “j” tube and be constructed with a weather durable material.
4. Well wells and intakes shall be designed in compliance with Hydraulics Institute standard ANSI/HI 9.8 (latest edition).

#### 6.3.2.1 Odor Control

As ReWa’s request, the Applicant’s Engineer may be required to add odor control facilities. The Applicant’s Engineer shall be responsible for incorporating odor control into their pump station design such that acceptable levels as determined by ReWa are achieved. If it is determined that odor control measures are required, the Applicant’s Engineer shall adhere to the following guidelines:

1. Odor control measures via mechanical or chemical treatment may be allowed. Any odor control methods and technologies must be approved by ReWa before it can be implemented.
2. The Applicant’s Engineer shall predict hydrogen sulfide levels at force main discharges and incorporate odor control facilities as deemed necessary and/or as required by ReWa.

### 6.3.3 Capacity Design

The pump station shall be sized to convey the peak hourly design flow, with the largest pump out of service. The design must consider the immediate peak daily design flow and the peak flow at basin build-out, as directed by ReWa. Both peak flows must be accommodated by the design.

Future additions or modifications to the station may be required to handle the range of flows in order to maintain force main velocities and to minimize hydrogen sulfide corrosion. To meet these criteria, impellers may have to be trimmed initially and then replaced with larger impellers when flows increase. However, no operating condition (current or future) shall require the impeller diameter to be trimmed beyond the manufacturer's recommendations.

#### 6.3.4 Pumping Unit(s) Design

Pumps shall meet the following criteria:

1. All pumps shall exhibit continuously rising head to shut-off. Pumps with sags or dips in their performance curves shall not be allowed.
2. At a minimum, pumping conditions shall be evaluated using Hazen-Williams friction "C" values of both 120 and 140 (for PVC and DIP). Other "C" values may be evaluated depending on project conditions. Calculations shall use the actual pipe inside diameter, not the nominal pipe diameter.
3. Under all operating conditions, including multiple pump operation, pumps shall operate within their published Allowable Operating Range (AOR) and, where practicable, within the ReWa AOR as shown in Figures 6-1 & 6-2. Operating conditions outside of the manufacturer AOR under any operating condition will not be accepted. Operating conditions outside of the ReWa AOR, but within the manufacturer's AOR, will be considered on a case-by-case basis where sufficient documentation is provided to justify the operating conditions.
4. Where one or more pump selections are available to meet the design conditions, the following criteria shall be evaluated to determine the most appropriate selection:
  - a. ReWa prefers selections with primary operating points within the Preferred Operating Range (POR) which is a flow range on either side of the Best Efficiency Point (BEP). The flow range is expressed as a percentage of the flow range corresponding to the pump's BEP as shown in Table 6-3. Refer to Hydraulics Institute standard ANSI/HI-9.6.3.1 (latest edition) for additional information.

**Table 6-3: Preferred Operating Region Related to Specific Speed<sup>2</sup>**

Specific Speed (US Customary)	Preferred Operating Range
<4500*	Between 70% and 120% of BEP
>4500	Between 80% and 120% of BEP
<7000	
>7000	Between 85% and 115% of BEP
10,000	
10,000	Between 90% and 110% of BEP

\*Most wastewater pumps for purposes of this manual will fall within this specific speed range

Impeller specific speed in Table 6-3 is calculated per the following equation<sup>3</sup> :

$$N_s = \frac{rpm \sqrt{gpm}}{H^{3/4}}$$

Where:

*N<sub>s</sub>* = Impeller specific speed

*rpm* = Pump speed

*gpm* = Design capacity at best efficiency point

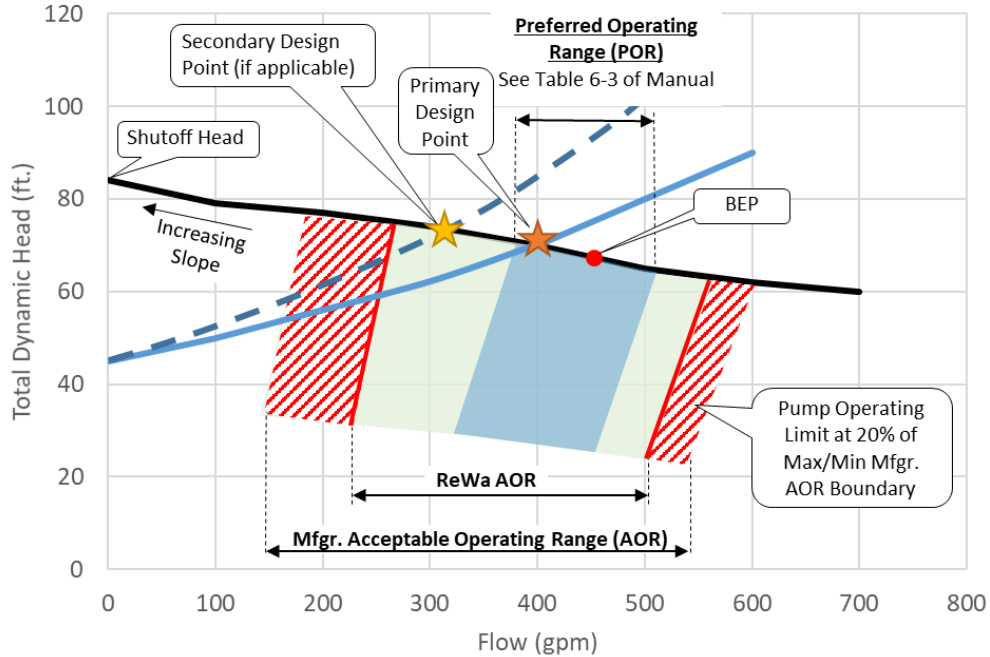
*H* = Total head per stage in feet at BEP

- The pump(s) shall achieve a NPSH margin and NPSH margin ratio across its entire operating range equal to or greater than the values listed in Table 9.6.1.5.5 of Hydraulics Institute standard ANSI/HI 9.6.1 (latest edition). If a manufacturer uses NPSH margin and margin ratios less than the values listed in HI 9.6.1., the manufacturer may submit independent calculations justifying the variance subject to review and approval by the design engineer and ReWa.
- On a case-by-case basis, these requirements (Items 1 through 5) may be made more expansive or restrictive at the discretion of ReWa.

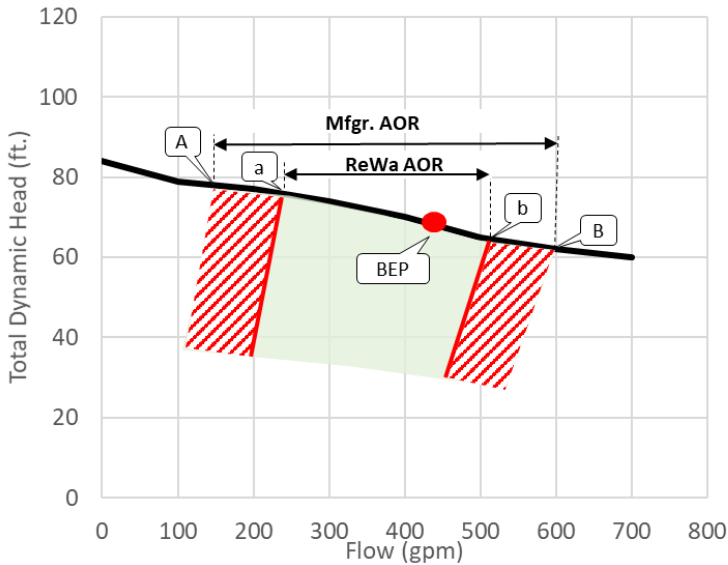
<sup>2</sup> Adapted from Table 9.6.3.1 of ANSI/HI-9.6.3.

<sup>3</sup> Flowserve Corporation, *Cameron Hydraulic Data*, 19<sup>th</sup> ed., pg. 1-19.

**Figure 6-1: Example Pump Selection Requirements**



**Figure 6-2: ReWa AOR Calculation Example**



Where:

A = Flow @ Lower Limit, Mfgr. AOR

B = Flow @ Upper Limit, Mfgr. AOR

a = Flow @ Lower Limit, ReWa AOR

b = Flow @ Upper Limit, ReWa AOR

**Equations 1 & 2:**

**Example:**

Eq. 1  $a = A + 0.2(B - A)$

$a = 150 + 0.2(600 - 150) = 240 \text{ gpm}$

Eq. 2  $b = B - 0.2(B - A)$

$b = 600 - 0.2(600 - 150) = 510 \text{ gpm}$

### 6.3.5 Wet Well Criteria

Wet wells shall meet the following design criteria:

1. Well wells and intakes shall be designed in compliance with Hydraulics Institute standard ANSI/HI 9.8 (latest edition).
2. Wet wells for pump stations shall be made of standard precast concrete, with a minimum 6 feet in diameter, unless otherwise approved.
3. The minimum size of the wet well shall be determined based on the type of pump station (i.e., small above ground, large above ground, duplex submersible, triplex submersible, etc.)
4. All wet wells shall be constructed of polymer concrete as specified in *Section 33 05 75, Polymer Concrete Manholes, Wetwells and Structures* or coated pre-cast concrete as specified in *Section 33 01 30, Corrosion Protection for Concrete Wastewater Structures* in [Appendix II – Standard Specifications](#).
5. Steps shall not be provided in wet wells.
6. Wet wells shall be sized to minimize pump start/stop cycles. ReWa may require that the wet well volume and control systems are modified to minimize the pump cycles per hour. The critical inflow rate is at half the capacity of the pump. The following equation<sup>4</sup> should be used to determine the minimum active wetwell volume.

$$V = \frac{Tq}{4}$$

Where:

$V$  = Active Volume between Low Water Level (LWL) and High Water Level (HWL), gal.

$T$  = 10, minutes (minimum)

Allowable minimum cycle time between starts (time to fill + time to empty)

$q$  = pumping rate of single pump, gpm

7. Where required by ReWa, total wet well storage (i.e., wet well storage + pipe storage + manhole storage) must exceed the volume in force main from wet well to global high point along force main. This applies mostly to smaller pump stations and short run force mains. For large diameter and long force mains, this requirement may be waived.
8. The buoyant (uplift) force factor of safety (F.S.) must meet or exceed 2.0. Refer to the equation below:

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<sup>4</sup> Adapted from Eq. 12-8: *Pumping Station Design*, Revised 3<sup>rd</sup> ed., 2009; Jones, Bosserman, Sanks, Tchobanaoglous

$$F.S. = \frac{(Wet\ Well\ Weight + Soil\ Overburden + Soil\ Resistance)}{(Uplift\ Force)} \geq 2.0$$

9. Pump manufacturer shall determine minimum submergence of pumps or suction bell (i.e. Pumps off elevation) in wet well.
10. The wet well and control system shall be designed such that the pump(s) turn off when the water surface elevation (WSE) reaches 6" above the manufacturer recommended minimum pump submergence elevation.
11. A minimum difference of 6" shall be maintained between the Pumps off elevation and the Pumps

The Applicant's Engineer shall submit detailed design calculations as part of the Capacity Approval Package which demonstrate how wet well was sized and how the pumps will operate over the full range of flows. Certification from the pump manufacturer shall be submitted with the design calculations to demonstrate that the motor and control circuit will minimize the number of cycles per hour.

#### 6.3.6 Materials of Construction

Refer to the appropriate pump station details in [Appendix I – Standard Drawings](#) and *Section 33 21 00 – Submersible Sewage Pumping Stations* and *Section 33 32 13 – Packaged Wastewater Pumping Stations* in [Appendix II – Standard Specifications](#) for all required materials associated with wastewater pumping station construction and design.

#### 6.3.7 Construction Procedures

Refer to *Section 33 21 00, Submersible Sewage Pumping Stations* and *Section 33 32 13, Packaged Wastewater Pumping Stations* in [Appendix II – Standard Specifications](#) for all wastewater pumping construction procedures, required installation methods and testing standards.

- 6.3.7.1 All pumps shall undergo factory and field hydraulic acceptance testing and meet Grade 1U tolerances in accordance with Hydraulic Institute standard ANSI/HI 14.6 (latest edition)
- 6.3.7.2 All pumps shall undergo factory and field vibration testing and not exceed allowable vibration levels in accordance with Hydraulics Institute standard ANSI/HI 9.6.4 (latest edition).
- 6.3.7.3 **Wet Well Leakage Testing**  
Leakage tests shall be performed on all wet wells prior to backfilling. Refer to *Section 33 01 32 – Sewer and Manhole Testing* in [Appendix II – Standard Specifications](#) for further instructions on how to perform testing.

## 6.4 FORCE MAINS

### 6.4.1 General

1. The pump station and force main piping shall be designed to have the adequate capacity to serve the proposed and future developments upstream of the proposed pump station.
2. Where it is necessary for wastewater force mains to cross surface water or wetlands, the Applicant's Engineer shall include a proposed method of construction with their submittal package for review and approval prior to submitting plans for permitting.
3. ReWa does not allow aerial force main crossings. Examples of aerial crossings include, but are not limited to, force mains constructed on piers or pilings, and force mains attached to structures such as roadways, bridges or piers.

### 6.4.2 Design Criteria

All force mains designed to connect to the ReWa sewer system shall meet the following design criteria requirements:

1. Velocities in the force main shall be at least 2 feet per second (fps) and not greater than 5 fps.
2. All force mains shall be a minimum of 4 inches in diameter.
3. Minimum bury depth from top of pipe to finished grade shall be 3 feet, or 42" if located in SC DOT R/W.
4. Refer to *Section 33 31 23, Sanitary Sewerage Force Main Piping* in [Appendix II – Standard Specifications](#) for all required materials of construction and standards for piping, fittings, joints and associated appurtenances.
5. Air release valves and air/vacuum release valves shall be installed at the following locations:
  - a. system high points,
  - b. at significant changes in grade,
  - c. and/or in locations requested by ReWa.

In some situations, ReWa may require that air release valves (ARVs) are in valve vaults at pump stations. If deemed necessary, this requirement shall be communicated to the

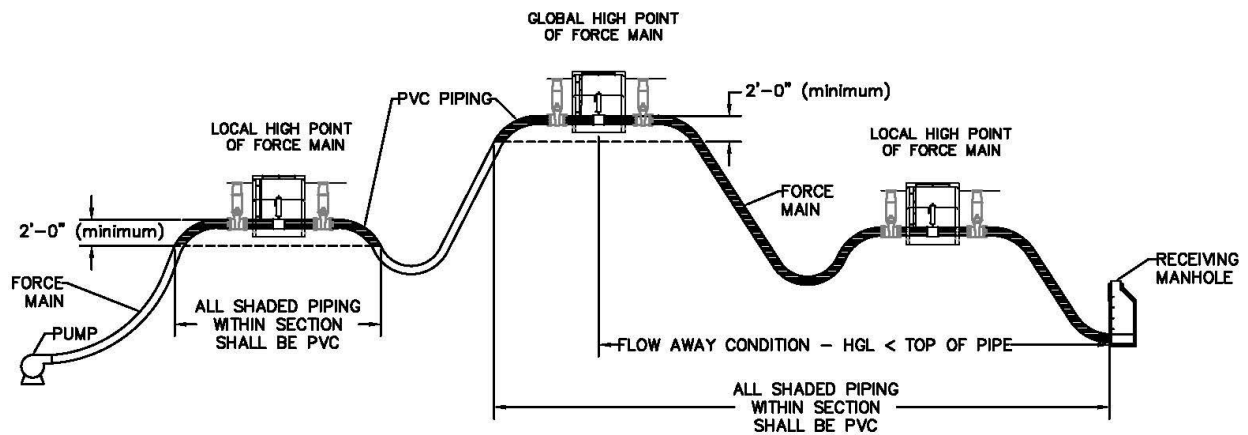
Applicant's Engineer in ReWa's comments to the submittal package. Refer to the appropriate Air/Vacuum Release Valve detail in [Appendix I – Standard Drawings](#).

The ARVs shall be sized to thoroughly exhaust all trapped air and prevent a destructive vacuum from forming. Refer to *40 05 78.23, Air-Vacuum Valves for Wastewater Service* in [Appendix II – Standard Specifications](#) for acceptable materials and construction procedures for air release valves.

- PVC piping shall be the only type of piping permissible at all local and global high points along the force main alignment. All piping within 2 feet vertically of the high point shall be PVC. At the global high point of the force main, the PVC piping is only required for the upstream piping with 2 feet vertically of the high point.

In certain situations, all or portions of the force main downstream of the global high point may experience a “flow away” condition in which the hydraulic grade line (HGL) falls below the pipe elevation, thus creating partially full pipe flow. In this situation, air will be introduced into the force main and create a condition for hydrogen sulfide corrosion. Therefore, PVC pipe shall be used in sections where the “flow away” condition may occur. In general, changes in pipe material shall be minimized. Refer to [Figure 6-2](#) for illustration:

**Figure 6-2: Pipe Material for Force Main at High Points**



- Air release valve vaults shall be made of polymer concrete or standard precast concrete with a protective coating. Refer to *Section 33 05 75, Polymer Concrete Manholes, Wetwells and Structures* and/or *Section 33 01 30, Corrosion Protection for Concrete Wastewater Structures* in [Appendix II – Standard Specifications](#).
- Plug isolation valves shall be located on upstream and downstream ends of the air release valve. A plug isolation valve is only required to be located on the downstream end of the air release if there are no high points in between pump station and air release valve. If



the air release valve is located within a valve vault, the plug valves shall be located outside of the vault. Refer to the appropriate air release valve detail in [Appendix I – Standard Drawings](#).

9. All force mains entering receiving manholes shall be designed to match details in [Appendix I – Standard Drawings](#).

#### 6.4.3 Capacity Design

1. Refer to [Section 6.1.2 - Sanitary Sewer Sizing](#) for further instruction on the appropriate peaking factor to use for capacity design.

#### 6.4.4 Connections to New or Existing Force Main

1. A connection to a new or existing force mains is site-specific and subject to multiple design options. Connections may include cutting in a new fitting or connecting with a tapping saddle. At a minimum, force main will include a plug valve for isolation of the secondary (new) force main. Exact configuration of connection will be advised by ReWa on a case-by-case basis.

#### 6.4.5 Receiving Manholes

New or existing receiving manholes (manholes where the force main discharges into the gravity sewer) must follow the criteria below:

1. Force main connections to manholes shall be made in accordance with the *Standard Detail No. PS-7, Typical Force Main Discharge to Existing Receiving Manhole* in [Appendix I – Standard Drawings](#) unless otherwise approved by ReWa.
2. New receiving manholes shall be designed and installed in accordance with *Section 33 01 30, Corrosion Protection for Concrete Wastewater Structures* or *Section 33 05 75, Polymer Concrete Manholes and Wetwells* in [Appendix II – Standard Specifications](#).
3. Existing receiving precast concrete manholes shall be coated in accordance with *Section 33 01 30, Corrosion Protection for Concrete Wastewater Structures* in [Appendix II – Standard Specifications](#). Existing brick manholes shall be replaced with precast concrete manholes prior to connection of the proposed force main.
4. The next five existing manholes downstream of the force main connection points or the manholes along the next 1,500 feet of downstream sewer, whichever is greater, shall be coated in accordance with *Section 33 01 30, Corrosion Protection for Concrete Wastewater Structures* or provide new manholes in accordance with *Section 33 05 75, Polymer Concrete Manholes and Wetwells* in [Appendix II – Standard Specifications](#).
5. ReWa reserves the right to determine the final number of manholes to be coated downstream of the force main connection point based on their condition.

#### 6.4.6 Construction Procedures

Refer to *Section 33 31 23, Sanitary Sewerage Force Main Piping* in [Appendix II – Standard Specifications](#) for all force main construction procedures, required installation methods and testing standards.

#### 6.4.6.1 Metallic Detection Tape

Metallic detection must be installed for all buried piping. Applicants shall adhere to the guidelines as specified in *Section 33 05 97, Identification and Signage for Utilities* in [Appendix II – Standard Specifications](#).

#### 6.4.6.2 Tracer Wire

Tracer wire must be installed on all PVC force mains. Applicants shall adhere to the guidelines as specified in *Section 33 05 97, Identification and Signage for Utilities* in [Appendix II – Standard Specifications](#).

#### 6.4.6.3 Testing of Pressure Piping

Hydrostatic testing is required for all force main piping. Refer to *Section 33 01 32 – Sewer and Manhole Testing* in [Appendix II – Standard Specifications](#) for further instructions on how to perform testing.

#### 6.4.7 Surge Analysis

The possibility of sudden changes in pressure (pressure surges) in the force main due to starting and/or stopping pumps (or operation of valves appurtenant to a pump) must be considered during design. The duration of such pressure surges typically ranges between 2 to 15 seconds. Each surge is site specific and depends on pipeline profile, flow, change in velocity, inertia of the pumping equipment, valve characteristics, pipeline materials, and pipeline accessories. Critical surges may be caused by power failure.

The force main should be designed to withstand calculated maximum surge pressures. Engineer shall provide surge analysis calculations and supporting documentation (pipe pressure analysis, surge relief valve locations, and valve orifice sizing, etc.).

### 6.5 GREASE CONTROL DEVICES

#### 6.5.1 General

ReWa has established the following technical requirements for the installation of Food Service Establishment (FSE) Fats, Oils and Greases (FOG) Grease Control Devices (GCD). All grease control devices are evaluated and approved in accordance with the technical requirements listed within this manual including number of seats, menu, site plan and location. ReWa reserves the right to make determinations of grease control device sizing and adequacy based on performance and condition and may require repairs to, modifications, or replacement of control devices as such. See ReWa Sewer Use Regulation Attachment F Grease Control Regulation for non-technical program criteria.

### 6.5.2 Inground Grease Interceptor Construction Requirements

1. Grease Interceptors shall be sized based on 20 gallons per seat for FSEs or 20 gallons per bed for healthcare facilities.
2. Minimum Grease Interceptor size requirement is 1500 gallons. Maximum single Grease Interceptor size is 2000 gallons. If sizing requires more than 2000 gallons, two or more tanks shall be installed in series.
3. Grease Interceptors shall be installed in non-traffic areas where feasible. Traffic rated tops or tanks must be used in traffic areas.
4. Grease Interceptors shall not be installed within 25-feet of garbage containment enclosures.
5. Grease Interceptor access manholes shall be installed with 24" metal covers and rings, and the 90° tee shall be visible from all manholes. Access manholes shall extend at least to finished grade and be designed and maintained to prevent water inflow and infiltration. Manhole covers shall be readily removable to facilitate inspection, grease removal and wastewater sampling activities and shall be kept clear of obstructions such as trees, shrubs, flowers, mulch, etc.
6. A potable water supply (hose bib) shall be located near all Grease Interceptors for maintenance and cleaning.
7. Vent lines from Grease Interceptors shall be vented according to local plumbing codes.
8. Mop sinks, floor drains, floor sinks, 3-compartment sinks, and the pre-rinse of the dishwasher must be connected to the grease interceptor. Output of the dishwashing machine must be connected to the sanitary line. Ice machines, hand sinks, tea/soda stations, food prep sinks must be connected to the sanitary line. Interceptors must be maintained on a quarterly basis. Modified maintenance schedules must be approved by ReWa.
9. All Grease Interceptors shall be adequately secured against unauthorized access.

### 6.5.3 Under-the-Sink Grease Trap Requirements

1. Under-the-sink Grease traps will be allowed if an outside grease interceptor cannot be installed, or the seat sizing, or type of food served, does not warrant an in-ground grease interceptor. Grease traps are located inside an FSE and installed in accordance with applicable building codes.
2. All Grease Traps shall be constructed of non-metallic, non-corrosive materials.
3. Grease Trap shall be externally smooth-sided (without grooves, fins or ridges).
4. All Grease Traps shall be located above grade of floor.
5. All Grease Traps shall be located to allow access for maintenance and inspection.
6. A minimum Grease Trap size of 20 # (pound) (10gpm) is required.

### 6.5.4 Connection Prohibitions

1. Wastewater discharged from a dishwasher.
2. Water from refrigerator drain lines, beverage dispenser drain lines, ice machines, hand washing sinks, food prep sinks or steamer table lines.

3. Wastewater discharged from garbage grinder
4. Showers, toilets, washing machines and baths.

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# APPENDIX I

## STANDARD DRAWINGS

## NEW SANITARY SEWER DETAILS

SS-1.1	STANDARD PIPE EMBEDMENT
SS-1.2	TRENCH CHECK DAM
SS-2	STANDARD MANHOLE SCHEDULES AND GENERAL REQUIREMENTS
SS-3	STANDARD PRECAST MANHOLES WITH CONE SECTIONS (4' AND 5' ONLY)
SS-4	STANDARD PRECAST MANHOLES WITH FLAT TOP SECTIONS
SS-5	T-SERIES MANHOLE
SS-6	PRECAST DOGHOUSE MANHOLE INSTALLED OVER EXISTING SEWER
SS-7.1	EXTERNAL DIP DROP CONNECTION AT MANHOLE
SS-7.2	SERVICE LATERAL INSIDE DROP CONNECTION
SS-8	BENCH AND INVERT PLAN
SS-9.1	STANDARD MANHOLE RING AND COVER
SS-9.2	STANDARD MANHOLE RING AND WATERTIGHT COVER
SS-9.3	SLAB-TYPE CAST-IN RING AND COVER
SS-9.4	SLAB-TYPE CAST-IN RING AND WATERTIGHT COVER
SS-9.5	HINGED MANHOLE RING AND COVER
SS-9.6	HINGED MANHOLE RING AND WATERTIGHT COVER
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SS-9.8	VENTILATED HINGED MANHOLE RING AND COVER
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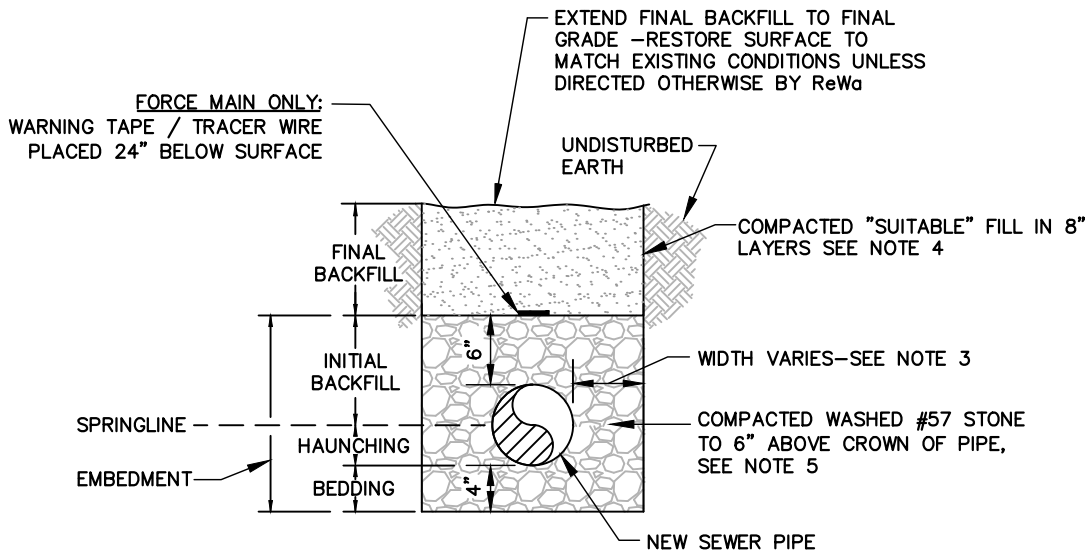


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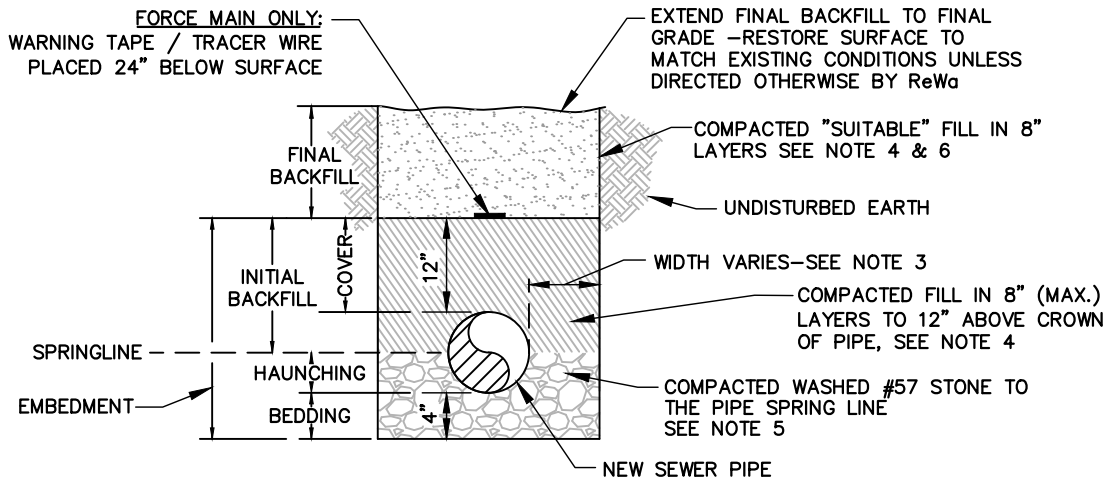
# SEWER STANDARD DETAILS TABLE OF CONTENTS

DETAIL No.  
SS-0

N.T.S.  
SCALE



PIPE BEDDING FOR C900 PVC



PIPE BEDDING FOR DIP

**NOTES:**

- PIPE BEDDING DETAIL APPLIES TO ALL NEW SEWER FORCE MAIN OR GRAVITY SEWER PIPES INSTALLED UP TO 20' MAXIMUM DEPTH. FOR DEPTHS GREATER THAN 20' ENGINEER TO PROVIDE PROJECT SPECIFIC BEDDING AND PIPE DESIGN.
- THE CONTRACTOR SHALL USE A TRENCH BOX OR SHEETING AND SHORING IN ACCORDANCE WITH OSHA REGULATIONS WHILE INSTALLING NEW SEWERS. THE CONTRACTOR WILL NOT BE ALLOWED TO SLOPE TRENCH WALLS.
- TRENCH WIDTH SHALL BE LIMITED TO THE FOLLOWING UNLESS OTHERWISE APPROVED BY ReWa:
 

4" AND 6" PIPE	--	12" EACH SIDE
8" TO 15" PIPE	--	15" EACH SIDE
16" TO 30" PIPE	--	18" EACH SIDE
36" AND LARGER	--	21" EACH SIDE
- IN GRASSED AREAS, SUITABLE (COMMON) FILL MAY BE USED AS BACKFILL. IN SCDOT, CITY AND COUNTY PAVED ROADS, COMMON FILL MAY BE USED AS BACKFILL UNLESS SPECIFIED OTHERWISE BY ReWa/ENGINEER. CRUSHER RUN OR FLOWABLE FILL MAY BE REQUIRED IN SPECIFIC CIRCUMSTANCES, IN WHICH CASE THE EXCAVATED MATERIAL SHALL BE REMOVED AND DISPOSED OF OFFSITE. IF FLOWABLE FILL IS USED, BACKFILL WITH WASHED STONE TO MIN 12" ABOVE THE TOP OF THE PIPE.
- MAINTAIN GROUND WATER LEVEL AT LEAST 1 FOOT BELOW THE BOTTOM OF THE STONE BEDDING AT ALL TIMES.
- SEE ReWa STANDARD SPECIFICATION 31 23 16.13 - "TRENCHING" FOR ADDITIONAL REQUIREMENTS.



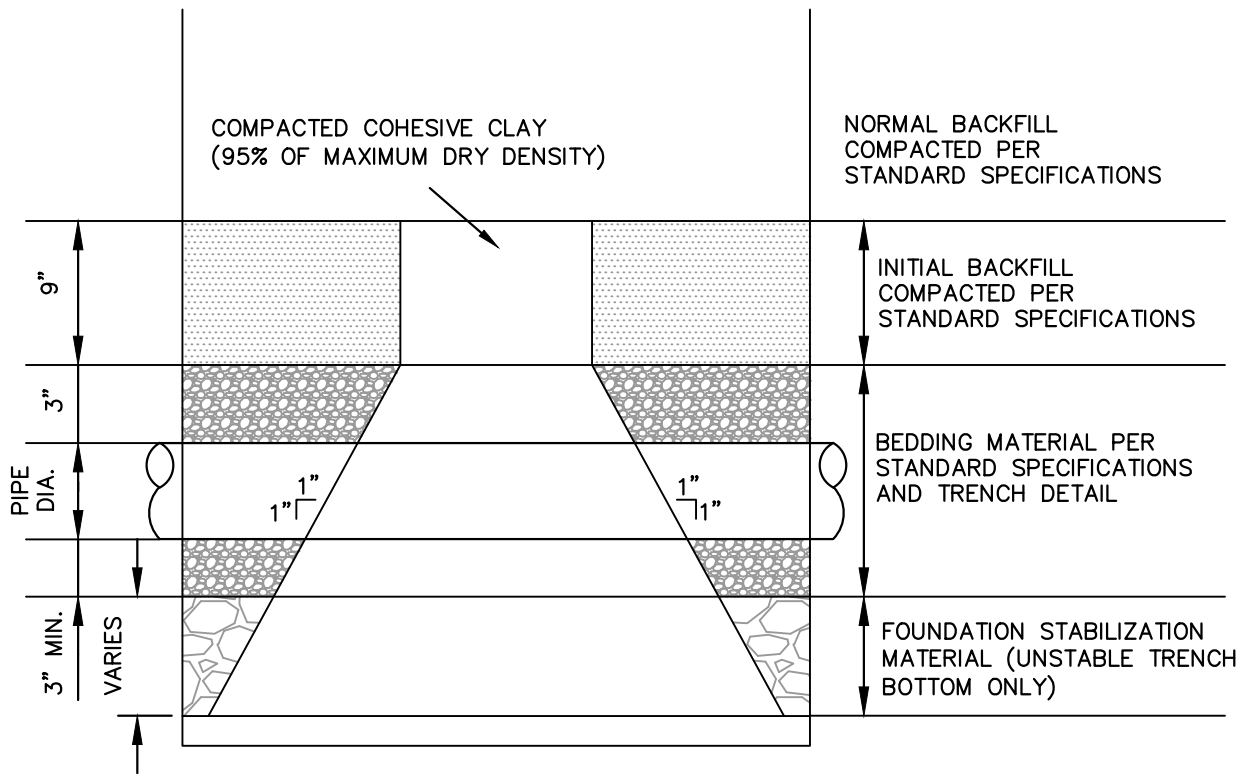
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REV DATE

**STANDARD PIPE  
EMBEDMENT**

DETAIL No.  
**SS-1.1**

**N.T.S.**  
SCALE





**NOTES:**

1. DO NOT CONSTRUCT CHECK DAM AROUND PIPE JOINT.
2. CHECK DAM INSTALLATION LOCATIONS SHALL BE ON THE PLANS. HOWEVER DURING CONSTRUCTION, CHECK DAM INSTALLATION LOCATIONS MAYBE BE MOVED DUE TO FIELD CONDITIONS.
3. THE CHECK DAM SHALL EXTEND FROM THE BOTTOM OF THE EXCAVATION THROUGH THE BEDDING MATERIAL TO THE "NORMAL BACKFILL" AND SHALL EXTEND COMPLETELY TO EACH TRENCH SIDEWALL. CHECK DAM MATERIAL SHALL BE COMPACTED COHESIVE CLAY THAT CONTAINS A MINIMUM OF 25% PASSING NO. 200 SIEVE MATERIAL, WITH 70% PASSING FOR 3/4 IN. SIEVE. IF THE NORMAL EXCAVATED MATERIAL IS NOT SUITABLE FOR CONSTRUCTION OF THE CHECK DAM, THEN THE CONTRACTOR SHALL OBTAIN THE MATERIAL FROM OUTSIDE SOURCES.



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**TRENCH CHECK DAM**

DETAIL No.  
**SS-1.2**

**N.T.S.**  
SCALE

## MANHOLE SCHEDULES

MH DIAMETER	LARGEST PIPE DIAMETER	MANHOLE COVER DIAMETER (CLEAR OPENING)	PIPE DIAMETER	MAX MH SPACING
4 FEET	8" TO 15"	24"	8" TO 12"	400 FEET
5 FEET	16" TO 27"	24"	15" TO 27"	450 FEET
6 FEET	30" TO 45"	24" (SEE NOTE 6)	30" TO 45"	550 FEET
8 FEET*	48"	24" (SEE NOTE 6)	48" AND LARGER	600 FEET
SPECIAL DESIGN*	> 48"	24" (SEE NOTE 6)		

\*ReWa MAY REQUIRE TWO COVERS FOR MANHOLES 8 FEET IN DIAMETER AND LARGER.

DETAIL NO.	MANHOLE TYPE	WHEN TO USE
SS-3	PRECAST WITH CONE SECTION	(1) USE FOR 4-FOOT AND 5-FOOT DIAMETER MANHOLES ONLY (2) MANHOLES WILL TERMINATE AT GRADE IN LANDSCAPED AREAS AND 2 FEET ABOVE GRADE IN EASEMENT AREAS.
SS-4	PRECAST WITH FLAT TOPS	(1) USE FOR ALL 6-FOOT AND 8-FOOT DIAMETER MANHOLES. (2) USE FOR ALL 4-FOOT AND 5-FOOT MANHOLES THAT TERMINATE MORE THAN 2 FEET ABOVE GRADE. (3) USE FOR SHORT MANHOLES (4-FOOT AND 5-FOOT) WHERE A CONE SECTION WILL NOT WORK.

**MANHOLE COVER ELEVATIONS:**

(1) FLUSH WITH FINISHED GRADE WITHIN STREET R/Ws AND IN LANDSCAPED/LAWN AREAS UNLESS OTHERWISE SPECIFIED.

(2) 2 FEET ABOVE GRADE IN EASEMENTS EXCEPT TO ACCOMMODATE FLOOD ELEVATIONS PER (3) BELOW.

(3) COVERS TO TERMINATE AT LEAST 1 FOOT ABOVE THE 100-YEAR FLOOD ELEVATION BUT NO GREATER THAN 4 FEET ABOVE GRADE TOTAL. WHERE THE FLOOD ELEVATION IS 4 FEET OR MORE ABOVE GROUND, WATERTIGHT COVERS SHALL BE USED. THE MANHOLE COVER SHALL TERMINATE 2 FEET ABOVE GRADE, AND A VENT PIPE SHALL BE INSTALLED TO 2 FEET ABOVE THE 100-YEAR FLOOD ELEVATION.

**NOTES:**

1. ALTERNATE COVERS TO THOSE SHOWN MUST BE APPROVED BY ReWa/ENGINEER.
  - COVERS MUST FIT ANY FRAME SHOWN ON SHEET 2 OF 2
  - USF = U.S. FOUNDRY (EAGLE MANUFACTURING COMPANY)
2. COVERS TO BE ASTM A48 CLASS 35 GRAY IRON WITH A MINIMUM WEIGHT OF 144 POUNDS.
3. NOMINAL DIMENSIONS SHOWN TYPICALLY MEAN PLUS OR MINUS 1/4" INCH UNLESS OTHERWISE APPROVED BY ENGINEER.
4. THE PICKBAR IS THE STANDARD OPENING DEVICE. IN SOME CASES, ENGINEER MAY SPECIFY THE NON-PENETRATING PICKHOLE.
5. ALL COVERS TO BE FURNISHED WITH GASKETS AS SHOWN. SIDE/WIPER GASKETS ARE NOT APPROVED.
6. 30" OR 36" DIA. COVERS MAY BE USED WHERE REQUESTED BY ReWa FOR MANHOLES 6 FEET IN DIAMETER AND LARGER SHALL BE MADE OF COMPOSITE FIBERGLASS MATERIAL OR DUCTILE IRON (PAMREX) (SEE STANDARD SPECIFICATIONS). TWO 24" COVERS MAY BE REQUIRED FOR 8-FOOT-DIAMETER AND LARGER MANHOLES.
7. COAT FRAMES AND COVERS WITH TWO 8-MIL MIN DFT COATS OF COAL TAR EPOXY WHEN CORROSION PROTECTION OF MANHOLES IS SPECIFIED. SANDBLAST PRIOR TO APPLYING EPOXY.

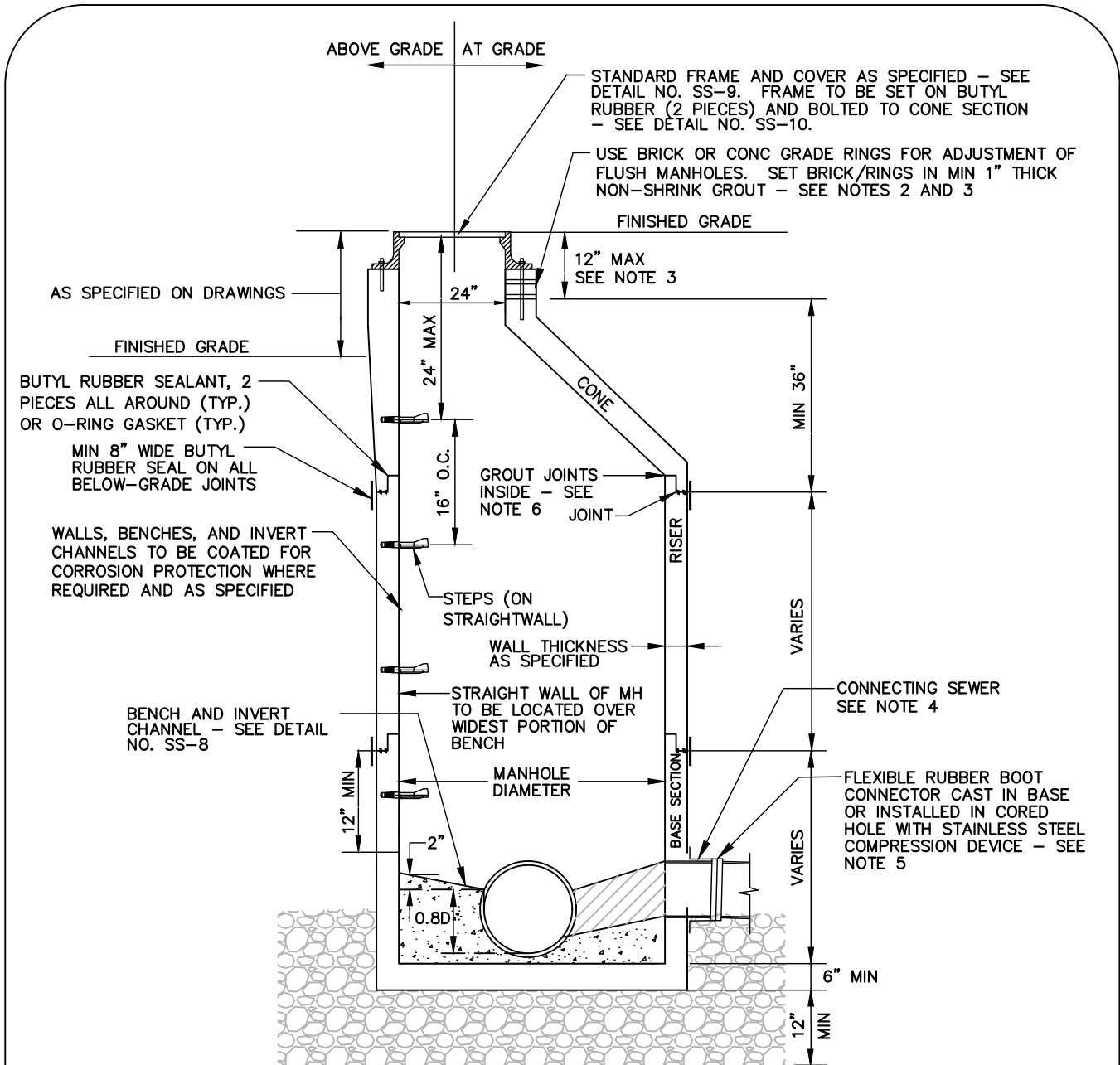


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### STANDARD MANHOLE SCHEDULES AND GENERAL REQUIREMENTS

DETAIL No.  
**SS-2**

**N.T.S.**  
SCALE



**NOTES:**

1. REFER TO GENERAL MANHOLE SPECIFICATIONS AND REQUIREMENTS.
2. NON-SHRINK GROUT SHALL COMPLETELY COVER THE BRICK/GRADE RINGS ON THE OUTSIDE, SHALL OVERLAP THE CONE SECTION A MINIMUM OF 6 INCHES AND SHALL COVER THE FRAME FLANGE COMPLETELY. SEE DETAIL NO. SS-9.
3. MANHOLE SHALL BE ORDERED WITH MINIMUM GRADE ADJUSTMENT. ORDER BASE, RISER, AND CONE HEIGHTS TO STACK OUT MANHOLE AS CLOSE AS POSSIBLE TO GRADE. CONTRACTOR TO SUPPLY ENGINEER WITH A SCHEDULE OF EACH MANHOLE SHOWING THE HEIGHTS OF EACH SECTION. MAXIMUM ADJUSTMENT SHALL BE 6 INCHES UNLESS APPROVED OTHERWISE.
4. MATCH PIPE CROWN ELEVATIONS OF CONNECTING/INFLUENT SEWERS AND MAIN SEWER.
5. IF HOLE FOR PIPE MUST BE CORE DRILLED IN THE FIELD, REFER TO DETAIL SS-20 FOR REQUIREMENTS.
6. ALL JOINTS SHALL BE GROUTED INSIDE THE MANHOLE WITH NON-SHRINK, HYDROGEN SULFIDE RESISTANT GROUT.

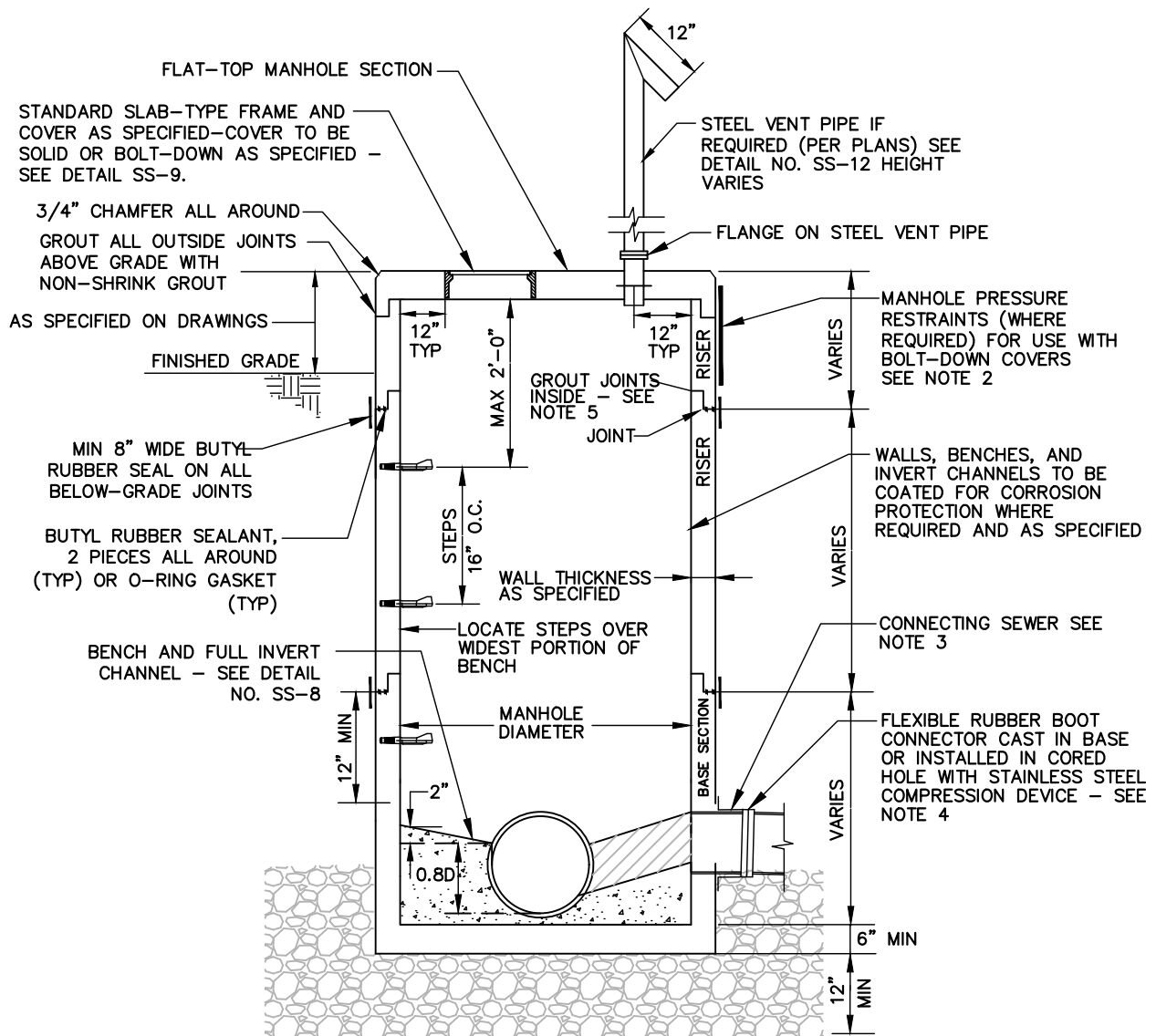


06/20/23  
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**STANDARD PRECAST  
MANHOLE WITH CONE  
SECTIONS (4' & 5' ONLY)**

DETAIL No.  
**SS-3**

**N.T.S.**  
SCALE



**NOTES:**

1. REFER TO GENERAL MANHOLE SPECIFICATIONS AND REQUIREMENTS.
2. PRESSURE RESTRAINTS ARE REQUIRED FOR ALL FLAT TOPS WITH WATERTIGHT COVERS WHERE APPROVED OR DIRECTED. THREE RESTRAINTS SHALL BE EQUALLY SPACED AROUND THE MANHOLE. RESTRAINTS SHALL BE FLAT STEEL PLATES 3/8" X 3" X 24" LONG WITH A 7/8" HOLE 1-1/2" FROM EACH END. ANCHOR WITH 3/4" X 4" LONG GALV STEEL ADHESIVE ANCHORS OR APPROVED EQUAL. RESTRAINTS TO BE HOT DIP GALVANIZED AFTER FABRICATION. AT LEAST 5 FEET OF VERTICAL RISER SHALL BE RESTRAINED - LENGTHEN BARS AS NECESSARY.
3. MATCH PIPE CROWN ELEVATIONS OF CONNECTING/INFLUENT SEWERS AND MAIN SEWER.
4. IF HOLE FOR PIPE MUST BE CORE DRILLED IN THE FIELD, REFER TO DETAIL SS-20 FOR REQUIREMENTS.
5. ALL JOINTS SHALL BE GROUTED INSIDE THE MANHOLE WITH NON-SHRINK, HYDROGEN SULFIDE RESISTANT GROUT.

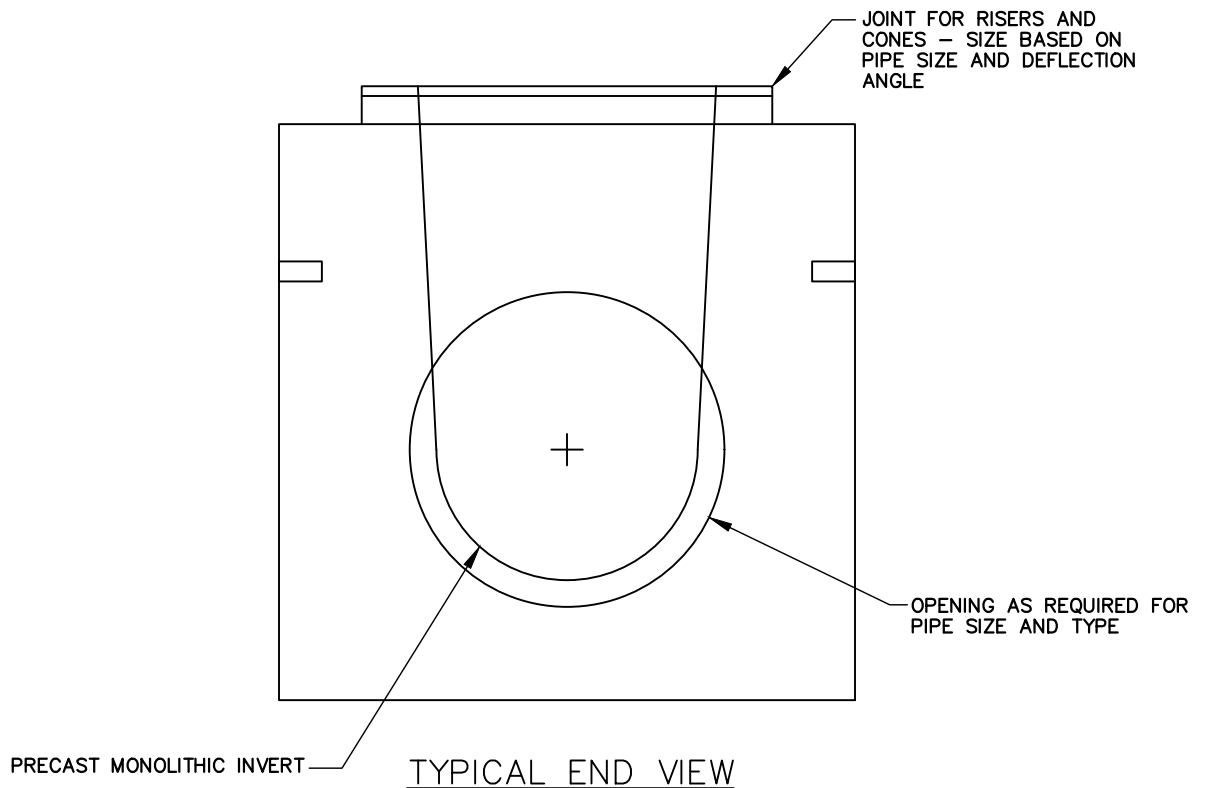


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**STANDARD PRECAST  
MANHOLE WITH FLAT TOP  
SECTIONS**

DETAIL No.  
**SS-4**

**N.T.S.**  
SCALE



**NOTES:**

1. T-SERIES MANHOLES MAY BE USED AS AN ALTERNATE TO ROUND MANHOLES WHEN SPECIFICALLY APPROVED BY ReWa AND/OR THE ENGINEER FOR PIPE DIAMETER GREATER THAN 48". IF NOT SPECIFICALLY APPROVED, STANDARD PRECAST MANHOLES PER DETAIL SS-3 OR SS-4 SHALL BE USED. T-SERIES MANHOLES SHALL BE AS MANUFACTURED BY TINDALL CORPORATION OR APPROVED EQUAL.
2. CONCRETE = 5,000 PSI MINIMUM
3. REINFORCING = ASTM A615 GRADE 60
4. WWF = ASTM A185
5. LIFTING AND HANDLING DESIGN IN ACCORDANCE WITH OSHA 1926.704
6. DESIGN LOADS IN ACCORDANCE WITH ASTM C890 WITH MANUFACTURE IN A PCI AND NPCA CERTIFIED PLANT. FOR T-SERIES MANHOLES, PIPE TO MANHOLE CONNECTORS MAY BE STANDARD MECHANICAL 7. BOOT TYPE CONNECTORS CONFORMING TO ASTM C923, WHICH ALLOW FOR THE EXPANSION RING AT THE MANHOLE WALL TO BE COMPLETELY SEATED IN A VERTICAL PLANE IN THE MANHOLE WALL.

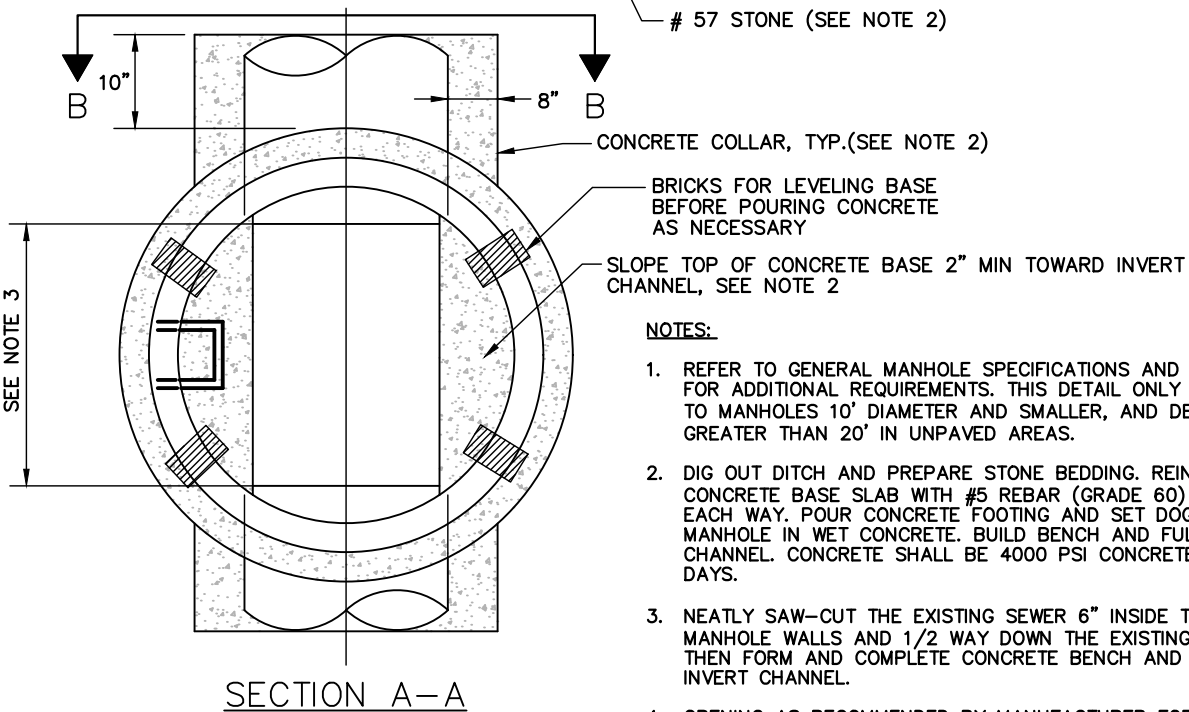
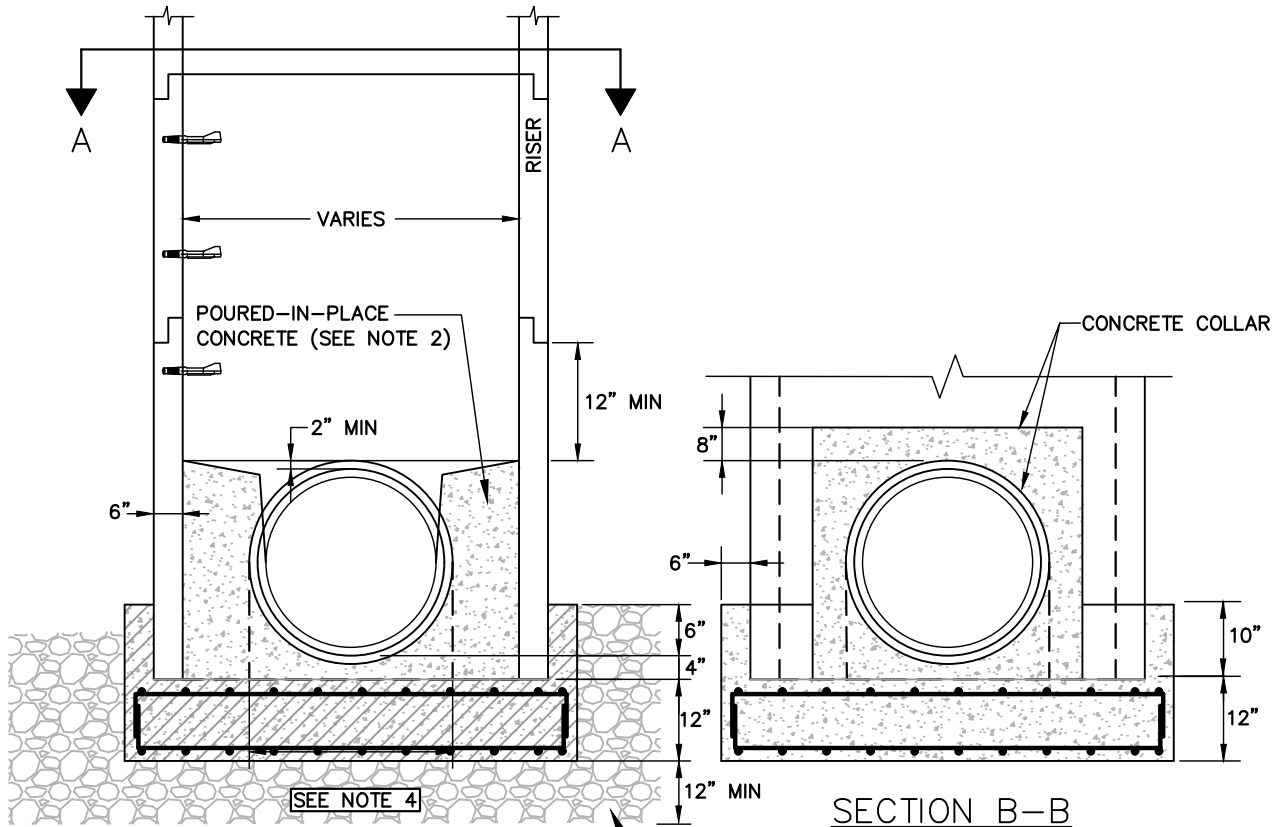


11/18/19  
REV DATE

**T-SERIES MANHOLE**

DETAIL No.  
**SS-5**

**N.T.S.**  
SCALE



**NOTES:**

1. REFER TO GENERAL MANHOLE SPECIFICATIONS AND DETAILS FOR ADDITIONAL REQUIREMENTS. THIS DETAIL ONLY APPLIES TO MANHOLES 10' DIAMETER AND SMALLER, AND DEPTHS NO GREATER THAN 20' IN UNPAVED AREAS.
2. DIG OUT DITCH AND PREPARE STONE BEDDING. REINFORCE CONCRETE BASE SLAB WITH #5 REBAR (GRADE 60) T&B @ 8" EACH WAY. POUR CONCRETE FOOTING AND SET DOGHOUSE MANHOLE IN WET CONCRETE. BUILD BENCH AND FULL INVERT CHANNEL. CONCRETE SHALL BE 4000 PSI CONCRETE @ 28 DAYS.
3. NEATLY SAW-CUT THE EXISTING SEWER 6" INSIDE THE NEW MANHOLE WALLS AND 1/2 WAY DOWN THE EXISTING PIPE. THEN FORM AND COMPLETE CONCRETE BENCH AND FULL INVERT CHANNEL.
4. OPENING AS RECOMMENDED BY MANUFACTURER FOR PIPE MATERIAL, FIELD VERIFY AS NECESSARY.
5. NEW PIPE OPENINGS IN THE MANHOLE REQUIRE THE USE OF A RUBBER BOOT.

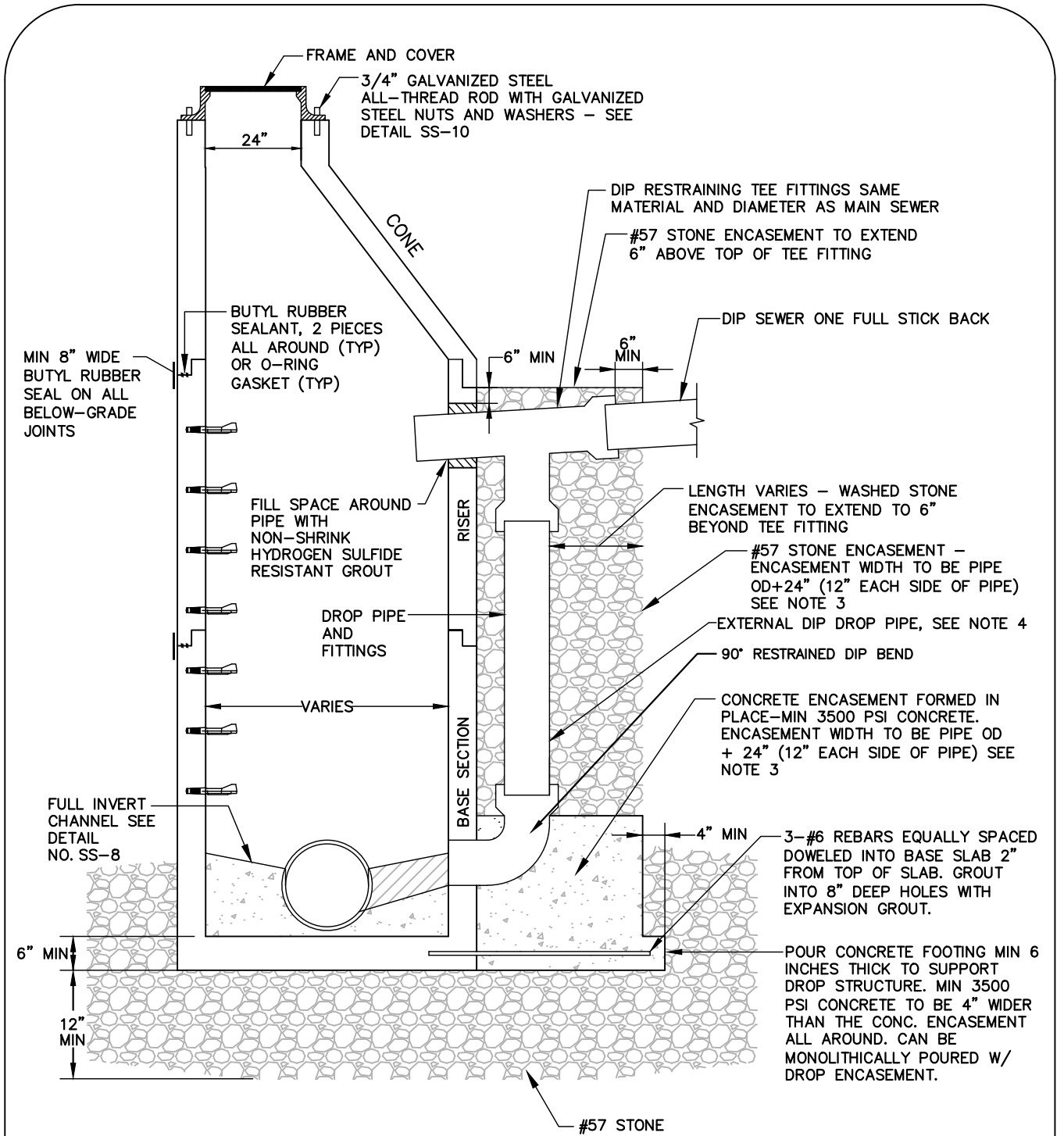


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**PRECAST DOGHOUSE  
MANHOLE INSTALLED OVER  
EXISTING SEWER**


DETAIL No.  
**SS-6**

**N.T.S.**  
SCALE

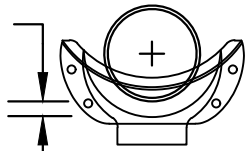


**NOTES:**

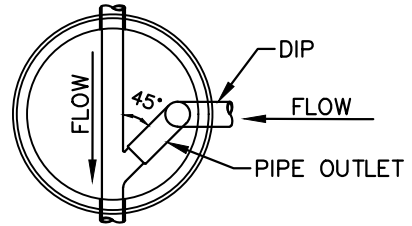
1. REFER TO DETAIL NO. SS-2, SS-3 AND SS-4 FOR ALL PRECAST MANHOLE AND INVERT REQUIREMENTS.
2. WHENEVER POSSIBLE, DROP CONNECTIONS SHALL NOT BE USED. ReWa MUST APPROVE THE DESIGN, LOCATION AND INSTALLATION OF ALL DROP CONNECTIONS
3. CONCRETE ENCASUREMENT MAY EXTEND TO 6" ABOVE THE TEE FITTING IN LIEU OF THE #57 STONE ENCASUREMENT.
4. DROP PIPE MAXIMUM DIAMETER SHALL BE 12". MAXIMUM DROP VERTICAL LENGTH IS 20 FT. LARGER INFLUENT PIPE SIZES SHALL UTILIZE CUSTOM DESIGNS, INCLUDING VORTEX INSERTS (WHERE APPLICABLE) AND STRUCTURAL DESIGN. DESIGN SUBJECT TO ReWa APPROVAL.

	<h2 style="margin: 0;">EXTERNAL DIP DROP CONNECTION AT MANHOLE</h2>	DETAIL No. <h2 style="margin: 0;">SS-7.1</h2>
06/20/23 REV DATE	<h2 style="margin: 0;">N.T.S. SCALE</h2>	

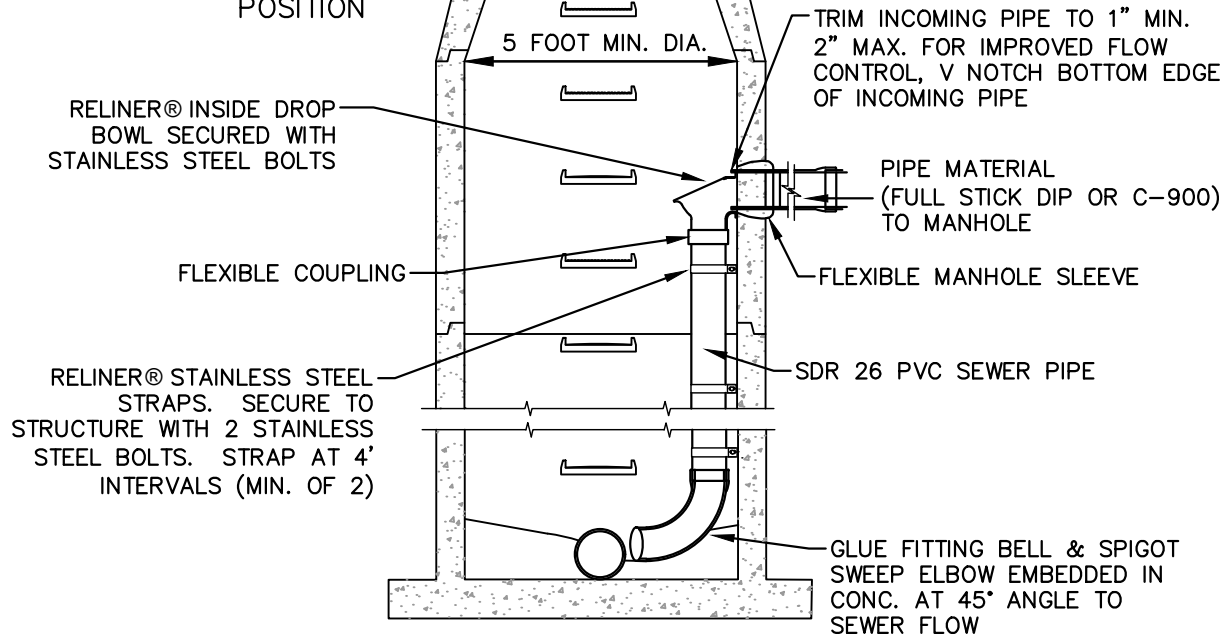
3" TO 5"  
BELOW PIPE



DROP BOWL  
MOUNTING  
POSITION



INSIDE DROP - PLAN



**NOTES:**

1. FOR SERVICE LATERAL CONNECTIONS 4" & 6". OUTSIDE DROP SHALL BE USED FOR COLLECTION LINES.
2. MINIMUM DROP (INVERT IN - DROP INVERT) SHALL BE 5'. MAXIMUM DROP SHALL BE 20'.
3. LOCATION OF STEPS SHALL NOT CONFLICT WITH DROP CONNECTION (90° FROM DROP PIPE).
4. PROVIDE CHANNEL WITH CONTINUOUS INVERT FROM DROP CONNECTION TO INVERT OF SEWER MAIN.
5. SEE DETAIL OF STANDARD PRECAST CONCRETE MANHOLE FOR ADDITIONAL DETAILS AND REQUIREMENTS.
6. SLOPE OF MAIN SEWER LINE APPROACH TO THE DROP ASSEMBLY SHOULD BE NO GREATER THAN 5%.
7. ALL INSIDE DROP CONNECTIONS FOR SERVICES SHALL USE THE DROP BOWL OR APPROVED EQUAL AS PRODUCED BY: RELINER-DURAN, INC. 53 MT. ARCHER RD, LYME, CT 06371.
8. SECURE DROP PIPE TO MANHOLE WALL WITH RELINER-DURAN, INC. STAINLESS STEEL ADJUSTABLE CLAMPING BRACKETS OR APPROVED EQUAL.



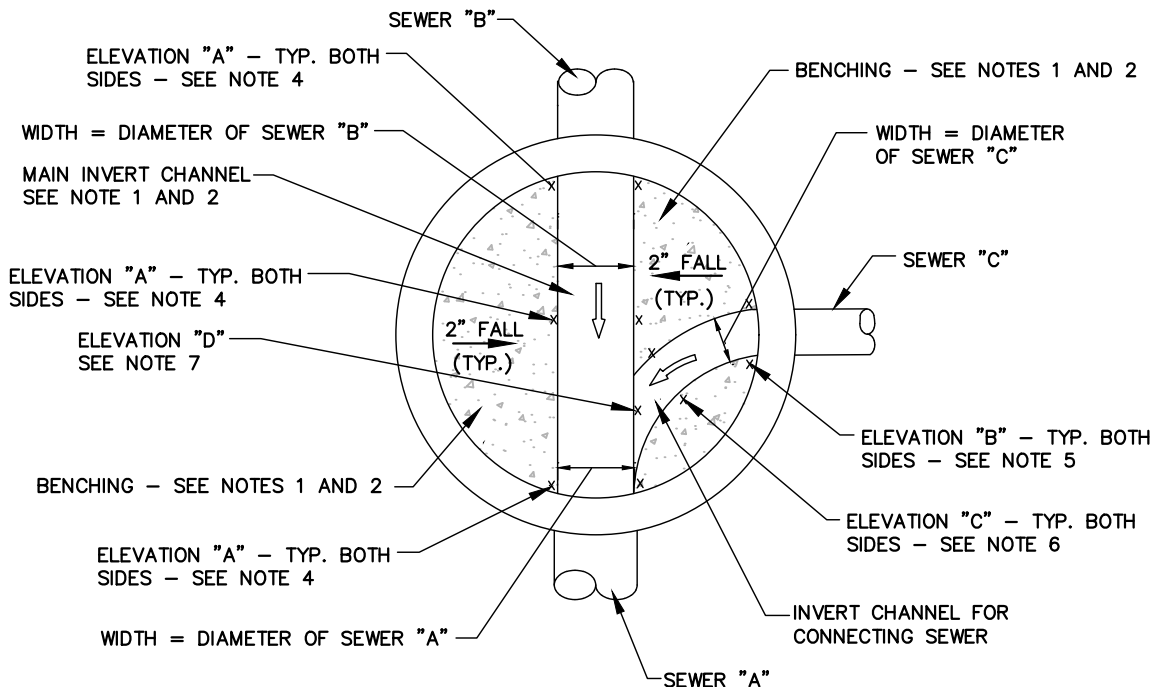
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**SERVICE LATERAL INSIDE  
DROP CONNECTION**

DETAIL No.  
**SS-7.2**

**N.T.S.**  
SCALE





**NOTES:**

1. THIS DETAIL DEPICTS A TYPICAL BENCHING AND INVERT CHANNEL CONFIGURATION. IT IS IMPOSSIBLE TO DETAIL AND DESCRIBE ALL CONFIGURATIONS THAT WILL BE ENCOUNTERED/REQUIRED. THIS DETAIL IS INTENDED TO PROVIDE GENERAL GUIDELINES AND REQUIREMENTS FOR BENCHING AND INVERT CHANNEL CONSTRUCTION. THE CONTRACTOR SHALL ACCOMMODATE ALL CONFIGURATIONS AND CONSTRUCT BENCHING AND INVERT CHANNELS TO THE SATISFACTION OF ENGINEER. ADJUSTMENTS AND REPAIRS TO THE BENCHING AND INVERT CHANNELS SHALL BE PERFORMED AS REQUIRED BY ENGINEER AT NO ADDITIONAL COST. ALL REPAIRS AND ADJUSTMENTS MUST BE MADE WITH AN APPROVED NON-SHRINK GROUT.
2. BENCHING AND INVERT CHANNELS SHALL BE PRECAST BY THE MANHOLE MANUFACTURER. FORMED AND POURED-IN-PLACE BENCHES AND INVERTS MAY BE APPROVED IN CERTAIN SITUATIONS BY THE ENGINEER AND SHALL BE USED WHERE SPECIFICALLY REQUIRED SUCH AS FOR A DOGHOUSE MANHOLE.
  - BENCHING AND INVERT CHANNELS SHALL BE CONSTRUCTED USING MINIMUM 4,000 PSI CONCRETE. ADD FIBER REINFORCING FOR POURED-IN-PLACE BENCHES/INVERTS. ELEVATIONS OF BENCHING AND CHANNELS SHALL BE AS DEFINED IN NOTES 4 THROUGH 7. AT LEAST 2 INCHES OF FALL SHALL BE PROVIDED ON THE TOP OF THE BENCHING FROM THE MANHOLE WALLS TO THE INVERT CHANNELS.
  - INVERT CHANNELS SHALL BE U-SHAPED CHANNELS FOLLOWING THE SHAPE AND DIAMETER OF THE CONNECTING SEWER PIPE FROM THE BOTTOM TO THE SPRINGLINE OF THE PIPE AND THEN EXTENDING VERTICAL TO 80% OF THE PIPE DIAMETER (0.8D). THUS, THE WIDTH OF THE TOP OF THE CHANNEL SHALL EQUAL THE CORRESPONDING SEWER DIAMETER. INVERT CHANNELS SHALL BE SMOOTH, UNIFORM, FREE OF BURRS AND BRIARS THAT MAY CATCH DEBRIS, AND CONSTANTLY SLOPING FROM INLET SEWERS TO THE OUTLET SEWER.
3. CONSTRUCT INVERT CHANNEL FOR CONNECTING SEWERS WITH A CONSTANT CURVE FROM THE EDGE OF THE MANHOLE WALL TO THE MAIN INVERT CHANNEL. PROVIDE MAXIMUM CURVATURE SUCH THAT FLOW FROM CONNECTING SEWERS WILL FREELY DISCHARGE INTO THE MAIN INVERT CHANNEL AND ALL FLOWS WILL FREELY EXIT THE MANHOLE. CHANNEL SHALL BE CONSTANTLY SLOPING WITH THE MAXIMUM POSSIBLE SLOPE. SEE NOTES 2 AND 7.
4. ELEVATION "A" TO EQUAL THE CROWN ELEVATION OF SEWER "B"
5. ELEVATION "B" TO EQUAL THE CROWN ELEVATION OF SEWER "C".
6. ELEVATION "C" SHALL EQUAL AT LEAST THE INVERT CHANNEL ELEVATION AT THAT POINT PLUS THE DIAMETER OF SEWER "C". ADJUST THE ELEVATION UPWARD AS NECESSARY TO AT LEAST EXCEED THE BENCHING ELEVATION AT THE NEARBY MAIN INVERT CHANNEL.
7. ELEVATION "D" REPRESENTS THE ELEVATION OF THE INVERT CHANNEL FOR THE CONNECTING SEWER WHERE IT JOINS THE MAIN INVERT CHANNEL. IF SEWER "C" IS THE SAME SIZE AS SEWER "B", THE CHANNELS SHALL JOIN AT THE SAME ELEVATION WHEREVER POSSIBLE. IF SEWER "C" IS A SERVICE LATERAL, THE CONNECTING SEWER INVERT CHANNEL SHALL JOIN THE MAIN CHANNEL A MINIMUM OF 3 INCHES ABOVE THE MAIN CHANNEL WHEREVER POSSIBLE. ANY SUCH DROP TO THE MAIN CHANNEL SHALL BE SMOOTH AND ROUNDED SO THAT DEBRIS WILL FREELY DISCHARGE INTO THE MAIN CHANNEL.

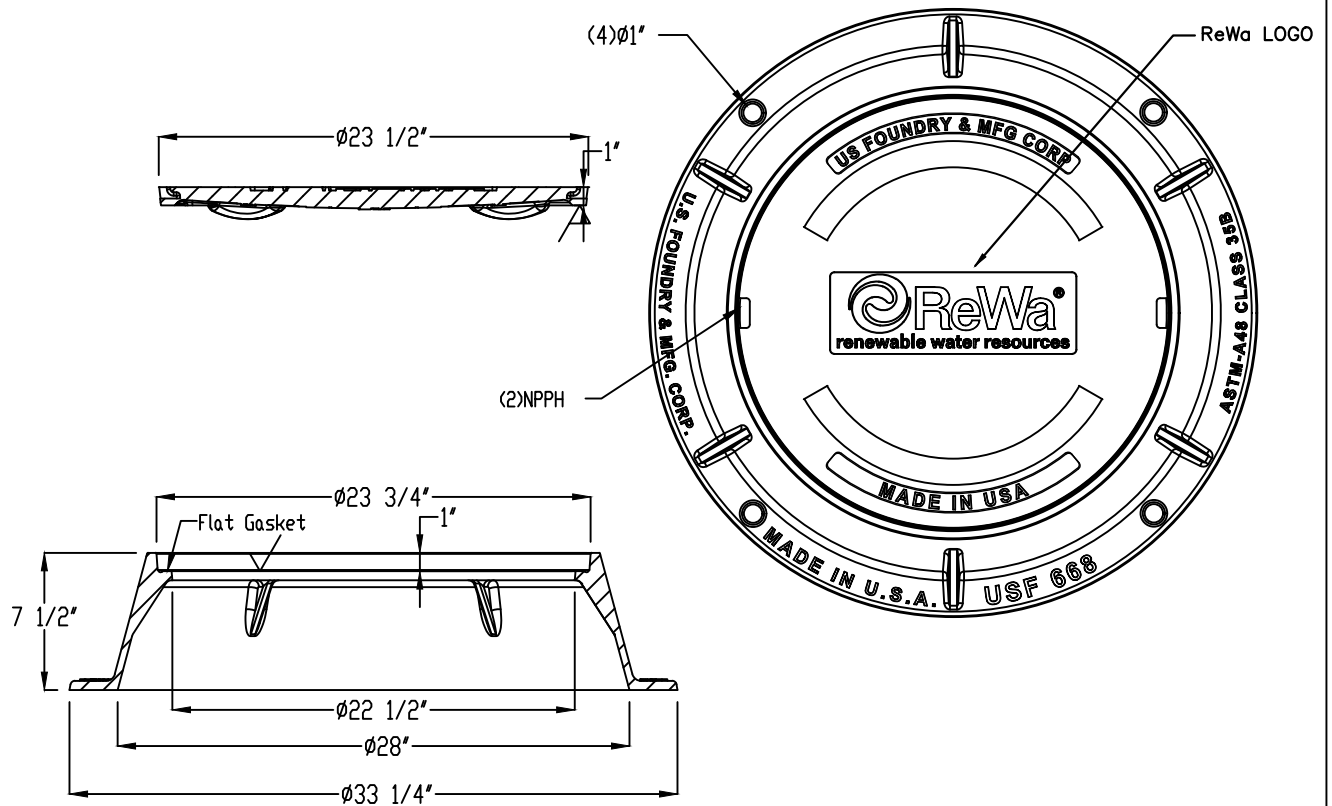


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**BENCH & INVERT PLAN**

DETAIL No.  
**SS-8**

**N.T.S.**  
SCALE



**NOTES:**

1. MODEL USF 668 RING AND YF COVER
2. NPPH = NON-PENETRATING PICK HOLE.

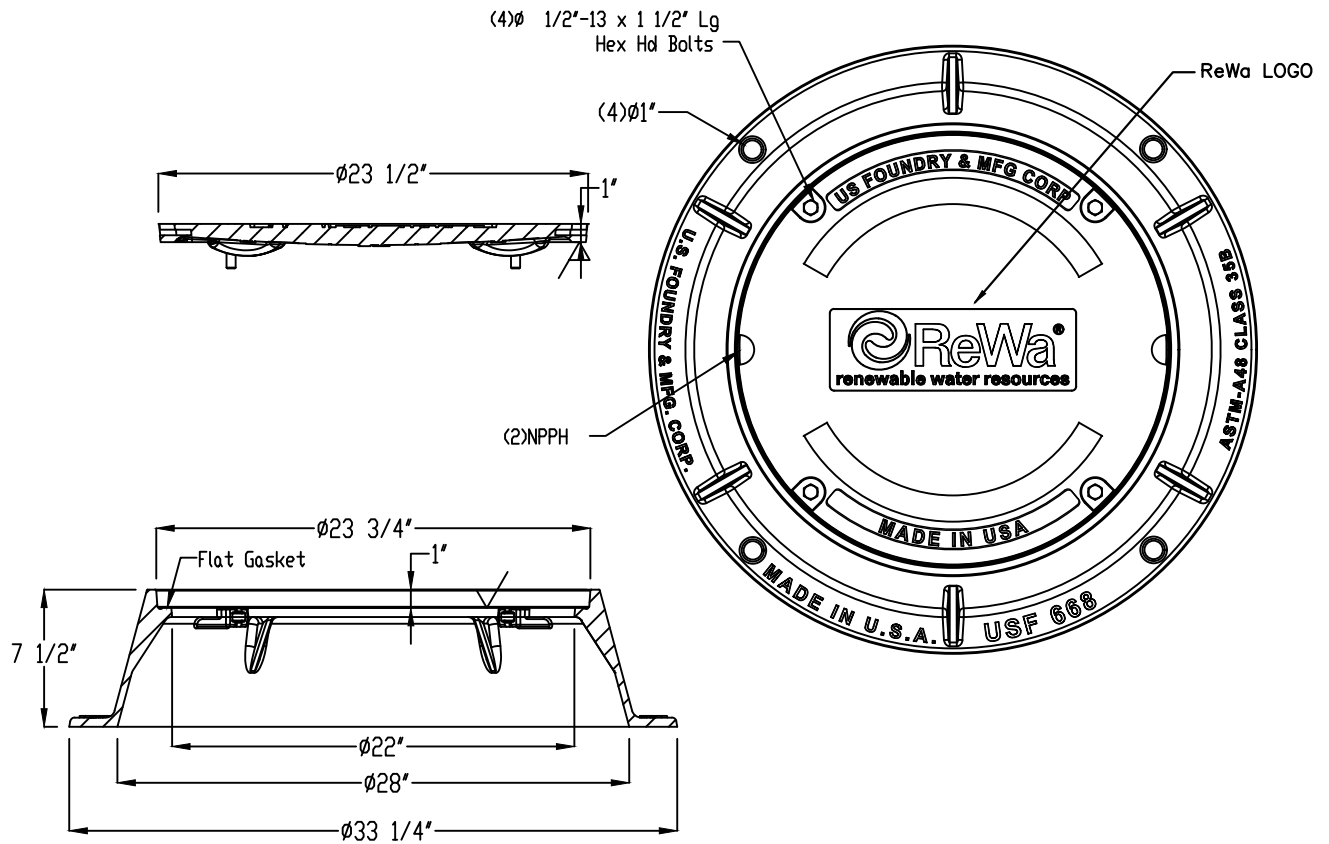


**STANDARD MANHOLE RING  
AND COVER**

DETAIL No.  
**SS-9.1**

**11/12/21**  
REV DATE

**N.T.S.**  
SCALE



**NOTES:**

1. MODEL USF 668 RING AND YF COVER, BWT
2. NPPH = NON-PENETRATING PICK HOLE.  
BWT = BOLT-DOWN, WATERTIGHT

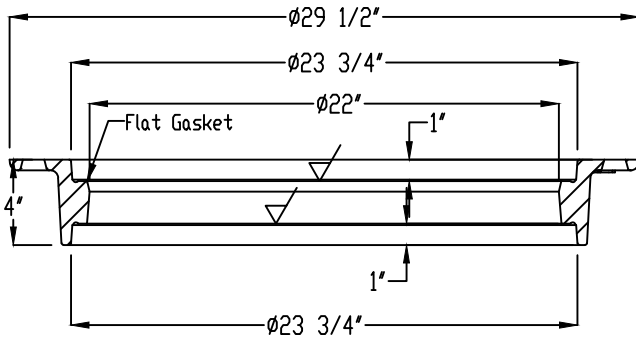
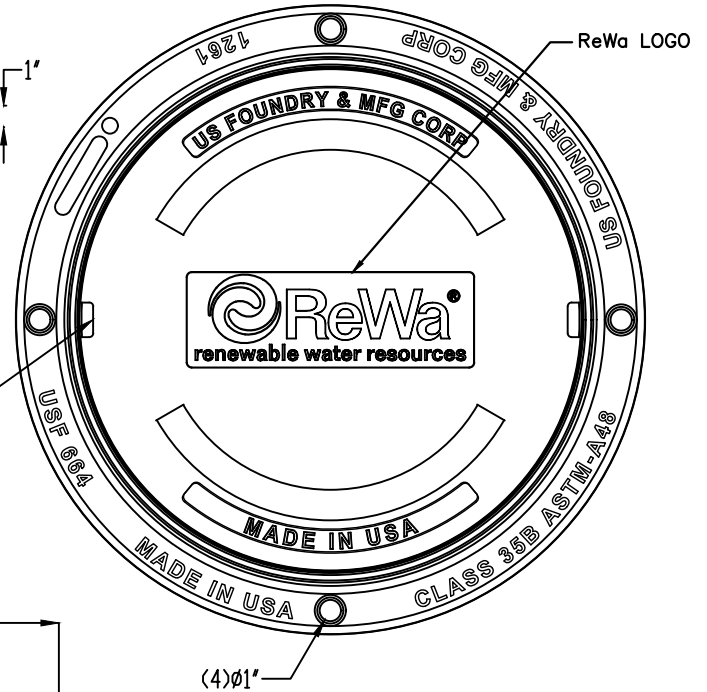
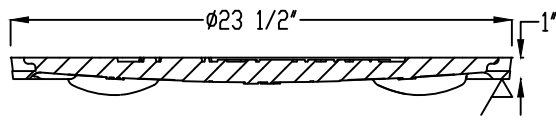


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**STANDARD MANHOLE RING  
AND WATERTIGHT COVER**

DETAIL No.  
SS-9.2

N.T.S.  
SCALE



**NOTES:**

1. MODEL USF 664 RING AND YF COVER.
2. NPPH = NON-PENETRATING PICK HOLE.

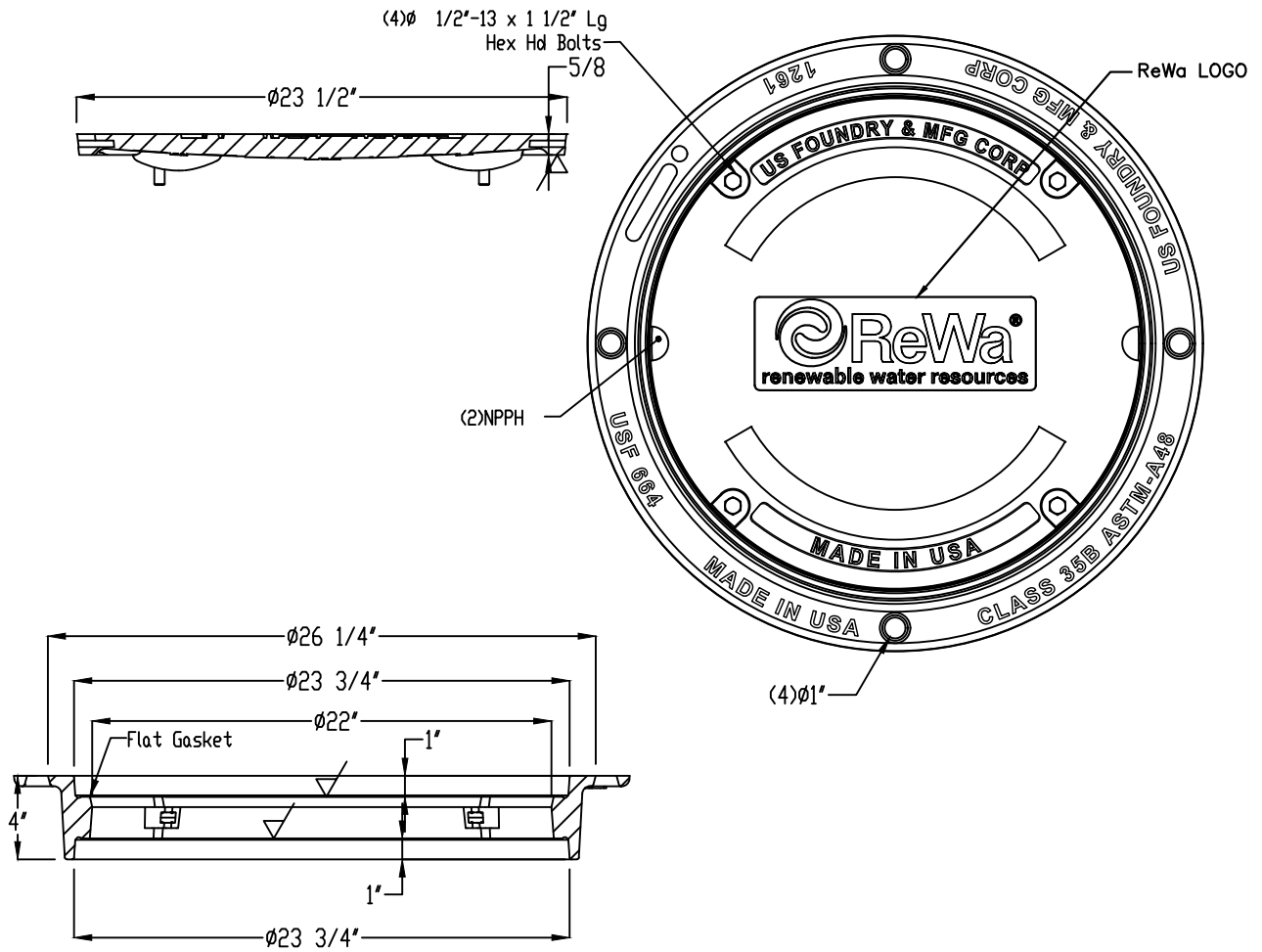


**SLAB-TYPE CAST-IN RING AND COVER**

DETAIL No.  
**SS-9.3**

**11/12/21**  
REV DATE

**N.T.S.**  
SCALE



**NOTES:**

1. MODEL USF 664 RING AND YF COVER, BWT.
2. NPPH = NON-PENETRATING PICK HOLE.  
BWT = BOLT-DOWN, WATERTIGHT



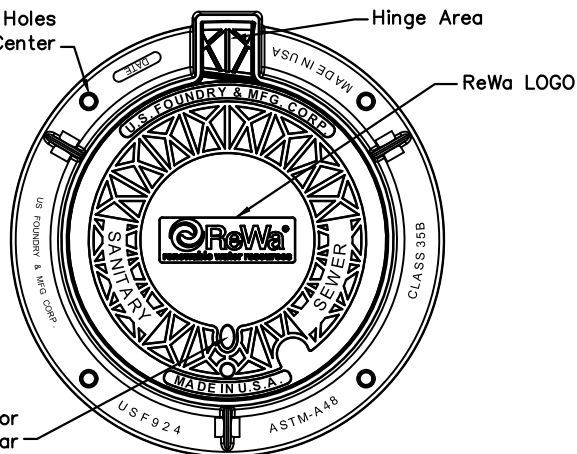
**SLAB-TYPE CAST-IN RING AND  
WATERTIGHT COVER**

DETAIL No.  
**SS-9.4**

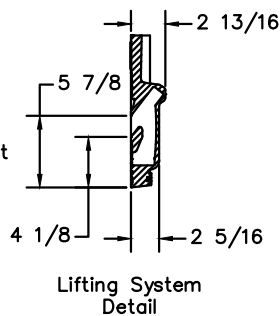
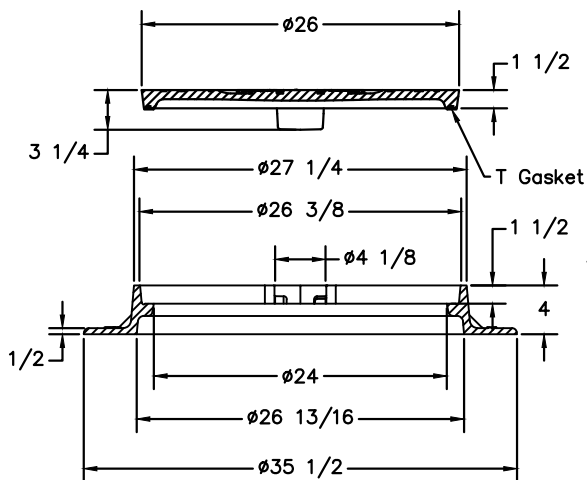
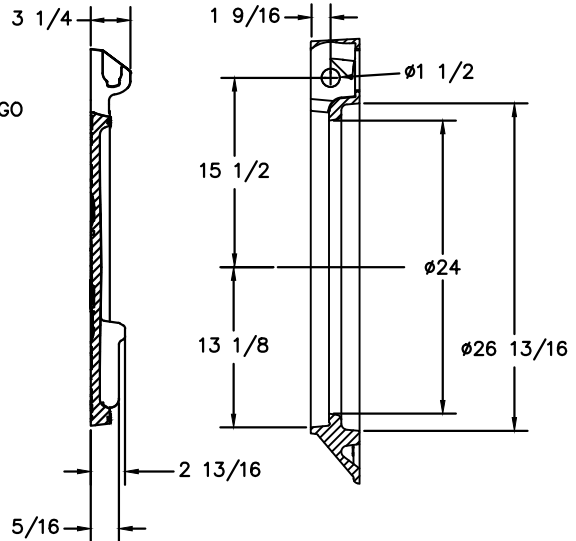
**11/12/21**  
REV DATE

**N.T.S.**  
SCALE

4x  $\varnothing 1"$  Anchor Holes  
 $\odot \varnothing 32 \frac{1}{8}"$  Center



1x  $\varnothing 1"$  Hole for Lifting Bar



**NOTES:**

1. MODEL USF 924 RING AND US COVER, T GASKET.



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 REV DATE

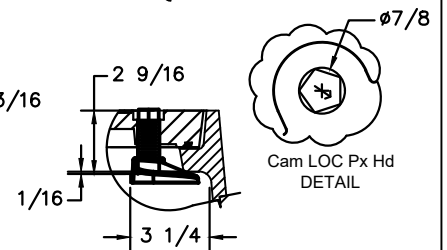
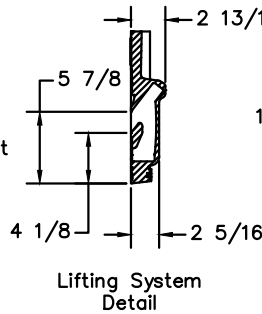
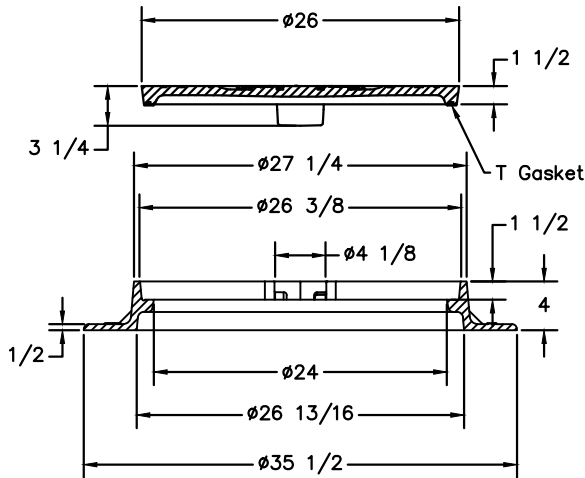
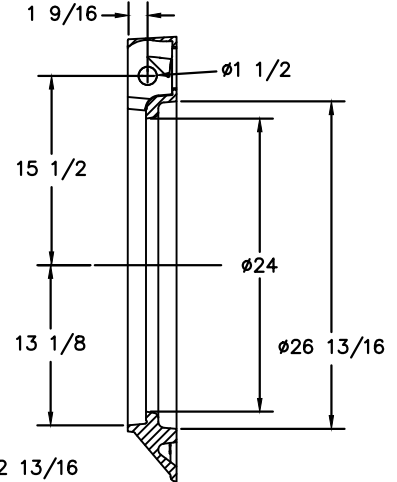
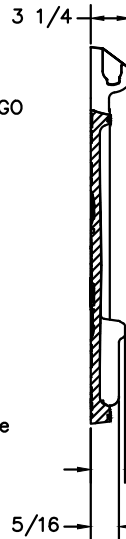
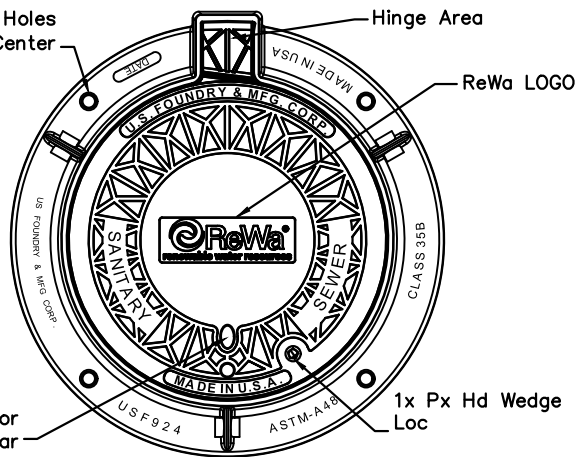
**HINGED MANHOLE RING  
 AND COVER**

DETAIL No.  
 SS-9.5

**N.T.S.**  
 SCALE

4x  $\varnothing 1"$  Anchor Holes  
 $\odot \varnothing 32 \frac{1}{8}"$  Center

1x  $\varnothing 1"$  Hole for Lifting Bar



**NOTES:**

1. MODEL USF 924 RING AND US COVER, T GASKET, WEDGE LOCK.

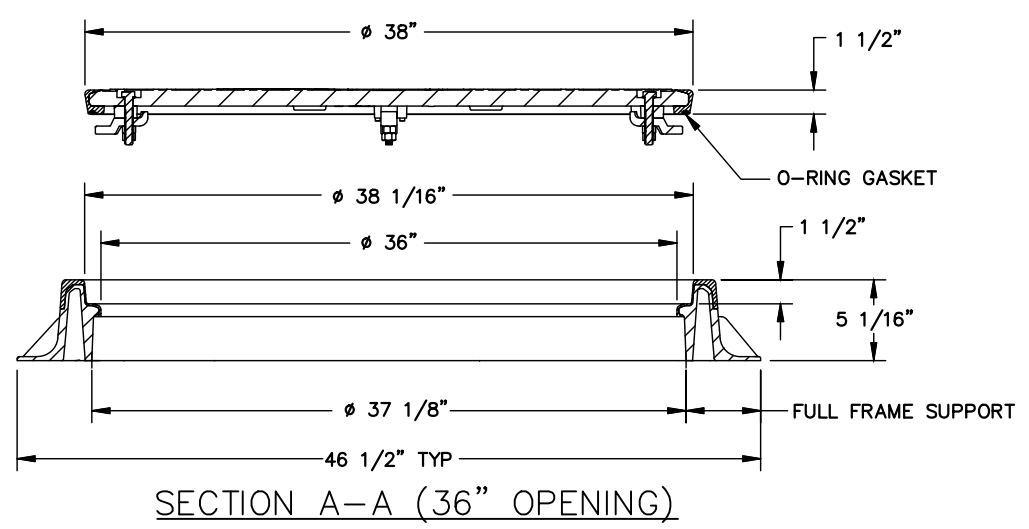
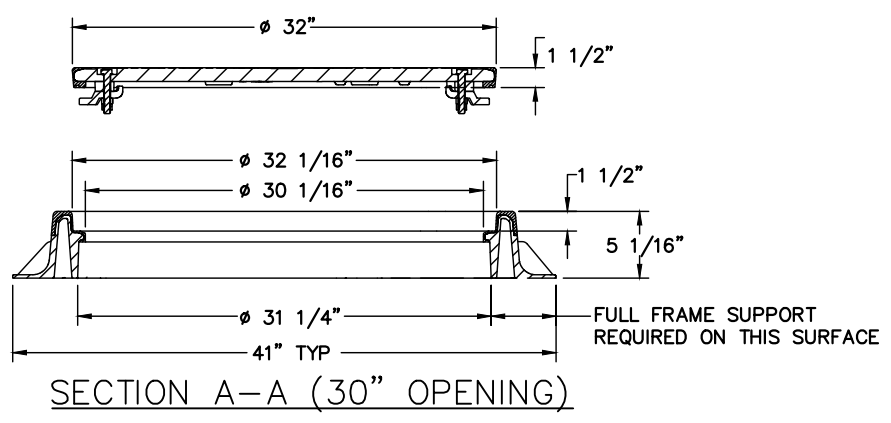
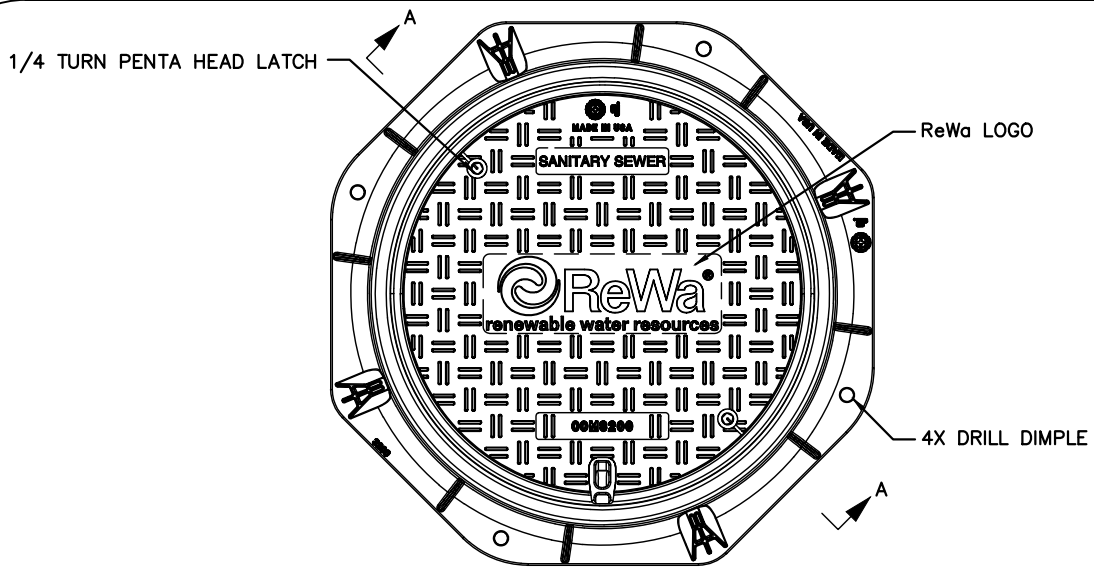


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 REV DATE

**HINGED MANHOLE RING  
 AND WATERTIGHT COVER**

DETAIL No.  
 SS-9.6

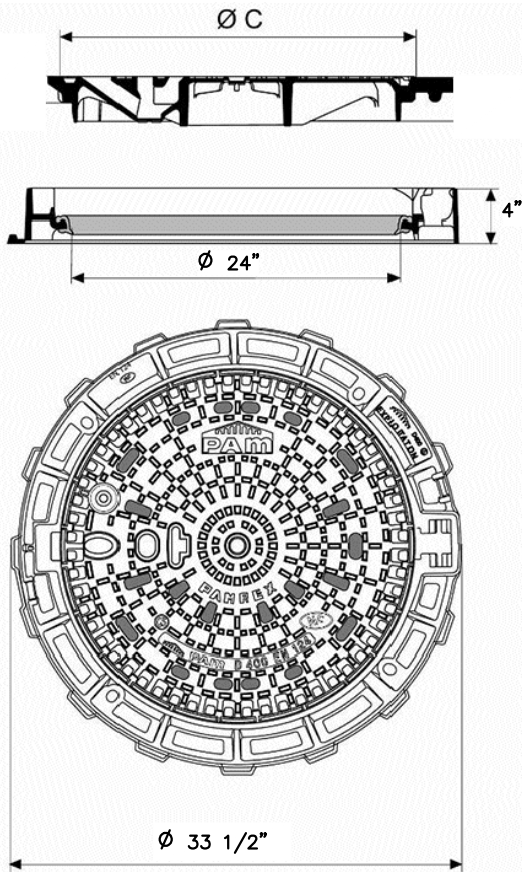
N.T.S.  
 SCALE



- NOTES:**
- MANUFACTURER: EAST JORDAN IRON WORKS (EJCO) OR APPROVED EQUAL:  
 30" RING AND COVER: MODEL COM320069A01 (FORMERLY GMI COMPOSITES MODEL 3200)  
 36" RING AND COVER: MODEL COM380151A01 (FORMERLY GMI COMPOSITES MODEL 3600)
  - PROVIDE TWO (2) 13/16" PENTA HEAD WRENCHES PER PROJECT

	<p align="center"><b>COMPOSITE MANHOLE RING AND WATERTIGHT COVER</b></p>	<p align="center">DETAIL No. <b>SS-9.7</b></p>
<p align="center">11/18/19 REV DATE</p>		<p align="center">N.T.S. SCALE</p>





**NOTES:**

1. MANUFACTURER: SAINT-GOBAIN PAMREX OR APPROVED EQUAL:  
 - 24" RING AND COVER: MODEL CD9A60EHSSE
2. PROVIDE STAINLESS STEEL LOCKING KIT. PROVIDE TWO (2) MIN. LOCK KEYS PER PROJECT.

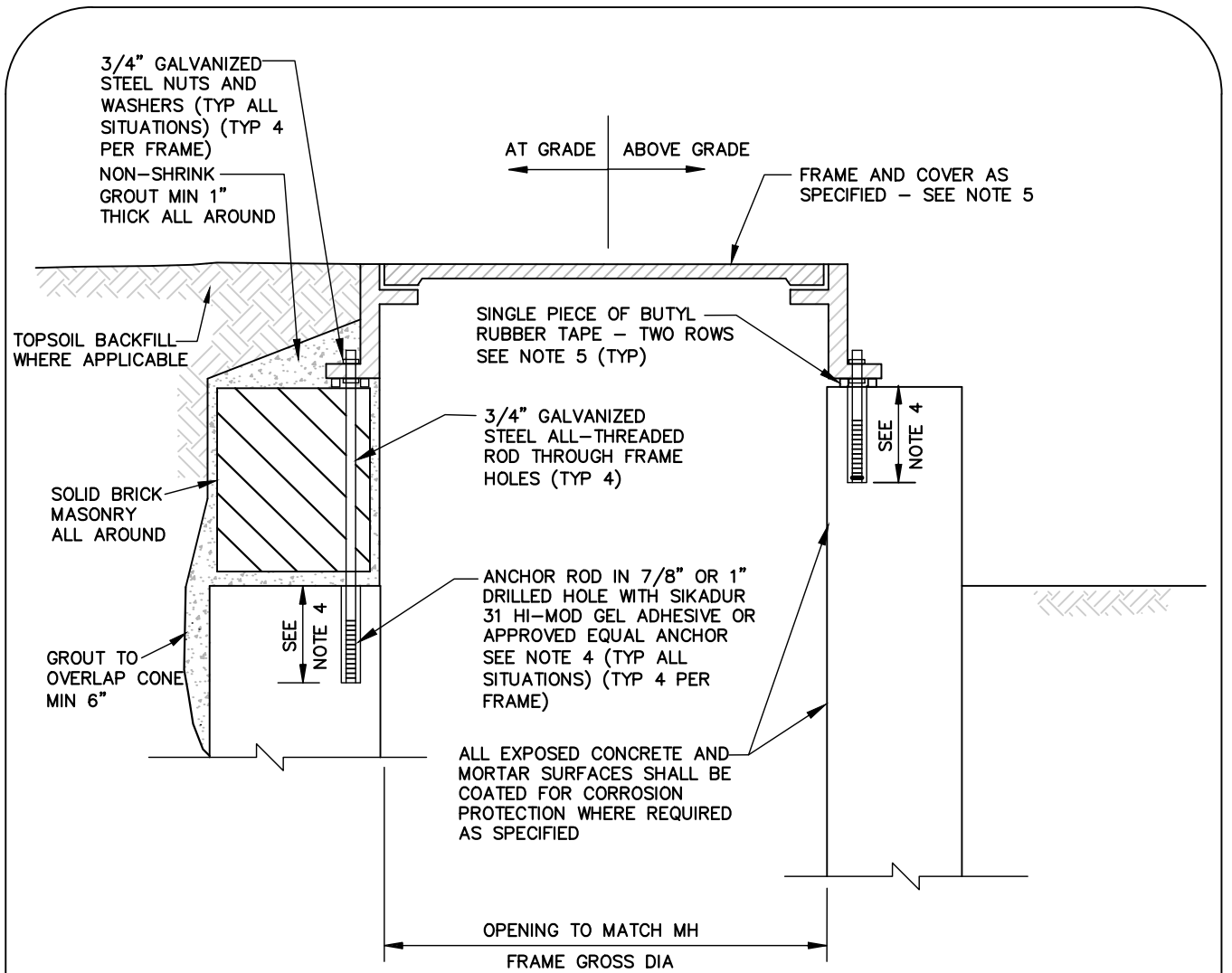


11/12/21  
REV DATE

**VENTILATED HINGED MANHOLE  
RING AND COVER**


DETAIL No.  
**SS-9.8**

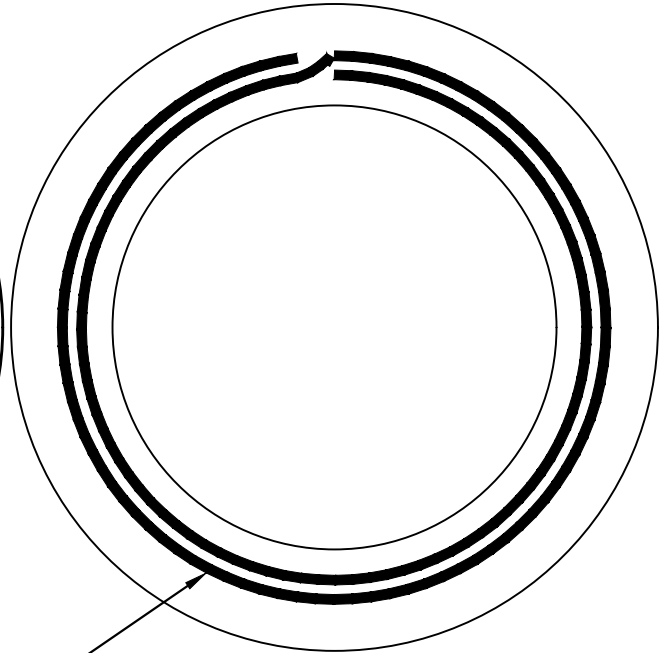
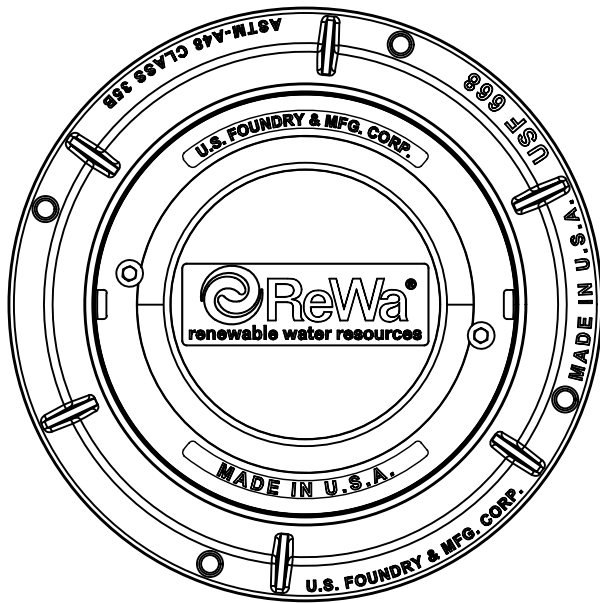
**N.T.S.**  
SCALE



**NOTES:**

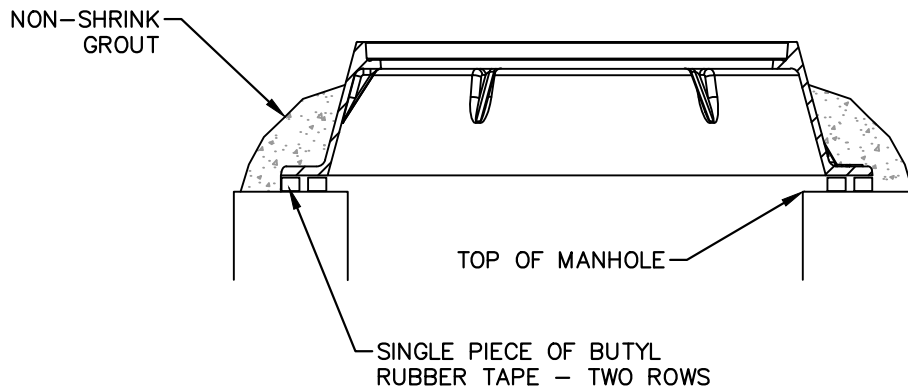
1. ALL FRAMES INSTALLED SHALL BE ANCHORED TO MANHOLE CONE SECTIONS PER THIS DETAIL. FOR FLAT TOP SECTIONS, THIS DETAIL ONLY APPLIES WHEN THE COVER IS TERMINATING FLUSH WITH THE GRADE (WHEN A NON-SLAB TYPE FRAME IS USED).
2. THIS DETAIL DEPICTS ANCHORING FRAMES AND COVERS TO CONE SECTIONS. THE DETAIL ALSO APPLIES TO FLAT TOP SECTIONS PER NOTE 1.
3. MANHOLE SECTIONS TO BE RESTRAINED WITH MANHOLE PRESSURE RESTRAINT SYSTEM SPECIFIED IN DETAIL NO. SS-4 WHENEVER ANCHORING WATERTIGHT FRAMES AND COVERS PER THIS DETAIL.
4. FOR FLAT-TOP SECTIONS, ANCHOR ROD MIN 3/4 OF THE SLAB THICKNESS. FOR CONE SECTIONS, ANCHOR ROD MIN 4" INTO CONE. SUBMIT PROPOSED ANCHORING TO ENGINEER FOR REVIEW AND APPROVAL.
5. INSTALL SINGLE PIECE OF BUTYL RUBBER (MASTIC) SEALANT UNDER FRAME - 2 ROWS. SEE DETAIL SS-10.2.
6. COAT FRAMES AND COVERS WITH TWO 8-MIL MIN DFT COATS OF COAL TAR EPOXY WHEN CORROSION PROTECTION OF MANHOLES IS SPECIFIED. SANDBLAST PRIOR TO APPLYING EPOXY.

	<h2 style="margin: 0;">RESTRAINT SYSTEM FOR FRAMES &amp; COVERS</h2>	<p>DETAIL No. <b>SS-10.1</b></p>
<p><b>11/12/21</b> REV DATE</p>		<p><b>N.T.S.</b> SCALE</p>



SINGLE PIECE OF BUTYL  
RUBBER TAPE – TWO ROWS

PLAN VIEW



SECTION A – RING

**NOTES:**

1. REMOVE ANY DEBRIS FROM TOP OF CONE AND BOTTOM OF RING.
2. PLACE A SINGLE PIECE OF BUTYL RUBBER TAPE AROUND TOP OF CONE CREATING 2 ROWS. SEE DETAIL ABOVE.
3. PLACE MANHOLE RING IN PLACE OVER TAPE AND APPLY PRESSURE.
4. USING NON-SHRINK GROUT, GROUT AROUND OUTSIDE OF RING.

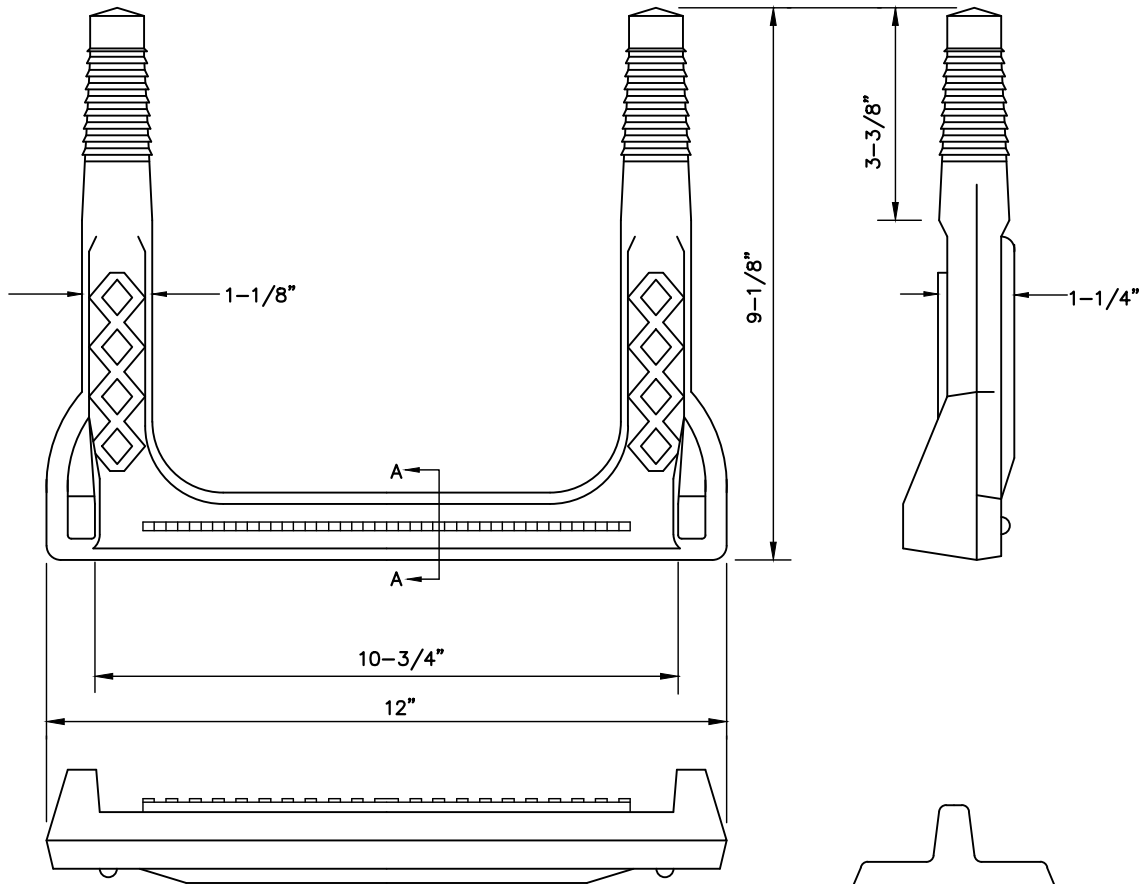


11/12/21  
REV DATE

**MANHOLE RING SEAL**

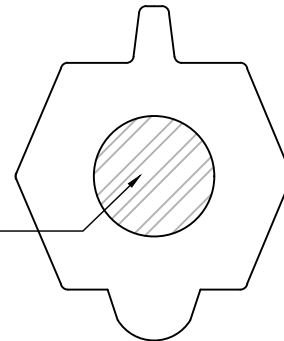
DETAIL No.  
SS-10.2

N.T.S.  
SCALE

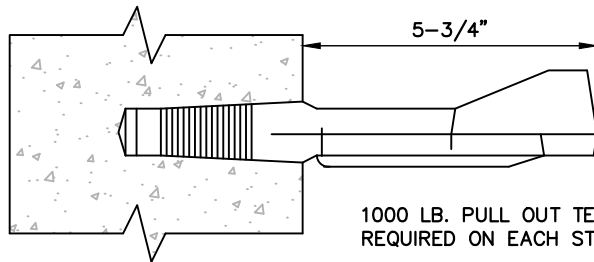


COPOLYMER POLYPROPYLENE PLASTIC

1/2" GRADE 60 STEEL REINFORCEMENT



SECTION A-A



1000 LB. PULL OUT TEST REPORT  
REQUIRED ON EACH STEP.

**NOTES:**

1. THIS STEP TO BE DRIVEN INTO TAPERED HOLES IN PRECAST MANHOLE SECTIONS. DO NOT USE AS A GROUTED-IN STEP.
2. DIAMETER AND DEPTH OF HOLE TO BE DRILLED FOR STEP SHALL BE AS SPECIFIED BY THE STEP MANUFACTURER.
3. SEE REWA STANDARD SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.

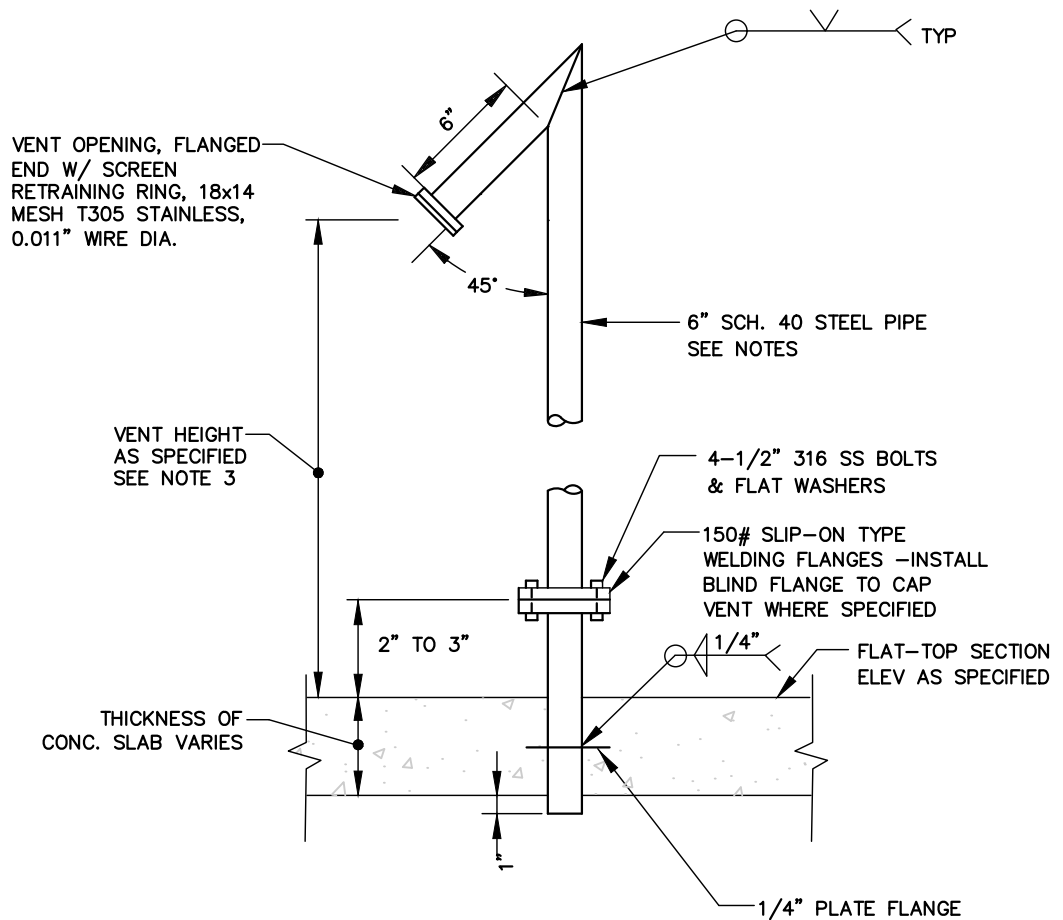


11/18/19  
REV DATE

PLASTIC MANHOLE STEP -  
CORED HOLE/DRIVEN IN PLACE

DETAIL No.  
SS-11

N.T.S.  
SCALE



**NOTES:**

1. SIX INCH DIAMETER FLANGED BY PLAIN END STEEL WALL PIPE SHALL BE CAST IN PLACE (PLUMB) WITH BOLT HOLES IN FLANGE STRADDLING THE CENTER LINES.  
  
SIX INCH DIAMETER STEEL VENT PIPE TO BE FURNISHED WITH COMPATIBLE FLANGE AND ALL NECESSARY STAINLESS STEEL HARDWARE FOR BOLTED ATTACHMENT. VENT OUTLET TO POINT DOWNSTREAM.  
  
PROVIDE SCREEN ON END OF VENT PIPES.
2. ALL STEEL COMPONENTS SHALL BE HOT DIP GALVANIZED AFTER FABRICATION AND BEFORE BEING CAST-IN-PLACE.
3. TOP OF VENT OPENING TO BE 2 FEET ABOVE THE 100-YEAR FLOOD ELEVATION. IF MANHOLE COVER/TOP SLAB IS ABOVE 100-YEAR FLOOD ELEVATION, VENT OPENING TO BE 2 FEET ABOVE TOP SLAB.
4. VENTS TO BE INSTALLED EVERY 1,200 FEET OR AS APPROVED BY ReWa.

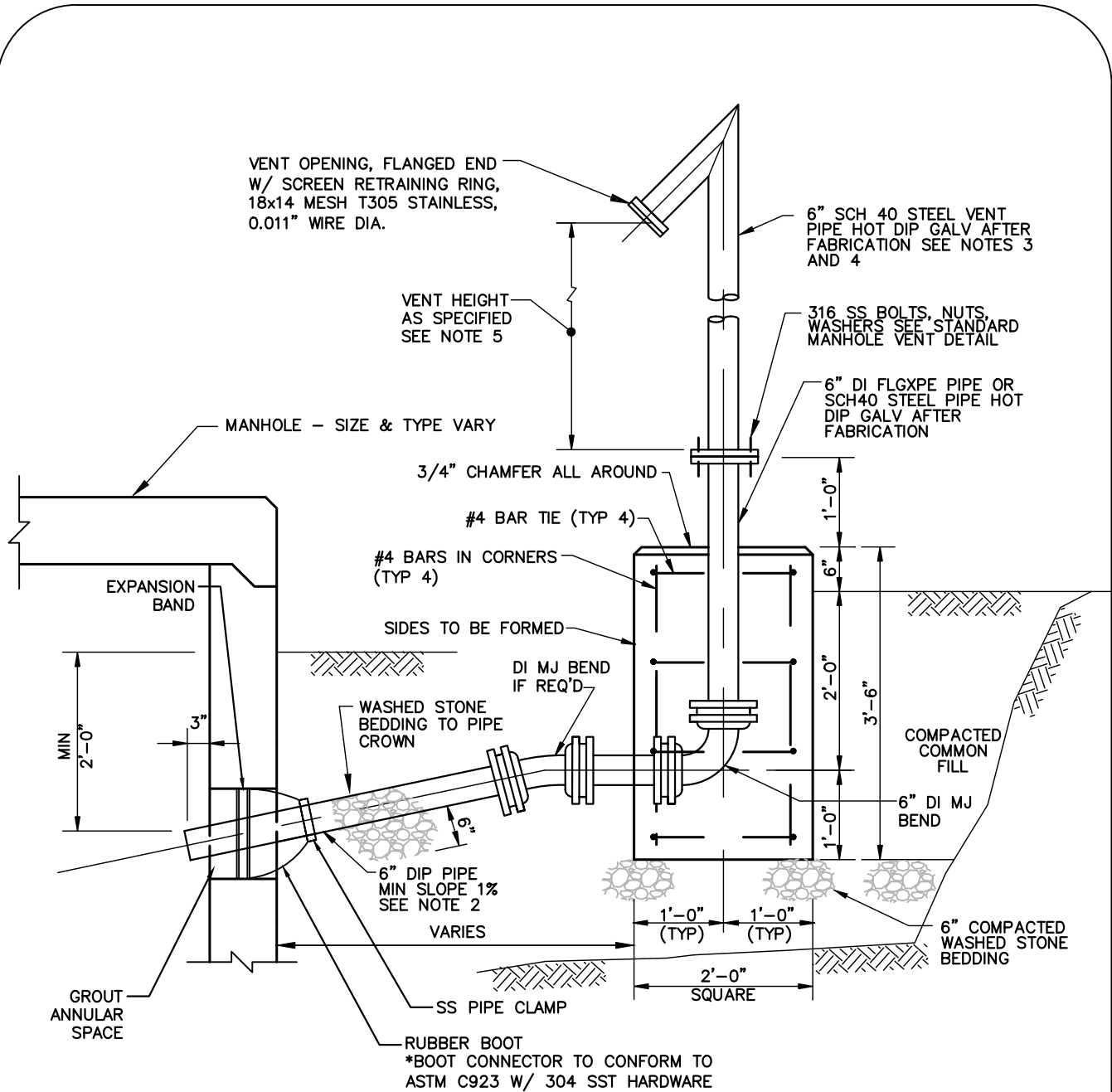


11/18/19  
REV DATE

**STANDARD MANHOLE  
VENT PIPE**

DETAIL No.  
**SS-12**

**N.T.S.**  
SCALE



**NOTES:**

1. INSTALL REMOTE VENT INSTEAD OF STANDARD VENT WHERE SPECIFIED. WHEN REMOTE VENT IS SPECIFIED, DO NOT PROVIDE VENT OPENING IN TOP SLAB OF MANHOLE.
2. COAT INSIDE OF ALL DIP WITH CERAMIC EPOXY (401 PROTECTO BY VULCAN PAINTERS) -SEE DIP SPECIFICATIONS.
3. VENT TO POINT DOWNSTREAM.
4. TOP OF VENT OPENING TO BE 2 FEET ABOVE THE 100-YEAR FLOOD ELEVATION. IF MANHOLE COVER/TOP SLAB IS ABOVE 100-YEAR FLOOD ELEVATION, VENT OPENING TO BE 2 FEET ABOVE TOP SLAB.
5. VENTS TO BE INSTALLED EVERY 1,200 FEET OR AS APPROVED BY ReWa.

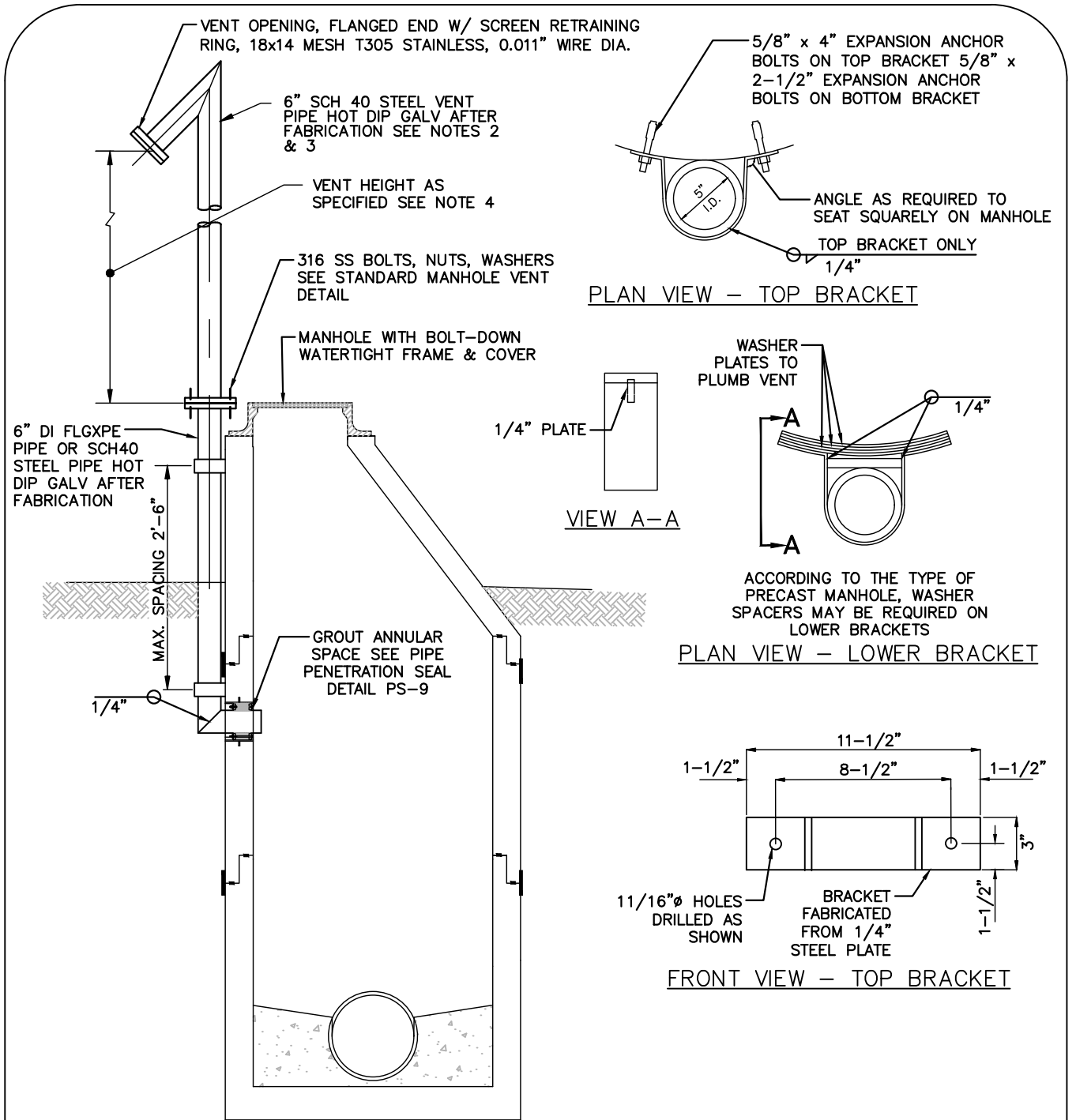


11/18/19  
REV DATE

**REMOTE MANHOLE  
VENT PIPE**

DETAIL No.  
**SS-13**

**N.T.S.**  
SCALE

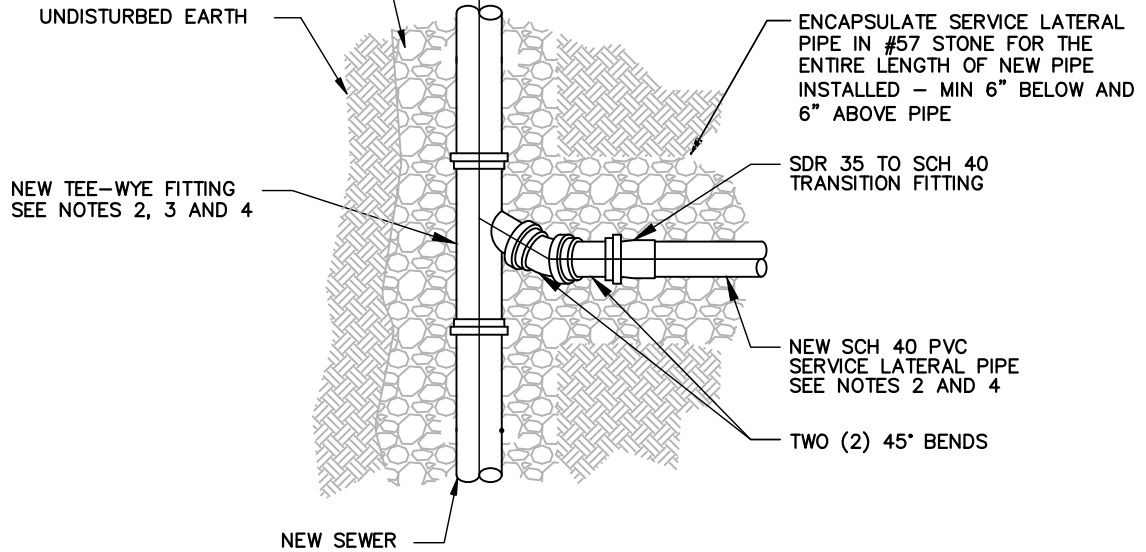


**NOTES:**

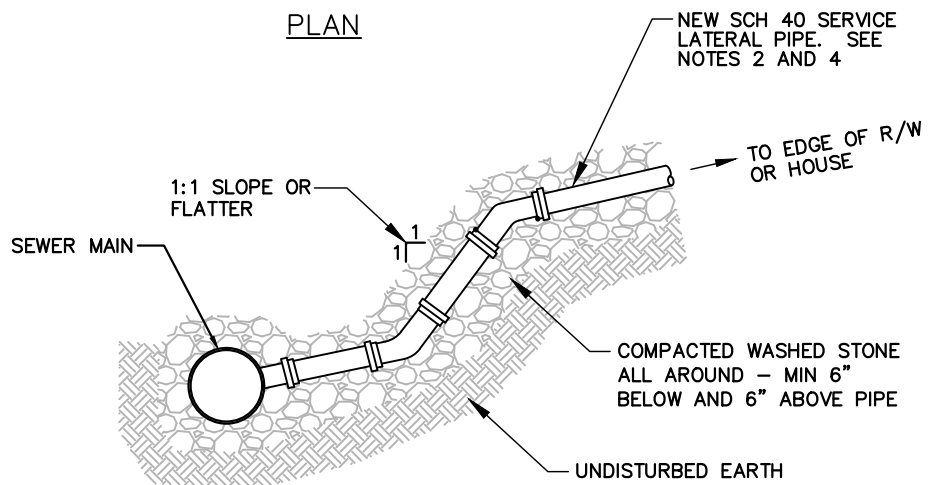
1. COAT INSIDE OF ALL DIP WITH CERAMIC EPOXY (401 PROTECTO BY VULCAN PAINTERS) –SEE DIP SPECIFICATIONS.
2. VENT TO POINT DOWNSTREAM.
3. TOP OF VENT OPENING TO BE 2 FEET ABOVE THE 100–YEAR FLOOD ELEVATION. IF MANHOLE COVER IS ABOVE 100–YEAR FLOOD ELEVATION, VENT OPENING TO BE 2 FEET ABOVE MANHOLE COVER. VENTS TO BE INSTALLED EVERY 1,200 FEET OR AS APPROVED BY ReWa.
4. AVOID PLACING PIPE BRACKETS AT MANHOLE JOINTS OR STEPS.

	<h2 style="margin: 0;">MANHOLE VENT PIPE</h2>	DETAIL No. <h2 style="margin: 0;">SS-14</h2>
06/20/23 REV DATE		N.T.S. SCALE

#57 STONE BEDDING ALL AROUND (MIN 8" BELOW AND 8" ABOVE PIPE) SEE NOTE 3



PLAN



PROFILE

**NOTES:**

1. THIS DETAIL APPLIES TO NEW SEWER PROJECTS ONLY WHERE A CONNECTION TO A MANHOLE CANNOT BE MADE. REFER TO THIS DETAIL WHEN CONNECTING NEW OR EXISTING SERVICE LATERALS TO NEW SEWERS WITH A TEE-WYE FITTING. TEE-WYE CONNECTIONS ARE THE REQUIRED METHOD FOR CONNECTING LATERALS TO NEW SEWERS. TEE-WYE FITTINGS SHALL BE INSTALLED AS THE NEW SEWER IS LAID. INSTALLING THE NEW SEWER AND THEN LATER TAPPING THE SEWER WITH A SADDLE CONNECTION SHALL NOT BE ALLOWED.
2. SERVICE LATERAL PIPING SHALL BE SOLID WALL SCH 40 PVC CONFORMING TO ASTM D 1785. INSTALL FITTINGS AND ADAPTERS AS NECESSARY TO CONNECT NEW TEE-WYE AND SERVICE LATERAL. WHERE 1:1 MAXIMUM SLOPE CANNOT BE MAINTAINED DUE TO SITE RESTRICTIONS, A VERTICAL RISER PIPE MAY BE ALLOWED ON A CASE-BY-CASE BASIS AS APPROVED BY REWA. VERTICAL RISER PIPE DESIGN SHALL BE RESPONSIBILITY OF THE APPLICANT'S ENGINEER AND SHALL BE SUBMITTED TO REWA FOR REVIEW PRIOR TO INSTALLATION. WHERE DEPTH OF COVER IS LESS THAN 18" LATERAL SHALL BE DUCTILE IRON PIPE UNTIL A DEPTH OF GREATER THAN 18" IS ACHIEVED.
3. STONE BEDDING TO EXTEND AT LEAST 6 INCHES BELOW AND ABOVE THE TEE-WYE FITTING.
4. ROTATE NEW TEE-WYE 45 DEGREES FROM HORIZONTAL TO THE LEFT OR RIGHT AS APPROPRIATE AND INSTALL FITTINGS/BENDS AS NECESSARY TO ROUTE LATERAL ALONG DESIRED ELEVATION. SERVICES SHALL NOT ENTER THE TOP OF THE SEWER.



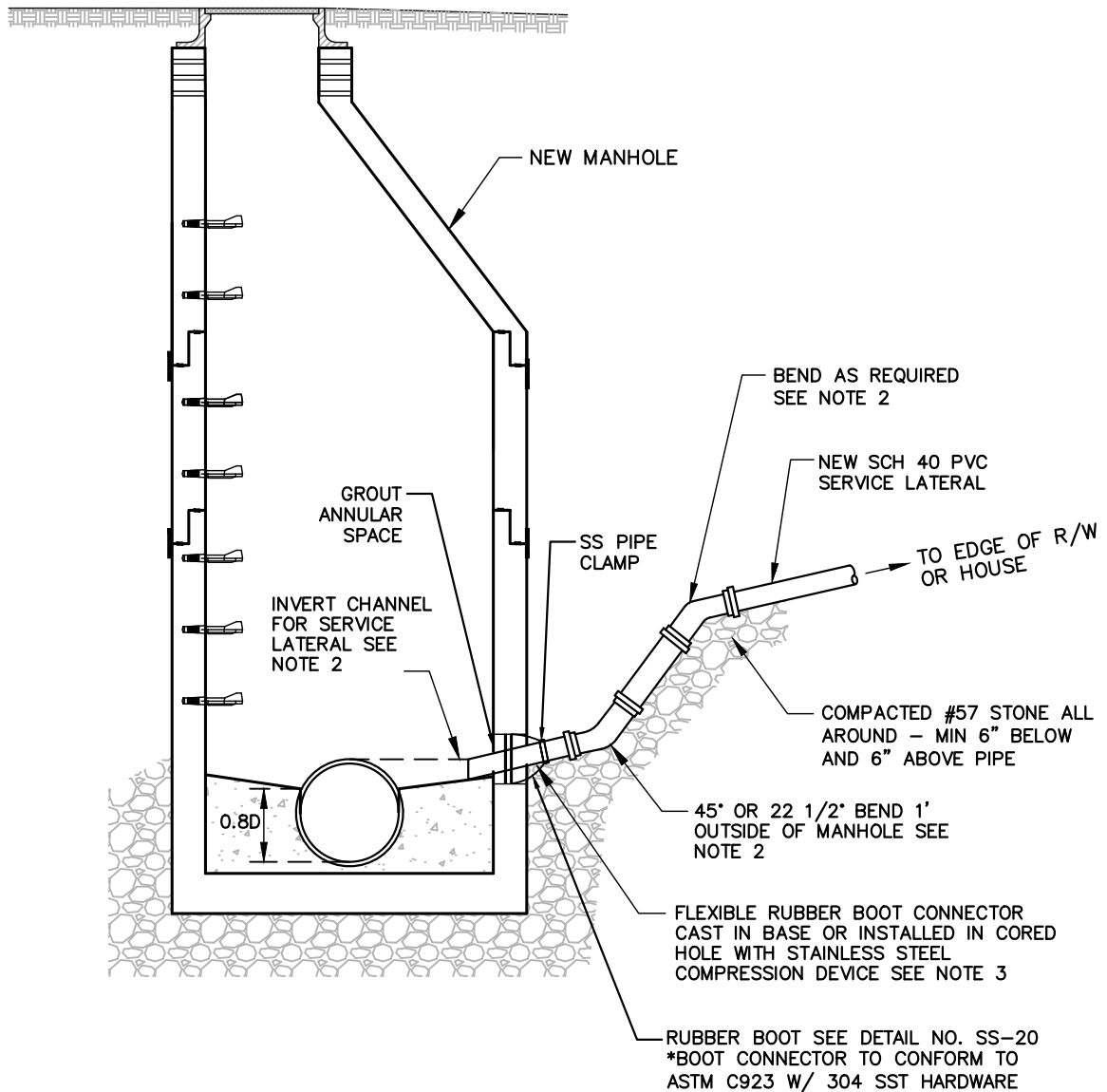
**SERVICE LATERAL TEE-WYE CONNECTION TO NEW SEWER**

DETAIL No.  
**SS-15**

**11/18/19**  
REV DATE

**N.T.S.**  
SCALE





**NOTES:**

1. REFER TO THIS DETAIL WHEN INSTALLING NEW SERVICE LATERALS TO NEW MANHOLES. SEE DETAIL SS-15, NOTE 2 FOR SERVICE LATERAL MATERIALS.
2. ROUTE ALL NEW SERVICE LATERALS BEING INSTALLED TO NEW MANHOLES SUCH THAT THE SERVICE LATERAL CROWN ELEVATION MATCHES THE HIGHEST CROWN ELEVATION OF THE CONNECTING SEWER(S). CONTRACTOR SHALL USE BENDS AS NECESSARY. 90° BENDS SHALL NOT BE USED. DROP PIPES INSIDE MANHOLES SHALL NOT BE ALLOWED.  
  
THE INVERT CHANNEL FOR THE NEW LATERAL SHALL BE FORMED AND POURED AS PART OF THE MAIN PRECAST INVERT CHANNEL AND SHALL MEET ALL REQUIREMENTS SHOWN IN DETAIL SS-8.
3. IF THE HOLE FOR THE SERVICE LATERAL MUST BE CORE-DRILLED IN THE FIELD, REFER TO DETAIL SS-20 FOR REQUIREMENTS.

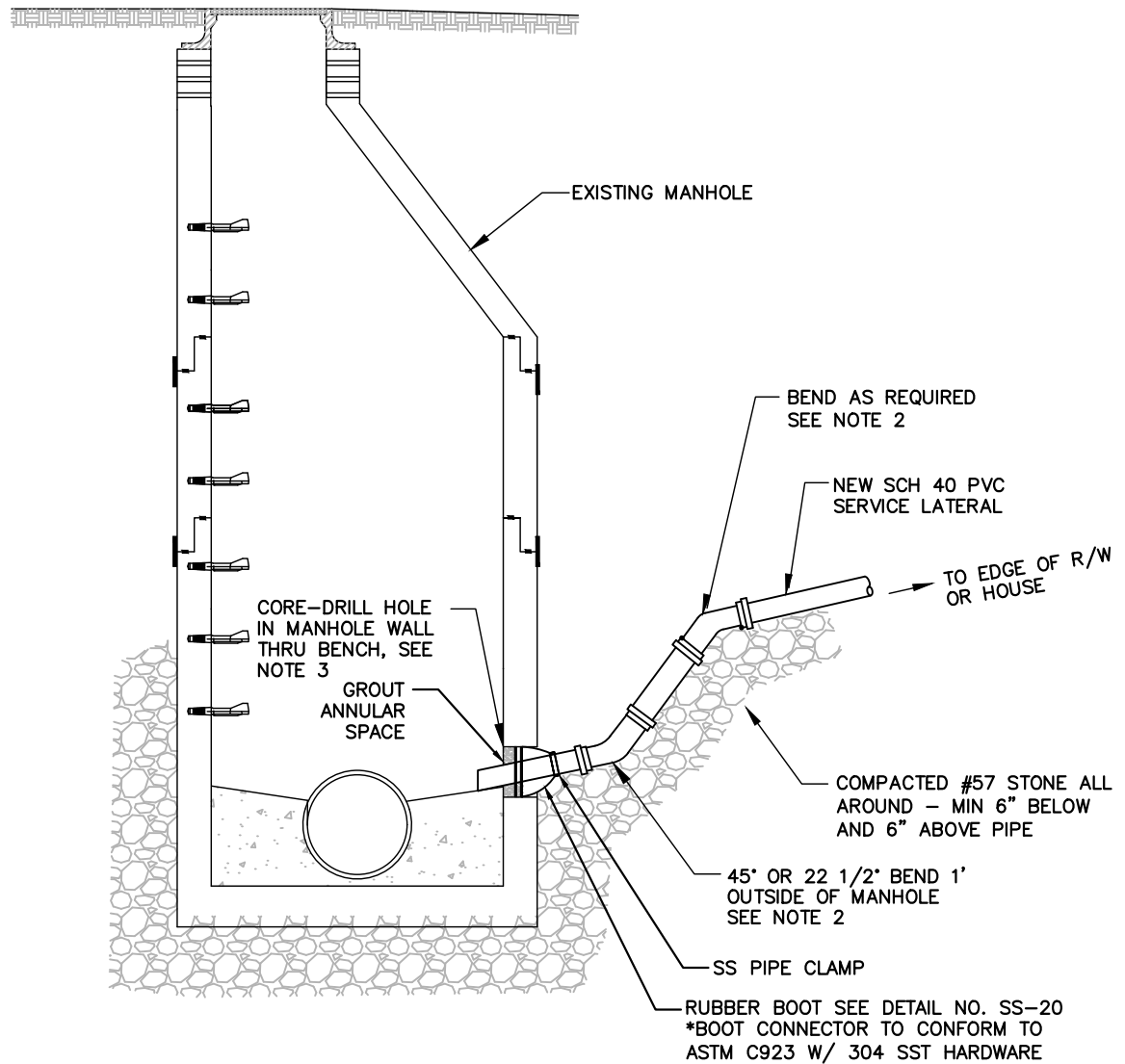


06/20/23  
REV DATE

**NEW SERVICE LATERAL  
INSTALLATION TO NEW  
MANHOLE**

DETAIL No.  
**SS-16**

**N.T.S.**  
SCALE



**NOTES:**

1. REFER TO THIS DETAIL WHEN INSTALLING NEW SERVICE LATERALS TO EXISTING MANHOLES. SEE DETAIL SS-15, NOTE 2 FOR SERVICE LATERAL MATERIALS OF CONSTRUCTION.
2. ROUTE ALL NEW SERVICE LATERALS BEING INSTALLED TO NEW MANHOLES SUCH THAT THE SERVICE LATERAL CROWN ELEVATION MATCHES THE HIGHEST CROWN ELEVATION OF THE CONNECTING SEWER(S). CONTRACTOR SHALL USE BENDS AS NECESSARY. 90° BENDS SHALL NOT BE USED. DROP PIPES INSIDE MANHOLES SHALL NOT BE ALLOWED.
3. CORE DRILL HOLE THROUGH WALL OF MANHOLE AND EXISTING BENCH AS DEPICTED IN THE DETAIL. PROVIDE A WATERTIGHT SEAL AT THE PIPE CONNECTION USING A FLEXIBLE RUBBER BOOT PER DETAIL NO. SS-20.

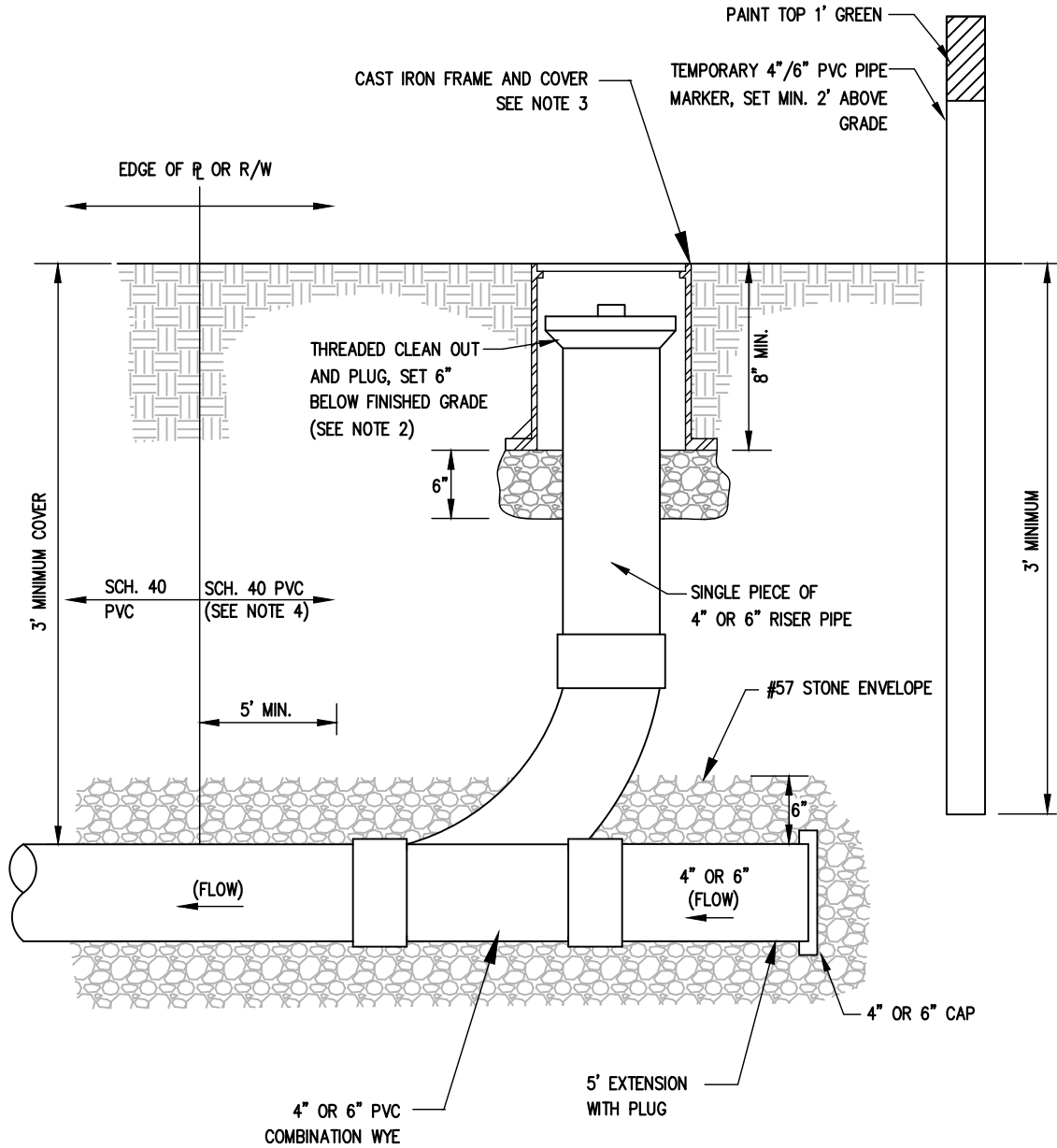


06/20/23  
REV DATE

**NEW SERVICE LATERAL  
INSTALLATION TO EXISTING  
MANHOLE**

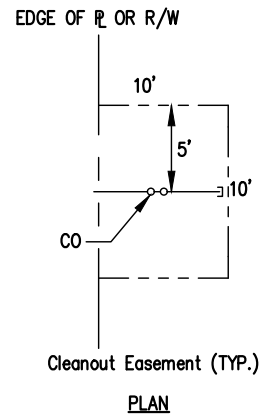
DETAIL No.  
**SS-17**

**N.T.S.**  
SCALE



**NOTES:**

1. SERVICE LATERAL PIPING SHALL BE SOLID WALL SCH 40 PVC CONFORMING TO ASTM D 1785. INSTALL FITTINGS AND ADAPTERS AS NECESSARY TO CONNECT CLEANOUT TO SERVICE LATERAL. LATERALS SHALL BE 4" UNLESS ADDITIONAL CAPACITY IS REQUIRED (MULTIFAMILY, COMMERCIAL, ETC.) IN WHICH CASE A 6" LATERAL SHALL BE USED. SIZE/CAPACITY TO BE DETERMINED BY DESIGN ENGINEER OR AS DIRECTED BY ReWa.
2. MIN. GRADE OF 1/4" PER FOOT (2%) REQUIRED.
3. CAST IRON METER BOX SHALL BE 16"x8" TRAFFIC RATED CLEANOUT BOX & LID. PROVIDE CAPITOL FOUNDRY OF VA., INC. MODEL VB9S, OR APPROVED EQUAL WITH "S" LETTERED COVER.
4. DURING FINAL GRADING OF BUILDING SITE, PLUMBER SHALL ADJUST FRAME AND COVER AND CLEAN OUT (INCLUDING WASHED STONE) AS NECESSARY TO MEET DETAIL REQUIREMENTS.
5. CONSTRUCTION OF CLEAN OUT AND APPURTENANCES SHALL BE IN ACCORDANCE WITH APPLICABLE COUNTY BUILDING CODES.

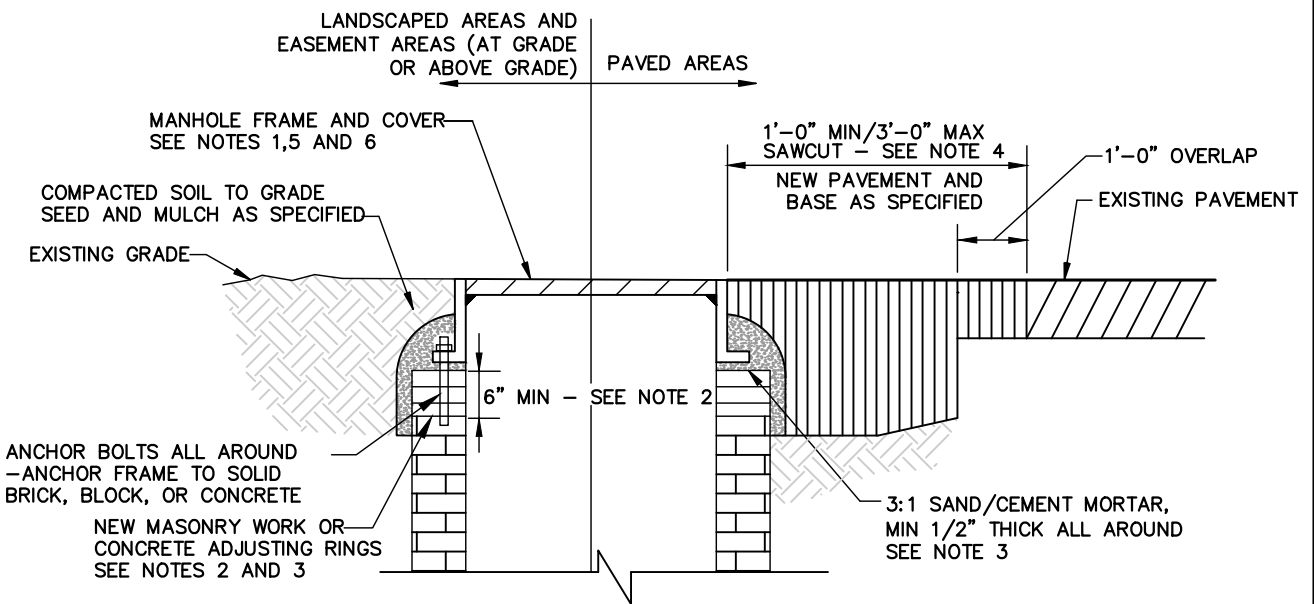


07/01/22  
REV DATE

## SERVICE LATERAL CLEANOUT

DETAIL No.  
SS-18

N.T.S.  
SCALE



**NOTES:**

1. CONTRACTOR SHALL REFER TO THIS DETAIL WHEN RAISING MANHOLES AND WHEN RESETTING OR REPLACING EXISTING FRAMES AND COVERS. ALL REHABILITATION OF FRAMES AND COVERS SHALL BE COMPLETED PRIOR TO OTHER MANHOLE REHABILITATION WORK. THIS DETAIL ILLUSTRATES MANHOLES AT GRADE. FOR FRAME AND COVERS ABOVE GRADE, WORK SHALL BE IN ACCORDANCE WITH THIS DETAIL AND ALL OTHER REQUIREMENTS IN THE STANDARD SPECIFICATIONS AND DETAILS.
2. CONTRACTOR TO REMOVE AT LEAST 6" OF EXISTING BRICK AND/OR MATERIAL PRIOR TO INSTALLING NEW MASONRY OR CONCRETE ADJUSTING RINGS, TO PROVIDE A NEW SOLID SURFACE FOR SEATING THE FRAME AND TO PROVIDE A LEAK-TIGHT SEAL.
3. REMOVE ALL LOOSE BRICKS AND MORTAR AND PROVIDE A SMOOTH LEVEL SURFACE PRIOR TO INSTALLING MASONRY OR CONCRETE ADJUSTING RINGS. BRUSH SURFACE WITH STIFF WIRE BRUSH PRIOR TO PLACING MORTAR.
4. IN PAVED AREAS, PAVEMENT SHALL BE SAW-CUT NEATLY IN A SQUARE AROUND EXISTING MANHOLES. PAVEMENT SHALL BE IN ACCORDANCE WITH ALL CITY, COUNTY AND SCDOT REQUIREMENTS. PROVIDE TACK COAT ALL AROUND AT SAW CUT/JOINT WITH EXISTING PAVEMENT. COMPLY WITH ALL ENCROACHMENT PERMIT REQUIREMENTS.
5. MANHOLE COVER TO BE FLUSH WITH EXISTING GRADE UNLESS NOTED OTHERWISE.
6. ALL NEW FRAME AND COVERS (WHERE REQUIRED) SHALL BE SOLID OR WATERTIGHT AS SPECIFIED AND SHOWN IN THE DETAILS.

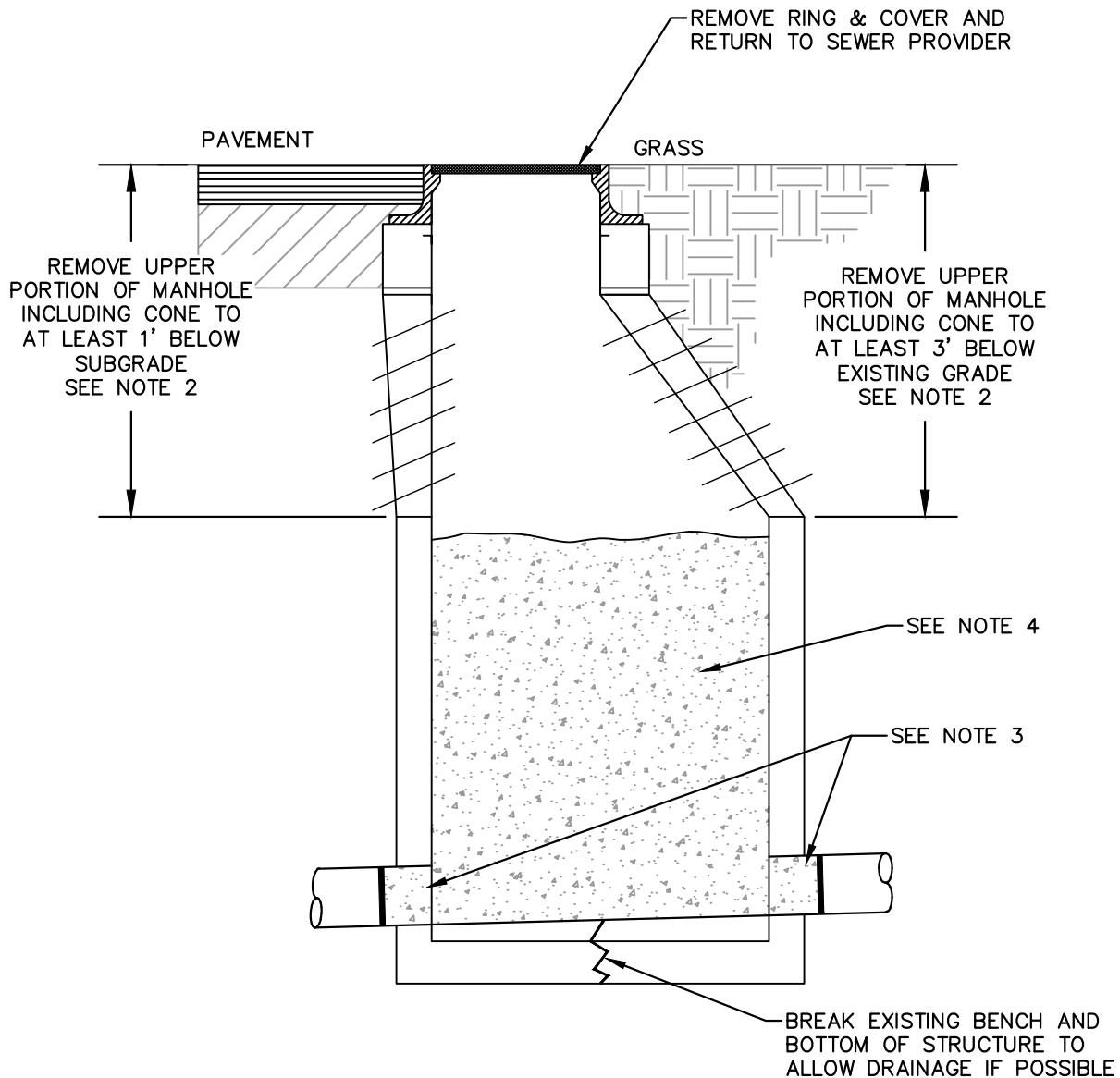


11/18/19  
REV DATE

**REHABILITATION & HEIGHT  
ADJUSTMENT OF EXISTING  
MANHOLE FRAME & COVER**

DETAIL No.  
**SS-19.1**

**N.T.S.**  
SCALE



**NOTES:**

1. MANHOLE SHAPES AND DIAMETERS WILL APPLY
2. REMOVE ALL OF THE CONE SECTION BELOW FINISHED OR EXISTING GRADE. THE BOTTOM OF THE STRUCTURES SHALL BE BROKEN OR PERFORATED TO PREVENT THE ENTRAPMENT OF WATER.
3. SEAL ALL CONDUITS CONNECTION TO THE STRUCTURES OR ENDS OF CONDUIT TO BE ABANDONED WITH A WALL OF CONCRETE NOT LESS THAN 6 INCHES THICK OR AN 8-INCH WALL OF BRICK AND MORTAR.
4. FILL STRUCTURAL VOIDS WITH SUITABLE MATERIAL COMPACTED TO 90% (UNPAVED) OR 95% (PAVED) OF MAXIMUM DENSITY AT OPTIMUM MOISTURE CONTENT AS DEFINED BY ASTM D698.
5. BACKFILL AND COMPACT REMAINDER OF TRENCH WITH SUITABLE BACKFILL. IN CONFORMANCE WITH STANDARD SPECIFICATIONS.

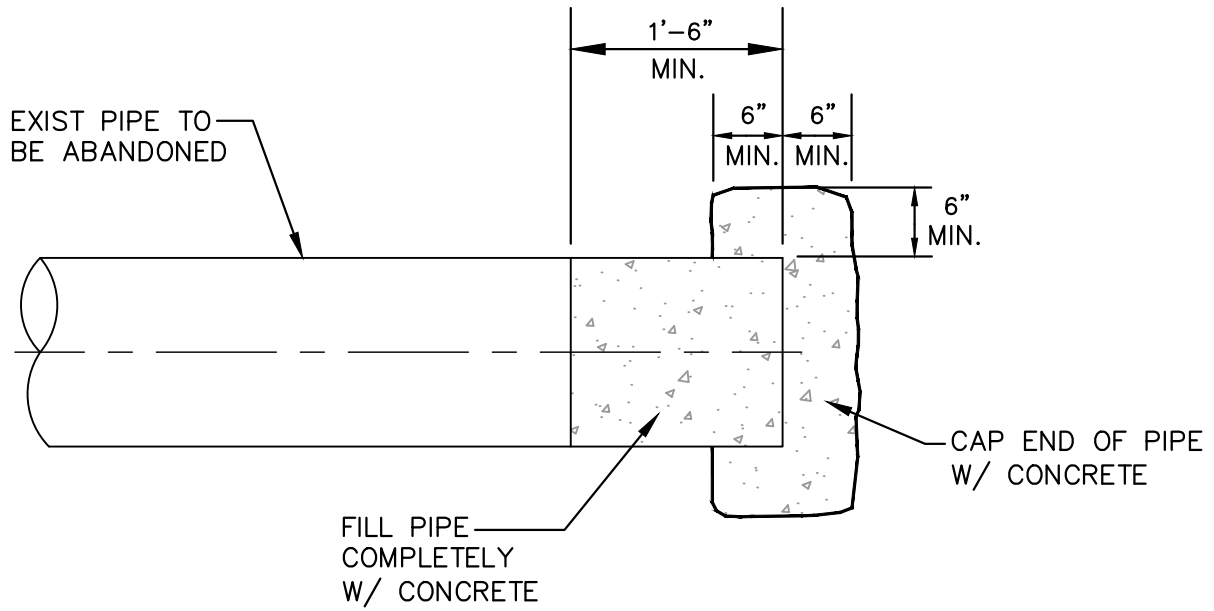


**PRECAST MANHOLE  
ABANDONMENT**

DETAIL No.  
**SS-19.2**

**11/12/21**  
REV DATE

**N.T.S.**  
SCALE



**NOTE:**

1. ALL ABANDONED IN PLACE PIPING SHALL HAVE ENDS CAPPED.



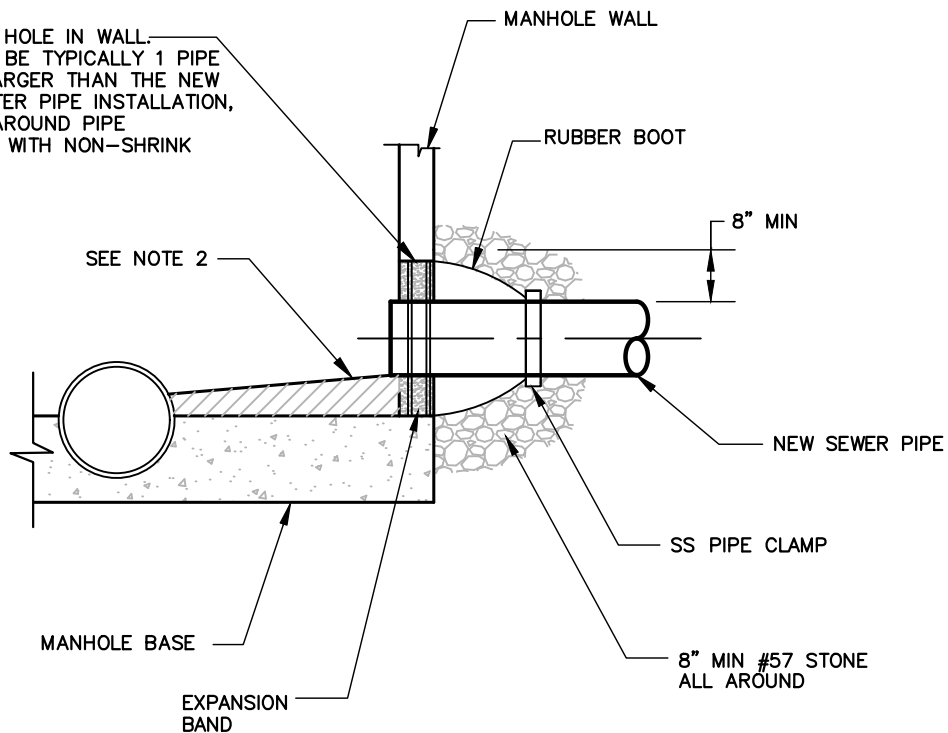
11/12/21  
REV DATE

**PIPE CAP DETAIL**

DETAIL No.  
**SS-19.3**

**N.T.S.**  
SCALE

CORE-DRILL HOLE IN WALL.  
 OPENING TO BE TYPICALLY 1 PIPE  
 DIAMETER LARGER THAN THE NEW  
 SEWER. AFTER PIPE INSTALLATION,  
 FILL VOIDS AROUND PIPE  
 COMPLETELY WITH NON-SHRINK  
 GROUT.



**NOTES:**

1. REFER TO THIS DETAIL WHEN CONNECTING NEW SEWER PIPES (INCLUDING SERVICE LATERALS) TO EXISTING MANHOLES OR NEW MANHOLES WHERE FLEXIBLE COUPLINGS ARE NOT USED.
2. PROVIDE A SMOOTH TRANSITION AND INVERT CHANNEL FOR ANY INCOMING ELEVATION PER THE STANDARD BENCH AND INVERT DETAIL.
3. BOOT CONNECTOR TO CONFORM TO ASTM C923 W/ 304 SST HARDWARE

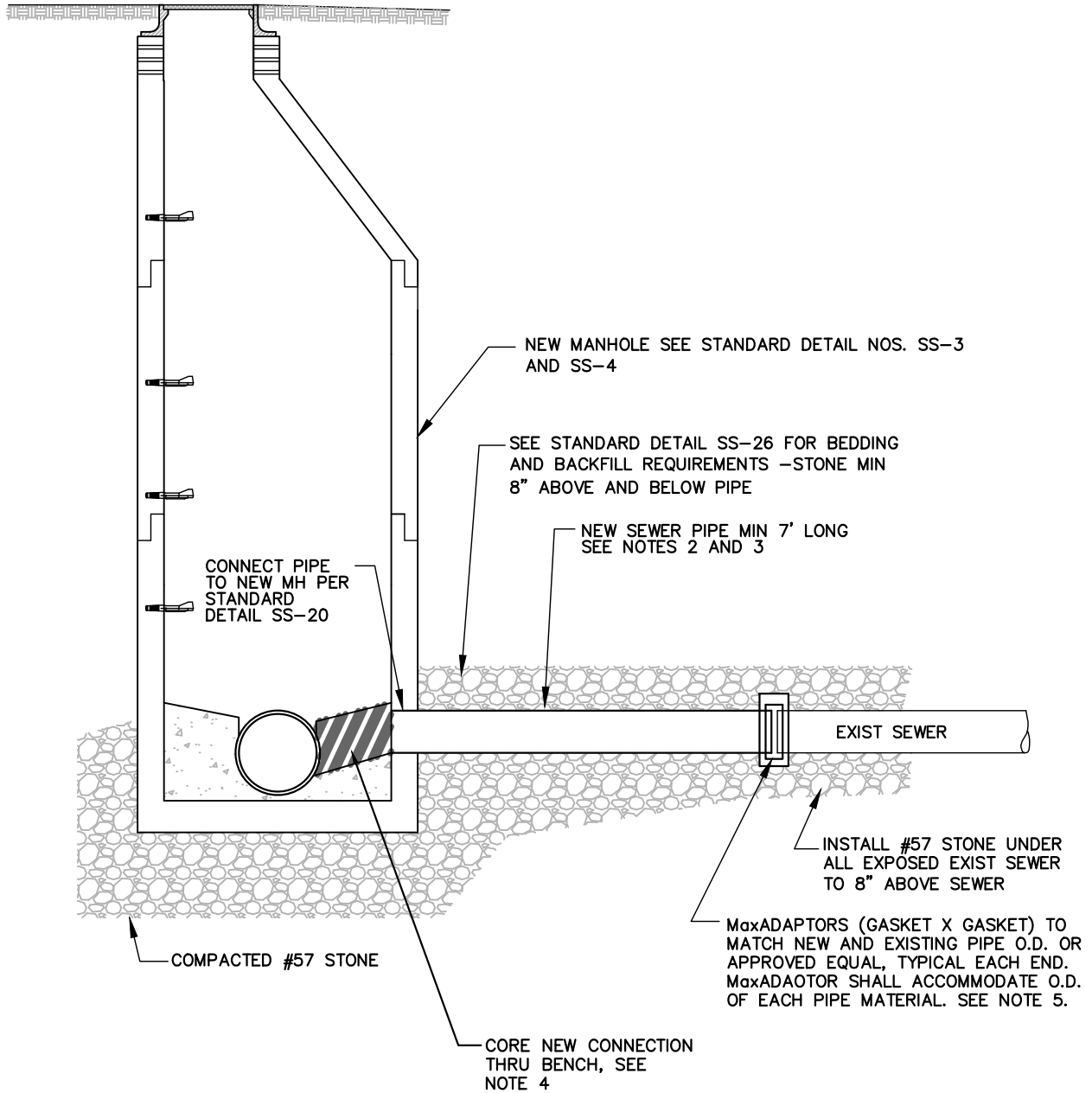


06/20/23  
 REV DATE

**NEW PIPE CONNECTION AT  
 MANHOLE**

DETAIL No.  
**SS-20**

**N.T.S.**  
 SCALE



**NOTES:**

1. CONTRACTOR SHALL REFER TO THIS DETAIL WHEN CONNECTING EXISTING SEWERS TO NEW MANHOLES INCLUDING CONNECTING EXISTING SEWERS TO NEW EXTERNAL DROP CONNECTIONS.
2. NEW PIPE SHALL BE DUCTILE IRON PIPE UNLESS APPROVED OTHERWISE BY ReWa.
3. THIS DETAIL DEPICTS RECONNECTING ONE PIPE TO A NEW MANHOLE. ALL INCOMING PIPES AND THE OUTGOING PIPE SHALL BE RECONNECTED PER THIS DETAIL - EACH SEWER SHALL BE RECONNECTED WITH MIN 7 FEET OF NEW PIPE.
4. CORE DRILL HOLE THROUGH WALL OF MANHOLE AND EXISTING BENCH AS DEPICTED IN THE DETAIL. PROVIDE A WATERTIGHT SEAL AT THE PIPE CONNECTION USING A FLEXIBLE RUBBER BOOT PER DETAIL NO. SS-20
5. MaxADAPTORS SHALL BE USED UP TO A NOMINAL PIPE SIZE OF 15". FOR PIPES LARGER THAN 15", PROJECT SPECIFIC ENGINEERING ADAPTORS APPROVED BY ReWa SHALL BE USE.



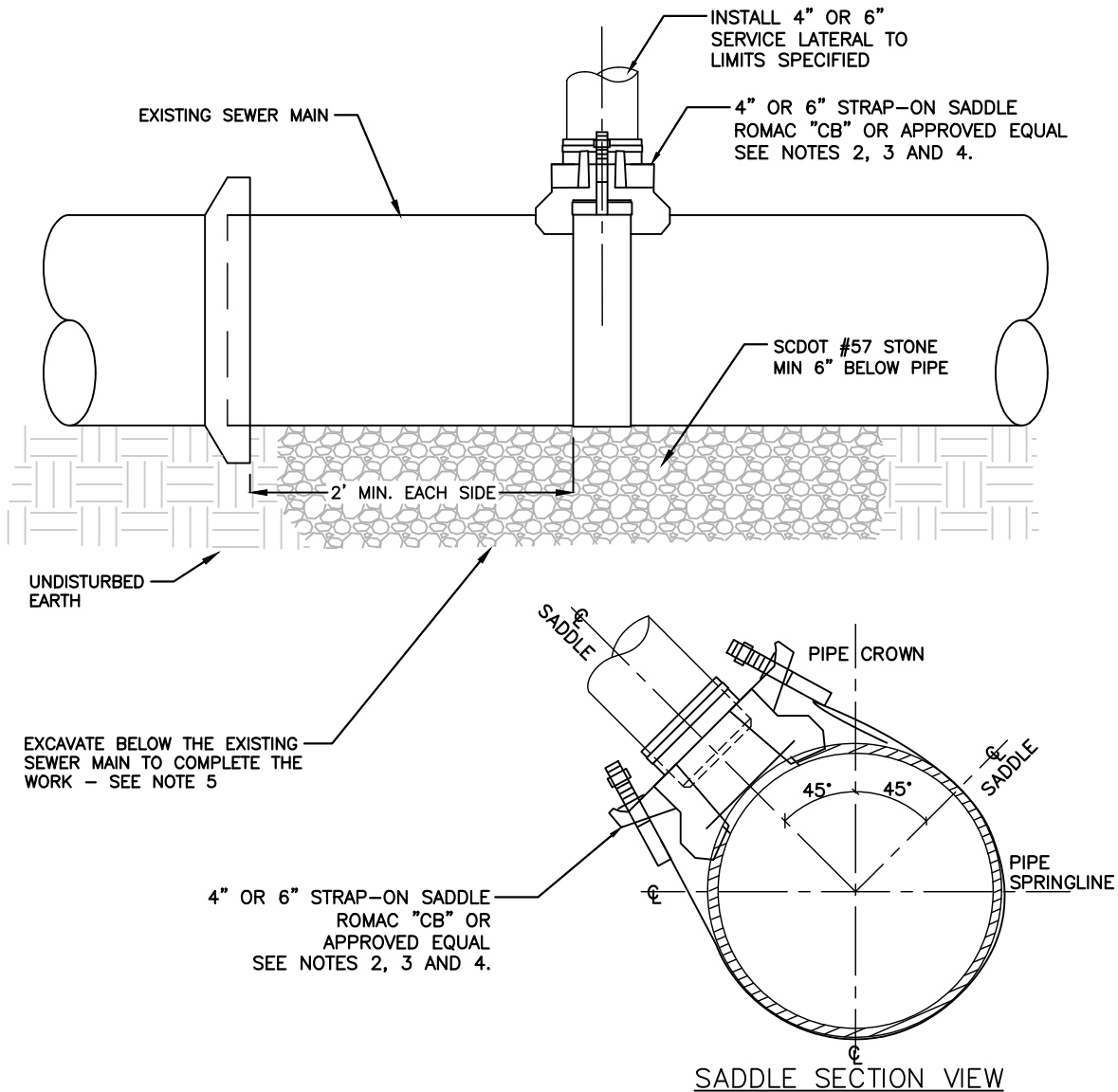
11/12/21  
REV DATE

**CONNECTION OF EXISTING  
SEWER TO NEW MANHOLE**

DETAIL No.  
**SS-21**

**N.T.S.**  
SCALE





**NOTES:**

1. REFER TO THIS DETAIL TO RECONNECT EXISTING SERVICE LATERALS TO SEWERS WHERE NO TEE CONNECTION EXISTS AND TO CONNECT NEW SERVICE LATERALS TO EXISTING SEWERS WHERE APPROVED BY ReWa.
2. STRAP-ON SADDLE SHALL BE A ROMAC "CB" SADDLE AS MANUFACTURED BY ROMAC INDUSTRIES, INC. OR APPROVED EQUAL. ANY APPROVED EQUAL SHALL BE SUBMITTED TO ReWa FOR REVIEW AND APPROVAL. SADDLE SHALL BE PROVIDED FOR THE SPECIFIC TYPE OF LATERAL PIPE MATERIAL BEING INSTALLED.
3. FOR RECONNECTING EXISTING LATERALS, CAREFULLY REMOVE THE LATERAL TO LIMIT DAMAGE TO THE SEWER MAIN. INCREASE THE OPENING FOR A 4" OR 6" LATERAL AS NECESSARY, INSTALL 4" OR 6" STRAP-ON SADDLE AND REPLACE LATERAL TO THE SPECIFIED LIMITS.
4. FOR NEW LATERAL CONNECTIONS, THE LATERAL SHALL CONNECT TO THE SEWER MAIN AT 45 DEGREES FROM HORIZONTAL TO THE LEFT OR RIGHT AS APPROPRIATE. USE AN APPROVED HOLE SAW FOR PVC, DIP, AND VCP TO NEATLY CUT THE SERVICE LATERAL OPENING. INSTALL THE 4" OR 6" STRAP-ON SADDLE AND INSTALL NEW 4" OR 6" LATERAL TO THE SPECIFIED LIMITS.
5. SUPPORT THE EXISTING SEWER DURING THIS WORK AS NECESSARY.
6. SEWER MAIN SHALL BE INSPECTED VIA CLOSED CIRCUIT TELEVISION (CCTV) AFTER INSTALLATION OF LATERAL TO VERIFY THAT THE CONNECTION IS ACCEPTABLE TO ReWa. DEFECTS SHALL BE REPAIRED BY THE CONTRACTOR.

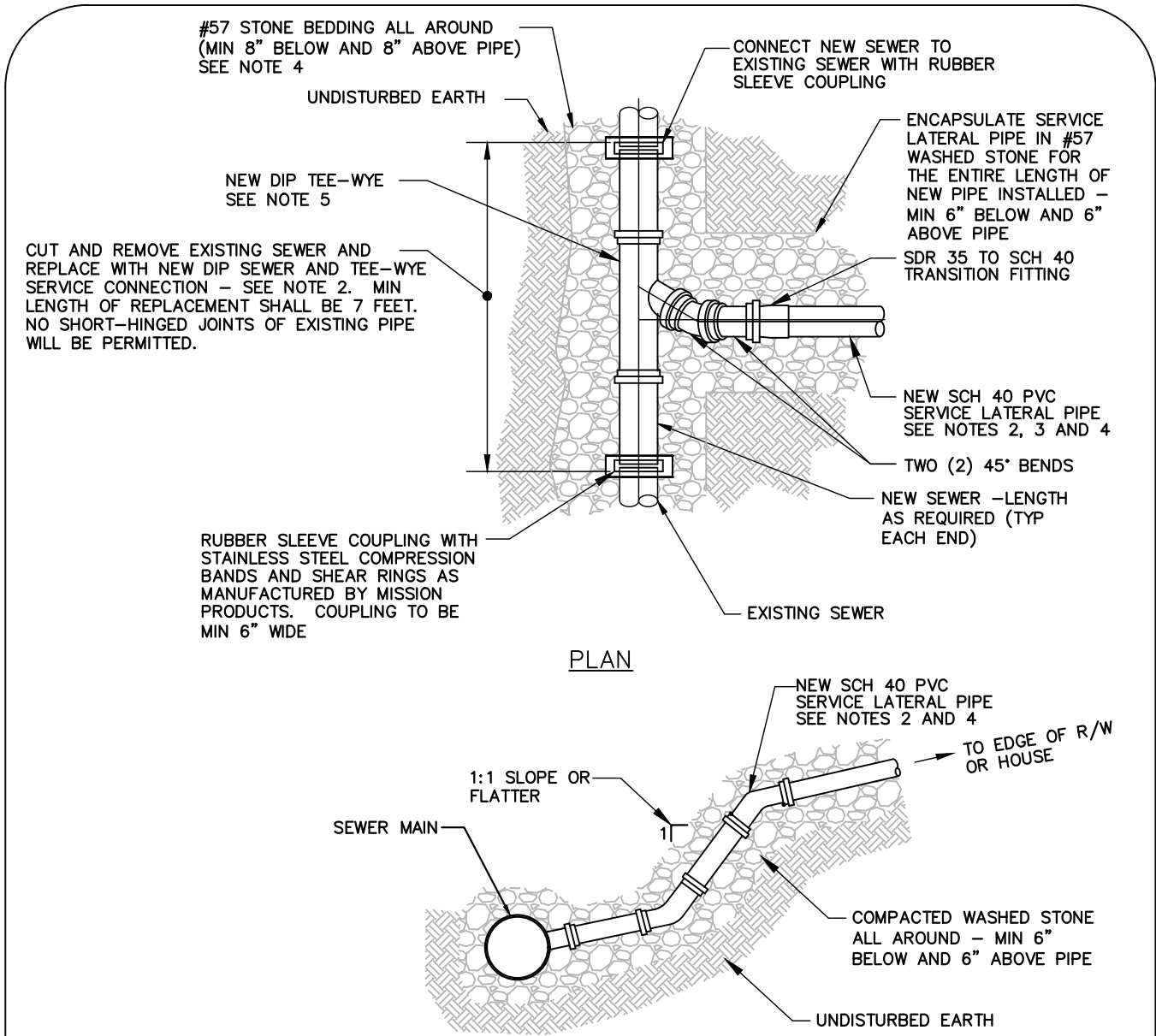


07/01/22  
REV DATE

**SERVICE LATERAL SADDLE  
CONNECTION TO EXISTING  
SEWER MAIN**

DETAIL No.  
**SS-22**

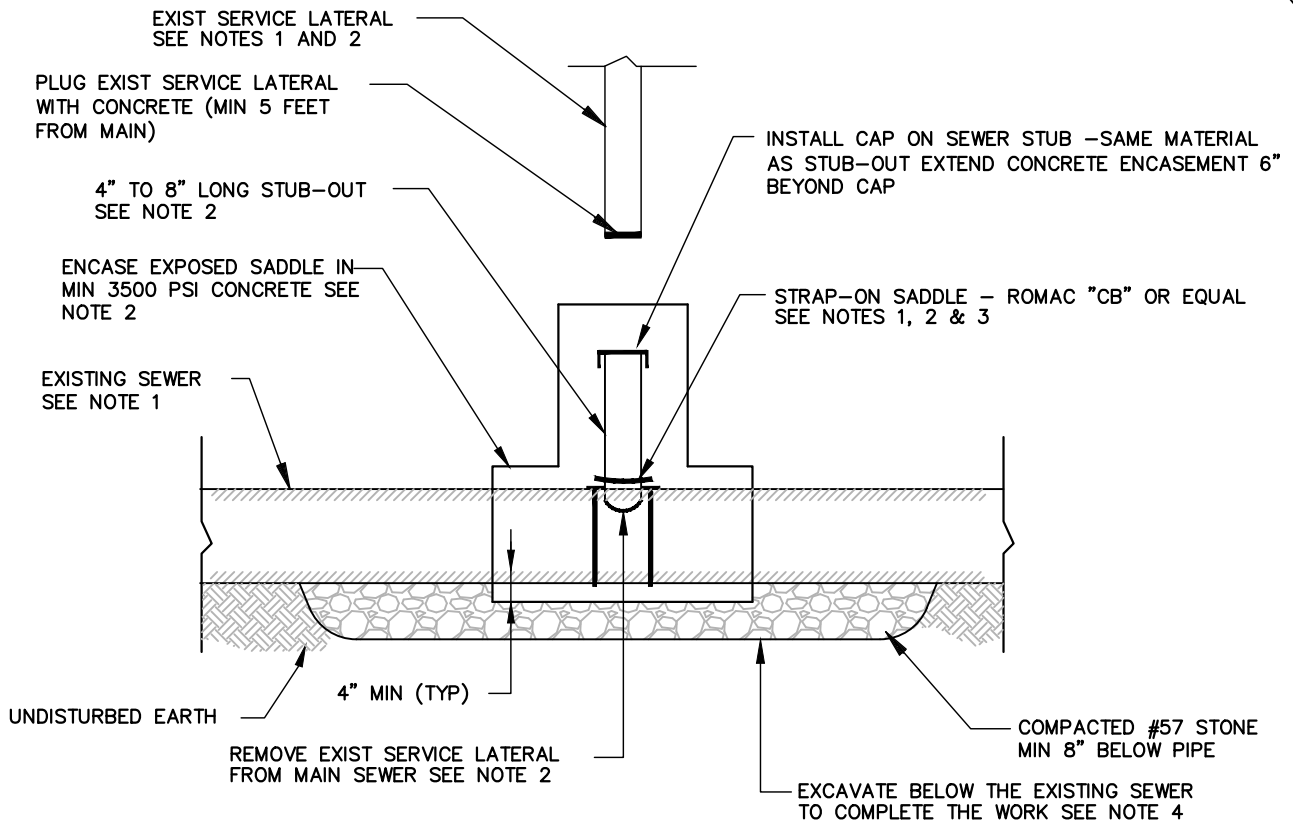
**N.T.S.**  
SCALE



**NOTES:**

1. REFER TO THIS DETAIL WHEN CONNECTING NEW SERVICE LATERALS TO EXISTING SEWERS WITH A TEE. TEE CONNECTIONS MAY BE REQUIRED WHEN CONNECTING TO EXISTING SEWERS IN POOR STRUCTURAL CONDITION. SEE DETAIL SS-15, NOTE 2 FOR SERVICE LATERAL MATERIALS.
2. INSTALL THE NEW SEWER AT A CONSTANT SLOPE BETWEEN THE TWO EXISTING PIPE ENDS.
3. INSTALL FITTINGS, ADAPTERS AND RUBBER SLEEVE COUPLINGS AS NECESSARY TO CONNECT NEW TEE-WYE AND SERVICE LATERAL. NEW TEE-WYE AND MAIN SEWER PIPE SHALL BE DIP. NEW LATERALS AND TEE-WYE BRANCHES SHALL BE THE SAME SIZE AS THE EXISTING LATERAL.
4. STONE BEDDING TO EXTEND AT LEAST 8 INCHES BELOW AND ABOVE MAIN SEWER.
5. ROTATE NEW TEE-WYE 45 DEGREES FROM HORIZONTAL TO THE LEFT OR RIGHT AS APPROPRIATE AND INSTALL FITTINGS/BENDS AS NECESSARY TO ROUTE LATERAL ALONG DESIRED ELEVATION. 90° BENDS ARE NOT ALLOWED. SERVICES SHALL NOT ENTER THE TOP OF THE SEWER PIPE.
6. MAIN SEWER MAY BE INSPECTED VIA CLOSED CIRCUIT TELEVISION (CCTV) AFTER INSTALLATION OF LATERAL TO VERIFY PROPER ALIGNMENT OF NEW SEWER AND PROPER CONNECTION TO EXISTING SEWER. ANY OFFSET JOINTS OR MISALIGNMENT SHALL BE CORRECTED PRIOR TO ACCEPTANCE BY ReWa. THE CCTV INSPECTION TAPE AND LOG SHALL BE SUBMITTED TO ReWa FOR REVIEW AND APPROVAL AND SHALL CLEARLY SHOW EACH PIPE CONNECTION AND THE SERVICE LATERAL.

	<p><b>SERVICE LATERAL TEE-WYE CONNECTION TO EXISTING SEWER (REHAB PROJ. ONLY)</b></p>	<p>DETAIL No. <b>SS-23</b></p>
<p><b>11/18/19</b> REV DATE</p>		<p><b>N.T.S.</b> SCALE</p>



**NOTES:**

1. REFER TO THIS DETAIL WHEN ABANDONING EXIST SERVICE LATERALS. SERVICE LATERALS SHALL BE ABANDONED WHEN DIRECTED BY ReWa. ReWa WILL REQUIRE THAT EXIST LATERALS BE ABANDONED WHEN A NEW SERVICE LATERAL IS BEING INSTALLED TO SERVE A PROPERTY AND THE NEW LATERAL IS BEING CONNECTED TO THE MAIN SEWER AT A DIFFERENT LOCATION. THE SERVICE LATERAL SHALL ALSO BE ABANDONED PER THIS DETAIL WHEN ANY BUILDING OR STRUCTURE IS DEMOLISHED. SERVICE LATERALS CONNECTING TO MANHOLES TO BE ABANDONED AS REQUIRED BY ReWa PER DETAIL SS-22. ReWa MUST INSPECT THE WORK BEFORE IT IS COVERED - CALL ReWa FOR AN INSPECTION.
2. TO ABANDON THE EXIST SERVICE LATERAL AT THE MAIN SEWER, CAREFULLY REMOVE THE LATERAL FROM THE MAIN SEWER, CUT THE EXIST LATERAL AT LEAST 5 FEET FROM THE MAIN SEWER, AND PLUG THE REMAINING PIPE END WITH CONCRETE. INSTALL A SADDLE PER NOTE 3 AND A 4" TO 8" LONG STUB-OUT. INSTALL A CAP ON THE STUB-OUT AND ENCASE THE SADDLE, STUB-OUT AND CAP IN MIN 3500 PSI CONCRETE -ENCASEMENT TO EXTEND TO 8" EACH SIDE OF THE LATERAL/SADDLE AND 6" BEYOND THE CAP. BACKFILL AS SPECIFIED. IF THE EXISTING MAIN SEWER IS DAMAGED DURING THE REMOVAL OF THE EXIST LATERAL AND THE SADDLE CONNECTION WILL NOT WORK AS DETERMINED BY ReWa, A POINT REPAIR SHALL BE PERFORMED ON THE MAIN SEWER PER DETAIL NO. SS-26.
3. STRAP-ON SADDLE SHALL BE A ROMAC "CB" SADDLE AS MANUFACTURED BY ROMAC INDUSTRIES, INC. OR APPROVED EQUAL. ANY PROPOSED EQUAL SHALL BE SUBMITTED TO ReWa FOR REVIEW AND APPROVAL. SADDLE SHALL BE PROVIDED FOR THE SPECIFIC TYPE OF LATERAL PIPE BEING INSTALLED. SUBMIT SPECIFIC SADDLE MODEL NUMBERS TO ReWa FOR REVIEW AND APPROVAL PRIOR TO PERFORMING ANY WORK.
4. SUPPORT THE EXISTING SEWER DURING THIS WORK.

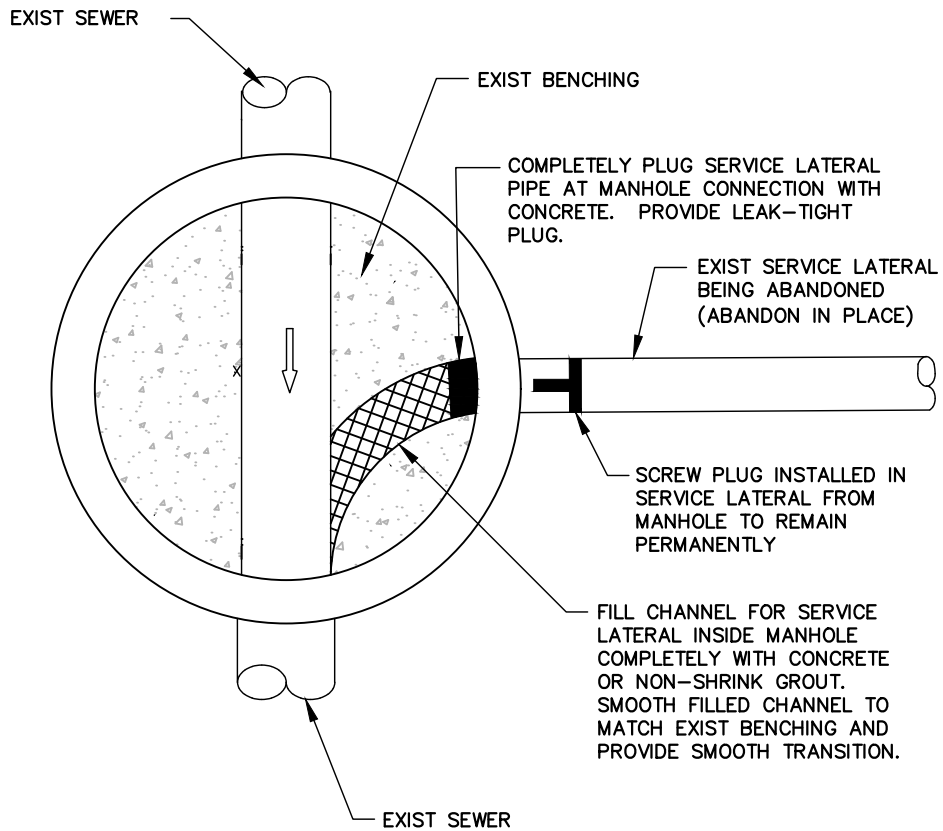


11/18/19  
REV DATE

**ABANDONING EXISTING  
SERVICE LATERALS  
CONNECTING TO MAIN SEWER**

DETAIL No.  
**SS-24**

**N.T.S.**  
SCALE



**NOTES:**

1. REFER TO THIS DETAIL WHEN ABANDONING EXIST SERVICE LATERALS CONNECTING TO MANHOLES.
2. CALL ReWa TO INSPECT THE WORK.

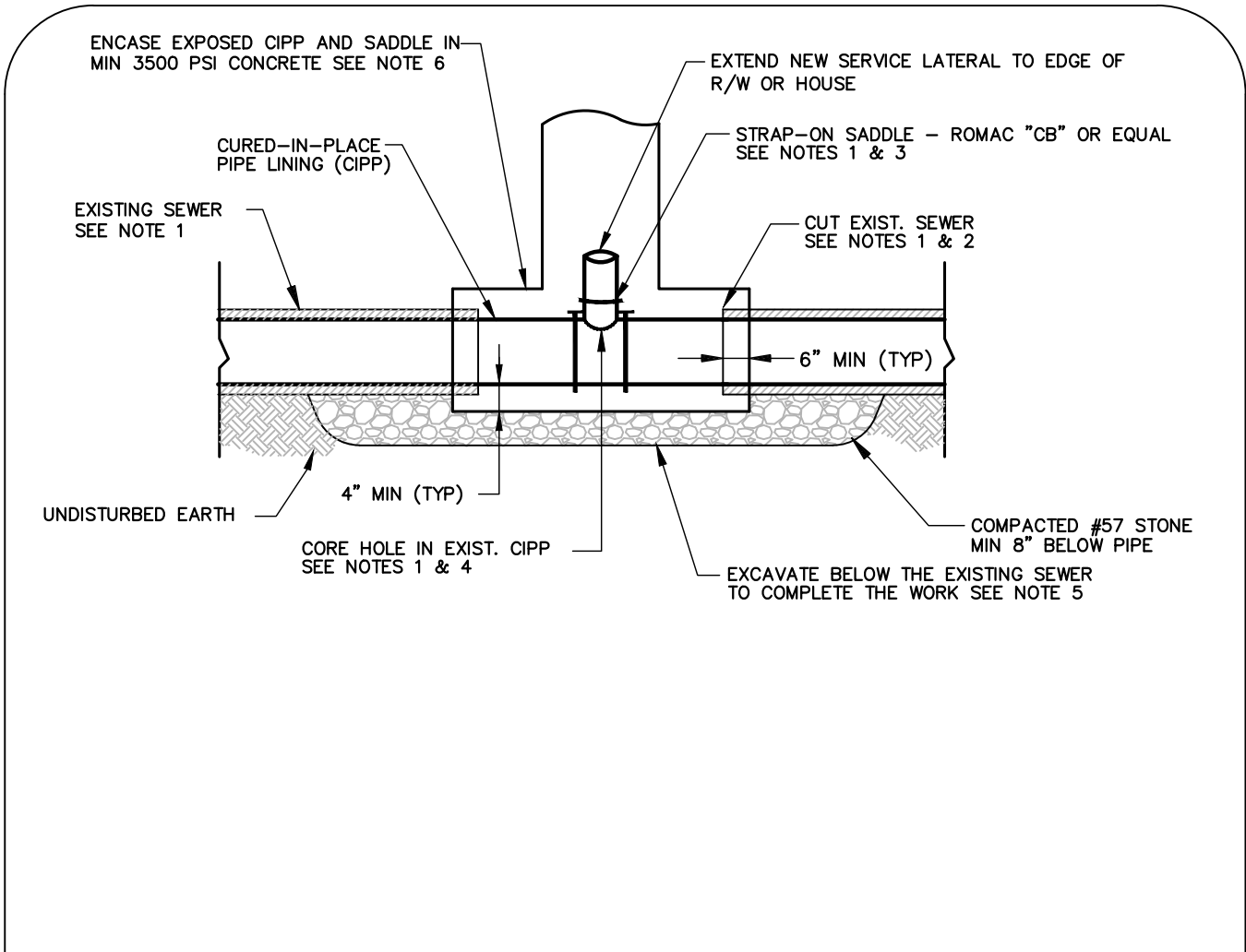


11/18/19  
REV DATE

**ABANDONING EXISTING  
SERVICE LATERALS  
CONNECTING TO MANHOLES**

DETAIL No.  
**SS-25**

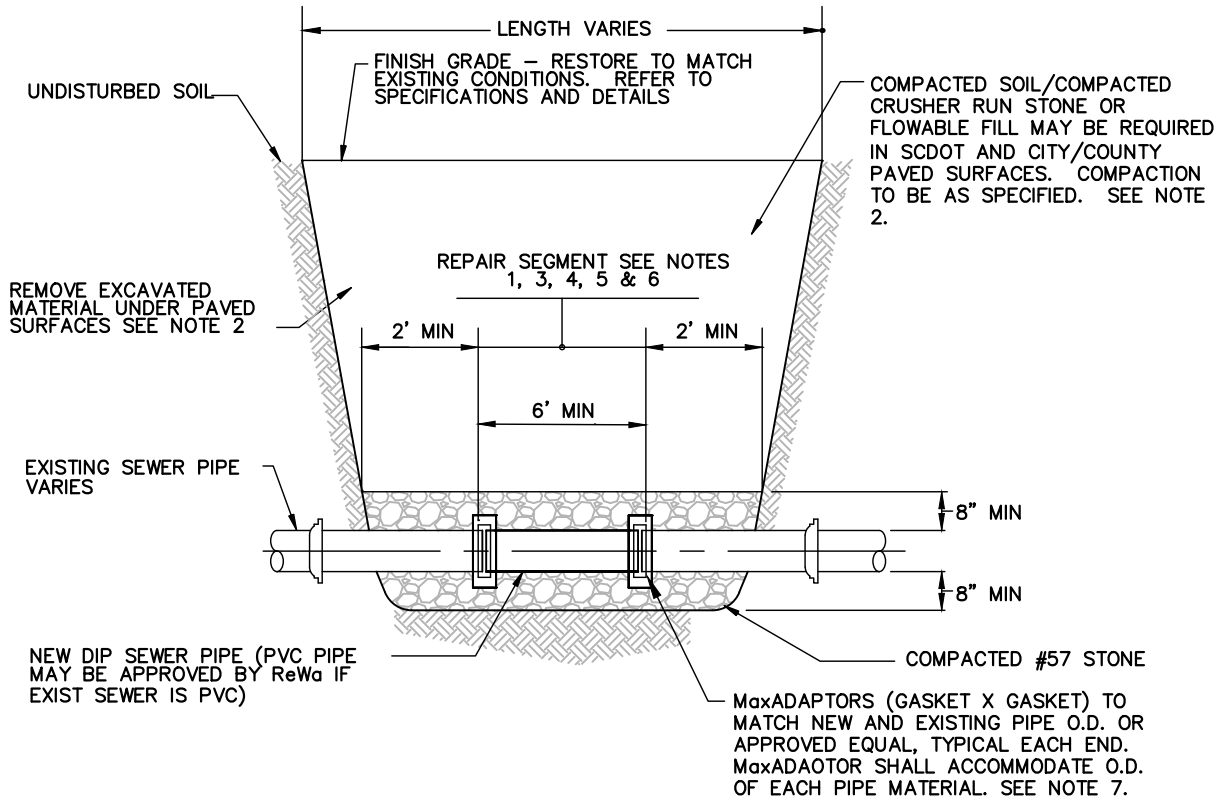
**N.T.S.**  
SCALE



**NOTES:**

1. REFER TO THIS DETAIL TO CONNECT NEW SERVICE LATERALS TO EXISTING SEWERS LINED WITH CIPP. THIS DETAIL ONLY APPLIES WHEN THE EXISTING SEWERS ARE VITRIFIED CLAY PIPE (VCP) OR CONCRETE PIPE.  
  
IF THE MAIN SEWER IS PVC, CAST IRON (CIP) OR DUCTILE IRON PIPE (DIP), REFER TO NOTE 7 FOR REQUIREMENTS.
2. NEATLY CUT THE EXISTING VCP OR CONCRETE SEWER WITH A CHAIN CUTTER SPECIFICALLY DESIGNED FOR CUTTING SUCH PIPE TO EXPOSE THE CIPP. USE CAUTION TO PREVENT DAMAGE TO THE CIPP. REPAIR ANY DAMAGE AS APPROVED BY ReWa.
3. STRAP-ON SADDLE SHALL BE A ROMAC "CB" SADDLE AS MANUFACTURED BY ROMAC INDUSTRIES, INC. OR APPROVED EQUAL. ANY PROPOSED EQUAL SHALL BE SUBMITTED TO ReWa FOR REVIEW AND APPROVAL. SADDLE SHALL BE ROTATED 45 DEGREES FROM HORIZONTAL TO THE LEFT OR RIGHT AS APPROPRIATE AND FITTINGS/BENDS INSTALLED AS NECESSARY TO ROUTE LATERAL ALONG THE DESIRED ELEVATION. SERVICES SHALL NOT ENTER THE TOP OF THE SEWER.  
  
SADDLE SHALL BE PROVIDED FOR THE SPECIFIC TYPE OF LATERAL PIPE BEING INSTALLED. SUBMIT SPECIFIC SADDLE MODEL NUMBERS TO ReWa FOR REVIEW AND APPROVAL PRIOR TO PERFORMING ANY WORK.
4. USE A HOLE SAW (SAME SIZE AS SERVICE LATERAL) TO NEATLY CUT THE SERVICE LATERAL OPENING. IF THE CIPP IS DAMAGED FROM OVERCUTTING THE NEW SERVICE CONNECTION, THEN THE NEXT LARGER SIZE HOLE SHALL BE CUT AND A SERVICE SADDLE WITH A BELL REDUCER SHALL BE INSTALLED FOR CONNECTING BACK TO THE NEW SERVICE DIAMETER.
5. SUPPORT THE EXISTING SEWER DURING THIS WORK AS NECESSARY.
6. EXTEND CONCRETE ENCASMENT 4" TO 6" BEYOND THE FIRST FITTING CONNECTED TO THE SADDLE.
7. FOR PVC, CIP AND DIP SEWERS, CORE HOLE THROUGH MAIN SEWER AND CIPP, INSTALL STRAP-ON SADDLE, AND ENCASE IN 3500 PSI CONCRETE TO 8" EACH SIDE LATERAL.

	<b>SERVICE LATERAL CONNECTING TO CURED-IN-PLACE PIPE LINING (CIPP)</b>	DETAIL No. <b>SS-26</b>
<b>11/18/19</b> REV DATE		<b>N.T.S.</b> SCALE



**NOTES:**

1. THE SEQUENCE OF WORK FOR PERFORMING REPAIRS SHALL BE AS FOLLOWS:
  - A. BYPASS PUMP FLOWS AROUND REPAIR SEGMENT OR PLUG LINE THE ENTIRE TIME THE REPAIR IS BEING MADE.
  - B. EXCAVATE TO AT LEAST 8" BELOW EXISTING SEWER.
  - C. NEATLY CUT EXISTING SEWER AT EACH END OF REPAIR SEGMENT AND REMOVE EXISTING SEWER COMPLETELY.
  - D. INSTALL #57 STONE TO SEWER INVERT ELEVATION AND COMPACT.
  - E. INSTALL NEW DIP SEWER AT A CONSTANT SLOPE BETWEEN THE TWO EXISTING PIPE ENDS. CONNECT THE NEW SEWER TO THE EXISTING WITH A MISSION COUPLING OR APPROVED EQUAL. REMOVE STONE BEDDING AS REQUIRED TO INSTALL PIPE AND COUPLINGS AND FILL VOIDS UNDER PIPE WITH STONE. ENCASE COUPLINGS IN CONCRETE.
  - F. RETURN FLOW THROUGH PIPE.
  - G. BACKFILL AND COMPACT AS SHOWN.
2. UNDER SCDOT AND CITY/COUNTY PAVED SURFACES, ReWa AND/OR THE ENGINEER MAY SPECIFY THAT THE CONTRACTOR REMOVE THE EXCAVATED SOIL AND DISPOSE OF IT OFFSITE AND IMPORT CRUSHER RUN STONE OR FLOWABLE FILL FOR BACKFILLING FROM TOP OF #57 STONE TO PAVEMENT SUBGRADE. FLOWABLE FILL MUST NOT BE POURED AGAINST THE DIP - PROVIDE 12" OF STONE ABOVE PIPE WHEN USING FLOWABLE FILL. MEET ALL SCDOT AND CITY/COUNTY REQUIREMENTS. DO NOT PLACE ANY SOIL ON PAVED SURFACES DURING THE WORK.
3. SERVICE LATERALS LOCATED WITHIN REPAIR SEGMENTS SHALL BE CONNECTED TO NEW SEWER WITH A TEE-WYE. SEE DETAIL NO. SS-17.
4. LENGTH OF REPAIR SEGMENT SHALL BE DETERMINED AND/OR APPROVED BY ReWa.
5. MAIN SEWER MAY BE INSPECTED VIA CLOSED CIRCUIT TELEVISION (CCTV) AFTER PERFORMING REPAIR TO VERIFY PROPER ALIGNMENT OF NEW SEWER AND PROPER CONNECTION TO EXISTING SEWER UNLESS OTHERWISE SPECIFIED OR APPROVED BY ReWa. ANY OFFSET JOINTS OR MISALIGNMENT SHALL BE CORRECTED PRIOR TO ACCEPTANCE BY ReWa. THE CCTV INSPECTION TAPE AND LOG SHALL BE SUBMITTED TO ReWa FOR REVIEW AND APPROVAL AND SHALL CLEARLY SHOW EACH PIPE CONNECTION AND ANY CONNECTING SERVICE LATERAL. IF CCTV IS NOT REQUIRED OF THE CONTRACTOR, ReWa MAY PERFORM THE CCTV INSPECTIONS AND THE CONTRACTOR SHALL REPAIR ANY DEFECTS IDENTIFIED AS NOTED ABOVE.
6. REFER TO DETAIL NO. SS-20 FOR CONNECTING TO MANHOLES.
7. MaxADAPTORS SHALL BE USED UP TO A NOMINAL PIPE SIZE OF 15". FOR PIPES LARGER THAN 15", PROJECT SPECIFIC ENGINEERING ADAPTORS APPROVED BY ReWa SHALL BE USE.

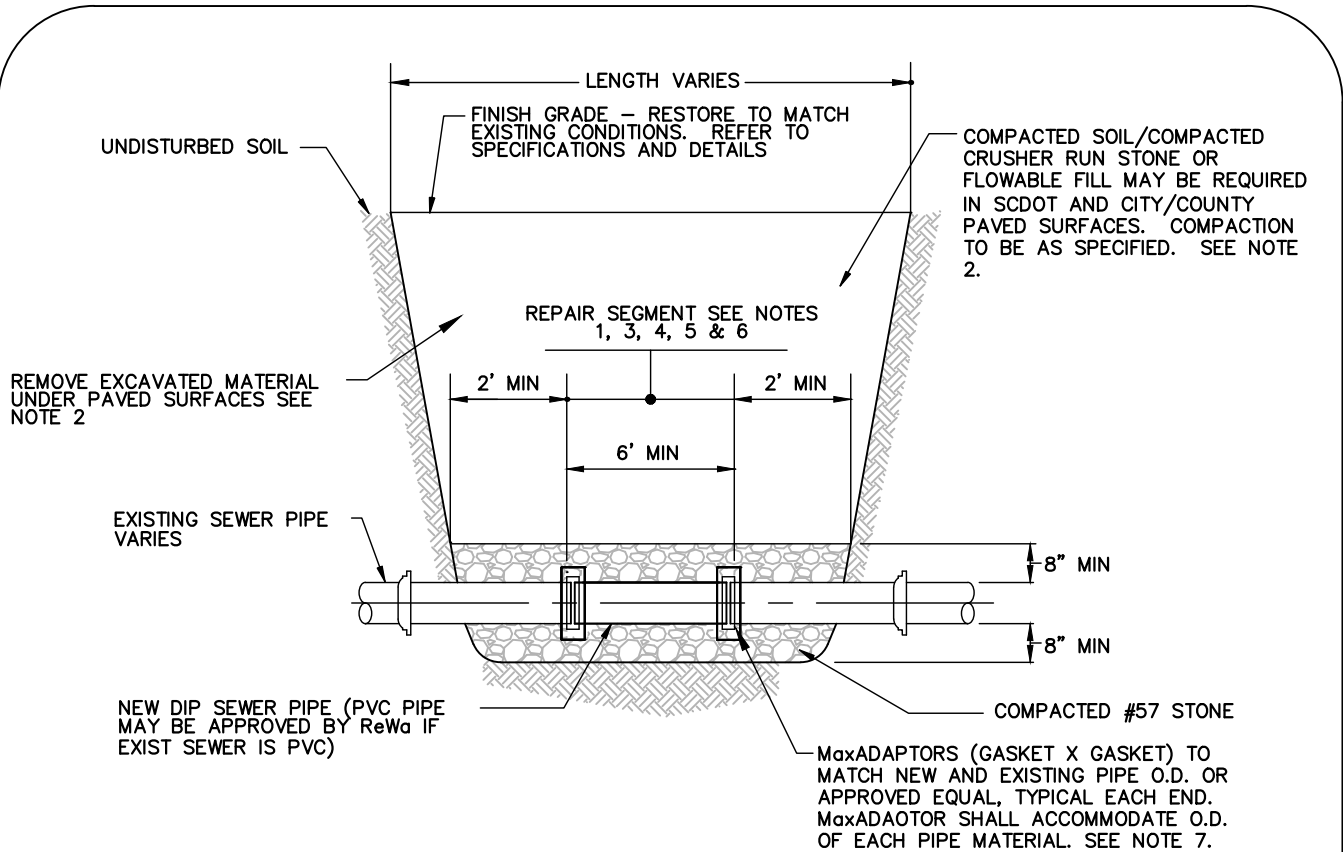


11/12/21  
REV DATE

TYPICAL REPAIR  
TO  
EXISTING SEWER

DETAIL No.  
SS-27

N.T.S.  
SCALE

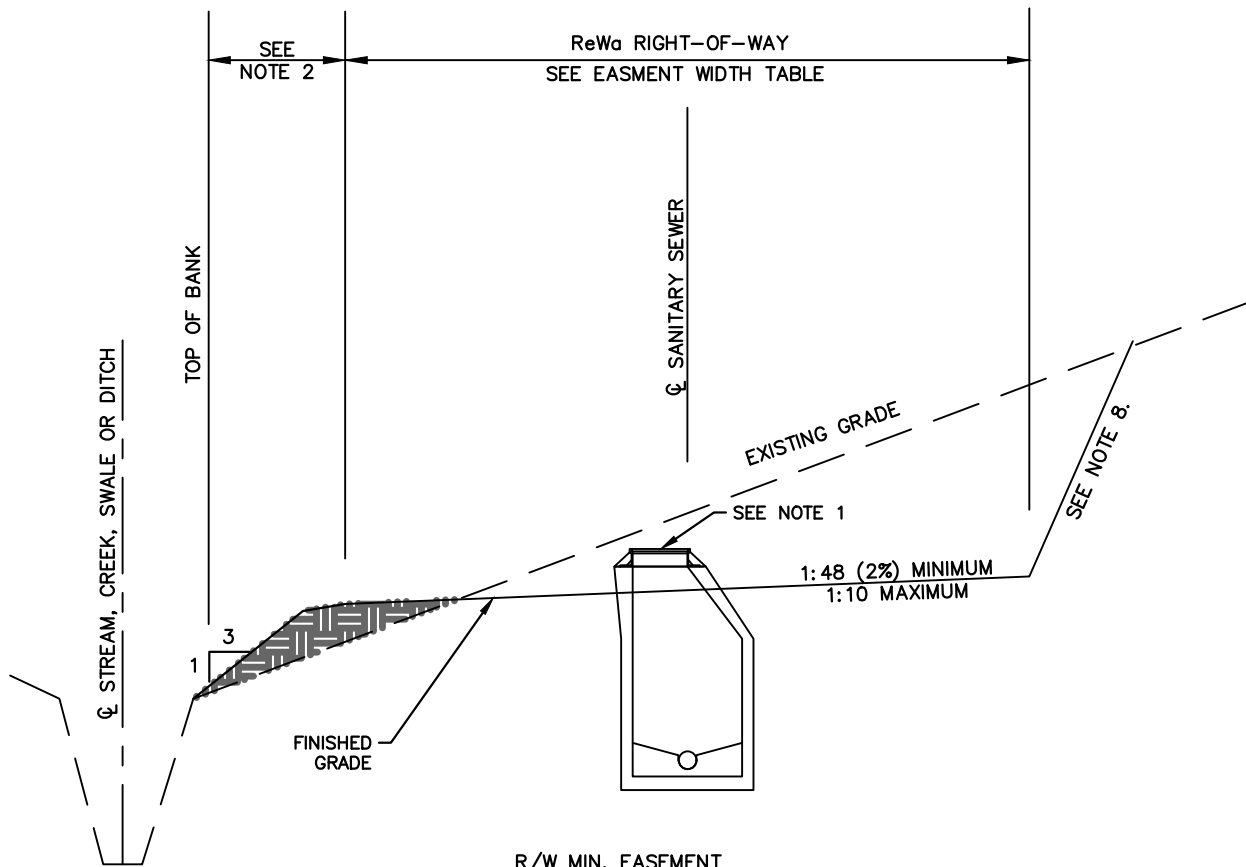


**NOTES:**

1. THE SEQUENCE OF WORK FOR PERFORMING REPAIRS SHALL BE AS FOLLOWS:
  - A. BYPASS PUMP FLOWS AROUND REPAIR SEGMENT OR PLUG LINE THE ENTIRE TIME THE REPAIR IS BEING MADE.
  - B. EXCAVATE TO AT LEAST 8" BELOW EXISTING SEWER.
  - C. NEATLY CUT EXISTING SEWER AT EACH END OF REPAIR SEGMENT AND REMOVE EXISTING SEWER COMPLETELY.
  - D. INSTALL #57 STONE TO SEWER INVERT ELEVATION AND COMPACT.
  - E. INSTALL NEW SEWER AT A CONSTANT SLOPE BETWEEN THE TWO EXISTING PIPE ENDS. CONNECT THE NEW SEWER TO THE EXISTING WITH A MISSION COUPLING OR APPROVED EQUAL. REMOVE STONE BEDDING AS REQUIRED TO INSTALL PIPE AND COUPLINGS AND FILL VOIDS UNDER PIPE WITH STONE.
  - F. RETURN FLOW THROUGH PIPE.
  - G. BACKFILL AND COMPACT AS SHOWN.
2. UNDER SCDOT AND CITY/COUNTY PAVED SURFACES, ReWa AND/OR THE ENGINEER MAY SPECIFY THAT THE CONTRACTOR REMOVE THE EXCAVATED SOIL AND DISPOSE OF IT OFFSITE AND IMPORT CRUSHER RUN STONE OR FLOWABLE FILL FOR BACKFILLING FROM TOP OF #57 STONE TO PAVEMENT SUBGRADE. FLOWABLE FILL MUST NOT BE POURED AGAINST THE DIP - PROVIDE 12" OF STONE ABOVE PIPE WHEN USING FLOWABLE FILL. MEET ALL SCDOT AND CITY/COUNTY REQUIREMENTS. DO NOT PLACE ANY SOIL ON PAVED SURFACES DURING THE WORK.
3. SERVICE LATERALS LOCATED WITHIN REPAIR SEGMENTS SHALL BE CONNECTED TO NEW SEWER WITH A TEE-WYE. SEE DETAIL NO. SS-17.
4. LENGTH OF REPAIR SEGMENT SHALL BE DETERMINED AND/OR APPROVED BY ReWa. MIN LENGTH TO BE 6 FEET.
5. MAIN SEWER MAY BE INSPECTED VIA CLOSED CIRCUIT TELEVISION (CCTV) AFTER PERFORMING REPAIR TO VERIFY PROPER ALIGNMENT OF NEW SEWER AND PROPER CONNECTION TO EXISTING SEWER UNLESS OTHERWISE SPECIFIED OR APPROVED BY ReWa. ANY OFFSET JOINTS OR MISALIGNMENT SHALL BE CORRECTED PRIOR TO ACCEPTANCE BY ReWa. THE CCTV INSPECTION TAPE AND LOG SHALL BE SUBMITTED TO ReWa FOR REVIEW AND APPROVAL AND SHALL CLEARLY SHOW EACH PIPE CONNECTION AND ANY CONNECTING SERVICE LATERAL. IF CCTV IS NOT REQUIRED OF THE CONTRACTOR, ReWa MAY PERFORM THE CCTV INSPECTIONS AND THE CONTRACTOR SHALL REPAIR ANY DEFECTS IDENTIFIED AS NOTED ABOVE.
6. REFER TO DETAIL NO. SS-20 FOR CONNECTING TO MANHOLES.
7. MaxADAPTORS SHALL BE USED UP TO A NOMINAL PIPE SIZE OF 15". FOR PIPES LARGER THAN 15", PROJECT SPECIFIC ENGINEERING ADAPTORS APPROVED BY ReWa SHALL BE USE.

	<p><b>TYPICAL REPAIR TO NEW SEWER</b></p>	<p>DETAIL No. <b>SS-28</b></p>
<p><b>11/12/21</b> REV DATE</p>		<p><b>N.T.S.</b> SCALE</p>





R/W MIN. EASEMENT WIDTH TABLE

PIPE DIAMETER	MIN. R/W WIDTH
8"–18"	25'
24"–30"	30'
36"–48"	35'
>48"	40'

**NOTES:**

1. RIM ELEVATION SHALL BE SET IN ACCORDANCE TO MANHOLE AND RIM ELEVATION DETAILS.
2. MINIMUM SEPARATION FROM TOP OF BANK SHALL BE AS FOLLOWS, OR AS REQUIRED BY JURISDICTIONAL PERMITS:  
 5' – FOR DRAINAGE SWALES AND DITCHES  
 15' – FOR CREEKS  
 25' – FOR RIVERS
3. CUT/FILL FOR R/W ACCESS, AS WELL AS SEWER LINE INSTALLATION, SHALL COMPLY WITH FLOODPLAIN REQUIREMENTS FROM THE STATE AND/OR LOCAL AGENCY HAVING JURISDICTION.
4. NO EXCAVATION, FILLING OR STOCKPILING MATERIALS MAY TAKE PLACE WITHIN ReWa RIGHT-OF-WAY WITHOUT CONTACTING ReWa AND OBTAINING PERMISSION.
5. FENCES ARE NOT PERMITTED IN THE 25' ReWa RIGHT-OF-WAY PARALLEL TO THE SEWER LINE. WRITTEN CONSENT IS REQUIRED WHERE A FENCE CROSSES THE ReWa RIGHT-OF-WAY.
6. MAXIMUM VERTICAL AND HORIZONTAL SLOPE WITHIN THE RIGHT-OF-WAY TO BE 1:10. THE MINIMUM SLOPE SHALL BE 1:48 (2%). SLOPE SHALL BE GRADED TO PROVIDE POSITIVE DRAINAGE ACROSS THE WIDTH OF THE RIGHT-OF-WAY.
7. MINIMUM DISTANCE FROM PIPE TO EITHER EDGE OF R/W IS 12'
8. MAXIMUM CUT SLOPE TO BE DETERMINED BY ENGINEER BASED ON TOPOGRAPHIC AND GEOTECHNICAL CONDITIONS.



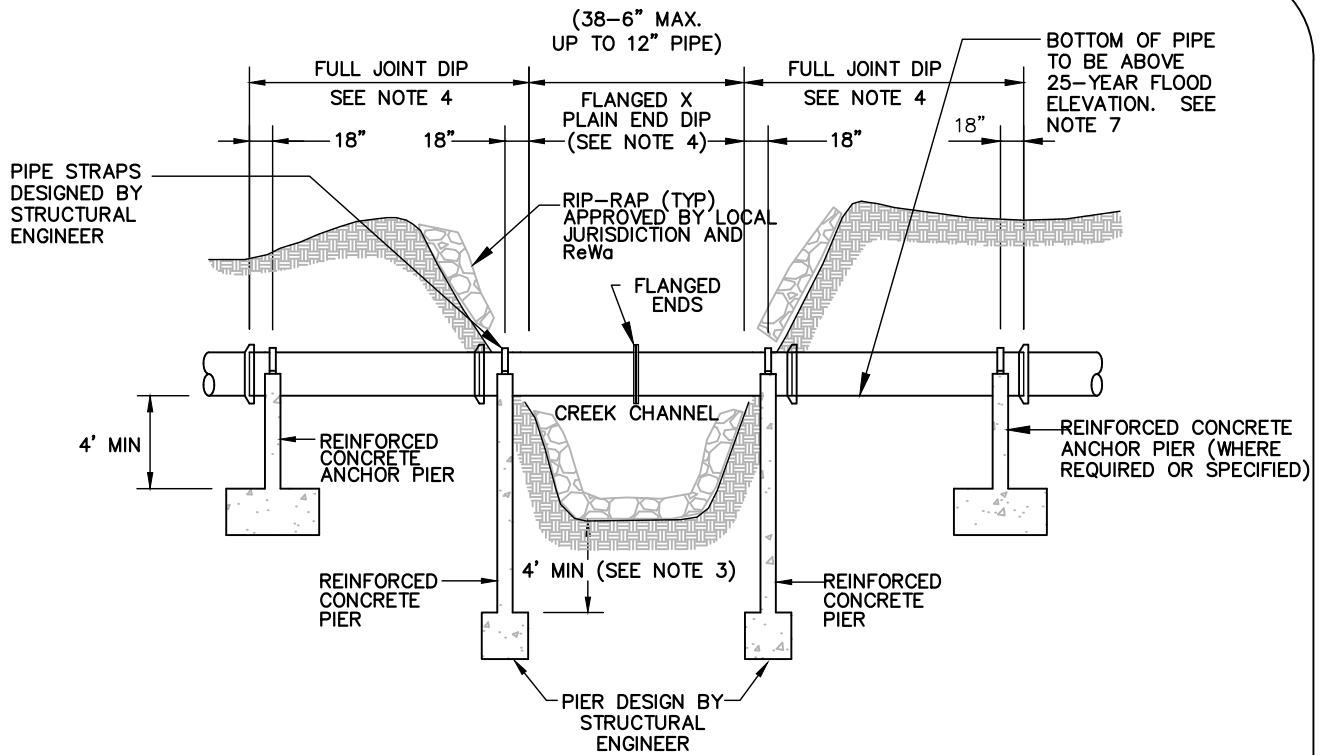
06/20/23  
REV DATE

TYPICAL  
RIGHT-OF-WAY DETAIL

DETAIL No.  
SS-29

N.T.S.  
SCALE





**NOTES:**

1. THIS DETAIL APPLIES TO SEWERS RANGING FROM 8" TO 12" IN DIAMETER. FOR SEWERS GREATER THAN 12", SUBMIT A DETAILED DESIGN TO ReWa FOR REVIEW AND APPROVAL.
2. DUCTILE IRON PIPE SHALL FOR SPAN SHALL BE FLANGED BY PLAIN END.
3. FOOTING DEPTH SHALL BE TO SUITABLE GRADE AS DETERMINED BY THE ENGINEER, BUT SHALL NOT BE LESS THAN AS SHOWN (EXCEPT WHEN PIER IS ANCHORED TO SOLID ROCK).
4. DUCTILE IRON PIPE TO EXTEND TO NEXT MANHOLE. NO PIPE TRANSITIONS BETWEEN MANHOLES SHALL BE ALLOWED.
5. CREEK CROSSINGS MAY REQUIRE A PERMIT FROM STATE AND FEDERAL REGULATORY AGENCIES. WHERE THE PIPE BOTTOM CAN NOT BE INSTALLED ABOVE THE 25-YEAR FLOOD ELEVATION, SPECIAL APPROVAL MUST BE GIVEN BY ReWa AND/OR REGULATORY AGENCIES.

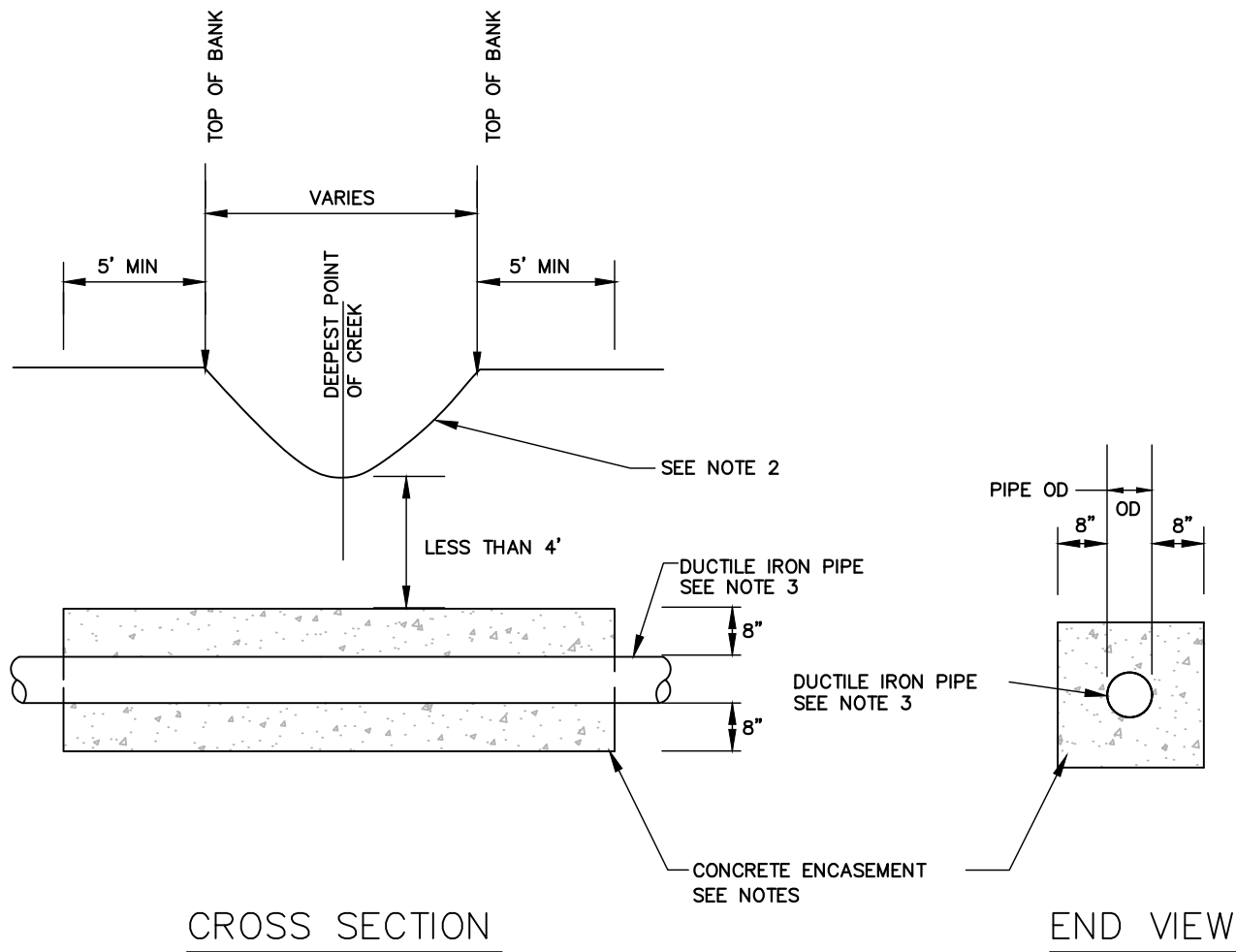


11/18/19  
REV DATE

**AERIAL CREEK CROSSING  
WITH CONCRETE PIERS**

DETAIL No.  
**SS-30**

**N.T.S.**  
SCALE



CROSS SECTION

END VIEW

**NOTES:**

1. CONCRETE SHALL BE MIN 3500 PSI FIBER REINFORCED CONCRETE. CONCRETE ENCASEMENT NOT REQUIRED WHEN THE TOP OF THE PIPE IS AT LEAST 4 FEET UNDER THE CREEK BOTTOM.
2. RESTORE CREEK BANKS PER DETAIL NO. SS-29. RESTORATION NOT SHOWN IN THIS DETAIL FOR CLARITY.
3. WHEN THE CREEK IS LESS THAN 20 FEET WIDE AND WHERE PRACTICABLE, THE DUCTILE IRON PIPE SHALL BE INSTALLED SUCH THAT THERE ARE NO JOINTS UNDER THE CREEK.

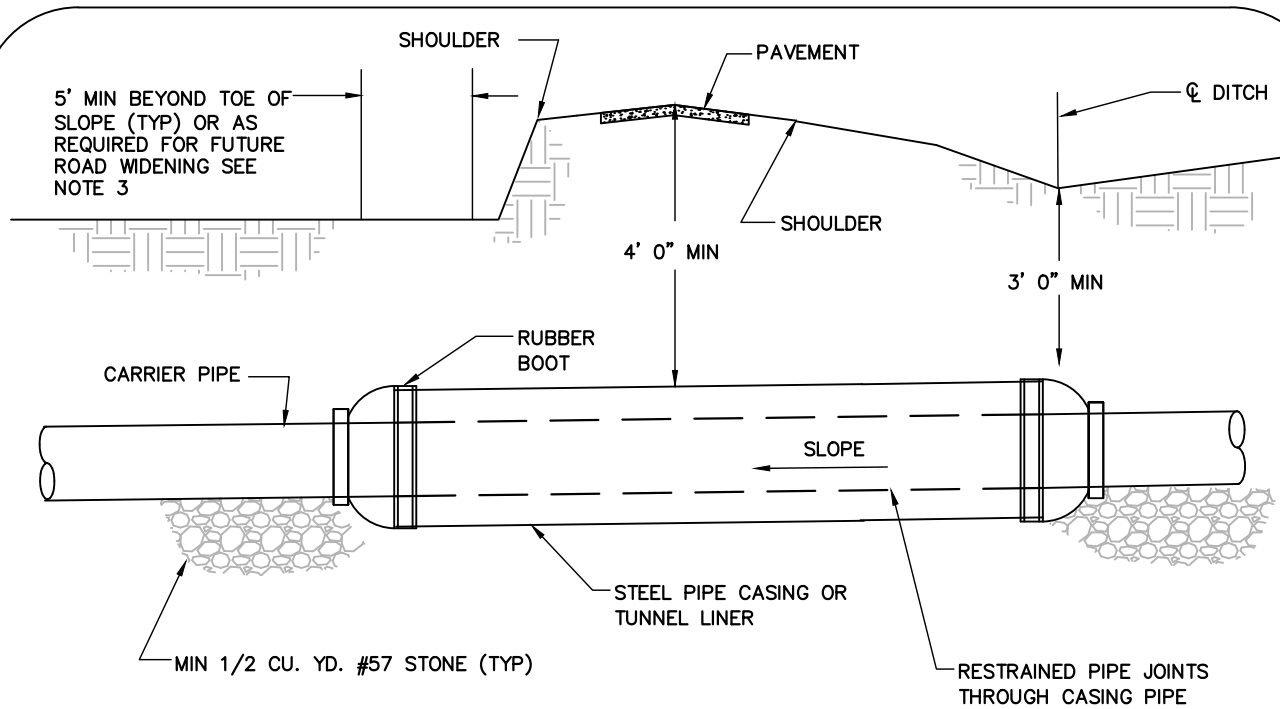


**CONCRETE ENCASEMENT FOR  
STREAM CROSSINGS**

DETAIL No.  
**SS-31**

**11/18/19**  
REV DATE

**N.T.S.**  
SCALE



TYPICAL PIPE CROSSING

**NOTES:**

1. THIS DETAIL ILLUSTRATES A TYPICAL SEWER INSTALLATION UNDER A HIGHWAY. EACH HIGHWAY CROSSING WILL BE DIFFERENT AND SHALL BE SPECIFICALLY DESIGNED. ALL CROSSINGS SHALL BE APPROVED BY SCDOT, THE COUNTY AND/OR THE CITY AND SHALL MEET ALL OF THEIR REQUIREMENTS.
2. REFER TO THE DRAWINGS FOR THE LOCATION, SIZE AND LENGTH OF STEEL PIPE CASINGS AND TUNNEL LINERS. REFER TO THE STANDARD SPECIFICATIONS FOR MATERIAL AND INSTALLATION REQUIREMENTS.
3. THE NEAR EDGE OF THE PIT FOR INSTALLING THE CASING/TUNNEL SHALL BE NO CLOSER TO THE EDGE OF THE TRAVELED WAY THAN ITS DEPTH BELOW THE SURFACE OF THE TRAVELED WAY UNLESS SPECIAL, APPROVED BULKHEADS ARE PROVIDED.

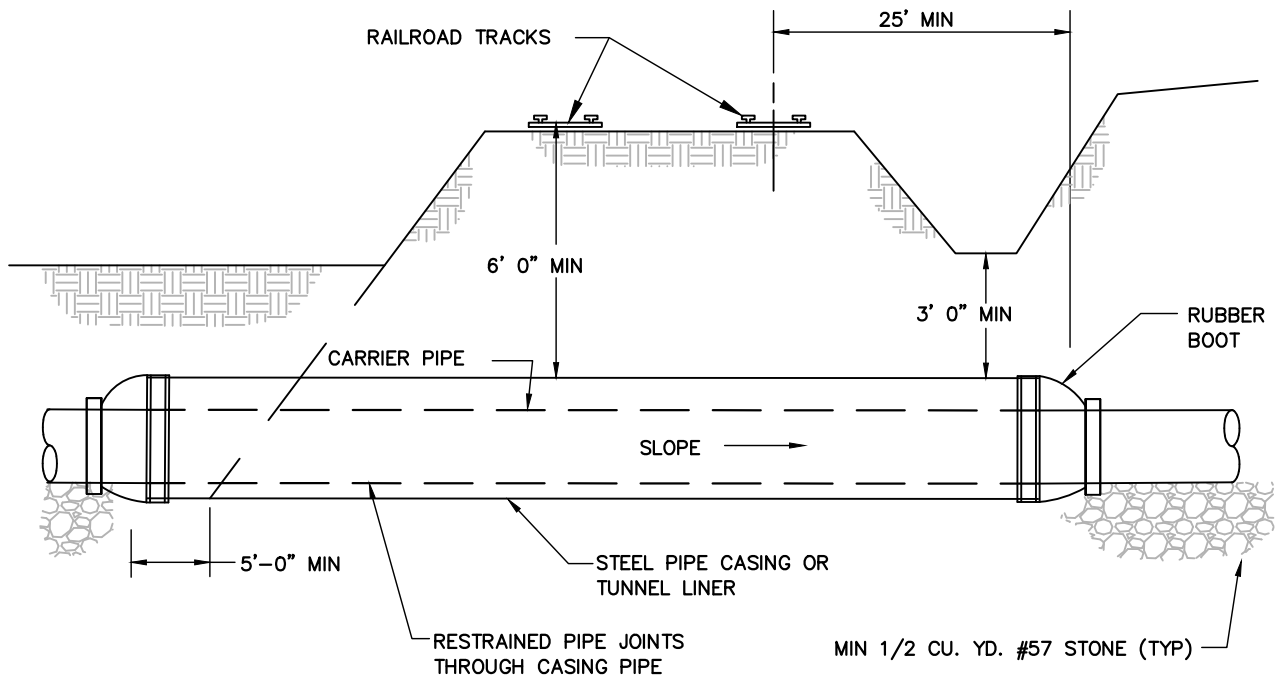


11/18/19  
REV DATE

PIPE INSTALLATION  
UNDER HIGHWAYS

DETAIL No.  
SS-32

N.T.S.  
SCALE



TYPICAL PIPE CROSSING

**NOTES:**

1. THIS DETAIL ILLUSTRATES A TYPICAL SEWER INSTALLATION UNDER A RAILROAD. EACH RAILROAD CROSSING WILL BE DIFFERENT AND SHALL BE SPECIFICALLY DESIGNED. ALL CROSSINGS SHALL BE APPROVED BY THE RAILROAD COMPANY AND SHALL MEET ALL OF THEIR REQUIREMENTS.
2. REFER TO THE DRAWINGS FOR THE LOCATION, SIZE AND LENGTH OF STEEL PIPE CASINGS AND TUNNEL LINERS. REFER TO THE STANDARD SPECIFICATIONS FOR MATERIAL AND INSTALLATION REQUIREMENTS.

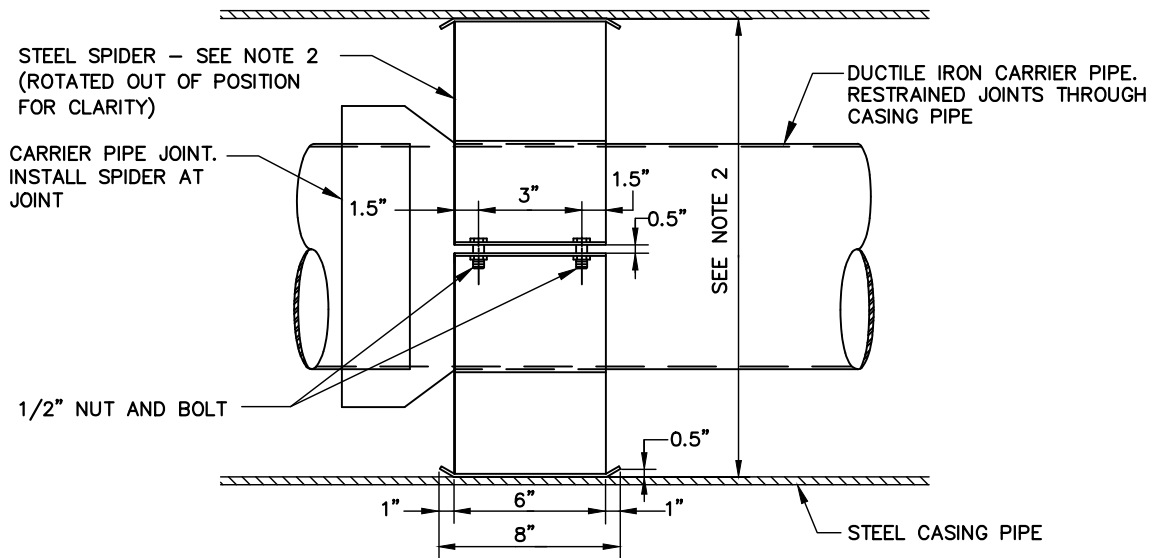
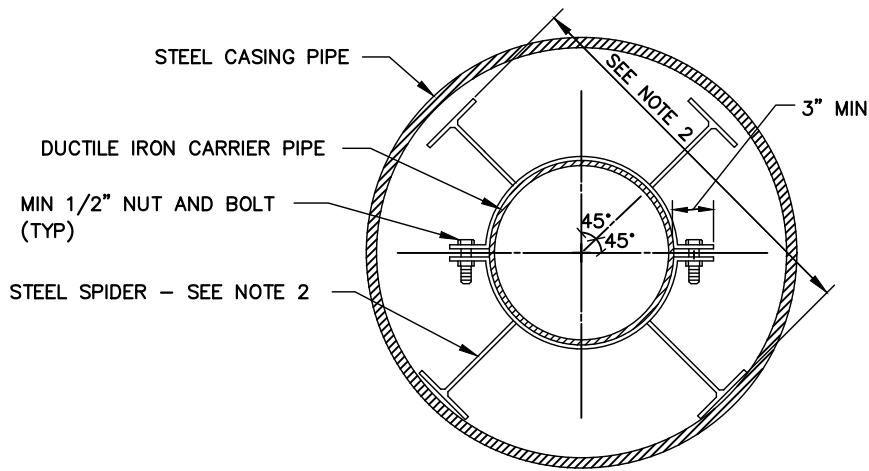


11/18/19  
REV DATE

**PIPE INSTALLATION  
UNDER RAILROADS**

DETAIL No.  
**SS-33**

**N.T.S.**  
SCALE



**NOTES:**

1. THIS DETAIL ILLUSTRATES A TYPICAL SEWER INSTALLATION IN A STEEL CASING PIPE USING STEEL SPIDERS. REFER TO DETAILS NO. SS-32 AND 33 FOR ADDITIONAL REQUIREMENTS. REFER TO THE STANDARD SPECIFICATIONS FOR MATERIAL AND INSTALLATION REQUIREMENTS FOR THE CASING PIPE AND CARRIER PIPE.
2. SEE STANDARD SPECIFICATIONS, SECTION 33 05 07.23 - UTILITY BORING AND JACKING FOR ADDITIONAL DETAILS.



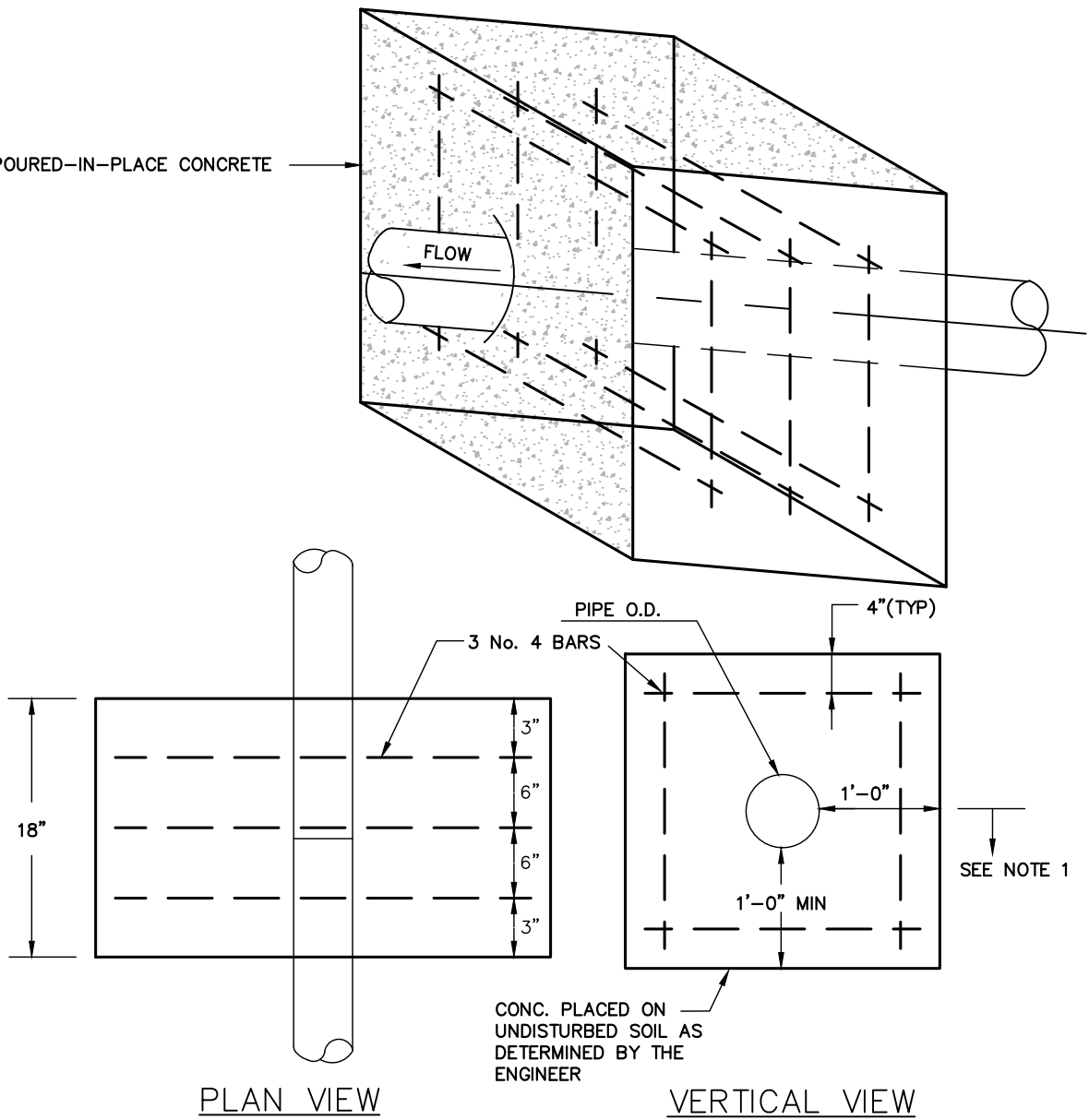
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REV DATE

**SEWER INSTALLATION  
WITHIN CASING PIPE**

DETAIL No.  
**SS-34**

**N.T.S.**  
SCALE

POURED-IN-PLACE CONCRETE



PLAN VIEW

VERTICAL VIEW

**NOTES:**

1. CONCRETE COLLARS SHALL BE INSTALLED WHERE REQUIRED OR SPECIFIED BY THE ENGINEER. COLLARS MAY BE INSTALLED AS ANCHORS FOR SMALL AERIAL CREEK CROSSINGS (SUCH AS SERVICE LATERALS) OR ON OTHER CREEK CROSSINGS. THE REINFORCEMENT SHOWN IN THIS DETAIL MAY BE ALLOWED OR REQUIRED FOR CONCRETE ENCASEMENTS OF SHALLOW PIPES OR AS A SUBSTITUTE FOR FIBER-REINFORCED CONCRETE FOR PIPE ENCASEMENTS UNDER STREAMS (SEE DETAIL NO. SS-34).

THIS DETAIL SHALL ALSO BE FOLLOWED WHEN ANCHORING PIPES ON SLOPES GREATER THAN 20% EXCEPT THAT THE WIDTH MAY BE REDUCED TO 12" AND THE LENGTH MUST BE INCREASED BY 6" EACH SIDE. ALSO, 12" ON EACH SIDE MUST BE KEYED INTO UNDISTURBED EARTH.

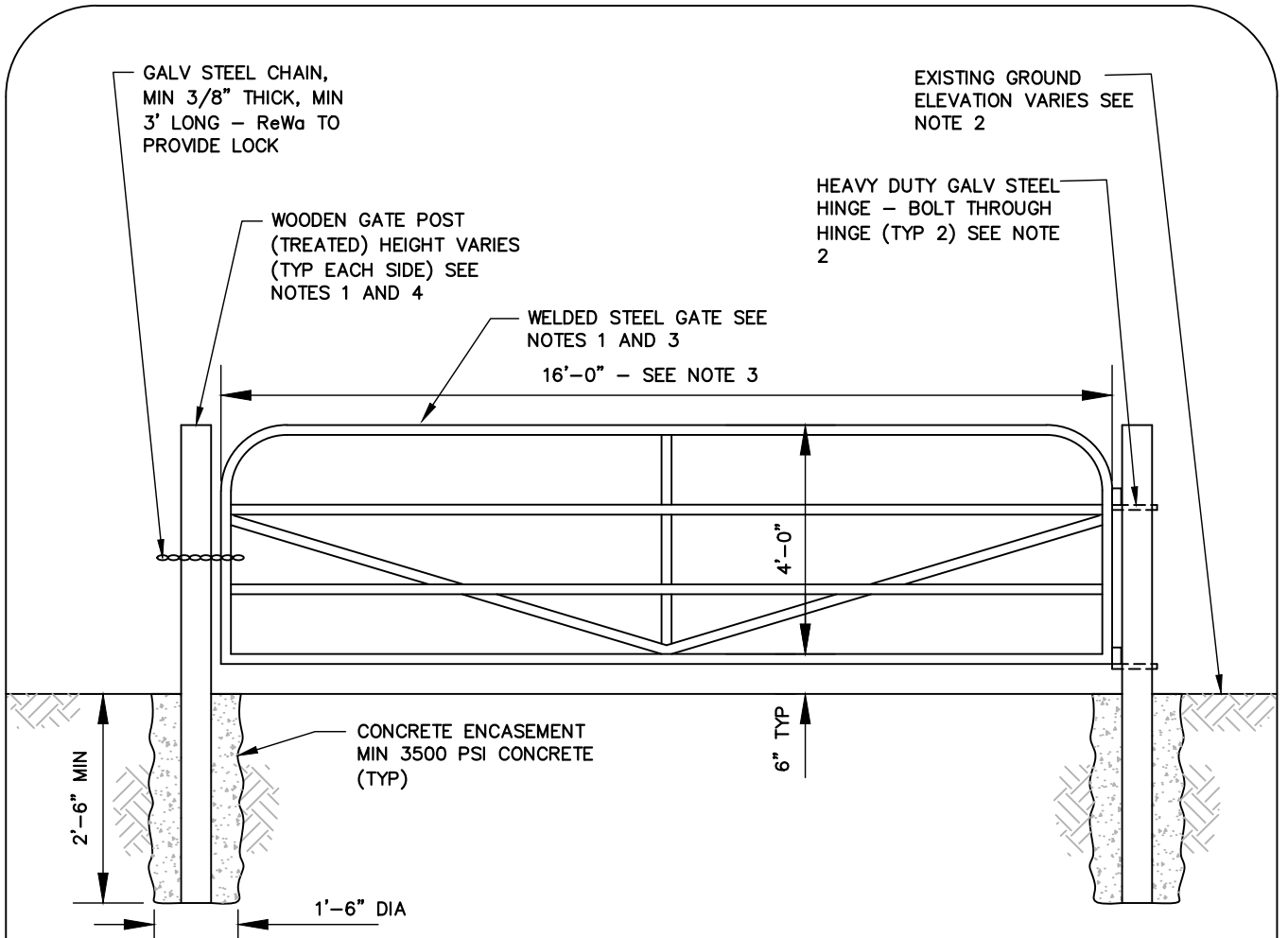
2. FORMS NOT REQUIRED BELOW SPRING LINE, CONCRETE MAY BE PLACED AGAINST SHAPED BANKS IN LIEU OF FORMS.

11/18/19  
REV DATE

CONCRETE COLLAR

DETAIL No.  
**SS-35**

N.T.S.  
SCALE



**NOTES:**

1. STEEL GATES WILL BE REQUIRED UNDER A VARIETY OF CIRCUMSTANCES AND SITUATIONS TO PROVIDE ACCESS TO SEWERS AND TO PREVENT UNAUTHORIZED PERSONNEL FROM ACCESSING THE SEWERS AND RIGHTS-OF-WAY. ReWa AND/OR THE INDIVIDUAL PROPERTY OWNER SHALL APPROVE THE LOCATION OF ALL GATES. GATES MAY BE INSTALLED IN AN EXISTING FENCE OR OVER A NEW SEWER RIGHT-OF-WAY WHERE NO FENCE CURRENTLY EXISTS. WHEN INSTALLING GATES IN AN EXISTING FENCE, THE CONTRACTOR SHALL NEATLY CUT THE EXISTING FENCE AND CONNECT THE FENCE TO THE NEW GATE POSTS IN A MANNER APPROVED BY ReWa. THE CONNECTION SHALL BE SECURE AND PERMANENT. EXISTING FENCES MAY BE WIRE, BARBED WIRE, WOOD, OR A COMBINATION OF SUCH. WHEN INSTALLING A GATE OVER A NEW SEWER RIGHT-OF-WAY, THE GATE WILL BE TYPICALLY CENTERED OVER THE RIGHT-OF-WAY. THE CONTRACTOR WILL BE REQUIRED TO INSTALL NEW FENCE ON EACH SIDE OF THE GATE TO A LOCATION DETERMINED BY ReWa TO BLOCK USE OF THE RIGHT-OF-WAY BY UNAUTHORIZED VEHICLES. THE EXTENT OF THE NEW FENCE WILL VARY WITH EACH INSTALLATION. THE NEW FENCE MATERIAL WILL BE DETERMINED BY ReWa BASED ON EACH INSTALLATION AND/OR DESIRES OF PROPERTY OWNERS. FENCES MAY BE WIRE, BARBED WIRE, WOOD OR A COMBINATION OF SUCH. NEW FENCE POSTS SHALL BE 6"x6" TREATED WOOD POSTS OR APPROVED EQUAL INSTALLED AND ANCHORED AS SPECIFIED FOR THE GATE POSTS.
2. GROUND ELEVATIONS WILL VARY AND WILL TYPICALLY NOT BE LEVEL. CONTRACTOR TO ADJUST GATE ELEVATION AND HINGE LOCATIONS TO ACCOMMODATE THE EXISTING GROUND ELEVATIONS TO PROVIDE 6" OF CLEARANCE. DOUBLE GATE INSTALLATION MAY BE REQUIRED IN SOME SITUATIONS. REFER TO DETAIL NO. SS-50.
3. GATE TO BE FABRICATED FROM 1-1/2" DIA MIN HIGH-STRENGTH STEEL TUBING WITH ALL WELDED JOINTS. GATE TO BE SAND-BLASTED AND PRIME COATED AT FACTORY AND FINISH COATED AFTER INSTALLATION. COLOR SHALL BE STANDARD PRIMER RED. SINGLE GATE TO BE 16'-0" WIDE UNLESS OTHERWISE APPROVED BY ReWa.
4. WOODEN GATE POSTS TO BE 6" NOM x 6" NOM TREATED POSTS OR APPROVED EQUAL. THE HEIGHT OF THE POSTS WILL VARY WITH EACH INSTALLATION BUT SHOULD BE AT LEAST EQUAL TO THE TOP OF THE GATE UNLESS OTHERWISE APPROVED BY ReWa. WHEN DETERMINING THE HEIGHT OF THE GATE POSTS, CONSIDERATION MUST BE GIVEN TO THE EXISTING GROUND ELEVATIONS, THE LOCATIONS AND ELEVATIONS OF EXISTING OR NEW FENCES THAT WILL CONNECT TO THE GATE POSTS, AND PROPERTY OWNER CONCERNS. THE HEIGHT OF THE POSTS SHALL BE APPROVED BY ReWa.

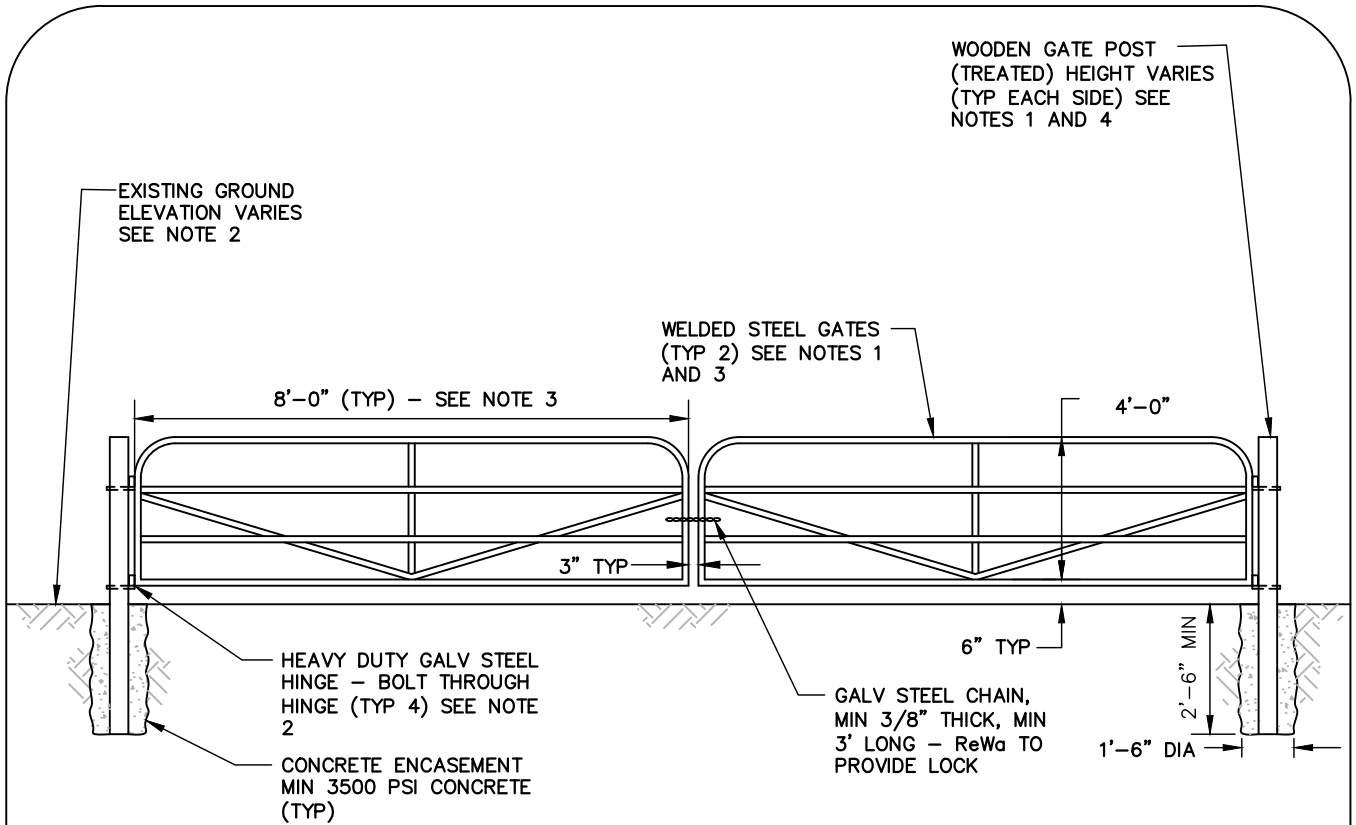


**STEEL GATE - SINGLE GATE  
INSTALLATION**

DETAIL No.  
**SS-36**

**11/18/19**  
REV DATE

**N.T.S.**  
SCALE

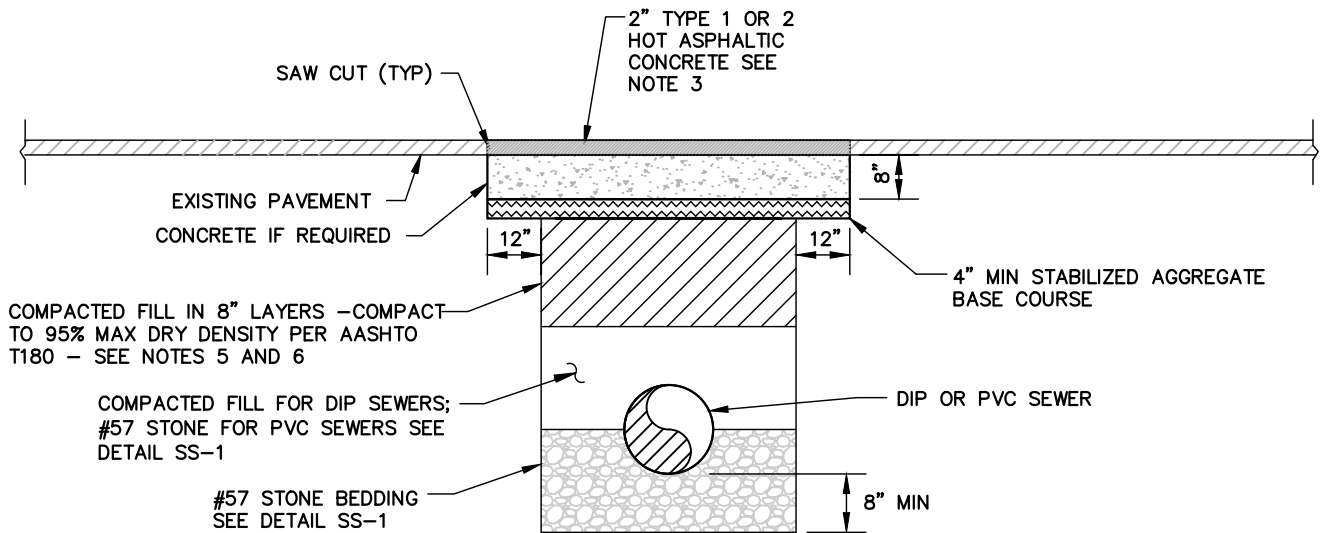


**NOTES:**

1. DOUBLE STEEL GATES WILL BE REQUIRED UNDER A VARIETY OF CIRCUMSTANCES AND SITUATIONS TO PROVIDE ACCESS TO SEWERS AND TO PREVENT UNAUTHORIZED PERSONNEL FROM ACCESSING THE SEWERS AND RIGHTS-OF-WAY. ReWa AND/OR THE INDIVIDUAL PROPERTY OWNER SHALL APPROVE THE LOCATION OF ALL GATES. GATES MAY BE INSTALLED IN AN EXISTING FENCE OR OVER A NEW SEWER RIGHT-OF-WAY WHERE NO FENCE CURRENTLY EXISTS. WHEN INSTALLING GATES IN AN EXISTING FENCE, THE CONTRACTOR SHALL NEATLY CUT THE EXISTING FENCE AND CONNECT THE FENCE TO THE NEW GATE POSTS IN A MANNER APPROVED BY ReWa. THE CONNECTION SHALL BE SECURE AND PERMANENT. EXISTING FENCES MAY BE WIRE, BARBED WIRE, WOOD, OR A COMBINATION OF SUCH. WHEN INSTALLING A GATE OVER A NEW SEWER RIGHT-OF-WAY, THE GATE WILL BE TYPICALLY CENTERED OVER THE RIGHT-OF-WAY. THE CONTRACTOR WILL BE REQUIRED TO INSTALL NEW FENCE ON EACH SIDE OF THE GATE TO A LOCATION DETERMINED BY ReWa TO BLOCK USE OF THE RIGHT-OF-WAY BY UNAUTHORIZED VEHICLES. THE EXTENT OF THE NEW FENCE WILL VARY WITH EACH INSTALLATION. THE NEW FENCE MATERIAL WILL BE DETERMINED BY ReWa BASED ON EACH INSTALLATION AND/OR DESIRES OF PROPERTY OWNERS. FENCES MAY BE WIRE, BARBED WIRE, WOOD OR A COMBINATION OF SUCH. NEW FENCE POSTS SHALL BE 6"x6" TREATED WOOD POSTS OR APPROVED EQUAL INSTALLED AND ANCHORED AS SPECIFIED FOR THE GATE POSTS.
2. GROUND ELEVATIONS WILL VARY AND WILL TYPICALLY NOT BE LEVEL. CONTRACTOR TO ADJUST GATE ELEVATION AND HINGE LOCATIONS TO ACCOMMODATE THE EXISTING GROUND ELEVATIONS TO PROVIDE 6" OF CLEARANCE. DOUBLE GATE INSTALLATION MAY BE REQUIRED IN MANY SITUATIONS DUE TO SIGNIFICANT GROUND ELEVATION CHANGES AT THE GATE.
3. GATES TO BE FABRICATED FROM 1-1/2" DIA MIN HIGH-STRENGTH STEEL TUBING WITH ALL WELDED JOINTS. GATES TO BE SAND-BLASTED AND PRIME COATED AT FACTORY AND FINISH COATED AFTER INSTALLATION. COLOR SHALL BE STANDARD PRIMER RED. EACH GATE TO BE 8'-0" WIDE UNLESS OTHERWISE APPROVED BY ReWa.
4. WOODEN GATE POSTS TO BE 6" NOM x 6" NOM TREATED POSTS OR APPROVED EQUAL. THE HEIGHT OF THE POSTS WILL VARY WITH EACH INSTALLATION BUT SHOULD BE AT LEAST EQUAL TO THE TOP OF THE GATE UNLESS OTHERWISE APPROVED BY ReWa. WHEN DETERMINING THE HEIGHT OF THE GATE POSTS, CONSIDERATION MUST BE GIVEN TO THE EXISTING GROUND ELEVATIONS, THE LOCATIONS AND ELEVATIONS OF EXISTING OR NEW FENCES THAT WILL CONNECT TO THE GATE POSTS, AND PROPERTY OWNER CONCERNS. THE HEIGHT OF THE POSTS SHALL BE APPROVED BY ReWa.

	<p><b>STEEL GATE - DOUBLE GATE INSTALLATION</b></p>	<p>DETAIL No. <b>SS-37</b></p>
<p><b>11/18/19</b> REV DATE</p>		<p><b>N.T.S.</b> SCALE</p>





**NOTES:**

1. ALL PAVEMENT MATERIALS AND INSTALLATION SHALL BE IN ACCORDANCE WITH SCDOT STANDARD SPECIFICATIONS. THIS DETAIL SHALL BE MODIFIED AS REQUIRED BY SCDOT.
2. ROLL ASPHALT SMOOTH, UNIFORM AND LEVEL WITH EXISTING PAVEMENT.
3. PRIOR TO PLACING NEW ASPHALT, APPLY BONDING AGENT ON THE SURFACES WHERE THE ASPHALT WILL BE PLACED INCLUDING ON THE CONCRETE BASE, ON THE EXISTING ASPHALT AND AT ALL SAWCUT JOINTS.
4. ASPHALT OVERLAY TO BE INSTALLED AS REQUIRED BY SCDOT OR ReWa PER DETAIL SS-43.
5. IMPORTED CRUSHER RUN STONE (COMPACTED) OR FLOWABLE FILL MAY BE SPECIFIED FOR BACKFILLING UNDER ROADS. IF FLOWABLE FILL IS SPECIFIED, EXTEND STONE BEDDING TO 12" ABOVE THE TOP OF THE PIPE PRIOR TO PLACING FLOWABLE FILL. IF EXCAVATED SOIL IS NOT SUITABLE FOR BACKFILL AS AGREED BY THE ENGINEER/ReWa, REMOVE THE EXISTING MATERIAL AND DISPOSE OF OFFSITE AND IMPORT CRUSHER RUN FOR BACKFILL.
6. ReWa MAY REQUIRE THAT COMPACTION TESTS BE PERFORMED TO CONFIRM PROPER COMPACTION PRIOR TO PLACING ABC STONE AND PAVEMENT.

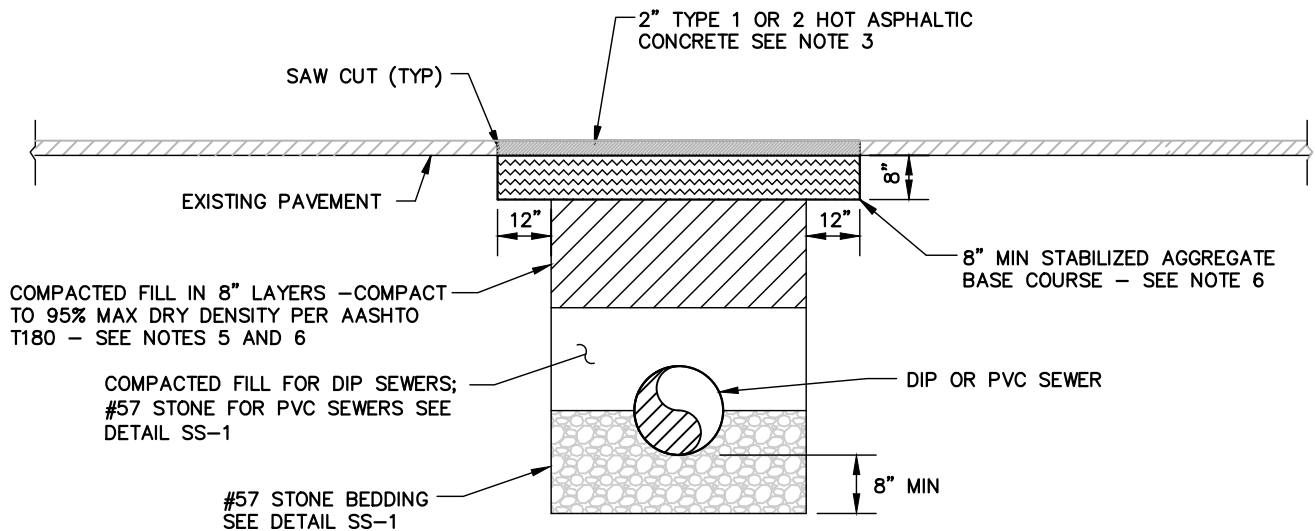


**ASPHALT PAVEMENT PATCH IN  
A PRIMARY  
SCDOT CITY/COUNTY ROAD**

DETAIL No.  
**SS-38**

11/18/19  
REV DATE

**N.T.S.**  
SCALE



**NOTES:**

1. ALL PAVEMENT MATERIALS AND INSTALLATION SHALL BE IN ACCORDANCE WITH SCDOT STANDARD SPECIFICATIONS. THIS DETAIL SHALL BE MODIFIED AS REQUIRED BY SCDOT.
2. ROLL ASPHALT SMOOTH, UNIFORM AND LEVEL WITH EXISTING PAVEMENT.
3. PRIOR TO PLACING NEW ASPHALT, APPLY BONDING AGENT ON THE SURFACES WHERE THE ASPHALT WILL BE PLACED ON THE CONCRETE BASE, ON THE EXISTING ASPHALT AND AT ALL SAWCUT JOINTS.
4. ASPHALT OVERLAY TO BE INSTALLED AS REQUIRED BY SCDOT OR ReWa PER DETAIL SS-43.
5. IMPORTED CRUSHER RUN STONE (COMPACTED) OR FLOWABLE FILL MAY BE SPECIFIED FOR BACKFILLING UNDER ROADS. IF FLOWABLE FILL IS SPECIFIED, EXTEND STONE BEDDING TO 12" ABOVE THE TOP OF THE PIPE PRIOR TO PLACING FLOWABLE FILL. IF EXCAVATED SOIL IS NOT SUITABLE FOR BACKFILL AS AGREED BY THE ENGINEER/ReWa, REMOVE THE EXISTING MATERIAL AND DISPOSE OF OFFSITE AND IMPORT CRUSHER RUN FOR BACKFILL.
6. ReWa MAY REQUIRE THAT COMPACTION TESTS BE PERFORMED TO CONFIRM PROPER COMPACTION PRIOR TO PLACING ABC STONE AND PAVEMENT.

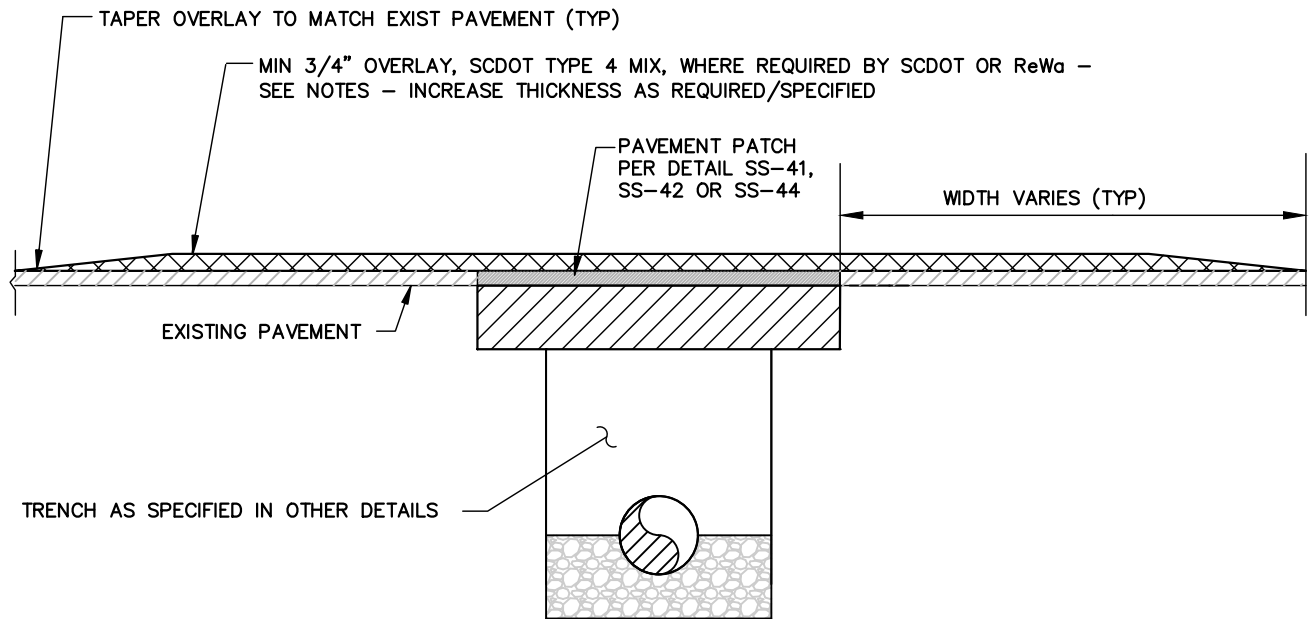


**ASPHALT PAVEMENT PATCH IN  
A SECONDARY  
SCDOT CITY/COUNTY ROAD**

DETAIL No.  
**SS-39**

**11/18/19**  
REV DATE

**N.T.S.**  
SCALE



**NOTES:**

1. ALL PAVEMENT MATERIALS AND INSTALLATION SHALL BE IN ACCORDANCE WITH SCDOT STANDARD SPECIFICATIONS. THIS DETAIL SHALL BE MODIFIED AS REQUIRED BY SCDOT.
2. OVERLAY TO BE INSTALLED WITH A PAVING MACHINE.
3. INCREASE THICKNESS OF OVERLAY AS REQUIRED BY SCDOT.
4. PRIOR TO PLACING NEW ASPHALT, APPLY BONDING AGENT ON THE SURFACES WHERE THE ASPHALT WILL BE PLACED.
5. OVERLAY REQUIREMENTS SPECIFIED IN THIS DETAIL CAN ALSO APPLY TO OVERLAYS INSTALLED WHERE NO SEWER WORK (NO SEWER TRENCH) HAS OCCURRED.

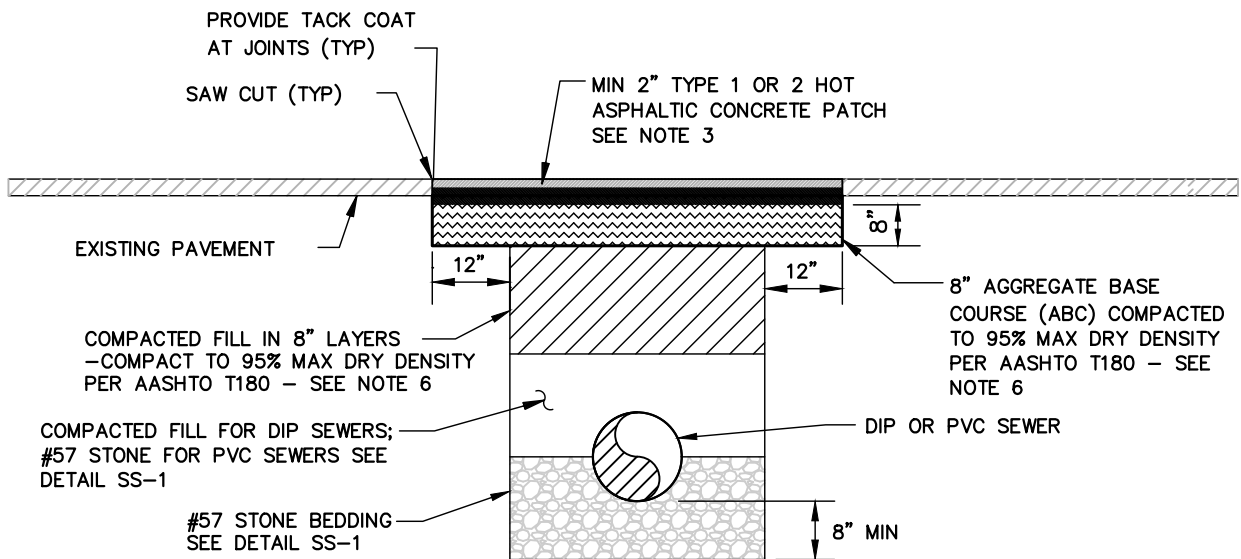


**ASPHALT OVERLAY**

DETAIL No.  
**SS-40**

**11/18/19**  
REV DATE

**N.T.S.**  
SCALE



**NOTES:**

1. ALL PAVEMENT MATERIALS AND INSTALLATION SHALL BE IN ACCORDANCE WITH SCDOT STANDARD SPECIFICATIONS. REFER TO THE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
2. ROLL ASPHALT PATCH SMOOTH, UNIFORM AND LEVEL WITH EXISTING PAVEMENT.
3. PAVEMENT THICKNESS TO BE EQUAL TO THE EXISTING PAVEMENT THICKNESS PLUS 1 INCH WITH A MIN THICKNESS OF 2 INCHES.
4. IN SOME INSTANCES, CONTRACTOR MAY BE REQUIRED TO FOLLOW ASPHALT PAVEMENT PATCH SHOWN IN DETAIL SS-41 OR SS-42.
5. INSTALL ASPHALT OVERLAY WHERE REQUIRED BY ReWa PER DETAIL SS-43.
6. ReWa MAY REQUIRE THAT COMPACTION TESTS BE PERFORMED TO CONFIRM PROPER COMPACTION PRIOR TO PLACING ABC STONE AND PAVEMENT.
7. IF THE EXCAVATED MATERIAL IS NOT SUITABLE FOR BACKFILL AS AGREED BY THE ENGINEER/ReWa, IMPORT CRUSHER RUN STONE FOR BACKFILL.

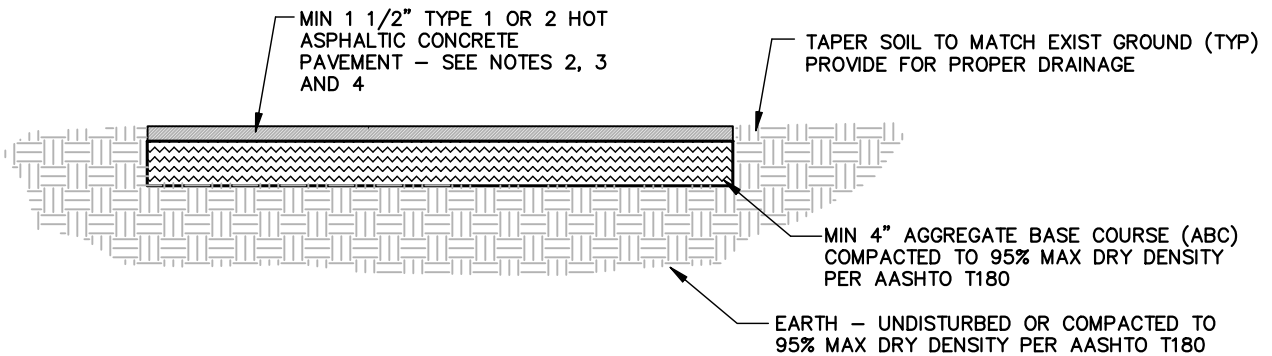


**ASPHALT PAVEMENT PATCH  
IN PARKING  
LOTS AND PRIVATE ROADS**

DETAIL No.  
**SS-41**


**11/18/19**  
REV DATE

**N.T.S.**  
SCALE



**NOTES:**

1. REFER TO THIS DETAIL WHEN REPLACING ASPHALT WALKPATHS AND DRIVEWAYS.
2. ALL PAVEMENT MATERIALS SHALL BE IN ACCORDANCE WITH SCDOT STANDARD SPECIFICATIONS.
3. PAVEMENT TO BE INSTALLED TO MATCH PRE-CONSTRUCTION ELEVATIONS, SLOPES AND CONFIGURATIONS. DRAINAGE PATTERN TO BE MAINTAINED – INSTALL DRAINAGE PIPES AND CULVERTS PER PRE-CONSTRUCTION CONDITIONS AS APPLICABLE.
4. PAVEMENT THICKNESS TO BE INCREASED TO MATCH EXISTING PAVEMENT THICKNESS AS APPLICABLE. MIN THICKNESS TO BE 1 1/2".
5. ReWa MAY REQUIRE THAT COMPACTION TESTS BE PERFORMED TO CONFIRM PROPER COMPACTION PRIOR TO PLACING ABC STONE AND PAVEMENT.

	<b>ASPHALT PAVEMENT FOR WALK PATHS AND DRIVEWAYS</b>	DETAIL No. <b>SS-42</b>
<b>11/18/19</b> REV DATE		<b>N.T.S.</b> SCALE

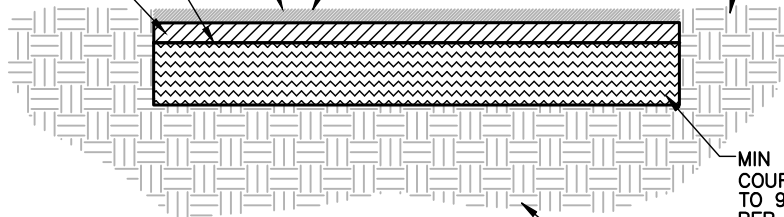
PROVIDE TACK COAT BETWEEN BINDER COURSE AND SURFACE COURSE

PRIME COAT IF REQUIRED

2" ASPHALT CONC BINDER COURSE (SCDOT SEC 402) SEE NOTES 2 AND 3

MIN 1 1/2" TYPE 1 OR 2 HOT ASPHALT CONC SURFACE COURSE (SCDOT SEC 403) SEE NOTES 2, 3 AND 4

TAPER SOIL TO MATCH EXIST GROUND (TYP) - PROVIDE FOR PROPER DRAINAGE



MIN 6" AGGREGATE BASE COURSE (ABC) COMPACTED TO 95% MAX DRY DENSITY PER AASHTO T180

EARTH - UNDISTURBED OR COMPACTED TO 95% MAX DRY DENSITY PER AASHTO T180

NOTES:

1. REFER TO THIS DETAIL WHEN REPLACING PAVED PARKING LOTS AND PRIVATE ROADS.
2. ALL PAVEMENT MATERIALS AND INSTALLATION SHALL BE IN ACCORDANCE WITH SCDOT STANDARD SPECIFICATIONS. REFER TO THE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
3. PAVEMENT TO BE INSTALLED TO MATCH PRE-CONSTRUCTION ELEVATIONS, SLOPES AND CONFIGURATIONS. DRAINAGE PATTERN TO BE MAINTAINED. RE-STRIPE PARKING SPACES AND INSTALL SPEED BUMPS PER PRE-CONSTRUCTION LOCATIONS AS APPLICABLE.
4. PAVEMENT THICKNESS TO BE INCREASED TO MATCH EXISTING PAVEMENT THICKNESS AS APPLICABLE. MIN THICKNESS TO BE 1 1/2".
5. REMOVE EXIST CONCRETE FROM EXPANSION JOINT TO EXPANSION JOINT AND REPLACE COMPLETELY UNLESS APPROVED OTHERWISE. PROVIDE NEW EXPANSION JOINTS PER NOTE 6. PROVIDE CONTROL JOINTS WHERE DIRECTED BY THE ENGINEER.

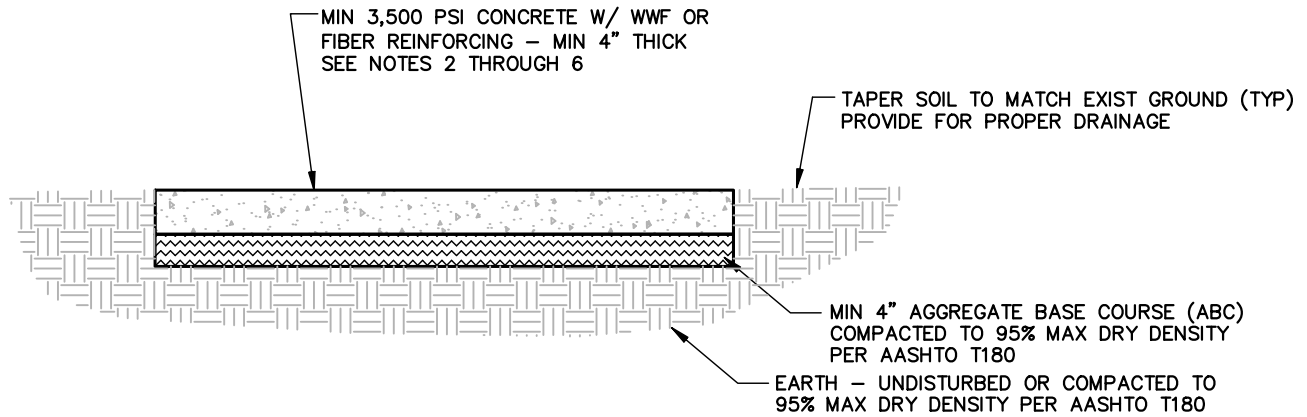


11/18/19  
REV DATE

ASPHALT RESTORATION FOR  
PARKING LOTS AND PRIVATE  
ROADS

DETAIL No.  
SS-43

N.T.S.  
SCALE



**NOTES:**

1. REFER TO THIS DETAIL WHEN REPLACING CONCRETE DRIVEWAYS, PARKING LOTS AND SIDEWALKS.
2. REFER TO THE SPECIFICATIONS FOR ADDITIONAL REQUIREMENTS.
3. CONCRETE TO BE INSTALLED TO MATCH PRE-CONSTRUCTION ELEVATIONS, SLOPES AND CONFIGURATIONS. DRAINAGE PATTERN TO BE MAINTAINED – INSTALL DRAINAGE PIPES AND CULVERTS PER PRE-CONSTRUCTION CONDITIONS AS APPLICABLE.
4. CONCRETE THICKNESS TO BE INCREASED TO MATCH EXISTING CONCRETE THICKNESS AS APPLICABLE. MIN THICKNESS TO BE 4".
5. REMOVE EXIST CONCRETE FROM EXPANSION JOINT TO EXPANSION JOINT AND REPLACE COMPLETELY UNLESS APPROVED OTHERWISE. PROVIDE NEW EXPANSION JOINTS PER NOTE 6. PROVIDE CONTROL JOINTS WHERE DIRECTED BY THE ENGINEER.
6. PROVIDE 1/2" EXPANSION JOINT WITH BITUMINOUS IMPREGNATED BACKER BOARD AND 1" DEEP POLYURETHANE JOINT SEALANT ON TOP AND SIDES AT 8' MAX SPACING UNLESS APPROVED OTHERWISE.
7. IN SOME INSTANCES, THE CONCRETE THICKNESS FOR DRIVEWAYS AND PARKING LOTS MAY BE INCREASED TO 6" OR 8" TO SUPPORT THE TRAFFIC LOADINGS. ALSO, THE BASE COURSE WILL BE INCREASED TO 6" AS DIRECTED BY THE ENGINEER.



11/18/19  
REV DATE

CONCRETE DRIVEWAYS,  
PARKING LOTS AND  
SIDEWALKS

DETAIL No.  
SS-44

N.T.S.  
SCALE

CAST IRON RING AND COVER  
USF 7631 WITH QF "SEWER" COVER

WARNING TAPE  
24" BELOW  
SURFACE

SCDOT #57 STONE  
12" MIN.

SCDOT #57 STONE  
18" MIN.

SDR 26 PVC SEWER PIPE

12 GAUGE SOLID COPPER  
TRACER WIRE PVC COATED  
(GREEN)

FILL PIPE WITH  
SCDOT #57 STONE

C-900 OR DIP FORCE MAIN

NOTES:

1. TRACER WIRE TO BE TAPED TO FORCE MAIN ON BELL SIDE OF EVERY JOINT WITH ADHESIVE TAPE (DUCT TAPE).
2. ALL BREAKS TO BE REPAIRED WITH WATERTIGHT CONNECTORS APPROVED FOR DIRECT BURIAL.
3. BOXES ARE NOT TO BE PLACED IN ASPHALT.
4. SEE ReWa STANDARD SPECIFICATION 33 05 97 – IDENTIFICATION AND SIGNAGE FOR UTILITIES FOR ADDITIONAL REQUIREMENTS.
5. MAXIMUM SPACING OF TRACER WIRE BOXES SHALL BE 500'. ARV VAULTS MAY BE INCLUDED IN THE SPACING REQUIREMENTS.



11/12/21  
REV DATE

TRACER WIRE BOX

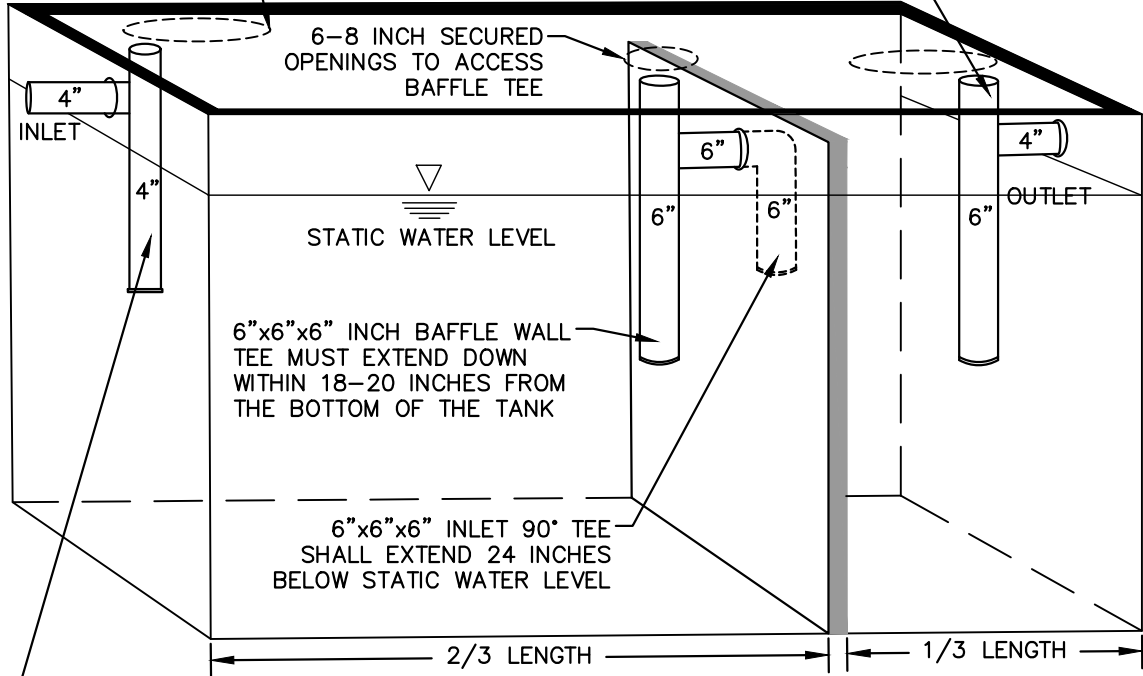
DETAIL No.  
SS-45

N.T.S.  
SCALE

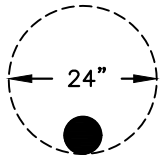


24" OPENING TO ACCOMMODATE A 24" SECURED MANHOLE RING AND COVER (TYP) SEE NOTE 5

6"x6"x4" OUTLET PIPE MUST EXTEND DOWN TO WITHIN 18-20 INCHES FROM THE BOTTOM OF THE TANK



4"x4"x4" INLET 90° TEE MUST EXTEND 24 INCHES BELOW STATIC WATER LEVEL



MANHOLE INLET/OUTLET TOP VIEW

**NOTES:**

1. GREASE INTERCEPTOR VAULT SHALL BE PRECAST CONCRETE. SEE ReWa STANDARD SPECIFICATIONS FOR ADDITIONAL DETAILS.
2. PROVIDE PRECAST MANHOLE RISERS AND/OR GRADE RINGS AS REQUIRED TO ADJUST MANHOLE RING AND COVER TO FINISHED GRADE. GRADE RINGS SHALL NOT BE USED WHERE ADJUSTMENT IS > 6".
3. ALL TEES THROUGHOUT TANK MUST BE DWV PVC 90 DEGREE STRAIGHT TEES.
4. ALL PIPING INSIDE THE GREASE INTERCEPTOR MUST BE PVC SCHEDULE 40.
5. PROCEDURES OR PHYSICAL MEASURES MUST BE IN PLACE TO MAKE TO MAKE EVIDENCE OF TAMPERING OR UNAUTHORIZED USE IMMEDIATELY APPARENT TO THE GI OWNER/REPRESENTATIVE.
6. A GREASE INTERCEPTOR WILL BE CONSIDERED SECURE IF IT IS EQUIPPED WITH PHYSICAL BARRIERS (SUCH AS LOCKING COVERS AND/OR PERMANENT FENCING) THAT ARE ONLY REMOVABLE BY THE OWNER/REPRESENTATIVE UTILIZING A UNIQUE KEY OR "UNLOCKING DEVICE". FURTHERMORE, THE BARRIER IN PLACE WILL REASONABLY ENSURE THAT UNAUTHORIZED ACCESS CAN ONLY BE GAINED BY DELIBERATE ACTIONS UTILIZING UNCOMMON TOOLS AND EXTREME EFFORT/FORCE.

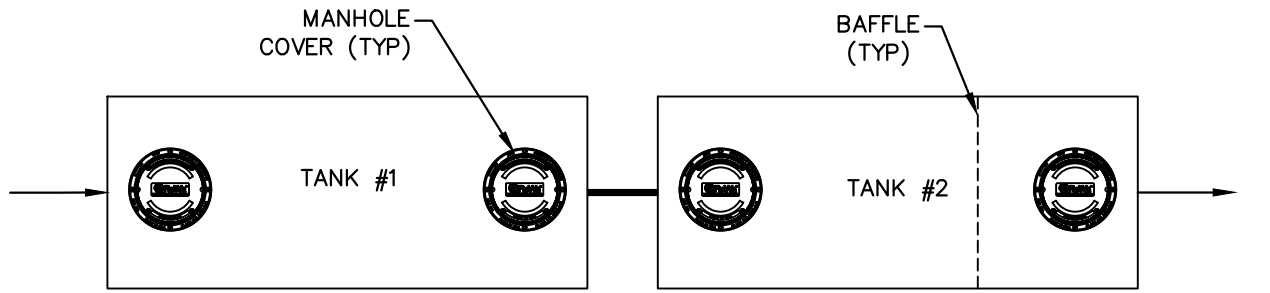


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REV DATE

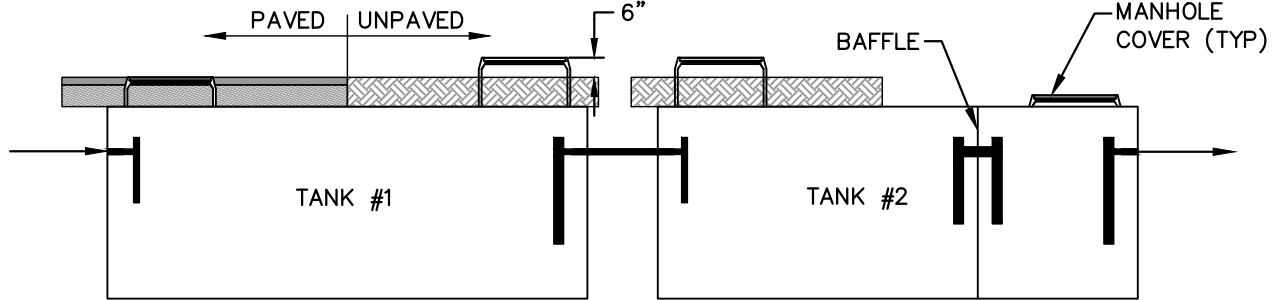
**GREASE INTERCEPTOR -  
BAFFLED**

DETAIL No.  
**SS-46.1**

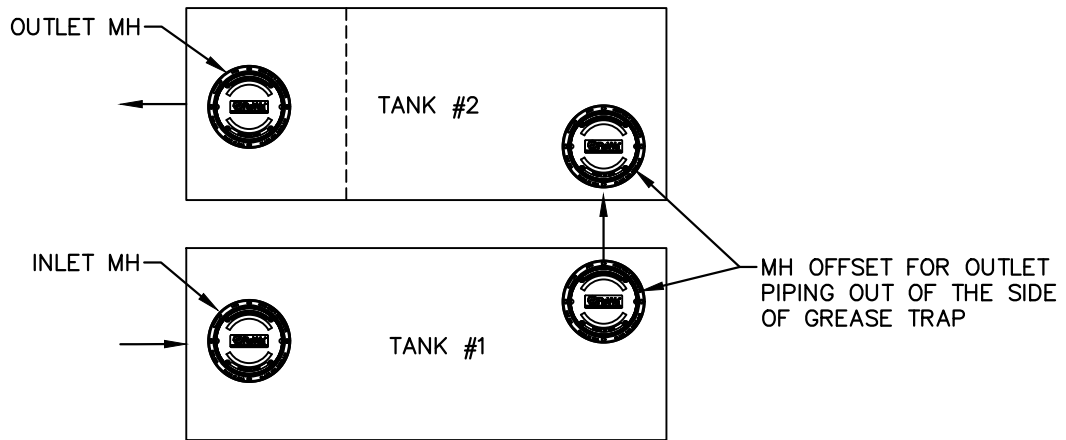
**N.T.S.**  
SCALE



TOP OUTSIDE VIEW



SIDE VIEW



MANHOLE  
INLET/OUTLET  
TOP VIEW

SIDE BY SIDE - TOP VIEW  
(ALERNATE CONFIGURATION)

**NOTES:**

1. MANHOLE COVERS MUST BE POSITIONED OVER INLET AND OUTLET PIPING FOR EACH TANK.
2. TANK #1 IS UNBAFFLED. MANHOLE COVERS ARE POSITIONED OVER BOTH INLET AND OUTLET PIPING. THE INLET PIPE IS TO BE 24" LONG AND THE OUTLET PIPE IS TO BE 18-20" OFF BOTTOM OF TANK. SEE DETAIL SS-XX.
3. TANK #2 WILL BE BAFFLED. MANHOLE COVERS ARE POSITIONED OVER BOTH INLET AND OUTLET PIPING. THE INLET PIPE IS 24" AND THE OUTLET PIPE MUST BE 6" VERTICAL AND 18-20" OFF BOTTOM OF TANK. CLEANOUTS TO BE POSITIONED OVER PIPING IN THE BAFFLE. SEE DETAIL SS-XX.

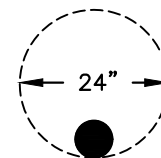
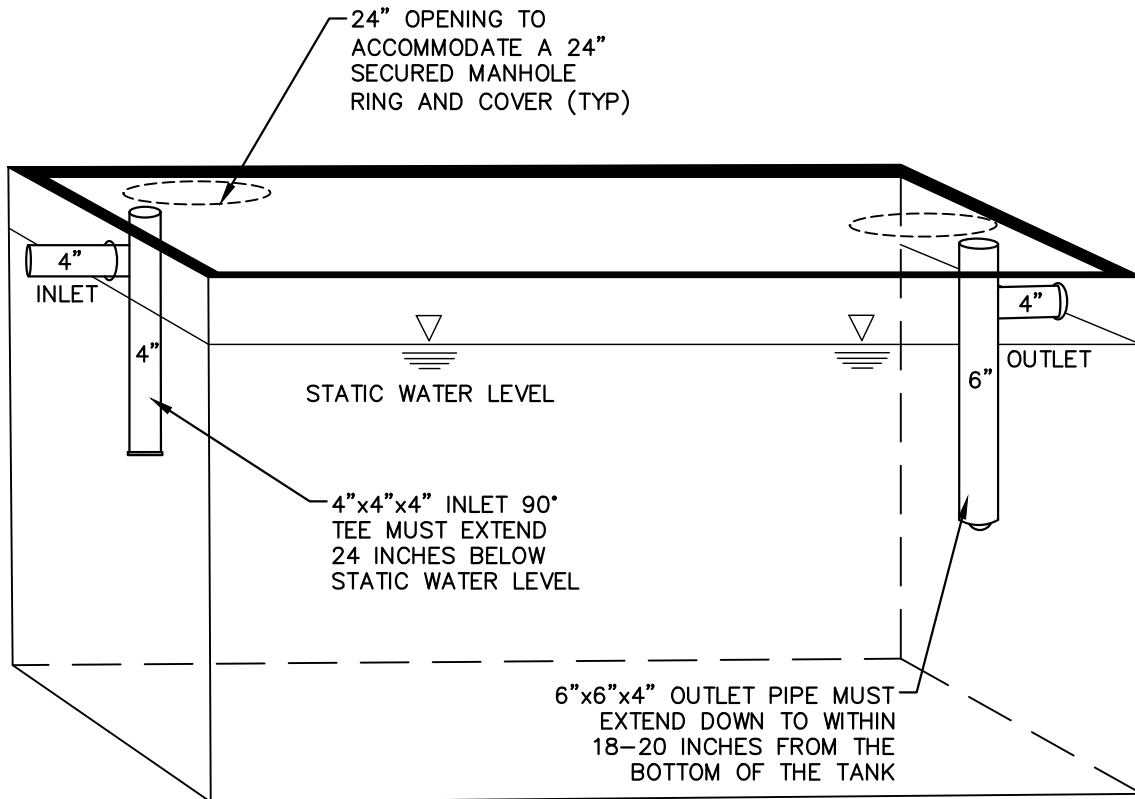


11/12/21  
REV DATE

**GREASE INTERCEPTOR -  
TWO TANK LAYOUT**

DETAIL No.  
SS-46.2

**N.T.S.**  
SCALE



MANHOLE INLET/OUTLET  
TOP VIEW

**NOTES:**

1. GREASE INTERCEPTOR VAULT SHALL BE PRECAST CONCRETE. SEE ReWa STANDARD SPECIFICATIONS FOR ADDITIONAL DETAILS.
2. PROVIDE PRECAST MANHOLE RISERS AND/OR GRADE RINGS AS REQUIRED TO ADJUST MANHOLE RING AND COVER TO FINISHED GRADE. GRADE RINGS SHALL NOT BE USED WHERE ADJUSTMENT IS > 6".
3. ALL TEES THROUGHOUT TANK MUST BE DWV PVC 90 DEGREE STRAIGHT TEES.
4. ALL PIPING INSIDE THE GREASE INTERCEPTOR MUST BE PVC SCHEDULE 40.
5. PROCEDURES OR PHYSICAL MEASURES MUST BE IN PLACE TO MAKE TO MAKE EVIDENCE OF TAMPERING OR UNAUTHORIZED USE IMMEDIATELY APPARENT TO THE GI OWNER/REPRESENTATIVE.
6. A GREASE INTERCEPTOR WILL BE CONSIDERED SECURE IF IT IS EQUIPPED WITH PHYSICAL BARRIERS (SUCH AS LOCKING COVERS AND/OR PERMANENT FENCING) THAT ARE ONLY REMOVABLE BY THE OWNER/REPRESENTATIVE UTILIZING A UNIQUE KEY OR "UNLOCKING DEVICE". FURTHERMORE, THE BARRIER IN PLACE WILL REASONABLY ENSURE THAT UNAUTHORIZED ACCESS CAN ONLY BE GAINED BY DELIBERATE ACTIONS UTILIZING UNCOMMON TOOLS AND EXTREME EFFORT/FORCE.



11/12/21  
REV DATE

**GREASE INTERCEPTOR -  
UNBAFFLED**

DETAIL No.  
**SS-46.3**

**N.T.S.**  
SCALE

## PUMP STATION AND FORCE MAIN DETAILS

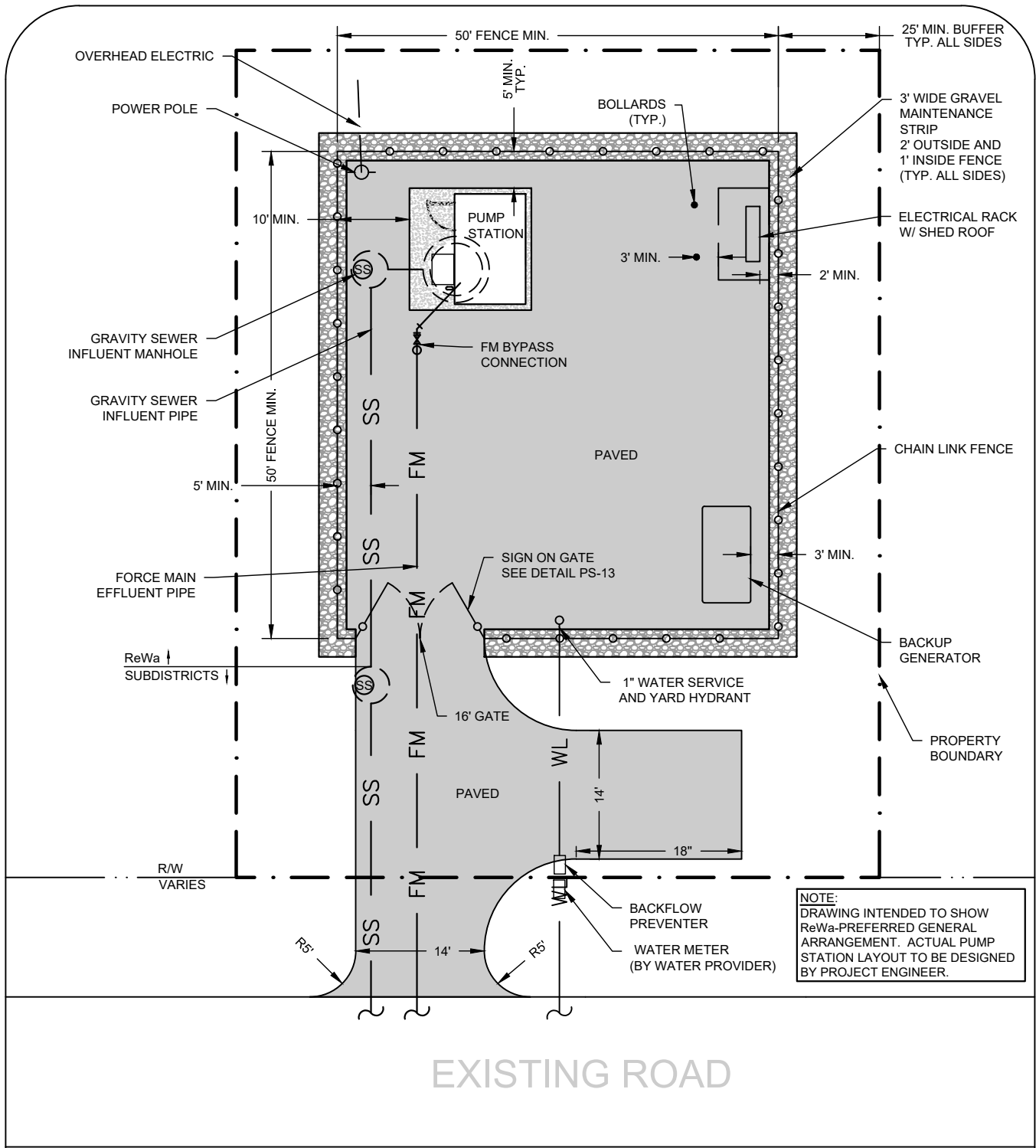
PS-1.1	TYPICAL SMALL ABOVE GROUND PUMP STATION – SITE PLAN
PS-1.2	STANDARD SMALL ABOVE GROUND PUMP STATION – PLAN VIEW
PS-1.3	STANDARD SMALL ABOVE GROUND PUMP STATION – SECTION VIEW
PS-2.1	LARGE ABOVE GROUND PUMP STATION – SITE PLAN
PS-2.2	LARGE PUMP STATION PLAN
PS-2.3	LARGE PUMP STATION SECTION
PS-3.1	TYPICAL DUPLEX SUBMERSIBLE PUMP STATION
PS-3.2	TYPICAL DUPLEX SUBMERSIBLE PUMP STATION – PLAN VIEW
PS-3.3	TYPICAL DUPLEX SUBMERSIBLE PUMP STATION – SECTION VIEW
PS-4.1	TYPICAL TRIPLEX SUBMERSIBLE PUMP STATION
PS-4.2	TYPICAL TRIPLEX SUBMERSIBLE PUMP STATION – PLAN VIEW
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PS-10	TYPICAL CHAIN LINK FENCE WITH DOUBLE SWING GATE
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EL-1.1	TYPICAL EQUIPMENT RACK PACKAGED WASTEWATER PUMPING STATION
EL-1.2	TYPICAL JUNCTION BOX DETAIL PACKAGED PUMPING STATION
EL-2.0	ONE-LINE DIAGRAM SUBMERSIBLE WASTEWATER PUMPING STATION
EL-2.1	TYPICAL EQUIPMENT RACK SUBMERSIBLE WASTEWATER PUMPING STATION
EL-2.2	TYPICAL JUNCTION BOX DETAIL SUBMERSIBLE PUMPING STATION
EL-3.0	CT CABINET RACK PACKAGED & SUBMERSIBLE PUMPING STATIONS
EL-3.1	SURGE PROTECTIVE DEVICE PACKAGED & SUBMERSIBLE PUMPING STATIONS
S-1	ELECTRICAL PANEL CANOPY FOUNDATION PLAN
S-2	ELECTRICAL PANEL CANOPY ROOF FRAMING PLAN
S-3	ELECTRICAL PANEL CANOPY BOLLARD DETAIL
S-4	ELECTRICAL PANEL CANOPY TYPICAL END ELEVATION
S-5	ELECTRICAL PANEL CANOPY TYPICAL SIDE ELEVATION
S-6	ELECTRICAL PANEL CANOPY SLAB SECTIONS
S-7	ELECTRICAL PANEL CANOPY COLUMN DETAIL
S-8	ELECTRICAL PANEL CANOPY NOTES, SCHEDULES & ANGLE CONNECTION DETAIL



11/12/21  
REV DATE

DETAIL No.  
PS-0

N.T.S.  
SCALE



NOTE:  
DRAWING INTENDED TO SHOW  
ReWa-PREFERRED GENERAL  
ARRANGEMENT. ACTUAL PUMP  
STATION LAYOUT TO BE DESIGNED  
BY PROJECT ENGINEER.

NOTES:

1. DIMENSIONS AND LOCATIONS OF EQUIPMENT AND STRUCTURES MAY VARY BY DEPENDING ON SPECIFIC SITE CONDITIONS AND EQUIPMENT DESIGN. HOWEVER, MINIMUM CLEARANCES AND DIMENSIONS SHALL BE MAINTAINED.
2. HORIZONTAL AND VERTICAL SEPARATION OF UNDERGROUND UTILITIES SHALL COMPLY WITH SCDHEC REQUIREMENTS.
3. PUMP STATION WET WELL SHALL HAVE A MAXIMUM OF ONE (1) INFLUENT CONNECTION.



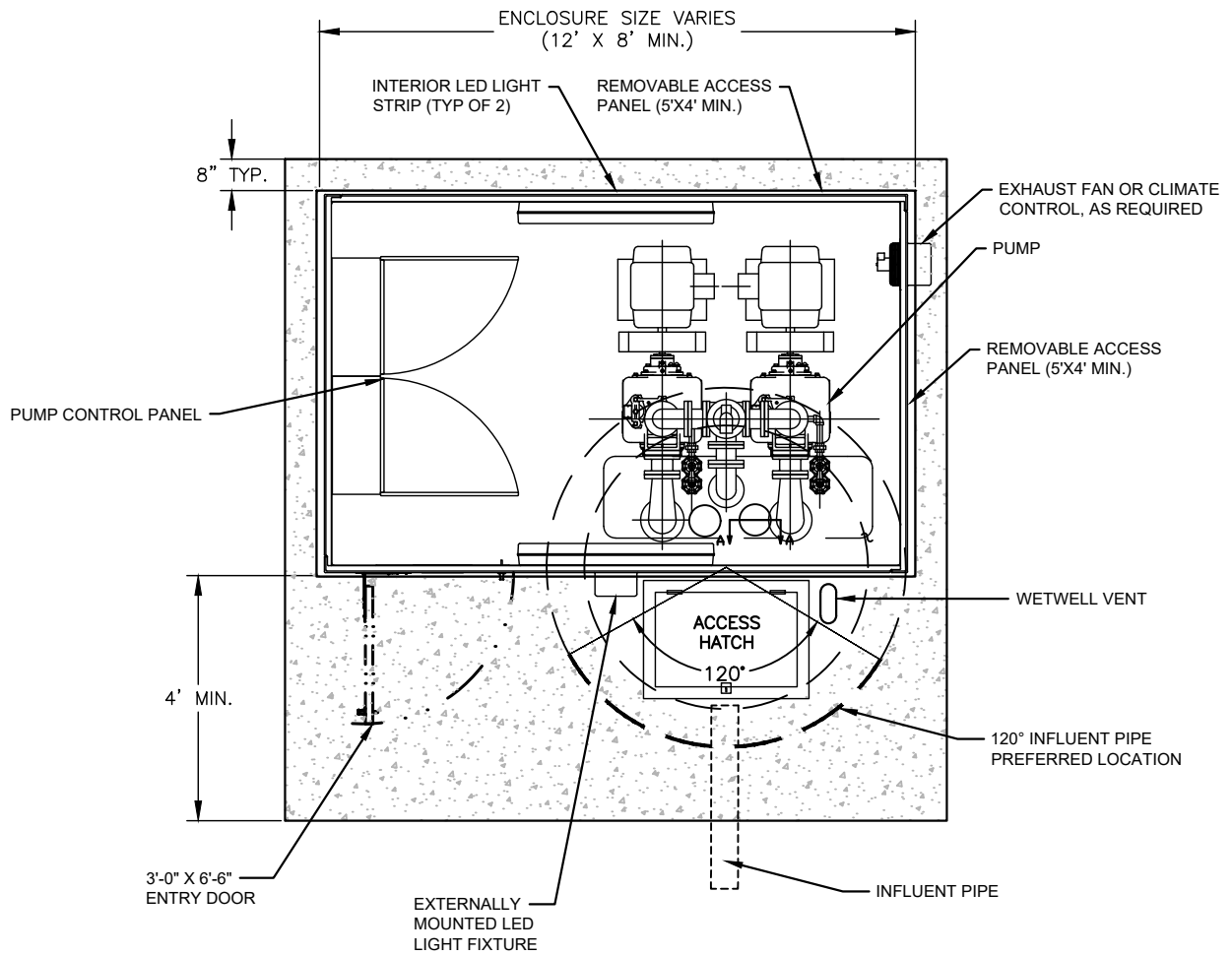
11/12/21  
REV DATE

TYPICAL SMALL ABOVE  
GROUND PUMP STATION  
SITE PLAN

DETAIL No.  
PS-1.1

N.T.S.  
SCALE

**NOTE:**  
DRAWING INTENDED TO SHOW ReWa-PREFERRED  
GENERAL ARRANGEMENT. ACTUAL PUMP STATION  
LAYOUT TO BE DESIGNED BY PROJECT ENGINEER.

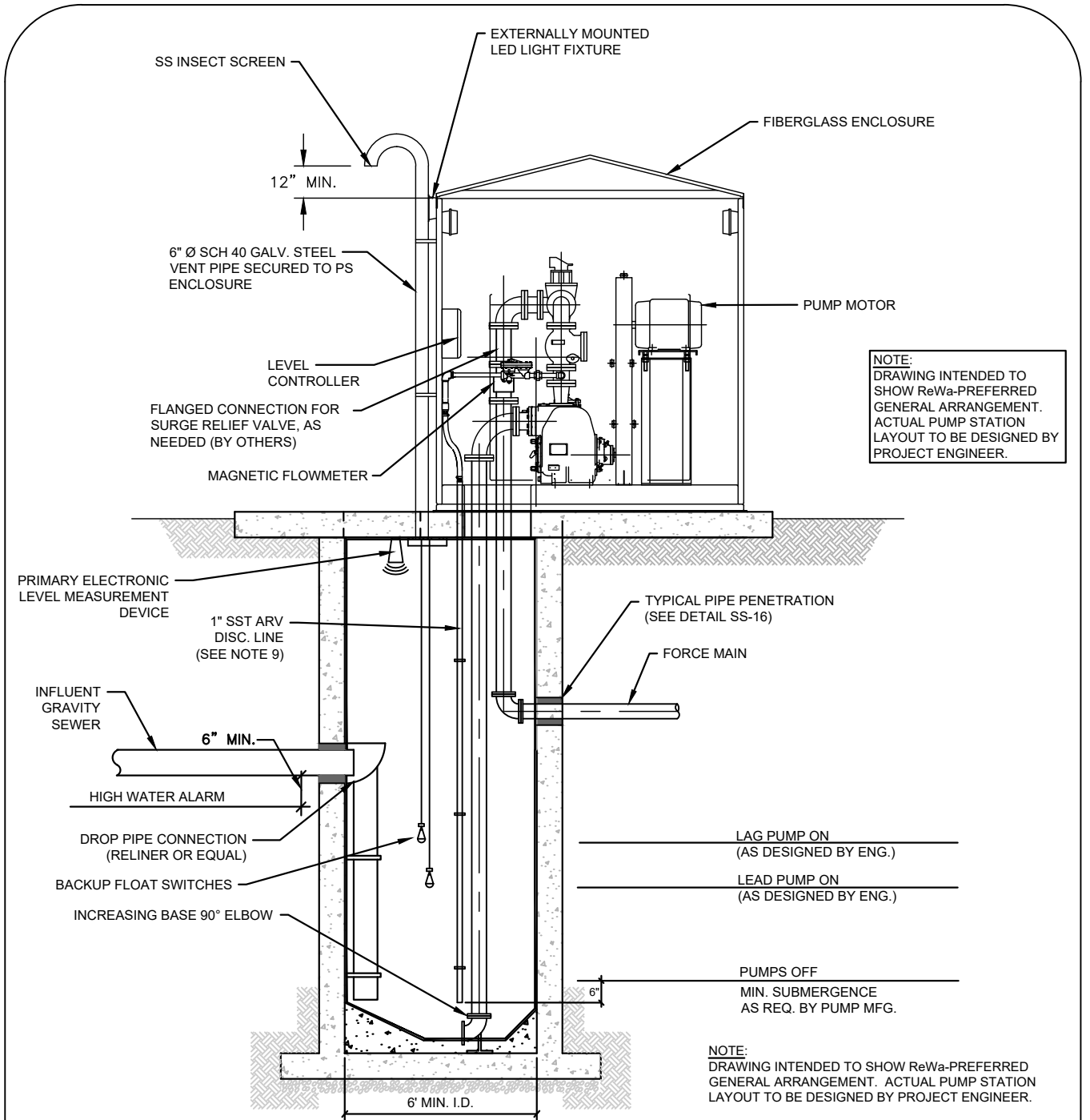


**STANDARD SMALL ABOVE  
GROUND PUMP STATION  
PLAN VIEW**

DETAIL No.  
**PS-1.2**

**11/12/21**  
REV DATE

**N.T.S.**  
SCALE



**GENERAL NOTES:**

1. ALL EXPOSED METAL (EXCEPT ALUMINUM OR SST) SHALL BE PAINTED WITH 2 COATS OF EXTERIOR ENAMEL PAINT.
2. BASE AND FIRST RISER UNIT TO BE CAST MONOLITHIC.
3. ALL LOCATIONS WHERE PIPES ENTER OR LEAVE THE WET WELL SHALL BE MADE WATERTIGHT WITH WALL SLEEVE, LINK-SEAL, OR EQUAL.
4. THERE SHALL BE NO VALVES OR ELECTRICAL JUNCTION BOXES IN THE WET WELL.
5. WET WELL ACCESS COVERS SHALL BE ALUMINUM WITH 316 SS HARDWARE AND LOCK HASP;
6. VALVES SHALL BE ORIENTED TO FACILITATE REMOVAL OF EQUIPMENT AND/OR VALVES.
7. SEE SPECIFICATIONS FOR PUMP SIZING.
8. ALL HARDWARE IN WET WELL TO BE 316 STAINLESS STEEL.
9. SUCTION LEG SHALL BE CONTINUOUS STICK OF PIPE (NO JOINTS) FROM PUMP SUCTION 90° ELBOW TO WETWELL BASE 90° ELBOW. WHEN WET WELL IS TOO DEEP FOR ONE CONTINUOUS STICK OF PIPE, JOINTS ARE ALLOWED AS LONG AS JOINTS ARE LOCATED BELOW NORMAL OPERATION LEVEL.
10. SECURE ARV DISCH. LINE TO INTERIOR OF WETWELL WITH SS HARDWARE.

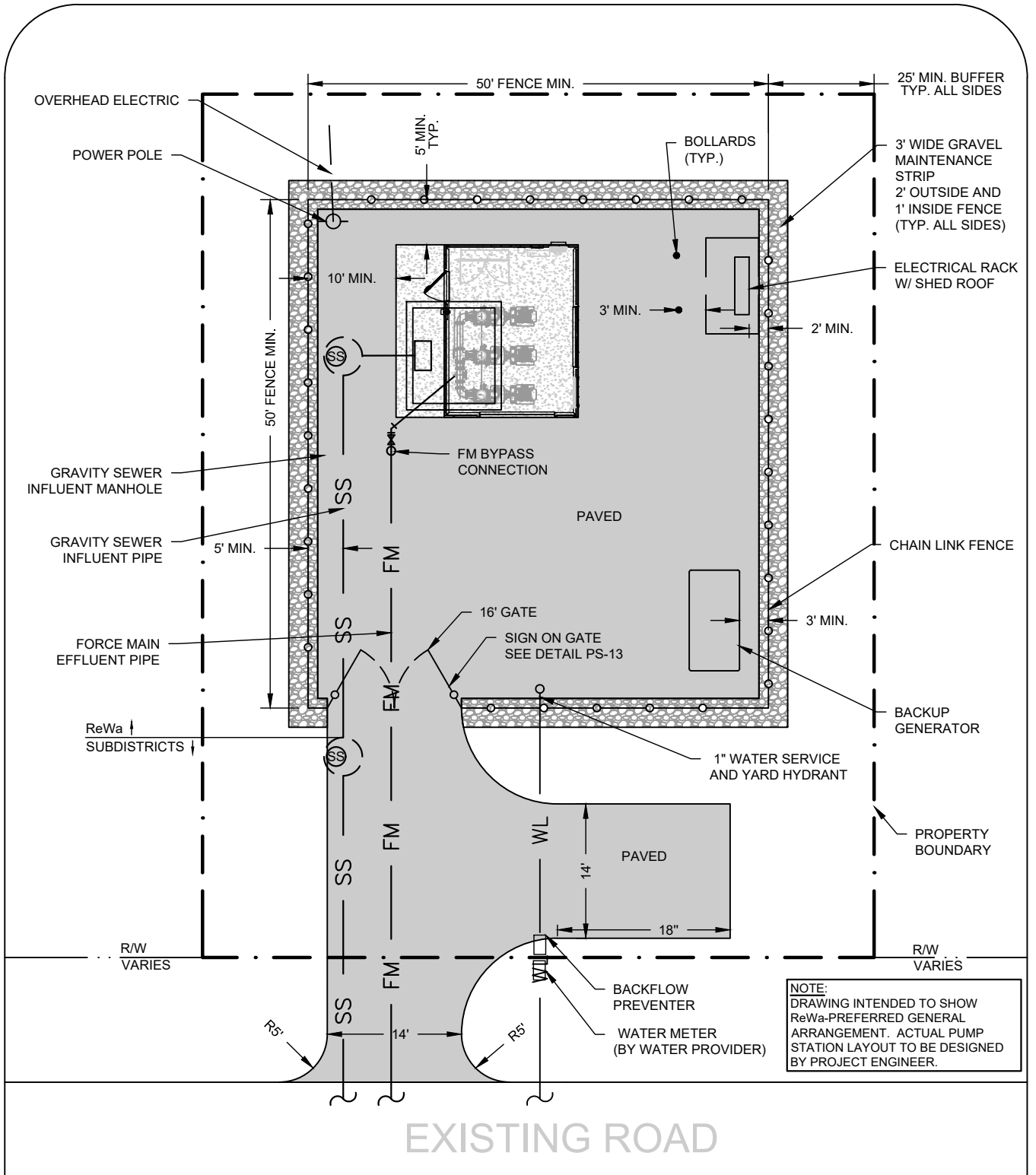


**STANDARD SMALL ABOVE  
GROUND PUMP STATION  
SECTION VIEW**

DETAIL No.  
**PS-1.3**

**11/12/21**  
REV DATE

**N.T.S.**  
SCALE



**NOTES:**

1. DIMENSIONS AND LOCATIONS OF EQUIPMENT AND STRUCTURES MAY VARY BY DEPENDING ON SPECIFIC SITE CONDITIONS AND EQUIPMENT DESIGN. HOWEVER, MINIMUM CLEARANCES AND DIMENSIONS SHALL BE MAINTAINED.
2. HORIZONTAL AND VERTICAL SEPARATION OF UNDERGROUND UTILITIES SHALL COMPLY WITH DHEC REQUIREMENTS.
3. PUMP STATION WET WELL SHALL HAVE A MAXIMUM ONE (1) INFLUENT CONNECTION.



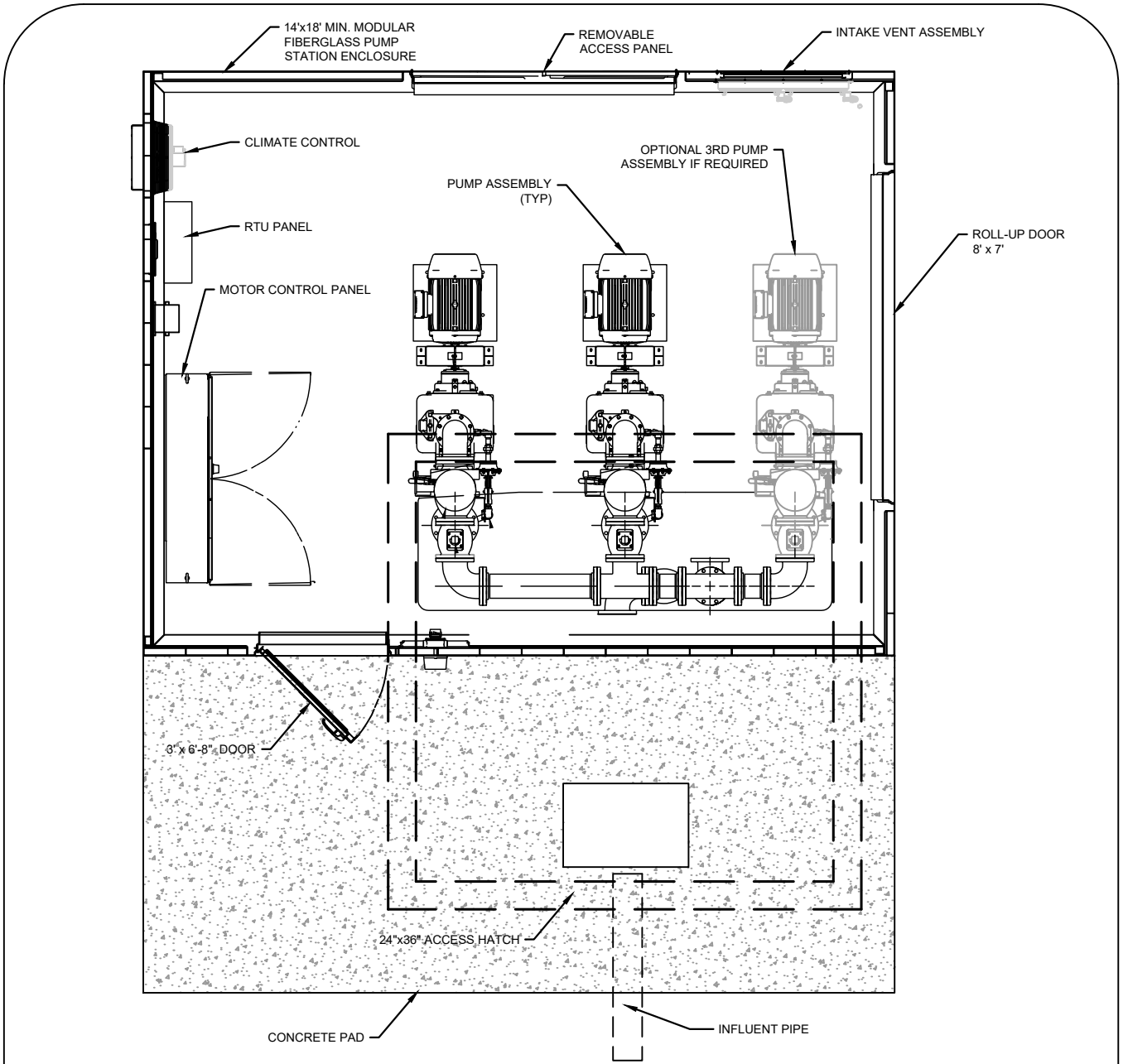
11/12/21  
REV DATE

**STANDARD LARGE ABOVE  
GROUND PUMP STATION  
SITE PLAN LAYOUT**

DETAIL No.  
**PS-2.1**

**N.T.S.**  
SCALE





**NOTE:**  
 1. DRAWING INTENDED TO SHOW ReWa-PREFERRED GENERAL ARRANGEMENT. ACTUAL PUMP STATION LAYOUT TO BE DESIGNED BY PROJECT ENGINEER.  
 2. CIRCULAR OR RECTANGULAR WETWELLS MAY BE USED.

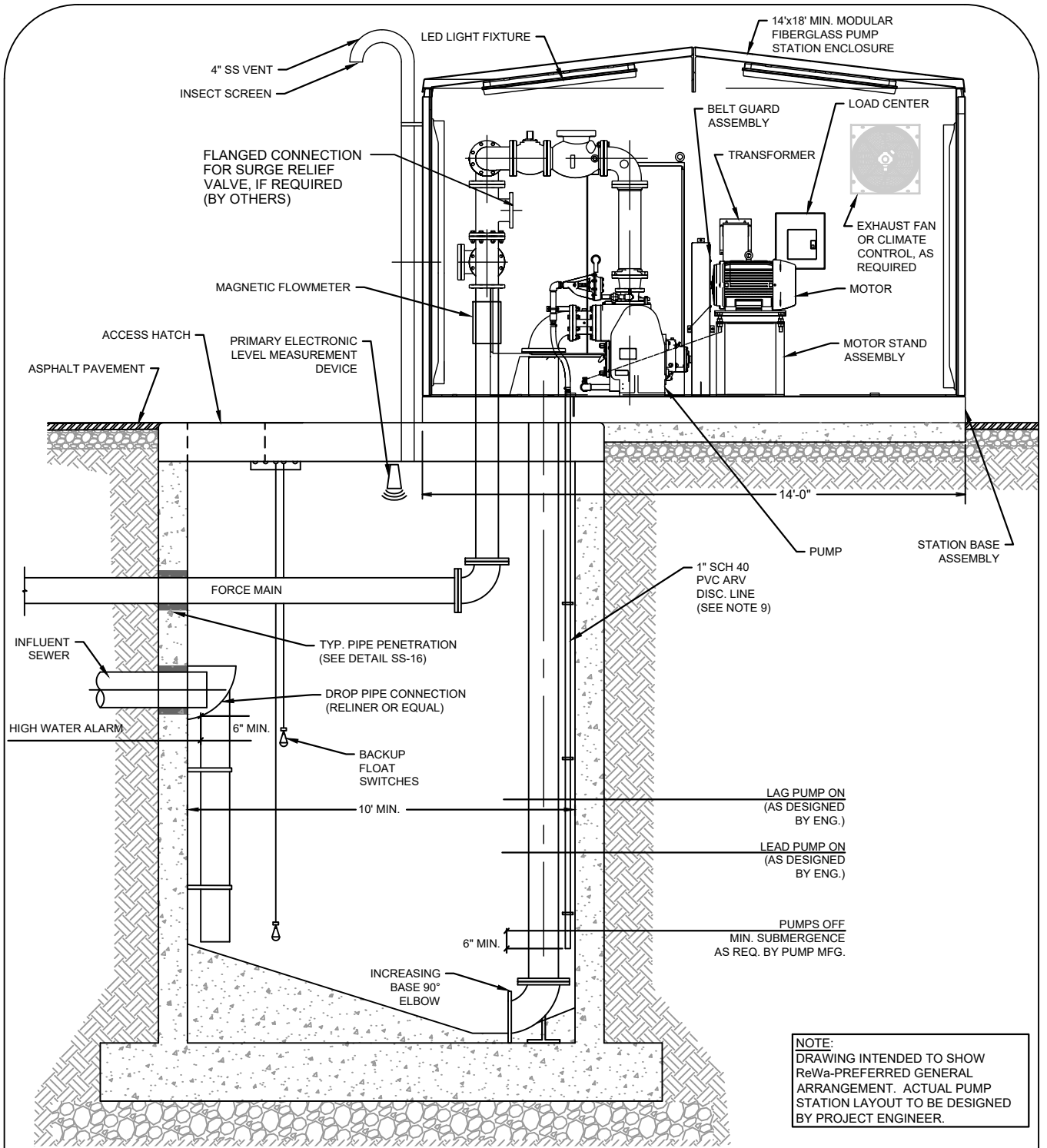


11/12/21  
REV DATE

STANDARD LARGE ABOVE  
GROUND PUMP STATION  
PLAN

DETAIL No.  
PS-2.2

N.T.S.  
SCALE



**NOTE:**  
 DRAWING INTENDED TO SHOW  
 ReWa-PREFERRED GENERAL  
 ARRANGEMENT. ACTUAL PUMP  
 STATION LAYOUT TO BE DESIGNED  
 BY PROJECT ENGINEER.

**GENERAL NOTES:**

1. ALL EXPOSED METAL (EXCEPT ALUMINUM OR SST) SHALL BE PAINTED WITH 2 COATS OF EXTERIOR ENAMEL PAINT.
2. BASE AND FIRST RISER UNIT TO BE CAST MONOLITHIC.
3. ALL LOCATIONS WHERE PIPES ENTER OR LEAVE THE WET WELL SHALL BE MADE WATERTIGHT WITH WALL SLEEVE, LINK-SEAL, OR EQUAL.
4. THERE SHALL BE NO VALVES OR ELECTRICAL JUNCTION BOXES IN THE WET WELL.
5. WET WELL ACCESS COVERS SHALL BE ALUMINUM WITH 316 SS HARDWARE AND LOCK HASP;
6. VALVES SHALL BE ORIENTED TO FACILITATE REMOVAL OF EQUIPMENT AND/OR VALVES.
7. SEE SPECIFICATIONS FOR PUMP SIZING.
8. ALL HARDWARE IN WET WELL TO BE 316 STAINLESS STEEL.
9. SUCTION LEG SHALL BE CONTINUOUS STICK OF PIPE (NO JOINTS) FROM PUMP SUCTION 90° ELBOW TO WETWELL BASE 90° ELBOW.
10. SECURE ARV DISCH. LINE TO INTERIOR OF WETWELL WITH SS HARDWARE.
11. PROVIDE INFLUENT DROP PIPE. PVC, DIP OR FRP PIPING MAY BE UTILIZED. DROP BOWL SYSTEM BY "RELINER" ALSO ACCEPTABLE. ENGINEER TO DESIGN ON A CASE BY CASE BASIS.

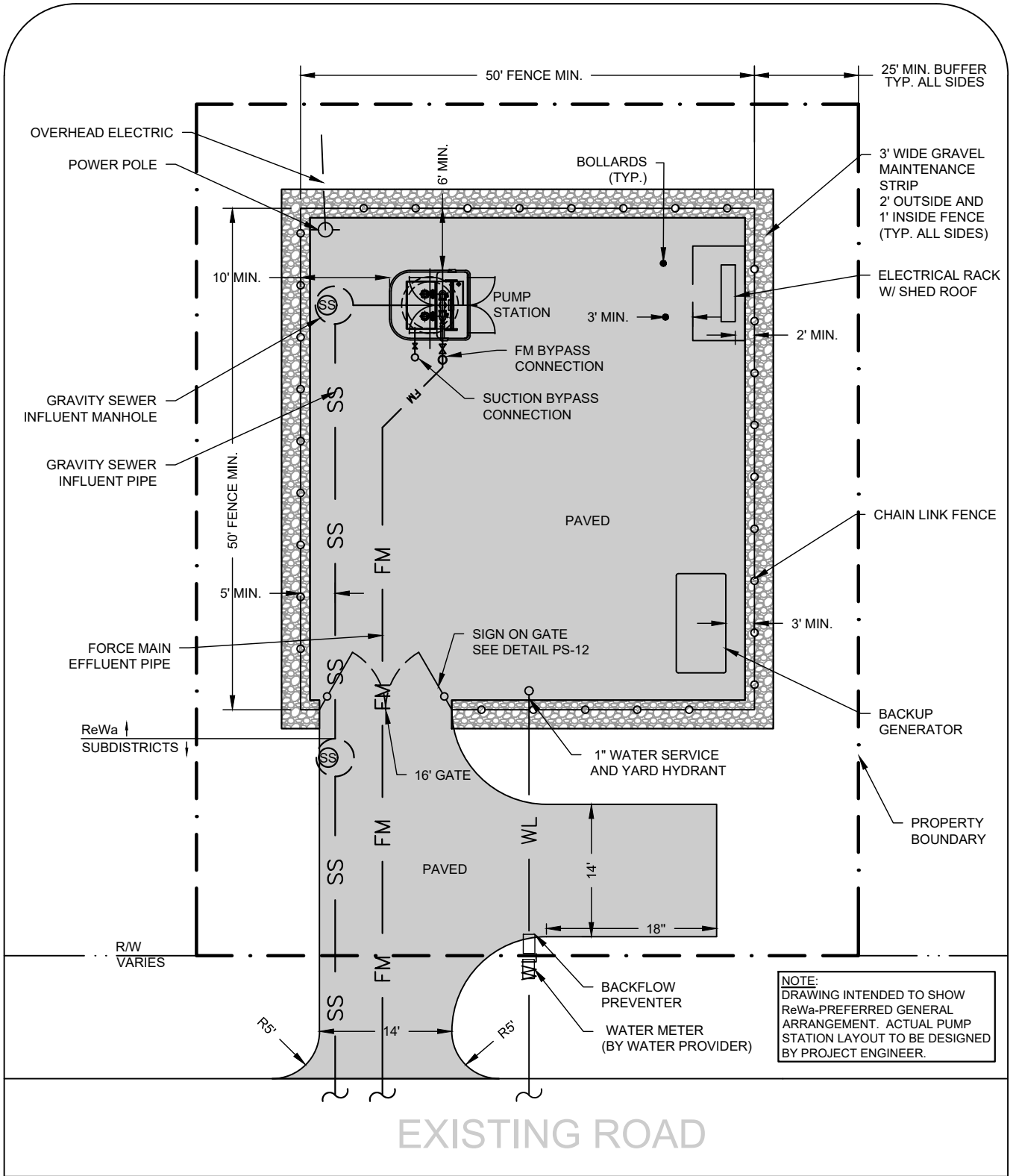


# STANDARD LARGE ABOVE GROUND PUMP STATION SECTION

DETAIL No.  
PS-2.3

11/12/21  
REV DATE

N.T.S.  
SCALE



**NOTES:**

1. DIMENSIONS AND LOCATIONS OF EQUIPMENT AND STRUCTURES MAY VARY BY DEPENDING ON SPECIFIC SITE CONDITIONS AND EQUIPMENT DESIGN. HOWEVER, MINIMUM CLEARANCES AND DIMENSIONS SHALL BE MAINTAINED.
2. HORIZONTAL AND VERTICAL SEPARATION OF UNDERGROUND UTILITIES SHALL COMPLY WITH DHEC REQUIREMENTS.
3. PUMP STATION WET WELL SHALL HAVE A MAXIMUM ONE (1) INFLUENT CONNECTION.



11/12/21  
REV DATE

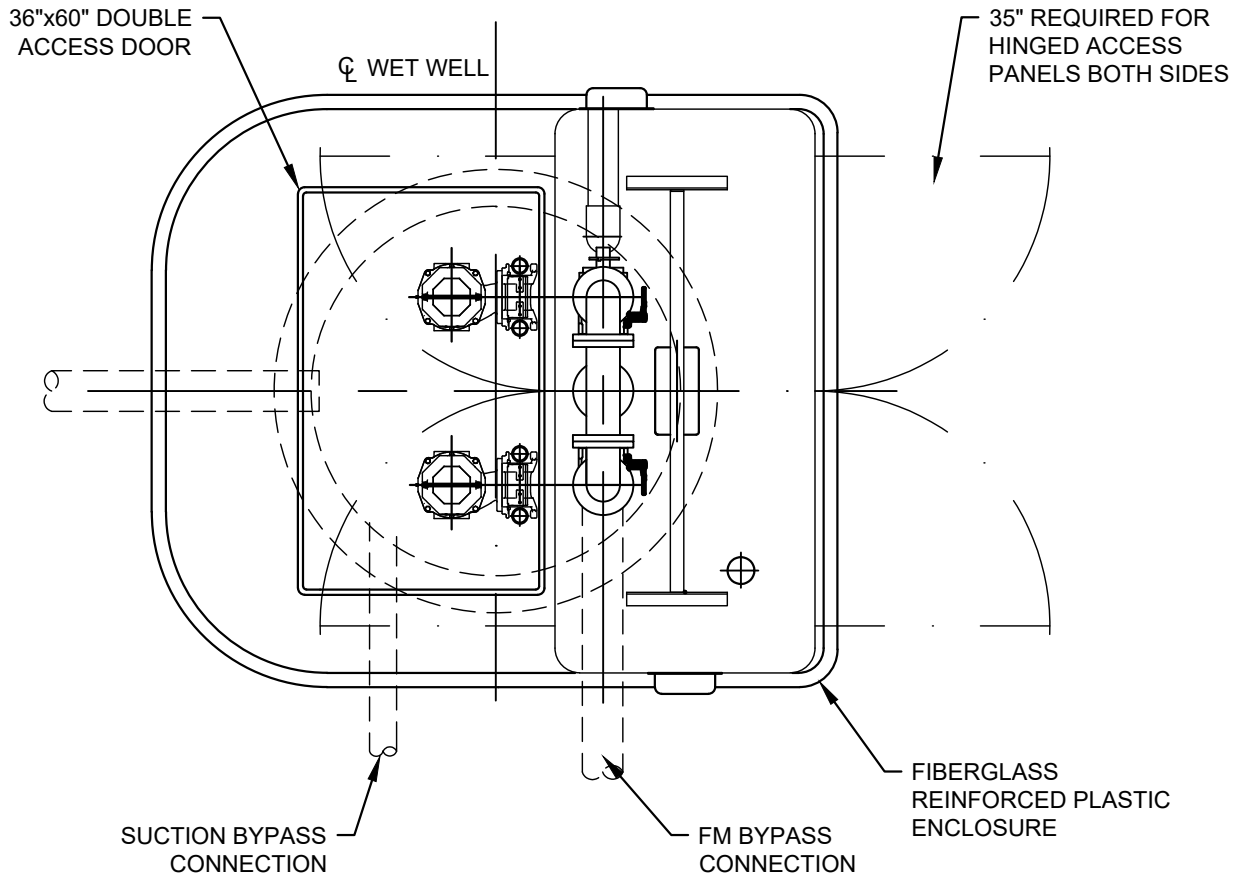
**TYPICAL DUPLEX  
SUBMERSIBLE PUMP STATION**

DETAIL No.  
**PS-3.1**

**N.T.S.**  
SCALE

**NOTE:**

1. DRAWING INTENDED TO SHOW ReWa-PREFERRED GENERAL ARRANGEMENT. ACTUAL PUMP STATION LAYOUT TO BE DESIGNED BY PROJECT ENGINEER.
2. CIRCULAR OR RECTANGULAR WETWELLS MAY BE USED.

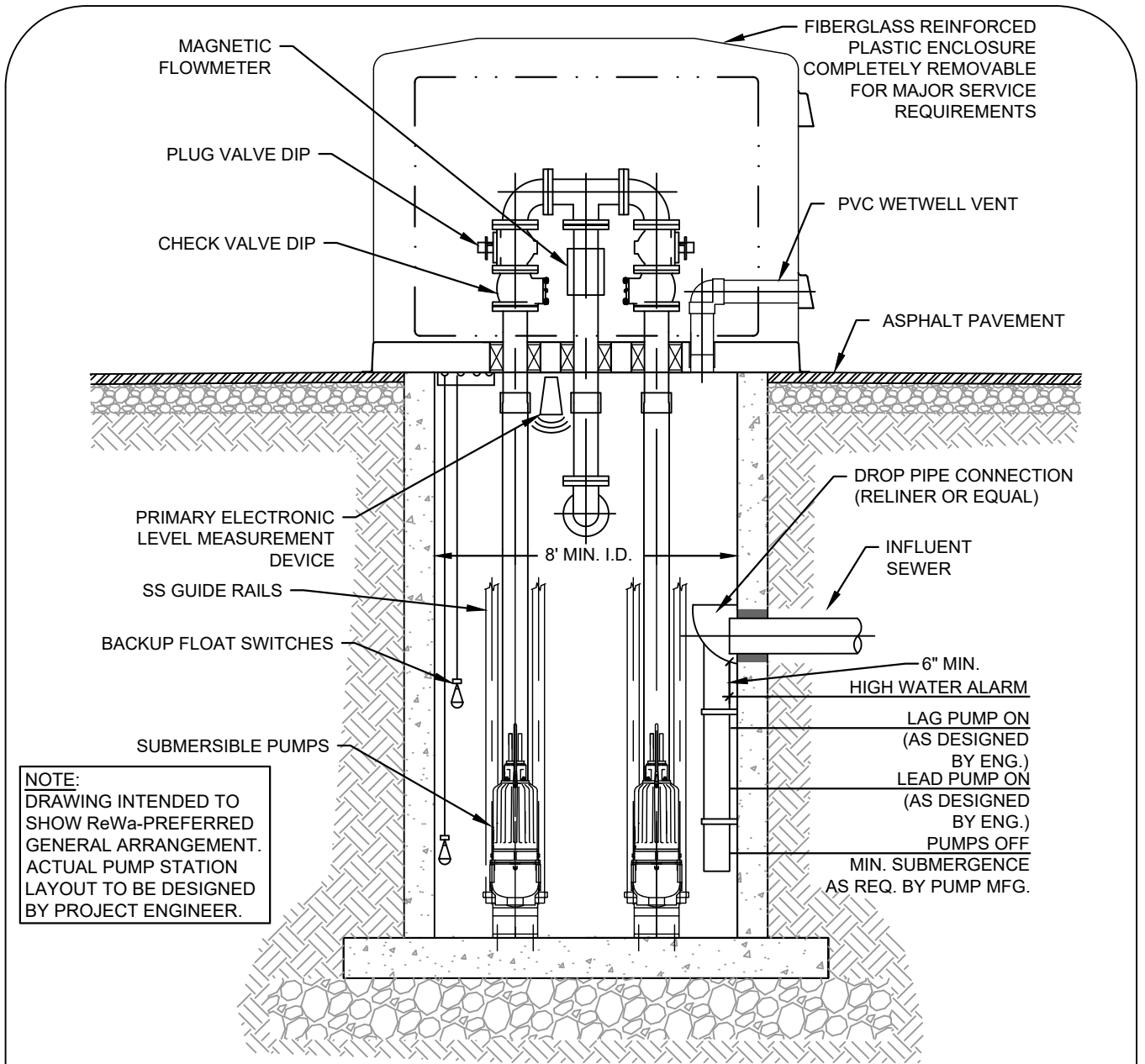


11/12/21  
REV DATE

**TYPICAL DUPLEX  
SUBMERSIBLE PUMP STATION  
PLAN VIEW**

DETAIL No.  
**PS-3.2**

**N.T.S.**  
SCALE




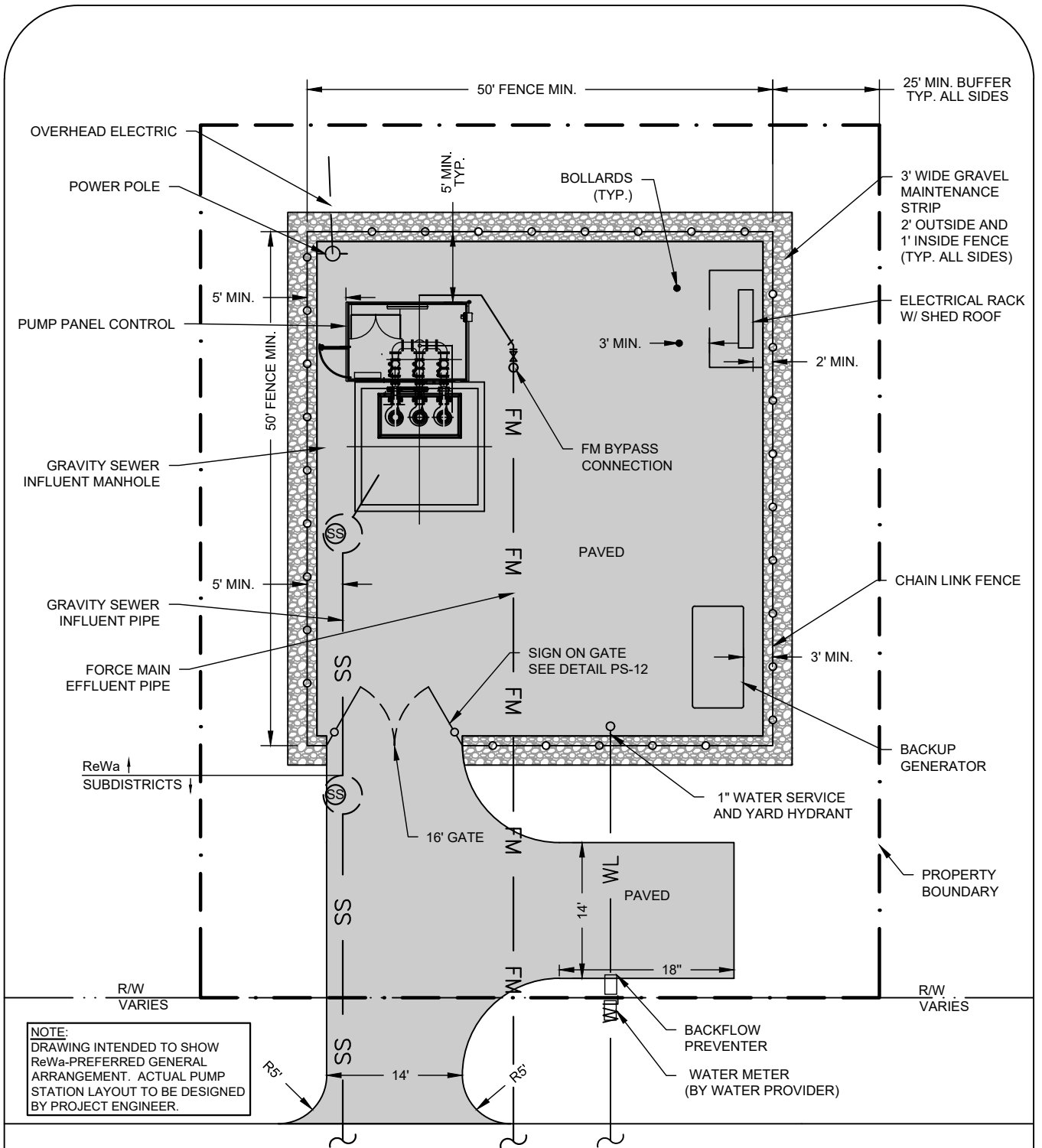
**NOTE:**  
DRAWING INTENDED TO SHOW ReWa-PREFERRED GENERAL ARRANGEMENT. ACTUAL PUMP STATION LAYOUT TO BE DESIGNED BY PROJECT ENGINEER.

HIGH WATER ALARM  
LAG PUMP ON  
(AS DESIGNED BY ENG.)  
LEAD PUMP ON  
(AS DESIGNED BY ENG.)  
PUMPS OFF  
MIN. SUBMERGENCE  
AS REQ. BY PUMP MFG.

**GENERAL NOTES:**

1. ALL EXPOSED METAL (EXCEPT ALUMINUM OR SST) SHALL BE PAINTED WITH 2 COATS OF EXTERIOR ENAMEL PAINT.
2. BASE AND FIRST RISER UNIT TO BE CAST MONOLITHIC.
3. ALL LOCATIONS WHERE PIPES ENTER OR LEAVE THE WET WELL SHALL BE MADE WATERTIGHT WITH WALL SLEEVE, LINK-SEAL, OR EQUAL.
4. THERE SHALL BE NO VALVES OR ELECTRICAL JUNCTION BOXES IN THE WET WELL.
5. WET WELL ACCESS COVERS SHALL BE ALUMINUM WITH 316 SS HARDWARE AND LOCK HASP; VALVES SHALL BE ORIENTED TO FACILITATE REMOVAL OF EQUIPMENT AND/OR VALVES.
6. SEE SPECIFICATIONS FOR PUMP SIZING.
7. ALL HARDWARE IN WET WELL TO BE 316 STAINLESS STEEL.

	<p><b>TYPICAL DUPLEX SUBMERSIBLE PUMP STATION SECTION VIEW</b></p>	<p><b>DETAIL No. PS-3.3</b></p>
<p><b>11/12/21 REV DATE</b></p>		<p><b>N.T.S. SCALE</b></p>



NOTE:  
DRAWING INTENDED TO SHOW  
ReWa-PREFERRED GENERAL  
ARRANGEMENT. ACTUAL PUMP  
STATION LAYOUT TO BE DESIGNED  
BY PROJECT ENGINEER.

EXISTING ROAD

NOTES:

1. DIMENSIONS AND LOCATIONS OF EQUIPMENT AND STRUCTURES MAY VARY BY DEPENDING ON SPECIFIC SITE CONDITIONS AND EQUIPMENT DESIGN. HOWEVER, MINIMUM CLEARANCES AND DIMENSIONS SHALL BE MAINTAINED.
2. HORIZONTAL AND VERTICAL SEPARATION OF UNDERGROUND UTILITIES SHALL COMPLY WITH DHEC REQUIREMENTS.
3. PUMP STATION WET WELL SHALL HAVE A MAXIMUM ONE (1) INFLUENT CONNECTION.



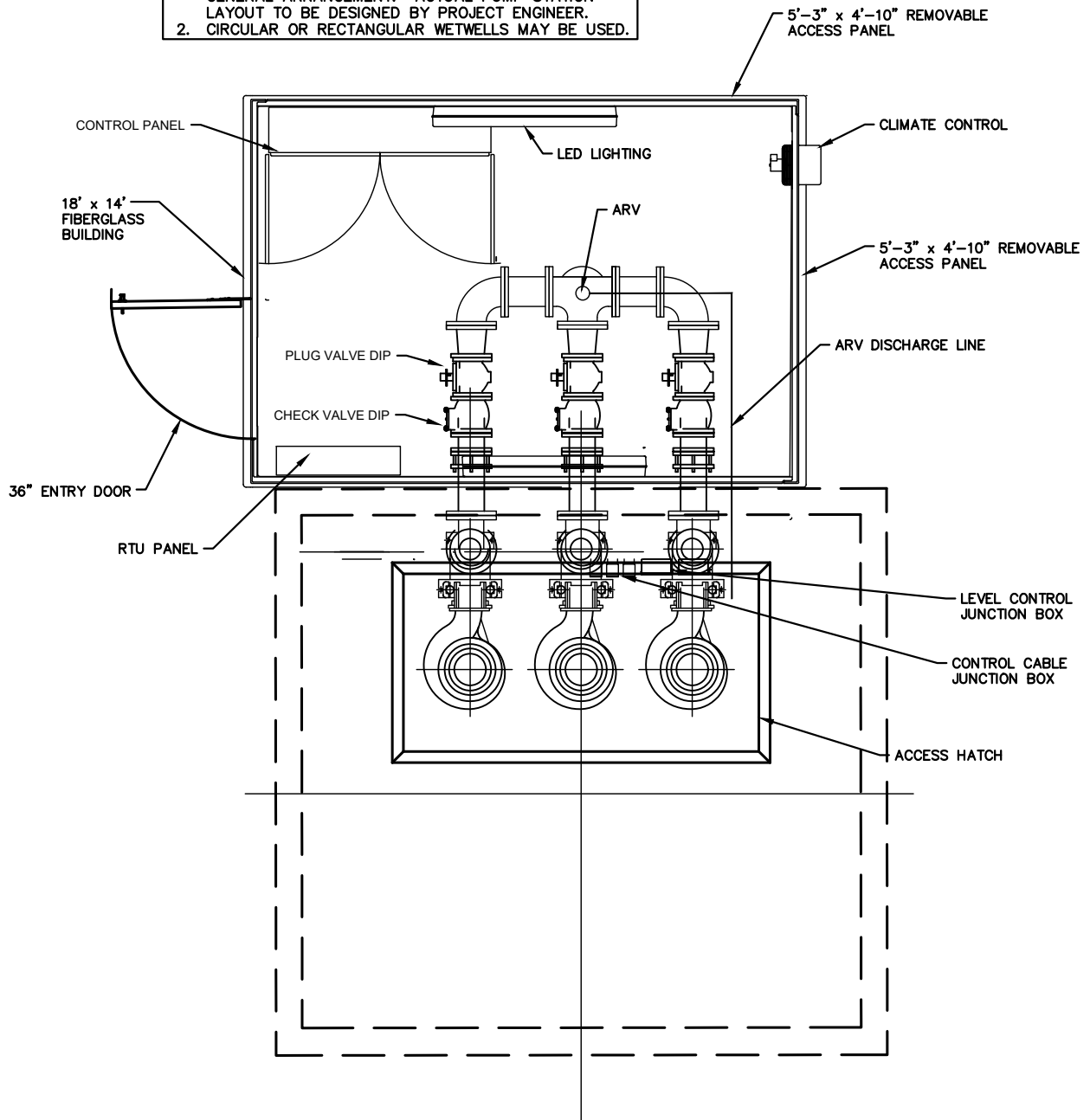
11/12/21  
REV DATE

TYPICAL TRIPLEX  
SUBMERSIBLE PUMP STATION

DETAIL No.  
PS-4.1

N.T.S.  
SCALE

**NOTE:**  
 1. DRAWING INTENDED TO SHOW ReWa-PREFERRED GENERAL ARRANGEMENT. ACTUAL PUMP STATION LAYOUT TO BE DESIGNED BY PROJECT ENGINEER.  
 2. CIRCULAR OR RECTANGULAR WETWELLS MAY BE USED.



**ReWa**  
 renewable water resources

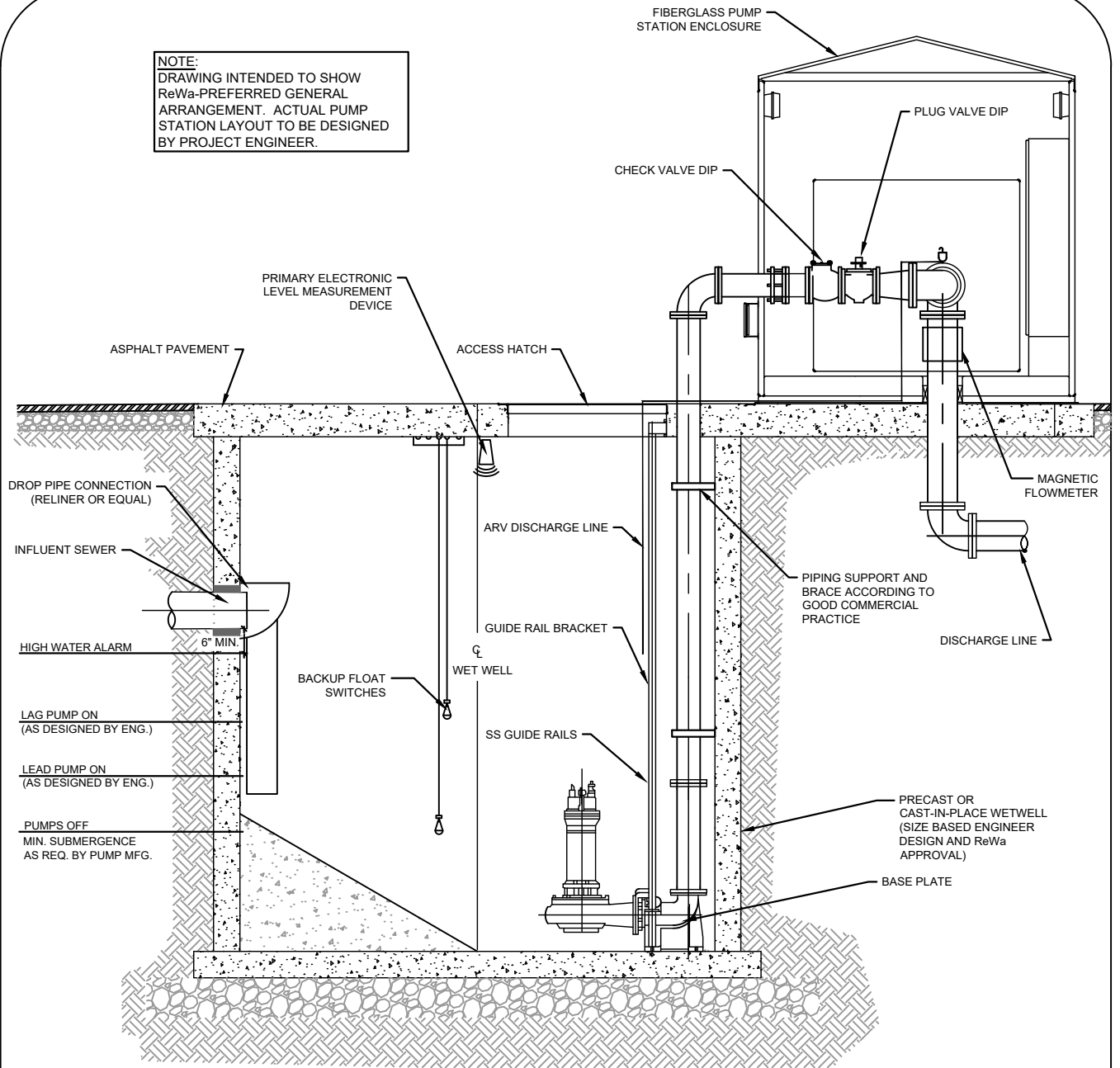
11/12/21  
 REV DATE

**TYPICAL TRIPLEX  
 SUBMERSIBLE PUMP STATION  
 PLAN VIEW**

DETAIL No.  
**PS-4.2**

**N.T.S.**  
 SCALE

NOTE:  
DRAWING INTENDED TO SHOW  
ReWa-PREFERRED GENERAL  
ARRANGEMENT. ACTUAL PUMP  
STATION LAYOUT TO BE DESIGNED  
BY PROJECT ENGINEER.



**GENERAL NOTES:**

1. ALL EXPOSED METAL (EXCEPT ALUMINUM OR SST) SHALL BE PAINTED WITH 2 COATS OF EXTERIOR ENAMEL PAINT.
2. BASE AND FIRST RISER UNIT TO BE CAST MONOLITHIC.
3. ALL LOCATIONS WHERE PIPES ENTER OR LEAVE THE WET WELL SHALL BE MADE WATERTIGHT WITH WALL SLEEVE, LINK-SEAL, OR EQUAL.
4. THERE SHALL BE NO VALVES OR ELECTRICAL JUNCTION BOXES IN THE WET WELL.
5. WET WELL ACCESS COVERS SHALL BE ALUMINUM WITH 316 SS HARDWARE AND LOCK HASP; VALVES SHALL BE ORIENTED TO FACILITATE REMOVAL OF EQUIPMENT AND/OR VALVES.
6. SEE SPECIFICATIONS FOR PUMP SIZING.
7. ALL HARDWARE IN WET WELL TO BE 316 STAINLESS STEEL.
8. RADAR LEVEL SENSORS SHALL BE MOUNTED IN LOCATION WHERE BEAM IS NOT OBSTRUCTED BY PUMPS, GROUT, INFLUENT FLOW OR OTHER OBSTRUCTIONS.
9. PROVIDE INFLUENT DROP PIPE. PVC, DIP OR FRP PIPING MAY BE UTILIZED. DROP BOWL SYSTEM TO "RELINER" ALSO ACCEPTABLE. ENGINEER TO DESIGN ON A CASE BY CASE BASIS.



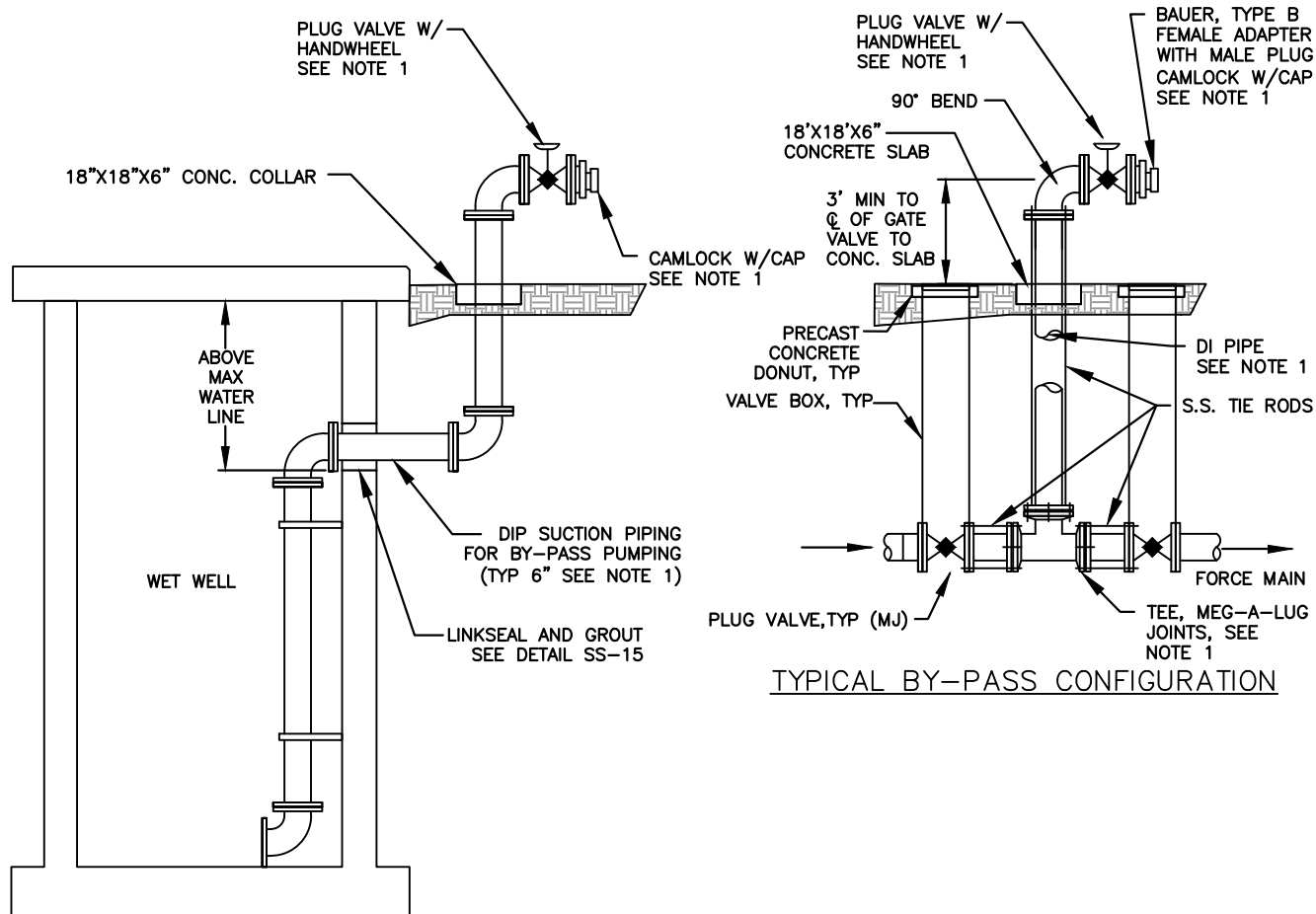
11/12/21  
REV DATE

**TYPICAL TRIPLEX  
SUBMERSIBLE PUMP STATION  
SECTION VIEW**

DETAIL No.  
**PS-4.3**

**N.T.S.**  
SCALE





TYPICAL SUCTION BY-PASS CONFIGURATION

**NOTES:**

1. THIS DETAIL DEPICTS A TYPICAL CONFIGURATION FOR BY-PASS PUMPING.. ReWa SHALL APPROVE ALL FINAL CONFIGURATIONS, PIPE DIAMETERS, PIPE MATERIALS, AND CAMLOCK CONNECTIONS.

ALL PUMP STATIONS SHALL BE PROVIDED WITH BY-PASS PUMPING. REFER TO THIS DETAIL FOR ALL PUMP STATIONS EXCEPT SUBMERSIBLE STATIONS. FOR SUBMERSIBLE STATIONS, ReWa WILL LOWER FLEXIBLE SUCTION PIPING DIRECTLY INTO THE WET WELL AND THE BY-PASS DISCHARGE PIPING WILL BE CONNECTED TO THE BY-PASS FORCE MAIN CONNECTION.

SUCTION PIPING IS TYPICALLY 6 INCH DIP. DISCHARGE PIPING SHALL BE AT LEAST EQUAL TO THE FORCE MAIN DIAMETER UP TO 6 INCHES. ReWa WILL DETERMINE DISCHARGE PIPE DIAMETER FOR FORCE MAINS LARGER THAN 6 INCHES IN DIAMETER. CONTRACTOR TO PROVIDE A REDUCING TEE AS NECESSARY TO TRANSITION FROM FORCE MAIN PIPING TO THE BY-PASS PUMP DISCHARGE PIPING.

2. CAST IRON VALVE BOX TO BE PROVIDED FOR OPERATING EACH BURIED PLUG VALVE. VALVE BOX TO BE RATED FOR TRAFFIC LOADING. COVER TO READ "SEWER".



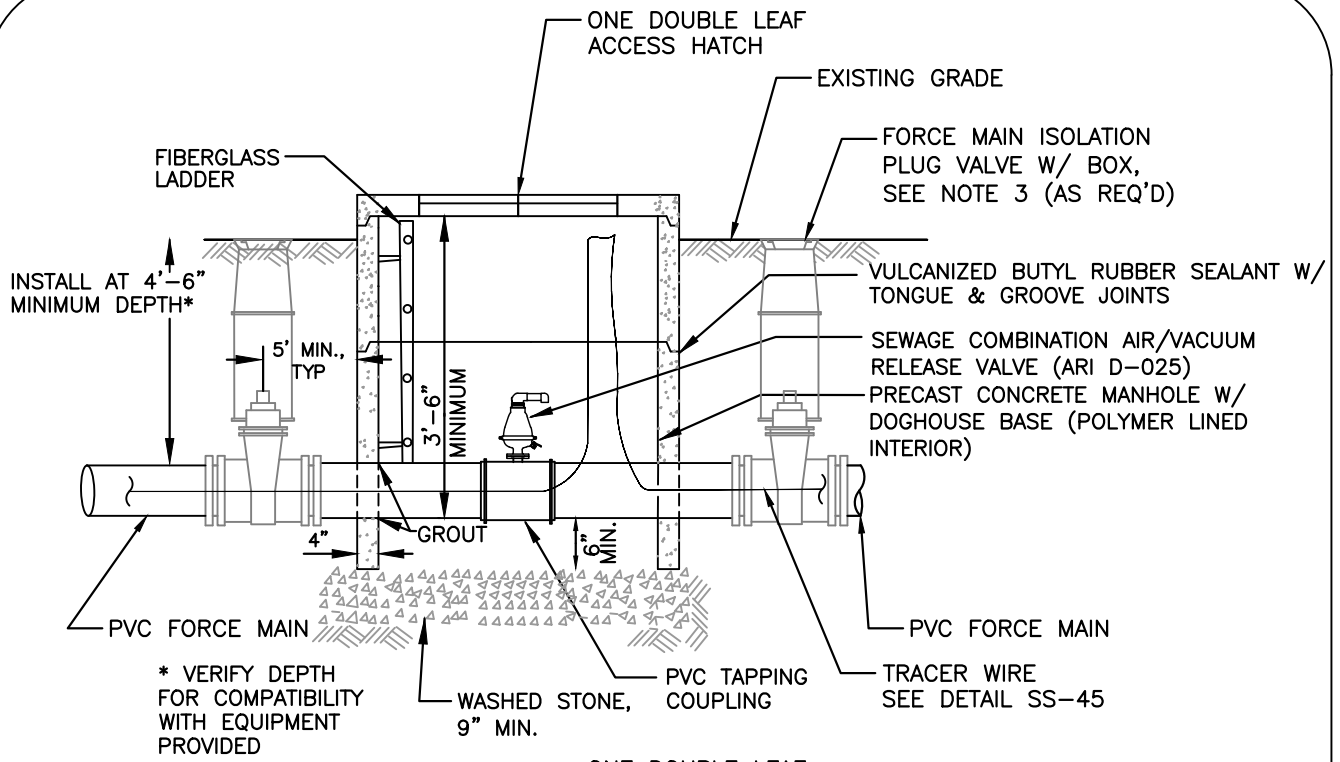
11/12/21  
REV DATE

TYPICAL BY-PASS PUMPING  
PIPING CONFIGURATION

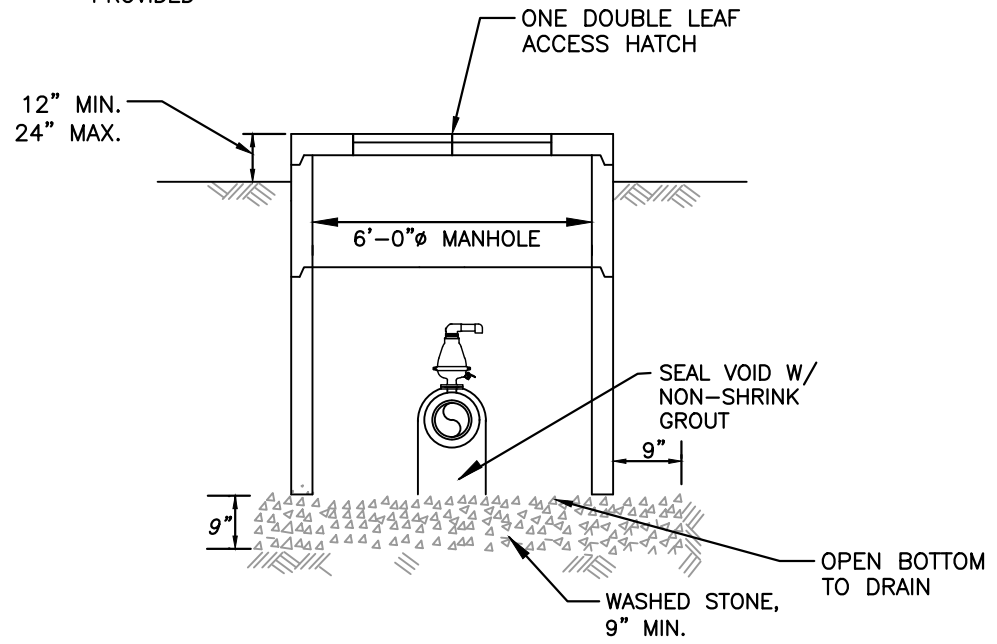
DETAIL No.  
PS-5

N.T.S.  
SCALE





\* VERIFY DEPTH FOR COMPATIBILITY WITH EQUIPMENT PROVIDED



**SEWER AIR RELEASE VALVE MANHOLE**

**NOTES:**

1. AIR RELEASE VALVE TO BE PLACED AT HIGH POINT OF FORCE MAIN.
2. FORCE MAIN SHALL BE C900 PVC WITHIN 2' OF VERTICAL ELEVATION ON EITHER SIDE OF THE HIGH POINT.
3. FORCE MAIN ISOLATION PLUG VALVES TO BE PROVIDED WHERE FORCE MAIN RISES VERTICALLY ON OF EITHER SIDE OF THE AIR RELEASE MANHOLE.



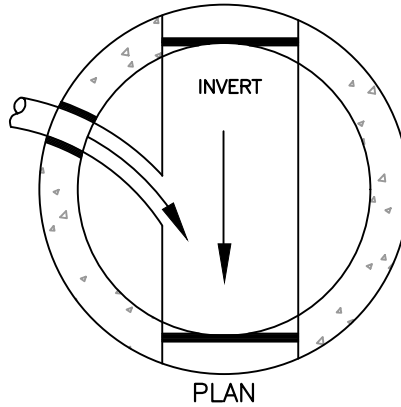
11/12/21  
REV DATE

**TYPICAL AIR/VACUUM  
RELEASE VALVE IN  
UNPAVED AREAS**

DETAIL No.  
**PS-6.2**

**N.T.S.**  
SCALE

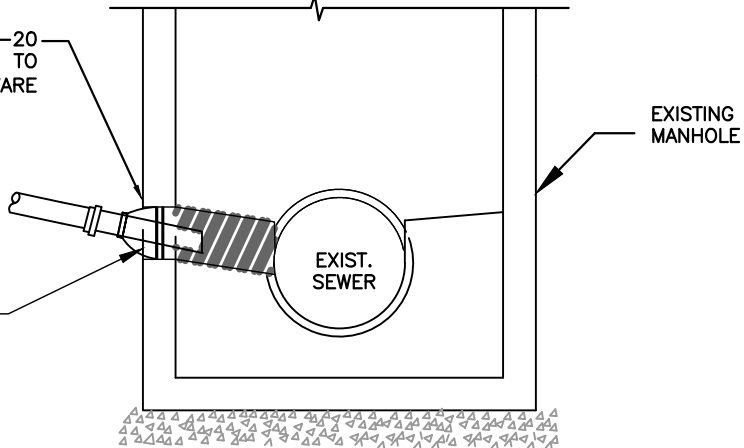
NOTE: FORCE MAIN  
MUST ENTER MANHOLE  
AT ANGLE NO GREATER  
THAN 90° DIRECTION OF  
FLOW.



PLAN

RUBBER BOOT SEE DETAIL NO. SS-20  
\*BOOT CONNECTOR TO CONFORM TO  
ASTM C923 W/ 304 SST HARDWARE

CORE-DRILL HOLE  
IN MANHOLE WALL  
THRU BENCH, SEE  
NOTE 2



SECTION

FORCE MAIN DISCHARGE DETAIL

CORROSION CONTROL NOTES:

1. EXISTING MANHOLES SHALL BE REHABILITATED AND COATED WITH A CORROSION RESISTANT PROTECTIVE COATING. SEE STANDARD SPECIFICATIONS FOR DETAILS.
2. CORE DRILL HOLE THROUGH WALL OF MANHOLE AND EXISTING BENCH AS DEPICTED IN THE DETAIL. PROVIDE A WATERTIGHT SEAL AT THE PIPE CONNECTION USING A FLEXIBLE RUBBER BOOT PER DETAIL NO. SS-20.

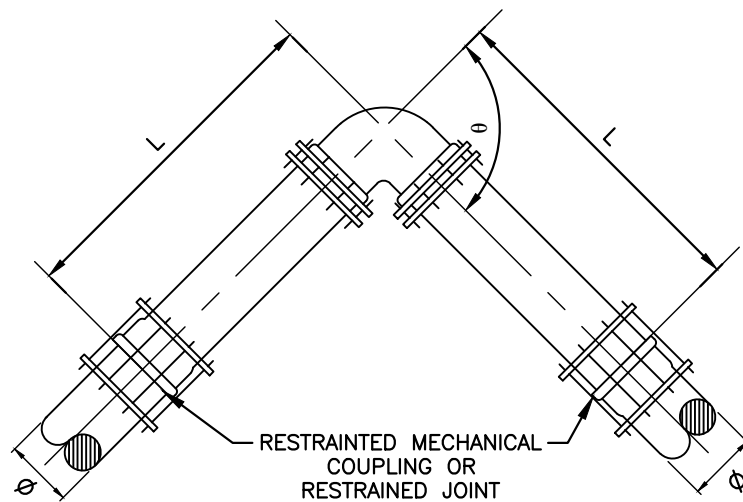


11/18/19  
REV DATE

TYPICAL FORCE MAIN  
DISCHARGE TO EXISTING  
RECEIVING MANHOLE

DETAIL No.  
PS-7

N.T.S.  
SCALE



$\theta$  = DEFLECTION ANGLE  
 $\phi$  = PIPE DIAMETER  
 L = RESTRAINED JOINT LENGTH

**NOTES:**

1. THIS DETAIL DEPICTS A GENERAL CONFIGURATION FOR MECHANICALLY RESTRAINED JOINTS.
2. JOINT RESTRAINT SHALL BE PROVIDED FOR DEFLECTION ANGLES GREATER THAN OR EQUAL TO 22 1/2 DEGREES IN EITHER HORIZONTAL OR VERTICAL ORIENTATION. RESTRAINT SHALL ALSO BE PROVIDED AT PIPE END FITTINGS (CAPS OR PLUGS) AND VALVES, WHICH SHALL BE TREATED AS ENDS ON BOTH SIDES OF THE VALVE.
3. DESIGN ENGINEER SHALL PROVIDE RESTRAINED JOINT CALCULATIONS BASED ON DIPRA "THRUST RESTRAINT DESIGN FOR DUCTILE IRON PIPE", LATEST EDITION OR EBAA IRON RESTRAINT LENGTH CALCULATOR.
4. IF RESTRAINED LENGTHS FALL BETWEEN PIPE JOINTS, RESTRAINT SHALL BE EXTENDED TO THE NEXT PIPE JOINT FURTHEST FROM THE FITTING.
5. SEE STANDARD SPECIFICATIONS FOR MECHANICAL RESTRAINT DETAILS.

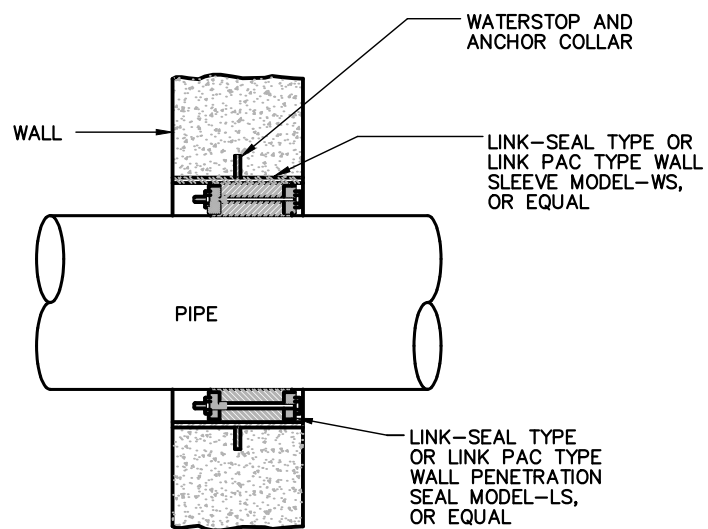


11/18/19  
 REV DATE

**TYPICAL MECHANICAL JOINT  
 RESTRAINT FOR HORIZONTAL  
 AND VERTICAL BENDS**

DETAIL No.  
**PS-8**

**N.T.S.**  
 SCALE



**NOTES:**

1. THIS DETAIL APPLIES TO PIPE PENETRATIONS THROUGH A CONCRETE STRUCTURE (WETWELL, MANHOLE, ETC.) WHERE A BOOT CONNECTION IS NOT REQUIRED.

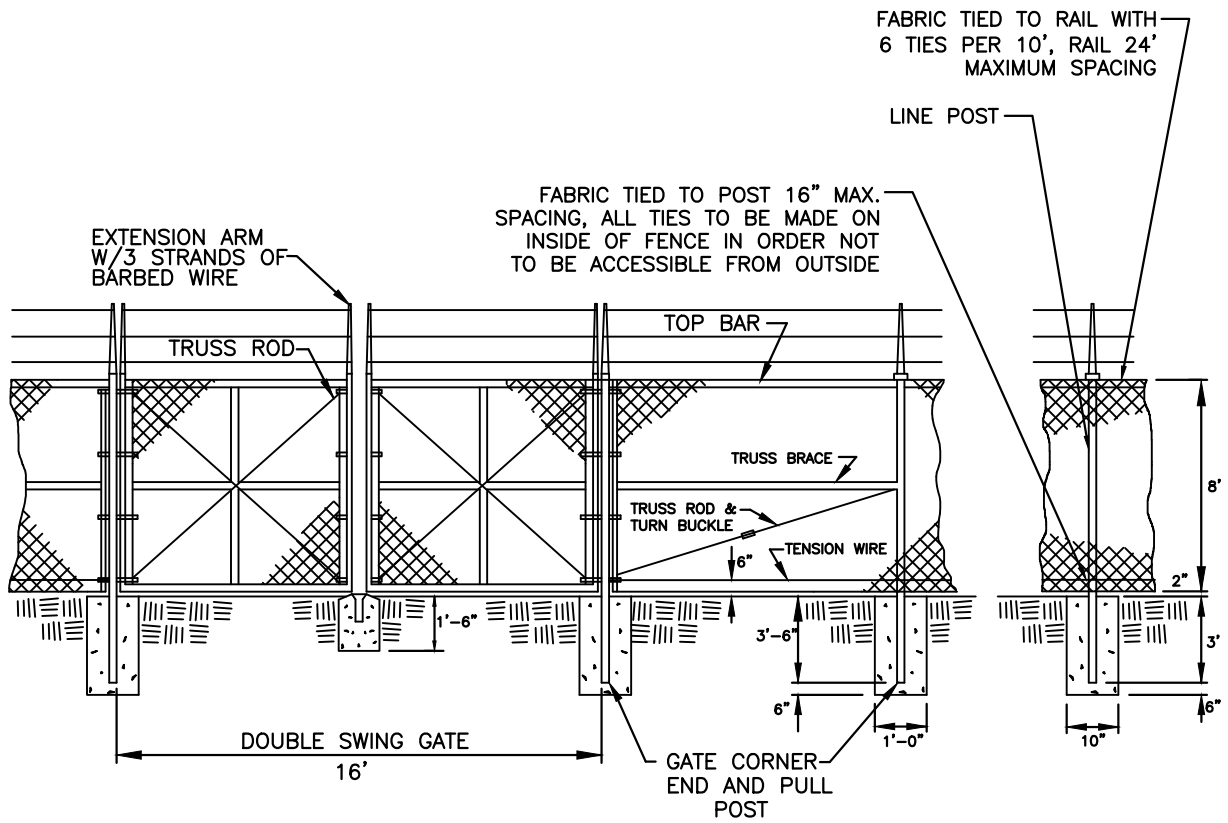


11/18/19  
REV DATE

TYPICAL PIPE  
PENETRATION SEAL

DETAIL No.  
PS-9

N.T.S.  
SCALE



**NOTES:**

1. SEE STANDARD SPECIFICATIONS FOR SIZING, FINISHES, AND OTHER REQUIREMENTS FOR POST, FENCE FABRIC, BARBED WIRE AND ACCESSORIES.



11/18/19  
REV DATE

**TYPICAL CHAIN LINK FENCE  
WITH DOUBLE SWING GATE**

DETAIL No.  
**PS-10**

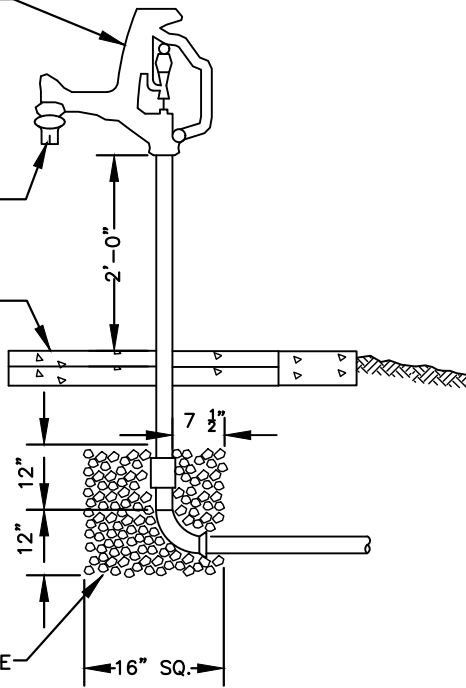
**N.T.S.**  
SCALE

SEE SPECIFICATIONS  
FOR FREEZE-PROOF  
HYDRANT DETAILS

3/4" OUTLET  
W/VAC. BREAKER

18"x18" MIN. x6" THICK  
CONCRETE SLAB SEE PLAN  
(IF APPLICABLE)

#57 WASHED STONE



YARD HYDRANT DETAIL



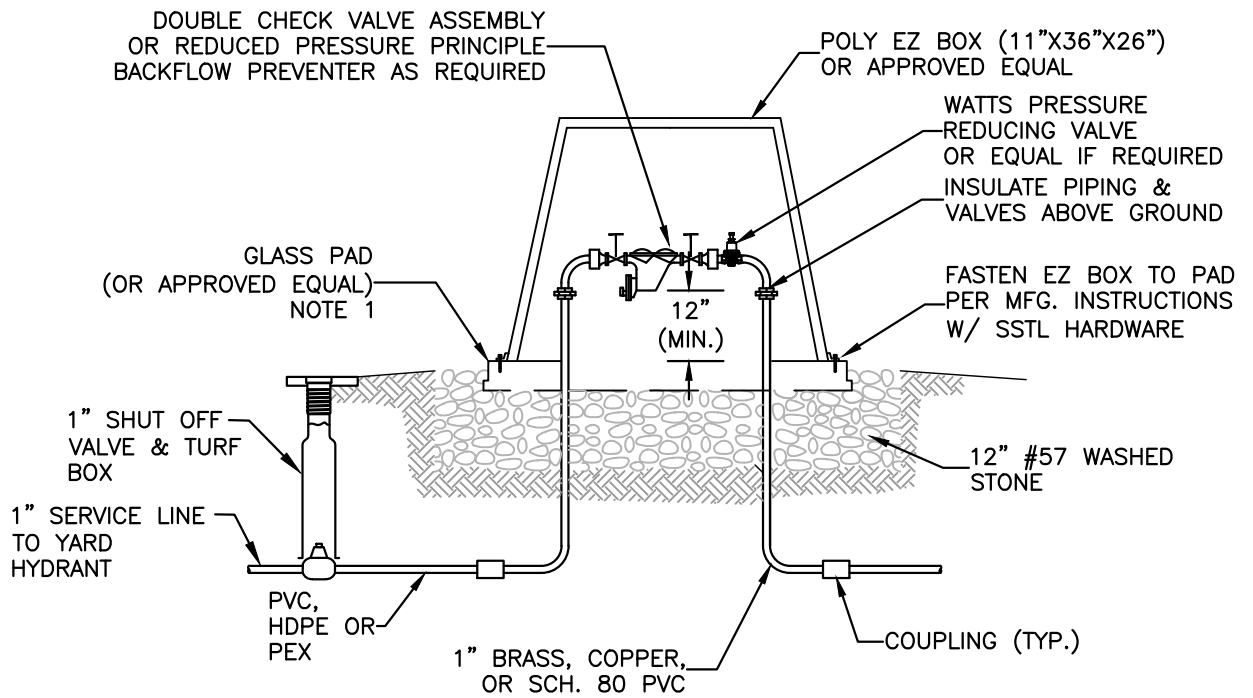
11/18/19  
REV DATE

TYPICAL  
YARD HYDRANT  
DETAIL

DETAIL No.  
PS-11

N.T.S.  
SCALE



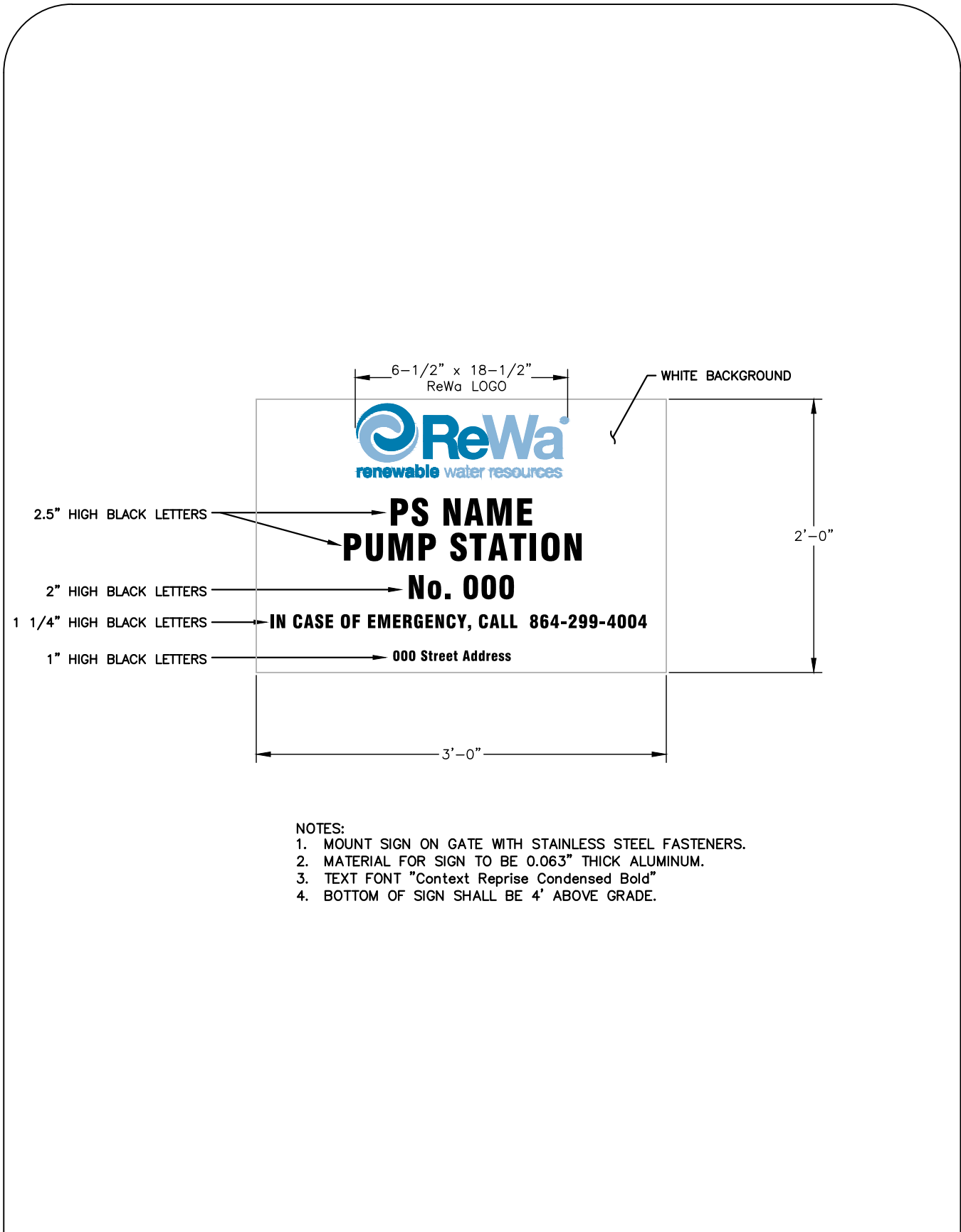


TYPICAL BACKFLOW  
PREVENTER FOR WATER  
SERVICE

DETAIL No.  
PS-12

11/12/21  
REV DATE

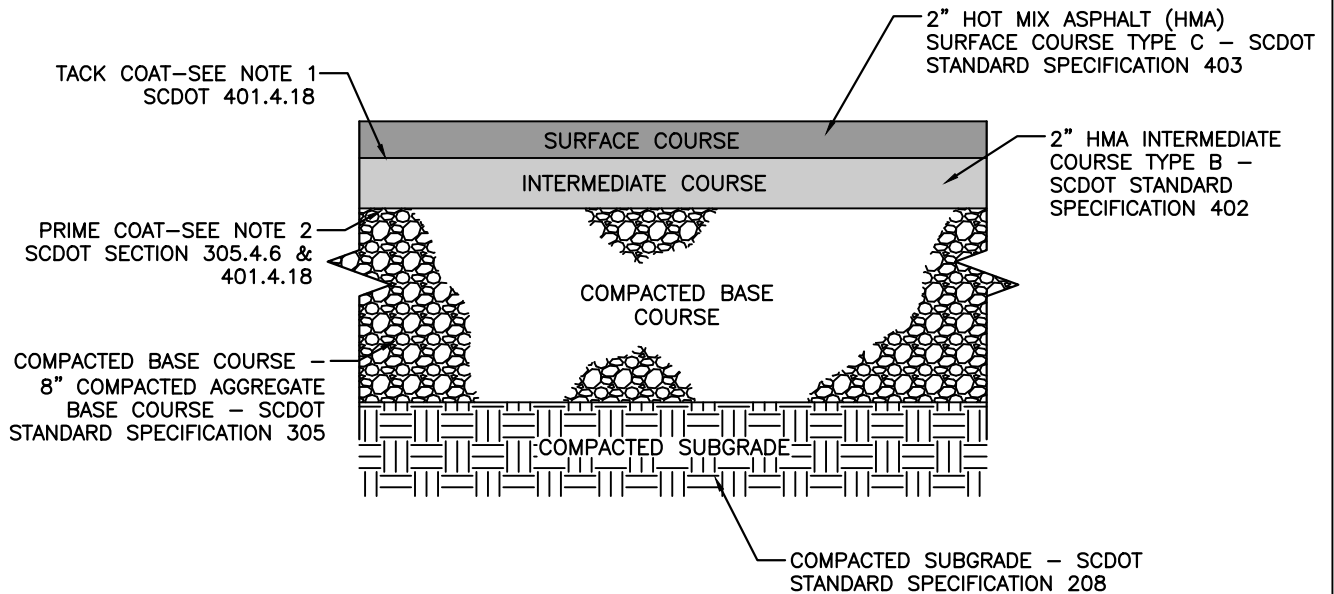
N.T.S.  
SCALE



NOTES:

1. MOUNT SIGN ON GATE WITH STAINLESS STEEL FASTENERS.
2. MATERIAL FOR SIGN TO BE 0.063" THICK ALUMINUM.
3. TEXT FONT "Context Reprise Condensed Bold"
4. BOTTOM OF SIGN SHALL BE 4' ABOVE GRADE.

	<p>STANDARD PUMP STATION SIGN</p>	<p>DETAIL No. <b>PS-13</b></p>
<p>11/18/19 REV DATE</p>		<p>N.T.S. SCALE</p>



HEAVY DUTY PAVEMENT SECTION

NOTES:

1. APPLICATION RATE FOR LAYING AND HMA ON EXISTING PAVEMENTS SHALL BE 0.05 — 0.15 GAL PER SQUARE YARD.
2. APPLICATION RATE FOR MACADAM AND RECYCLED PORTLAND CEMENT BASE COURSE SHALL BE 0.25 — 0.30 GAL PER SQUARE YARD.



11/18/19  
REV DATE

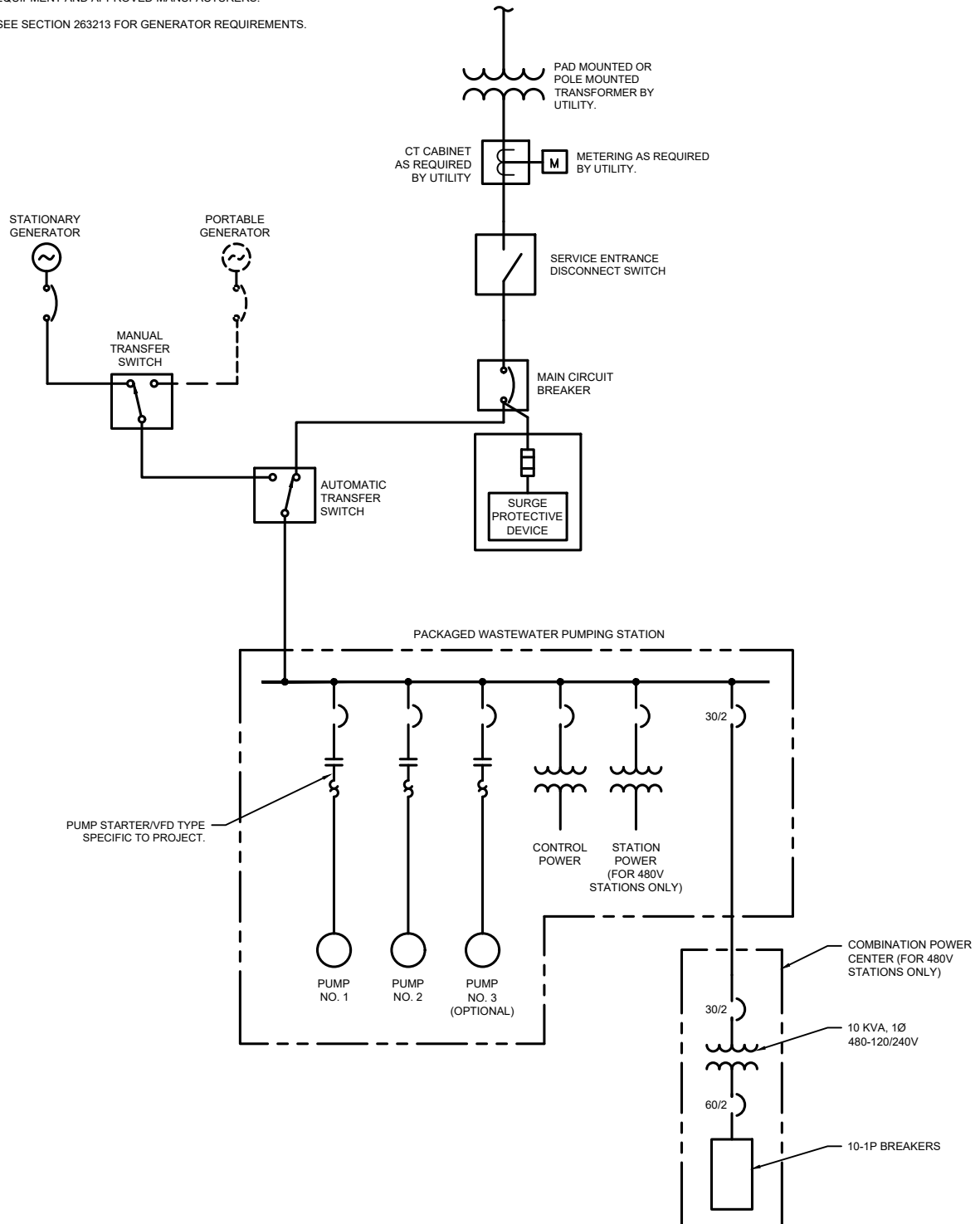
PUMP STATION  
ASPHALT PAVING DETAIL

DETAIL No.  
PS-14

N.T.S.  
SCALE

**GENERAL NOTES:**

- CONTRACTOR IS RESPONSIBLE FOR COORDINATING SERVICE WITH UTILITY.
- SEE SECTION 260000 FOR SPECIFICATIONS FOR EQUIPMENT AND APPROVED MANUFACTURERS.
- SEE SECTION 263213 FOR GENERATOR REQUIREMENTS.



11/18/19  
REV DATE

**ONE-LINE DIAGRAM  
PACKAGED WASTEWATER  
PUMPING STATION**

DETAIL No.  
**EL-1.0**

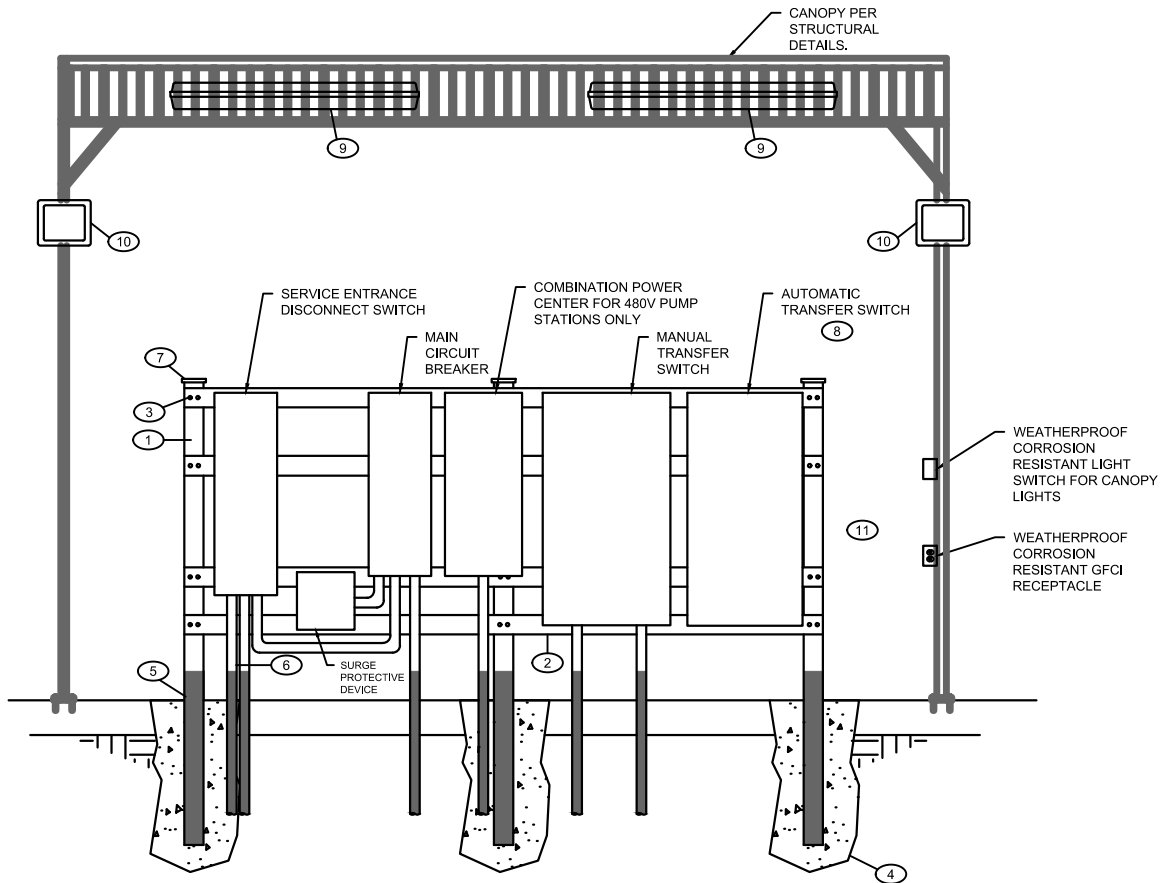
**N.T.S.**  
SCALE

GENERAL NOTES:

- QUANTITY OF FRAMING MEMBERS SHALL BE MODIFIED FOR SPECIFIC INSTALLATION.
- RACKS OVER 12 FT LONG SHALL REQUIRE ADDITIONAL VERTICAL TUBES.
- SEE SECTION 260000 FOR SPECIFICATIONS FOR EQUIPMENT AND APPROVED MANUFACTURERS.
- INSTALLATION SHALL BE IN COMPLIANCE WITH COUNTY FLOOD PLAIN ORDINANCE. WHERE GRADE ELEVATION DOES NOT PERMIT THE BOTTOM OF THE ELECTRICAL EQUIPMENT TO BE INSTALLED ABOVE THE COUNTY REQUIRED ELEVATION, THE RACK SHALL BE INSTALLED ON AN ELEVATED PLATFORM.

(X) DETAIL NOTES:

1. 4" SQUARE X 1/4" TH. ALUMINUM TUBING.
2. 4" SQUARE X 1/4" TH. ALUMINUM TUBING, NOTCHED AND BOLTED TO VERTICAL MEMBERS.
3. 316 STAINLESS STEEL HARDWARE.
4. CLASS C CONCRETE.
5. ALUMINUM TUBING OR CONDUIT SHALL NOT BE IN CONTACT WITH CONCRETE. COAT WITH TWO COATS OF BITUMINOUS PAINT TO 6" ABOVE FINISHED SURFACE.
6. SCH. 80 CONDUIT FOR GROUNDING ELECTRODE CONDUCTOR.
7. 4" SQUARE ALUMINUM ENDCAP.
8. ATS MAY BE INSTALLED IN PUMP STATION WHERE APPROVED BY REWA.
9. 4' WET LOCATION LED FIXTURE PER SPECIFICATION 260000.
10. WIDE AREA FLOOD PER SPECIFICATION 260000.
11. RACK HEIGHT MAY BE INCREASED TO ACCOMMODATE LARGER EQUIPMENT WHERE APPROVED BY ENGINEER.



11/18/19  
REV DATE

TYPICAL EQUIPMENT RACK  
PACKAGED WASTEWATER  
PUMPING STATION

DETAIL No.  
EL-1.1

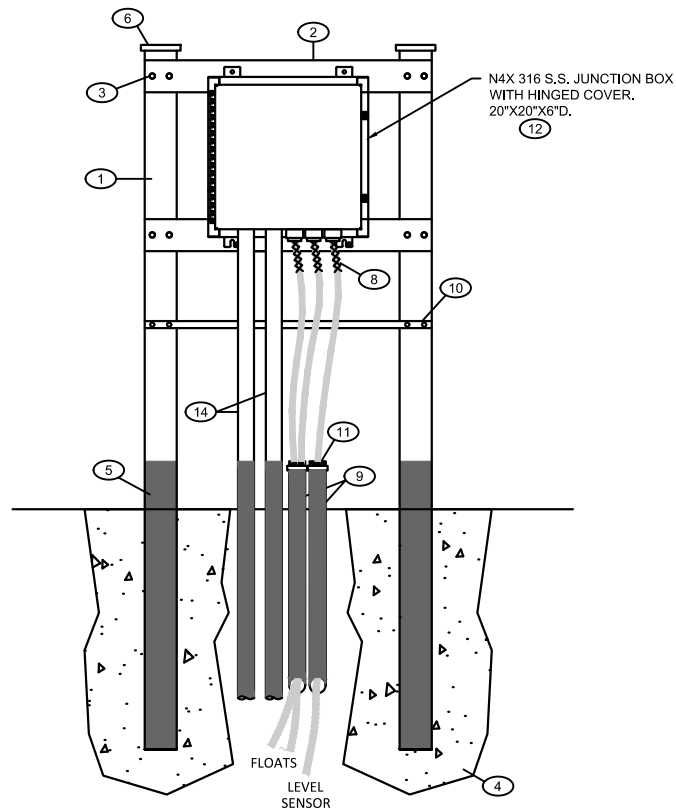
N.T.S.  
SCALE

GENERAL NOTES:

- QUANTITY OF FRAMING MEMBERS SHALL BE MODIFIED FOR SPECIFIC INSTALLATION.
- SEE SECTION 260000 FOR SPECIFICATIONS FOR EQUIPMENT AND APPROVED MANUFACTURERS.
- INSTALLATION SHALL BE IN COMPLIANCE WITH COUNTY FLOOD PLAIN ORDINANCE. WHERE GRADE ELEVATION DOES NOT PERMIT THE BOTTOM OF THE ELECTRICAL EQUIPMENT TO BE INSTALLED ABOVE THE COUNTY REQUIRED ELEVATION, THE RACK SHALL BE INSTALLED ON AN ELEVATED PLATFORM.

(X) DETAIL NOTES:

1. 4" SQUARE X 1/4" TH. ALUMINUM TUBING.
2. 4" SQUARE X 1/4" TH. ALUMINUM TUBING, NOTCHED AND BOLTED TO VERTICAL MEMBERS.
3. 316 STAINLESS STEEL HARDWARE.
4. CLASS C CONCRETE.
5. ALUMINUM TUBING OR CONDUIT SHALL NOT BE IN CONTACT WITH CONCRETE. COAT WITH TWO COATS OF BITUMINOUS PAINT TO 6" ABOVE FINISHED SURFACE.
6. 4" SQUARE ALUMINUM ENDCAP.
7. TYPE EYS SEALING FITTING WITH COMPOUND LISTED FOR FITTING.
8. STAINLESS STEEL CORD CONNECTOR WITH STAINLESS STEEL STRAIN RELIEF GRIP SIZED FOR PUMP/SENSOR/FLOAT CABLE RANGE.
9. 2" CONDUIT SLEEVE STUBBED INTO WETWELL. PROVIDE BUSHING AT EACH END.
10. 7/8" ALUMINUM STRUT TO SUPPORT CONDUITS.
11. DUCT SEAL.
12. PROVIDE BACKPLANE WITH FINGERSAFE TERMINALS FOR FLOATS AND SENSOR WITH 6" SEPARATION MAINTAINED BETWEEN CABLE TYPES.
13. CONDUIT SLEEVE STUBBED INTO WETWELL. PROVIDE BUSHING AT EACH END. CONDUIT SIZE ONE SIZE LARGER THAN NEC MINIMUM, NO SMALLER THAN 2".
14. TO PUMP CONTROL PANEL, CONDUIT SIZE ONE SIZE LARGER THAN NEC.



11/18/19  
REV DATE

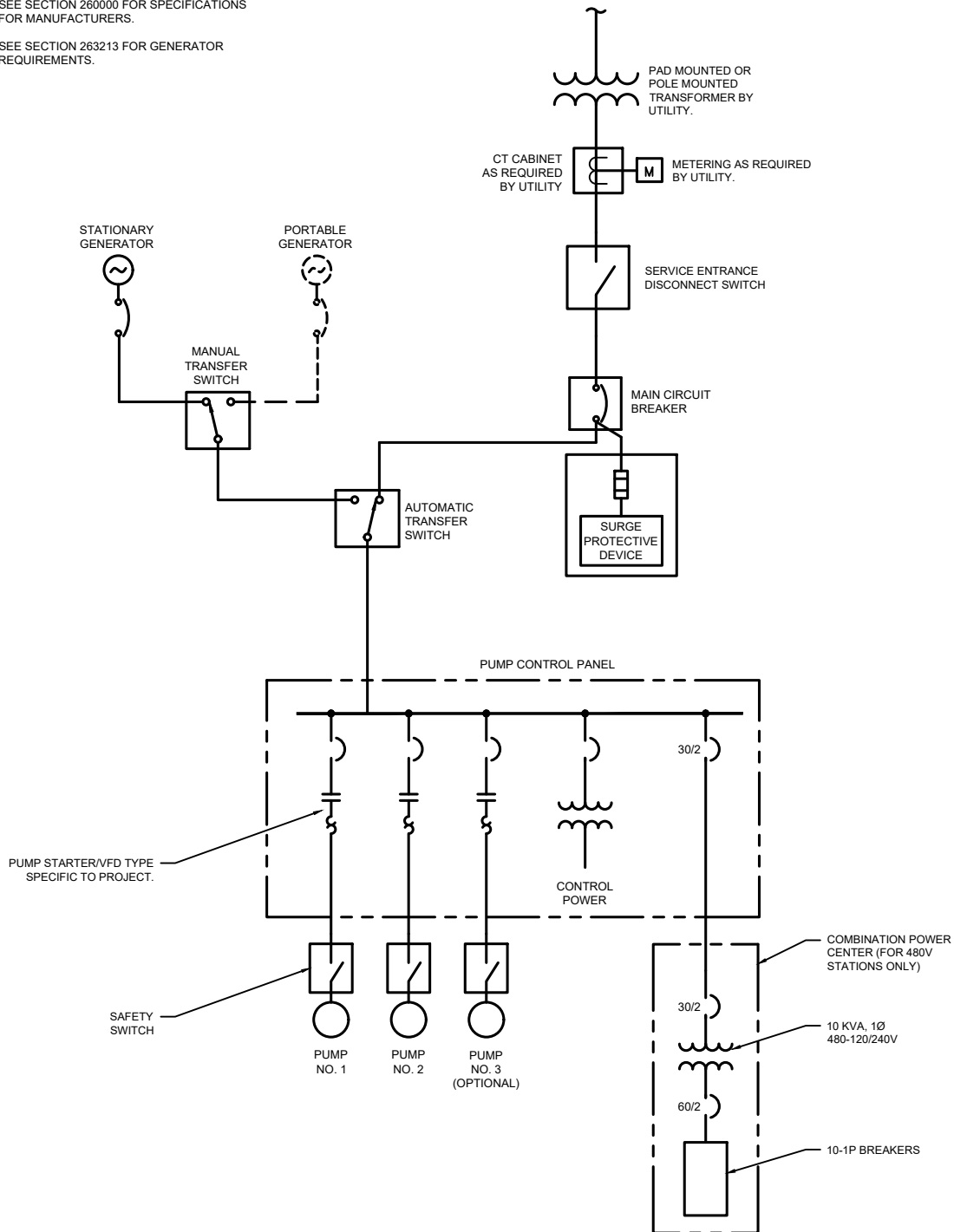
TYPICAL JUNCTION BOX  
DETAIL PACKAGED  
PUMPING STATION

DETAIL No.  
EL-1.2

N.T.S.  
SCALE

GENERAL NOTES:

- CONTRACTOR IS RESPONSIBLE FOR COORDINATING SERVICE WITH UTILITY.
- SEE SECTION 260000 FOR SPECIFICATIONS FOR MANUFACTURERS.
- SEE SECTION 263213 FOR GENERATOR REQUIREMENTS.



11/18/19  
REV DATE

ONE-LINE DIAGRAM  
SUBMERSIBLE WASTEWATER  
PUMPING STATION

DETAIL No.  
EL-2.0

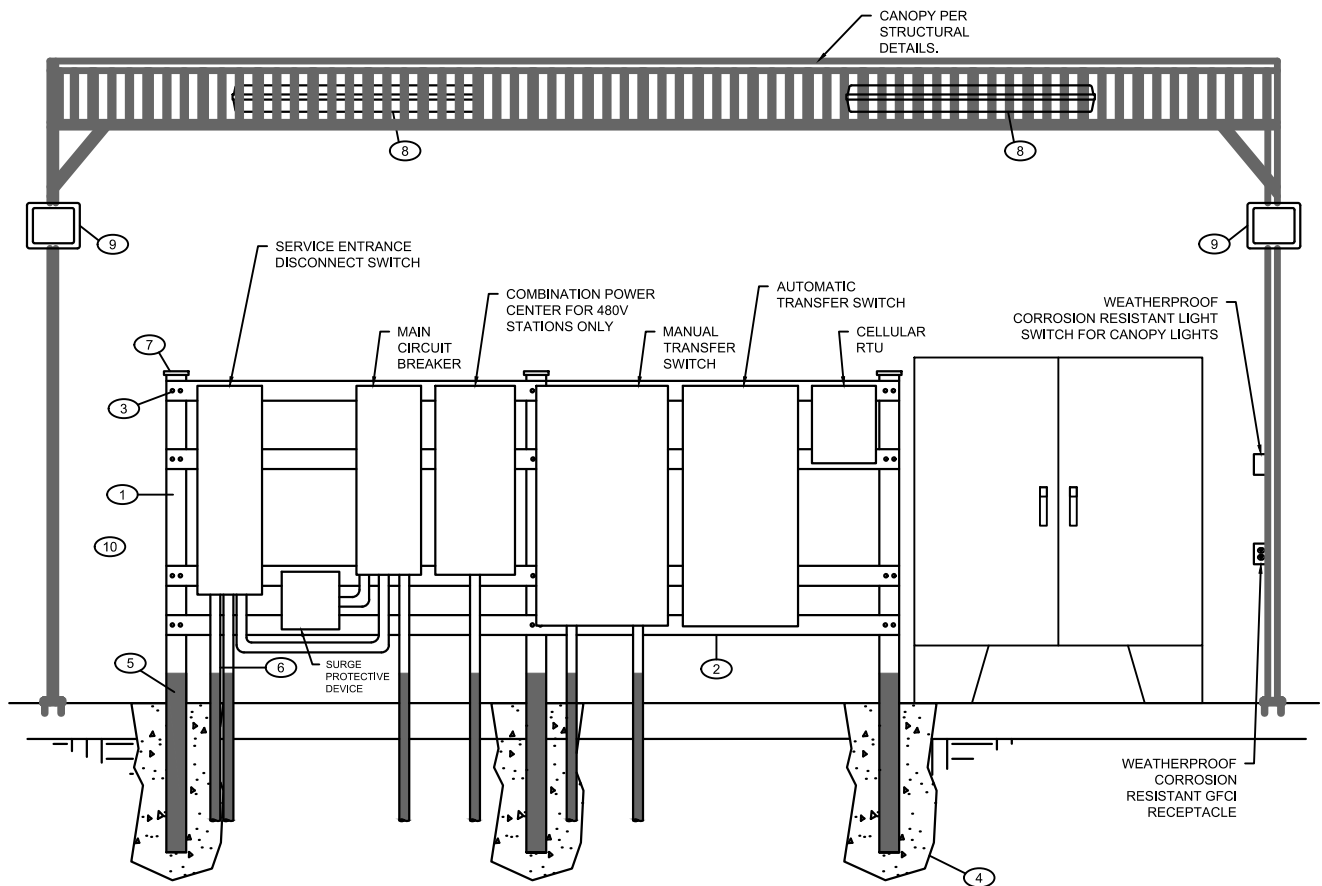
N.T.S.  
SCALE

GENERAL NOTES:

- QUANTITY OF FRAMING MEMBERS SHALL BE MODIFIED FOR SPECIFIC INSTALLATION.
- RACKS OVER 12 FT LONG SHALL REQUIRE ADDITIONAL VERTICAL TUBES.
- SEE SECTION 260000 FOR SPECIFICATIONS FOR EQUIPMENT AND APPROVED MANUFACTURERS.
- INSTALLATION SHALL BE IN COMPLIANCE WITH COUNTY FLOOD PLAIN ORDINANCE. WHERE GRADE ELEVATION DOES NOT PERMIT THE BOTTOM OF THE ELECTRICAL EQUIPMENT TO BE INSTALLED ABOVE THE COUNTY REQUIRED ELEVATION, THE RACK SHALL BE INSTALLED ON AN ELEVATED PLATFORM.

(X) DETAIL NOTES:

1. 4" SQUARE X 1/4" TH. ALUMINUM TUBING.
2. 4" SQUARE X 1/4" TH. ALUMINUM TUBING, NOTCHED AND BOLTED TO VERTICAL MEMBERS.
3. 316 STAINLESS STEEL HARDWARE.
4. CLASS C CONCRETE.
5. ALUMINUM TUBING OR CONDUIT SHALL NOT BE IN CONTACT WITH CONCRETE. COAT WITH TWO COATS OF BITUMINOUS PAINT TO 6" ABOVE FINISHED SURFACE.
6. SCH. 80 CONDUIT FOR GROUNDING ELECTRODE CONDUCTOR.
7. 4" SQUARE ALUMINUM END CAP.
8. 4" WET LOCATION LED FIXTURE PER SPECIFICATION 260000.
9. WIDE AREA FLOOD PER SPECIFICATION 260000.
10. RACK HEIGHT MAY BE INCREASED TO ACCOMMODATE LARGER EQUIPMENT WHERE APPROVED BY ENGINEER.



11/18/19  
REV DATE

TYPICAL EQUIPMENT RACK  
SUBMERSIBLE WASTEWATER  
PUMPING STATION

DETAIL No.  
EL-2.1

N.T.S.  
SCALE

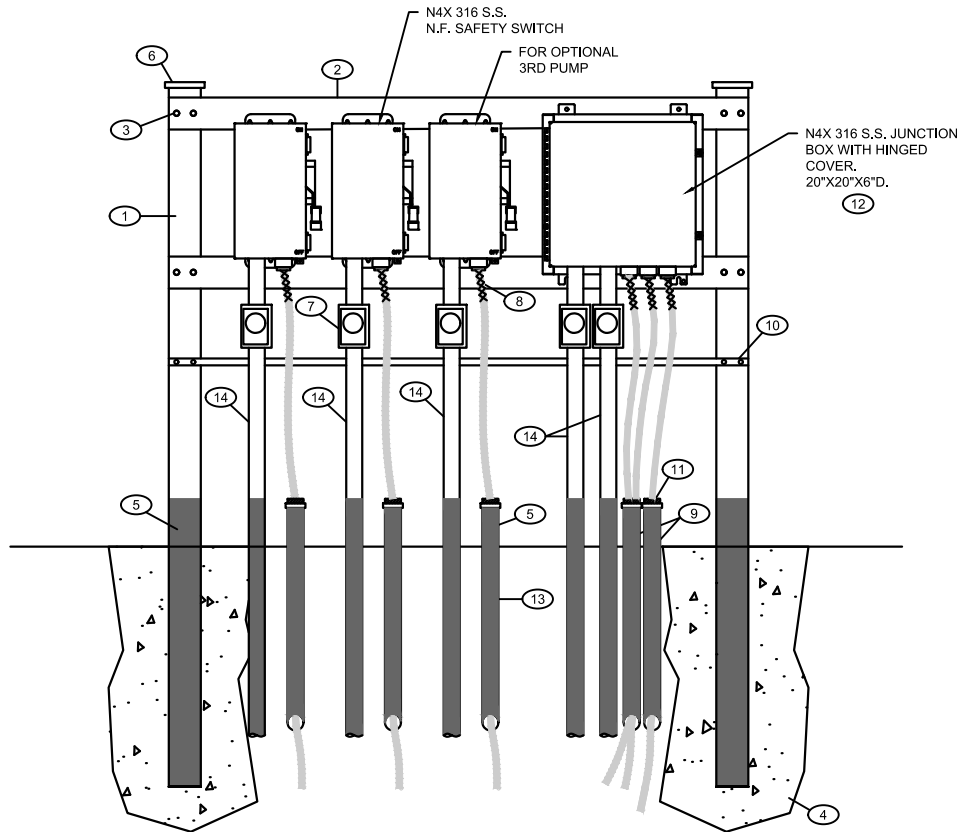


**GENERAL NOTES:**

- QUANTITY OF FRAMING MEMBERS SHALL BE MODIFIED FOR SPECIFIC INSTALLATION.
- SEE SECTION 260000 FOR SPECIFICATIONS FOR EQUIPMENT AND APPROVED MANUFACTURERS.
- INSTALL RACK WITH EQUIPMENT FACING WETWELL.
- INSTALLATION SHALL BE IN COMPLIANCE WITH COUNTY FLOOD PLAIN ORDINANCE. WHERE GRADE ELEVATION DOES NOT PERMIT THE BOTTOM OF THE ELECTRICAL EQUIPMENT TO BE INSTALLED ABOVE THE COUNTY REQUIRED ELEVATION, THE RACK SHALL BE INSTALLED ON AN ELEVATED PLATFORM

**(X) DETAIL NOTES:**

1. 4" SQUARE X 1/4" TH. ALUMINUM TUBING.
2. 4" SQUARE X 1/4" TH. ALUMINUM TUBING, NOTCHED AND BOLTED TO VERTICAL MEMBERS.
3. 316 STAINLESS STEEL HARDWARE.
4. CLASS C CONCRETE.
5. ALUMINUM TUBING OR CONDUIT SHALL NOT BE IN CONTACT WITH CONCRETE. COAT WITH TWO COATS OF BITUMINOUS PAINT TO 6" ABOVE FINISHED SURFACE.
6. 4" SQUARE ALUMINUM ENDCAP.
7. TYPE EYS SEALING FITTING WITH COMPOUND LISTED FOR FITTING.
8. STAINLESS STEEL CORD CONNECTOR WITH STAINLESS STEEL STRAIN RELIEF GRIP SIZED FOR PUMP/SENSOR/FLOAT CABLE RANGE.
9. 2" CONDUIT SLEEVE STUBBED INTO WETWELL. PROVIDE BUSHING AT EACH END.
10. 7/8" ALUMINUM STRUT TO SUPPORT CONDUITS.
11. DUCT SEAL
12. PROVIDE BACKPLANE WITH FINGERSAFE TERMINALS FOR FLOATS AND SENSOR WITH 6" SEPARATION MAINTAINED BETWEEN CABLE TYPES.
13. CONDUIT SLEEVE STUBBED INTO WETWELL. PROVIDE BUSHING AT EACH END. CONDUIT SIZE ONE SIZE LARGER THAN NEC MINIMUM, NO SMALLER THAN 2".
14. TO PUMP CONTROL PANEL. CONDUIT SIZE ONE SIZE LARGER THAN NEC.



11/18/19  
REV DATE

**TYPICAL JUNCTION BOX  
DETAIL SUBMERSIBLE  
PUMPING STATION**

DETAIL No.  
EL-2.2

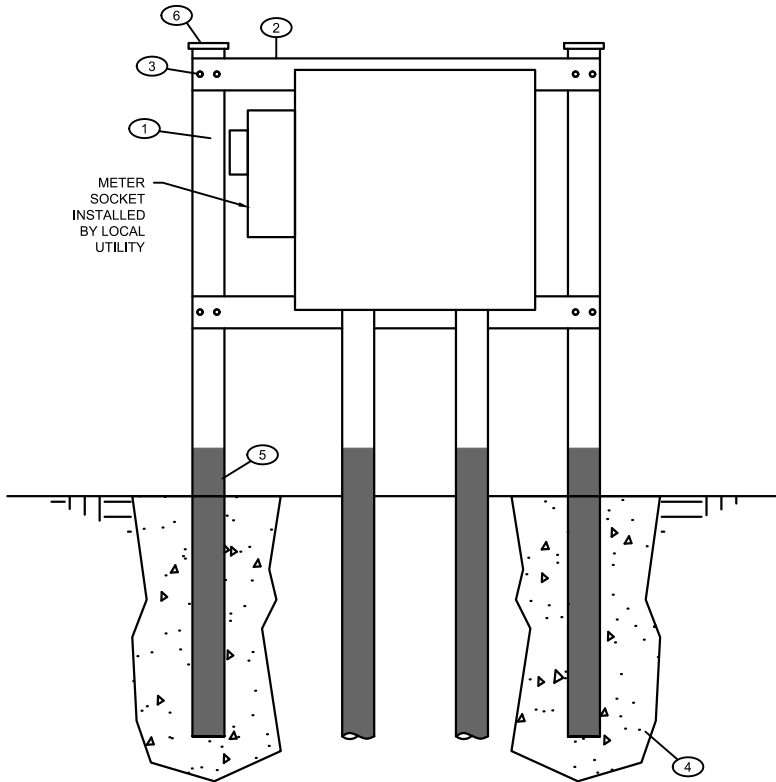
**N.T.S.**  
SCALE

GENERAL NOTES:

- CONTRACTOR IS RESPONSIBLE FOR COORDINATING SERVICE DETAILS WITH LOCAL UTILITY.
- WHERE SITE IS SERVED FROM POLE MOUNTED TRANSFORMERS AND CT CABINET IS REQUIRED, CONTRACTOR IS RESPONSIBLE FOR PROVIDING CT CABINET AND RACK PER LOCAL UTILITY'S GUIDELINES.
- WHEN POSSIBLE, THE CT CABINET AND METER RACK SHALL BE LOCATED OUTSIDE THE FENCE.
- INSTALLATION SHALL BE IN COMPLIANCE WITH COUNTY FLOOD PLAIN ORDINANCE. WHERE GRADE ELEVATION DOES NOT PERMIT THE BOTTOM OF THE ELECTRICAL EQUIPMENT TO BE INSTALLED ABOVE THE COUNTY REQUIRED ELEVATION, THE RACK SHALL BE INSTALLED ON AN ELEVATED PLATFORM.

(X) DETAIL NOTES:

1. 4" SQUARE X 1/4" TH. ALUMINUM TUBING.
2. 4" SQUARE X 1/4" TH. ALUMINUM TUBING, NOTCHED AND BOLTED TO VERTICAL MEMBERS.
3. 316 STAINLESS STEEL HARDWARE.
4. CLASS C CONCRETE.
5. ALUMINUM TUBING OR CONDUIT SHALL NOT BE IN CONTACT WITH CONCRETE. COAT WITH TWO COATS OF BITUMINOUS PAINT TO 6" ABOVE FINISHED SURFACE.
6. 4" SQUARE TUBING ENDCAP.



11/18/19  
REV DATE

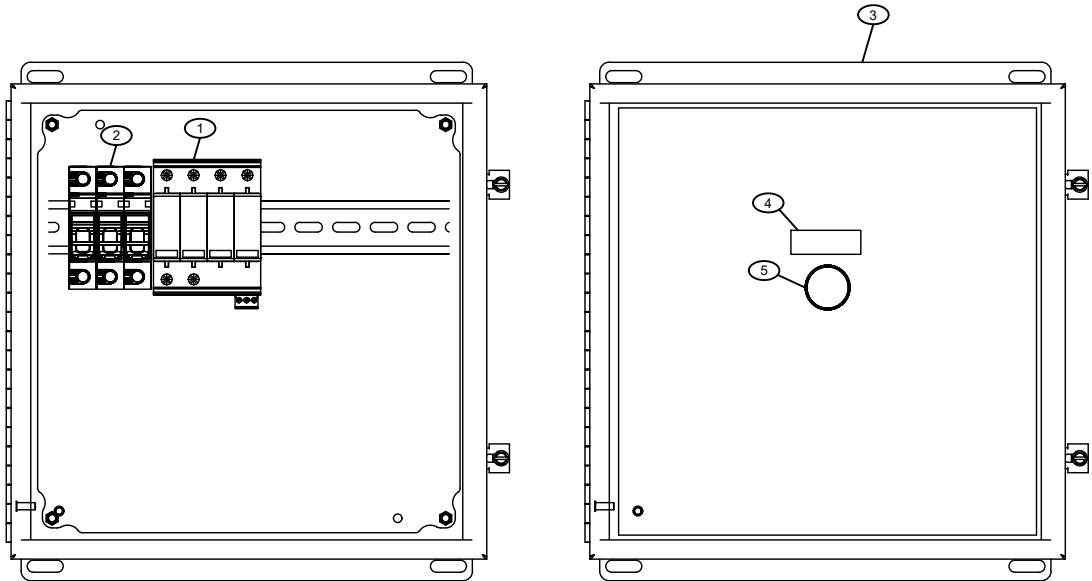
CT CABINET RACK  
PACKAGED & SUBMERSIBLE  
PUMPING STATIONS

DETAIL No.  
EL-3.0

N.T.S.  
SCALE

(X) DETAIL NOTES:

1. FOR 277/480 VOLT, 3 PHASE SYSTEMS PROVIDE PHOENIX CONTACT #2856689.  
FOR 120/208 VOLT, 3 PHASE SYSTEMS PROVIDE PHOENIX CONTACT #2905354.  
EQUIVALENT PRODUCTS BY MAXIVOLT, AND OTHER PRE-APPROVED MANUFACTURERS MAY ALSO BE USED.
2. FINGER SAFE, 3P FUSE HOLDER WITH FUSES COORDINATED WITH MAIN CIRCUIT BREAKER AS RECOMMENDED BY SPD MFR.
3. NEMA 4X 316 STAINLESS STEEL ENCLOSURE WITH CONTINUOUS HINGE (12"X12"X6"D.) AND BACK PANEL.
4. ENGRAVED NAMEPLATE PER SPECS "SURGE FAULT"
5. AMBER LED PUSH TO TEST PILOT LIGHT 30 MM, NEMA 4X, WIRE THROUGH SPD INDICATOR CONTACT TO ILLUMINATE ON DEVICE FAILURE.

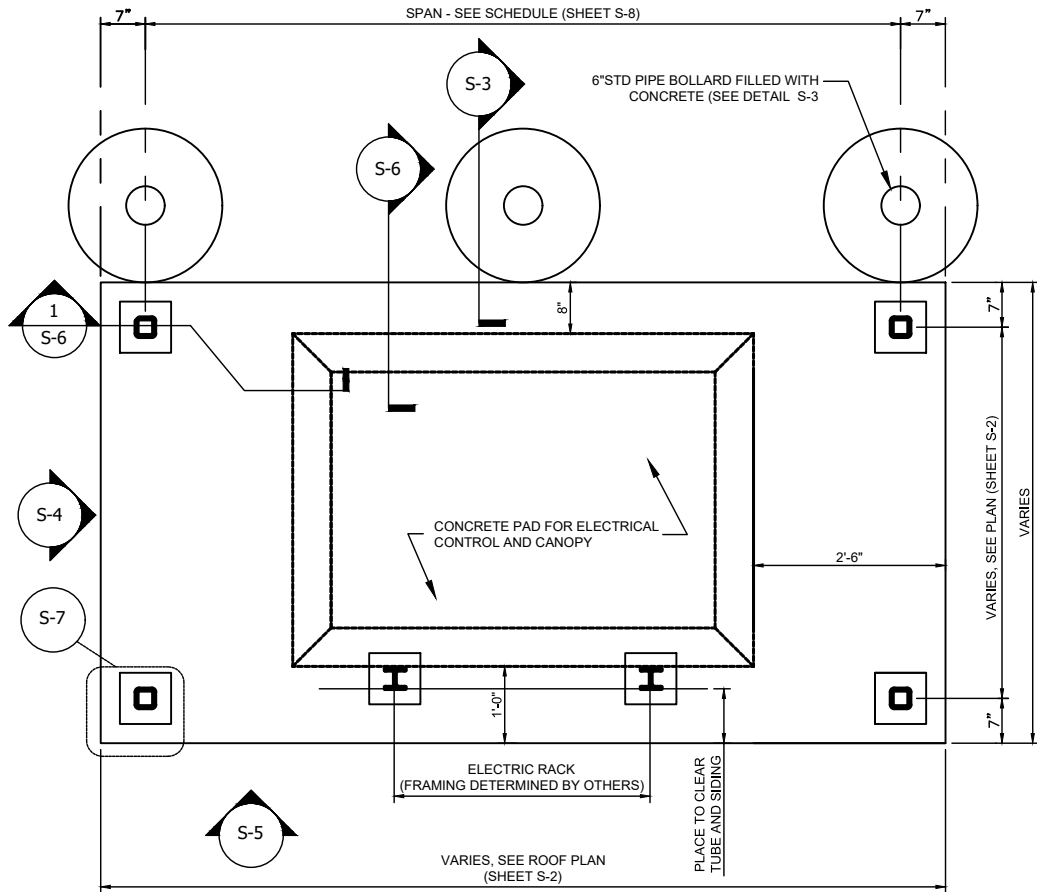


07/01/22  
REV DATE

SURGE PROTECTIVE DEVICE  
PACKAGED & SUBMERSIBLE  
PUMPING STATIONS

DETAIL No.  
EL-3.1

N.T.S.  
SCALE

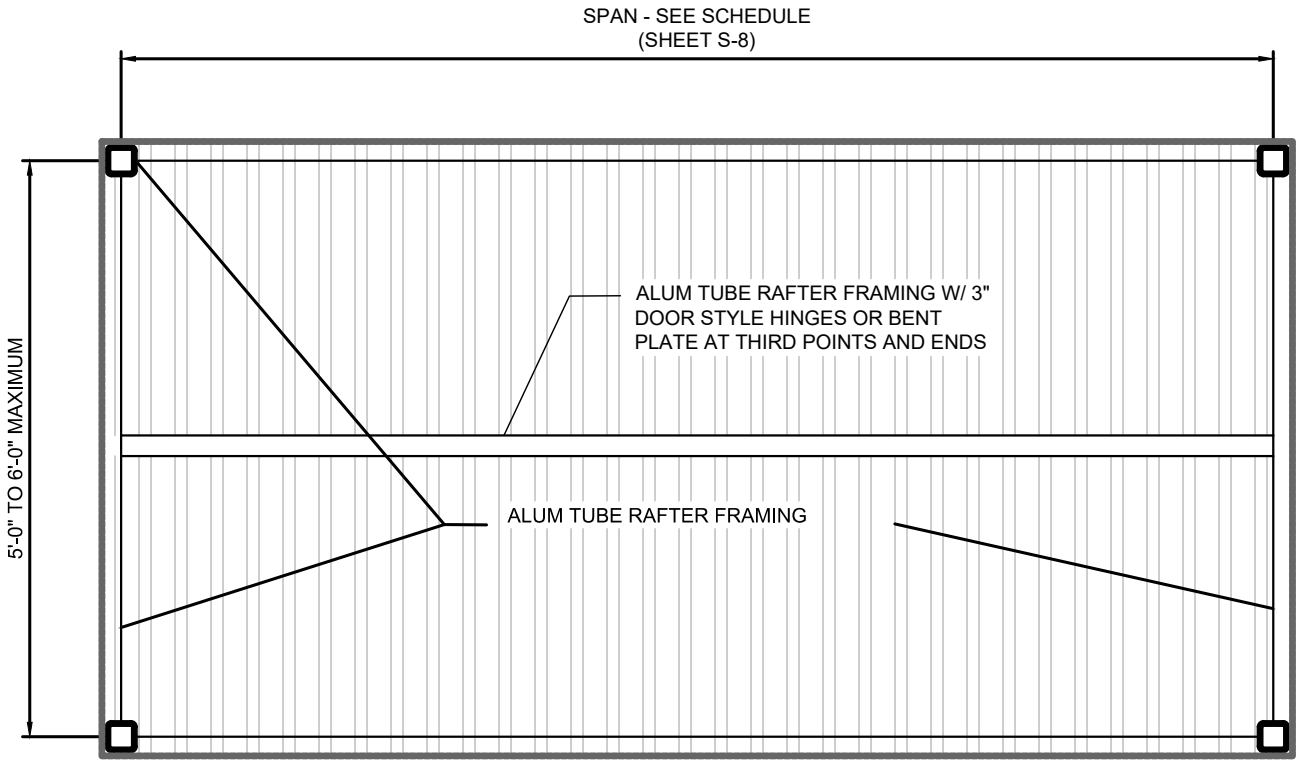


ELECTRICAL PANEL CANOPY  
FOUNDATION PLAN

DETAIL No.  
S-1

11/18/19  
REV DATE

N.T.S.  
SCALE

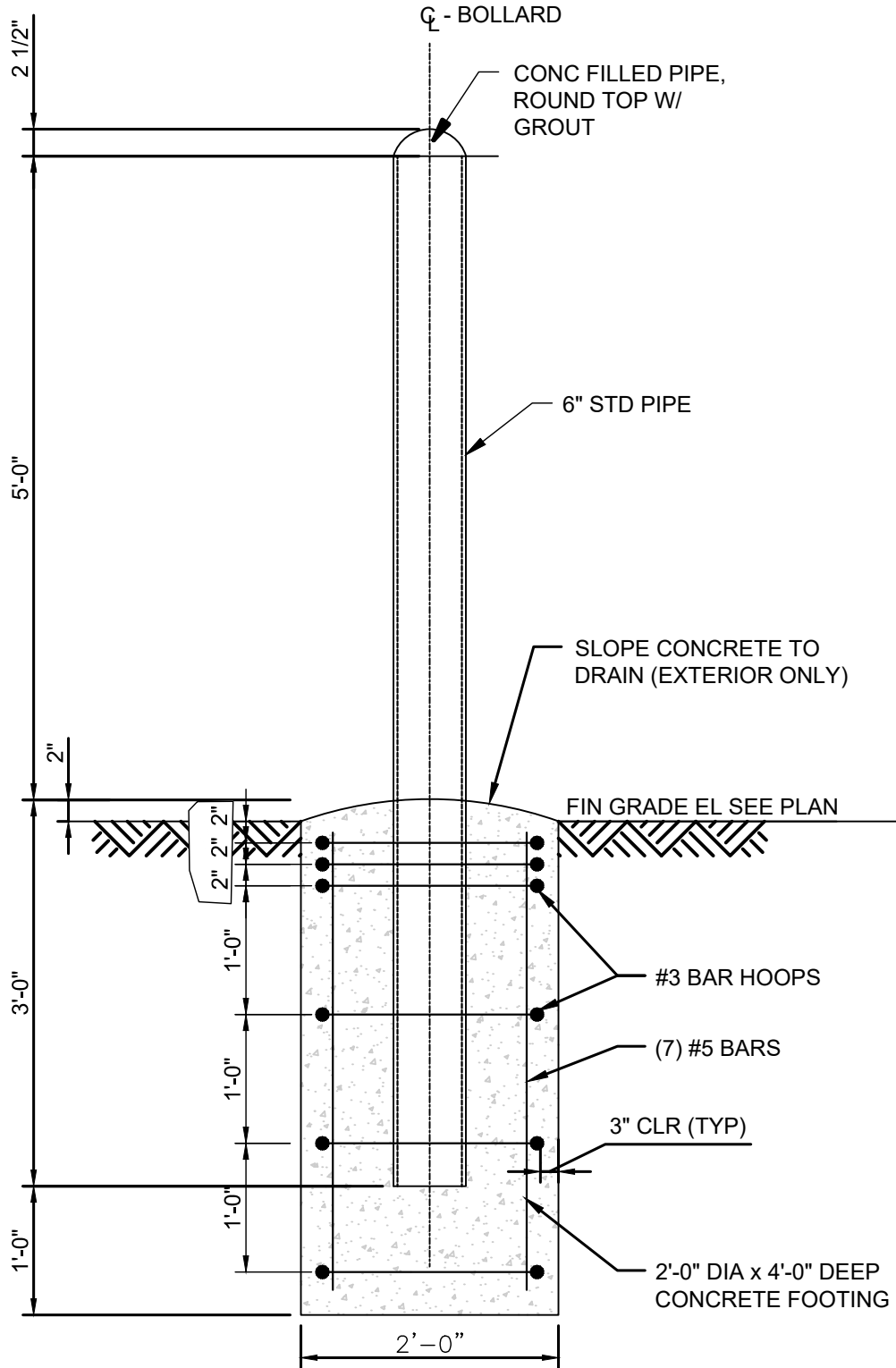


11/18/19  
REV DATE

ELECTRICAL PANEL CANOPY  
ROOF FRAMING

DETAIL No.  
S-2

N.T.S.  
SCALE

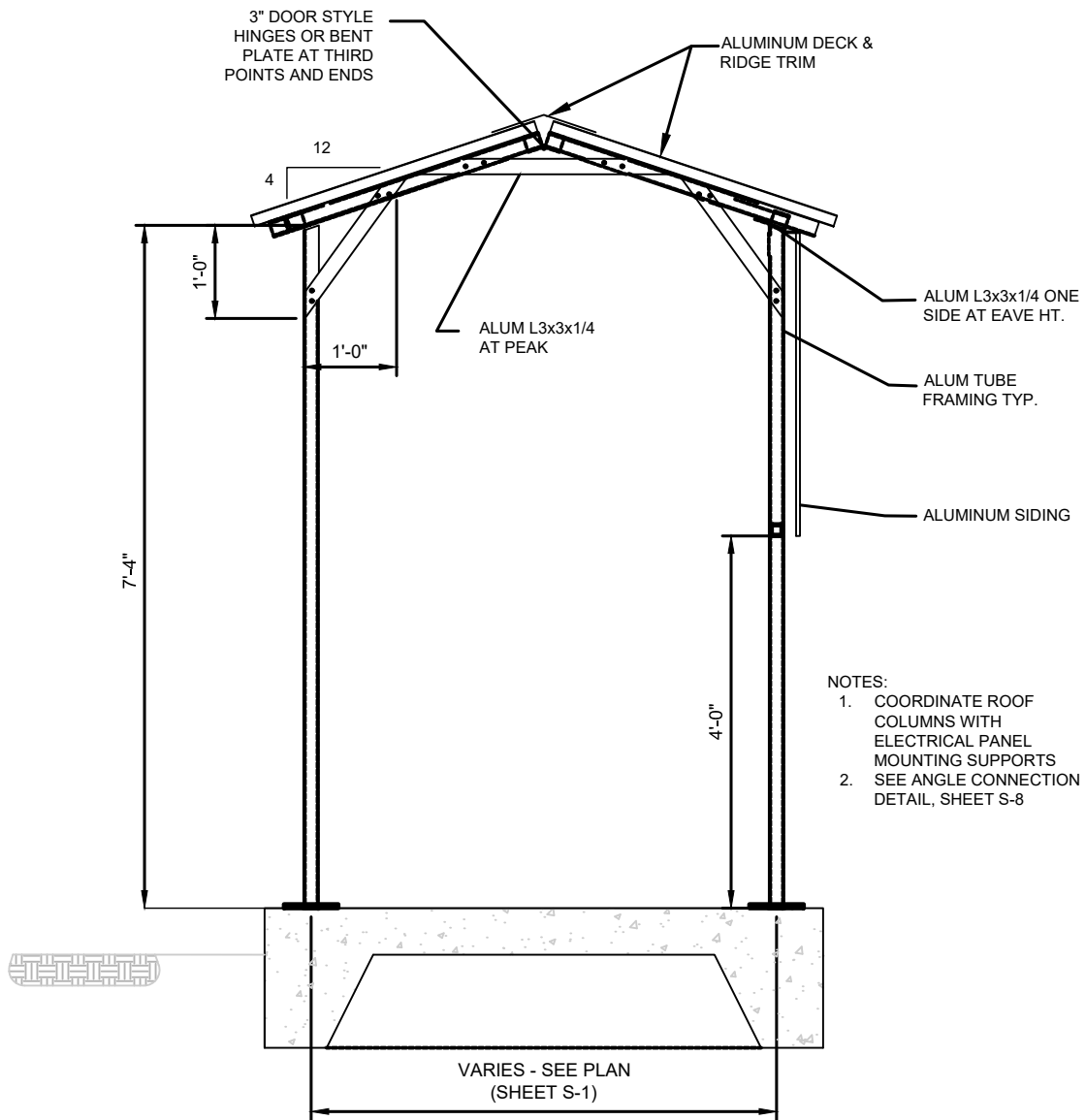


ELECTRICAL PANEL CANOPY  
BOLLARD DETAIL


DETAIL No.  
S-3

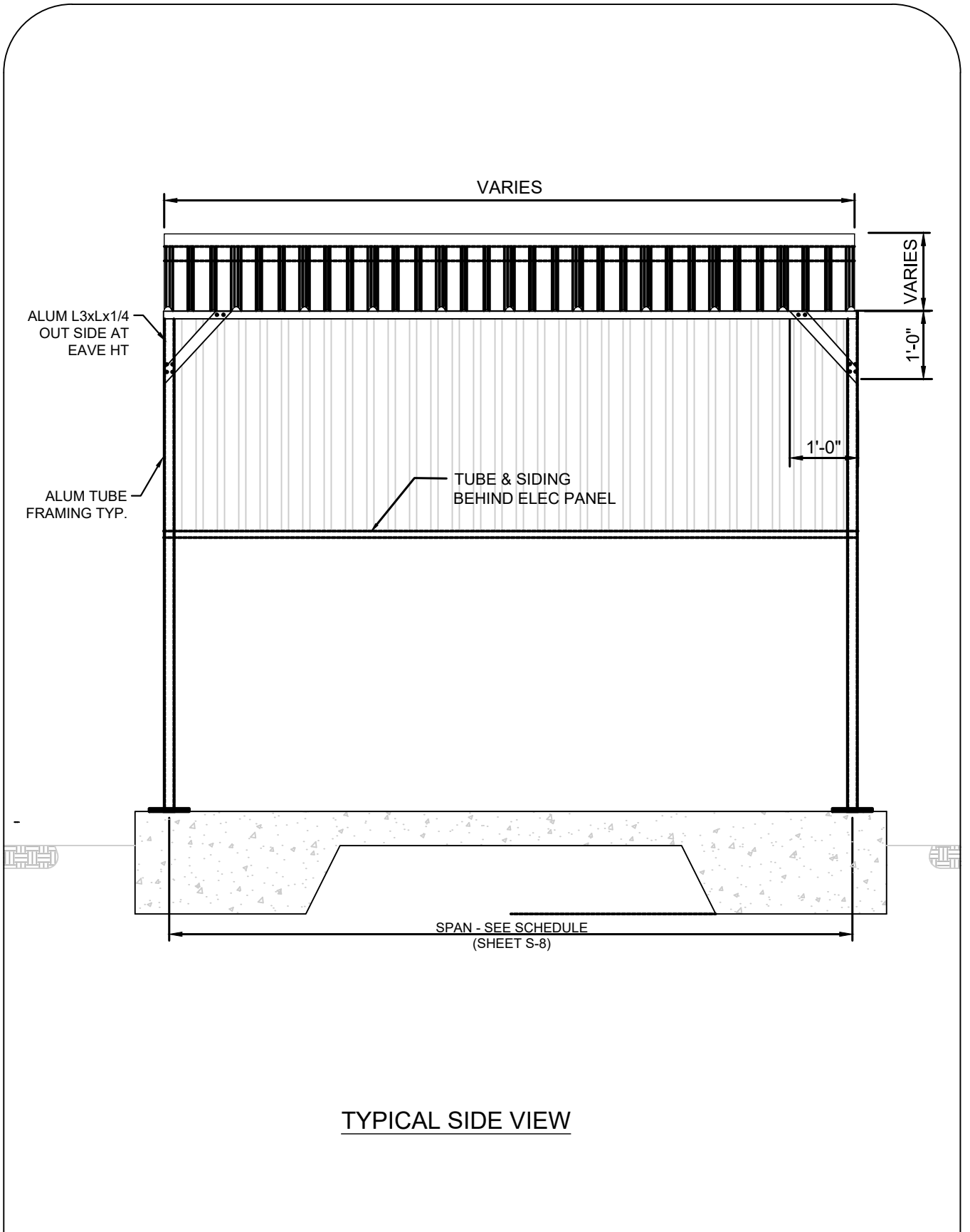
11/18/19  
REV DATE


N.T.S.  
SCALE



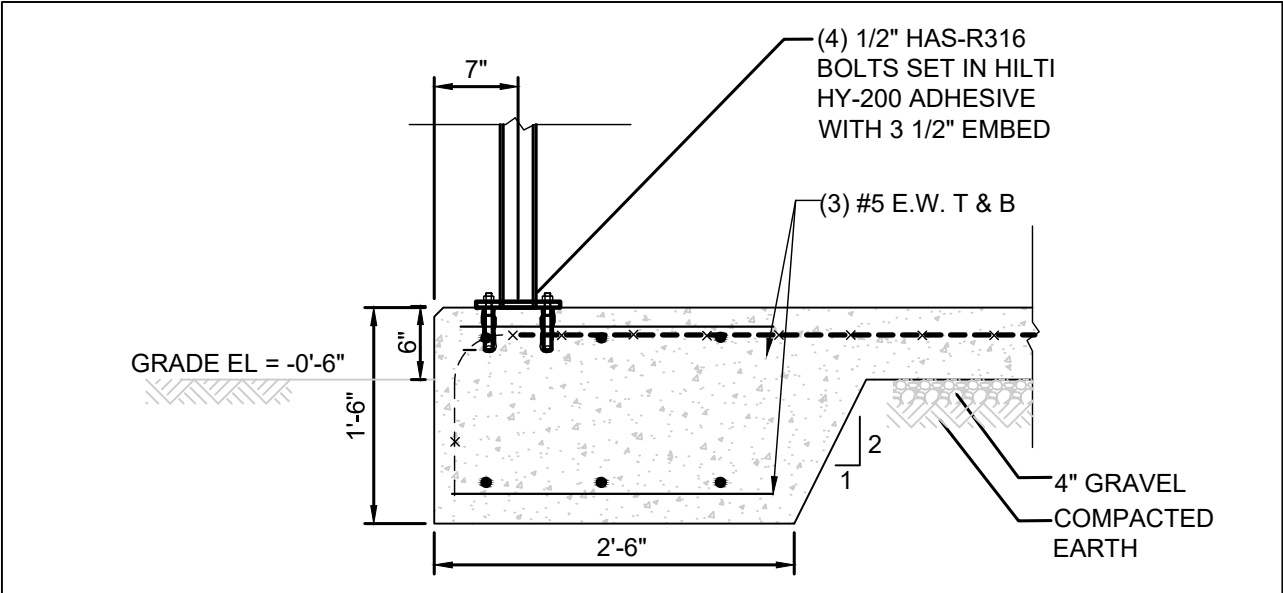
TYPICAL END VIEW

	<p>ELECTRICAL PANEL CANOPY TYPICAL END ELEVATION</p>	<p>DETAIL No. <b>S-4</b></p>
<p>11/18/19 REV DATE</p>		<p>N.T.S. SCALE</p>

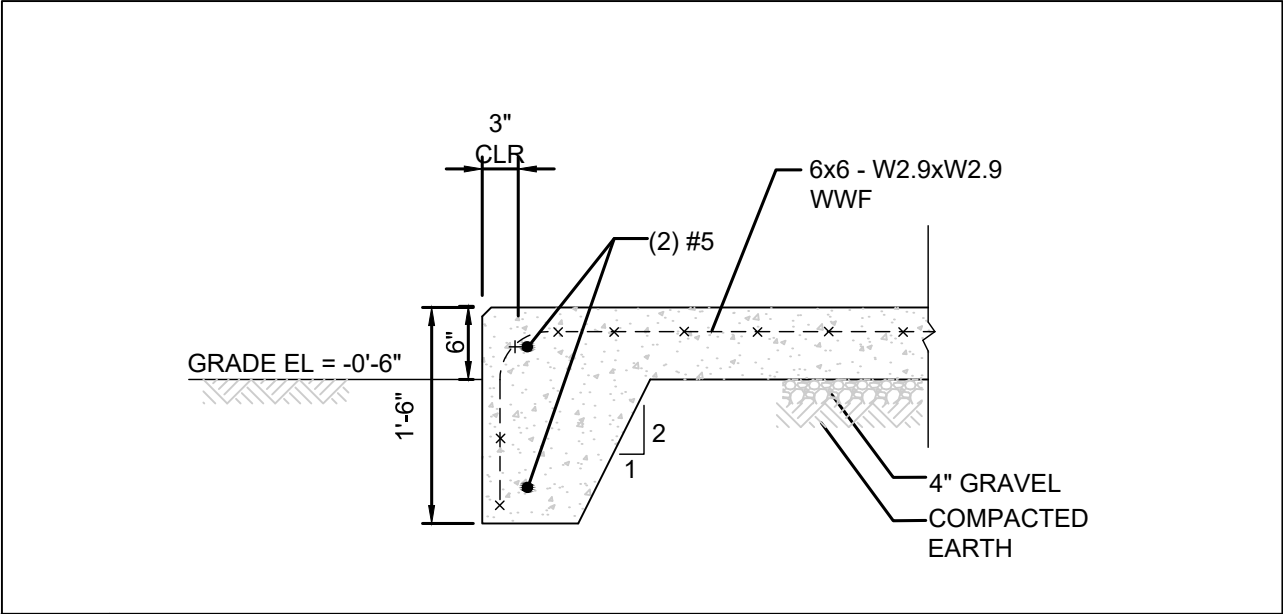


	<p>ELECTRICAL PANEL CANOPY TYPICAL SIDE ELEVATION</p>	<p>DETAIL No. S-5</p>
<p>11/18/19 REV DATE</p>		<p>N.T.S. SCALE</p>

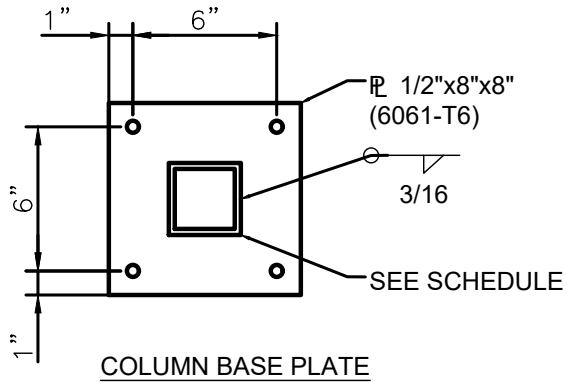




**1** SECTION THRU CANOPY FOOTING  
SCALE : 3/4" = 1'-0"



**2** SECTION THRU CANOPY SLAB  
SCALE : 3/4" = 1'-0"

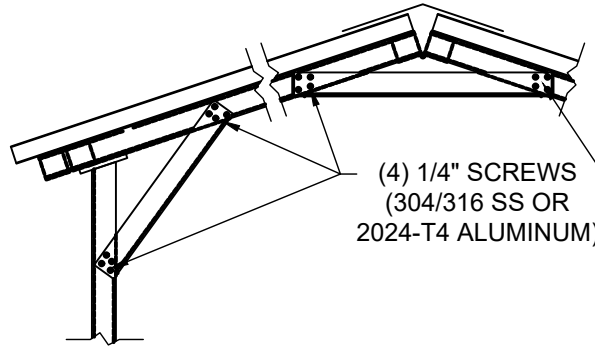


ELECTRICAL PANEL CANOPY  
COLUMN DETAIL

DETAIL No.  
S-7

11/18/19  
REV DATE

N.T.S.  
SCALE



**1** ANGLE CONNECTION DETAIL  
SCALE : 3/4" = 1'-0"

CANOPY MEMBER SCHEDULE		
SPAN	COLUMN TUBE	RAFTER AND SIDING SUPPORT TUBE
UP TO 8'	3 x 3 x 1/4	3 x 3 x 1/4
OVER 8' TO 12'	4 x 3 x 1/4 OR 4 x 4 x 1/4	3 x 3 x 1/4
OVER 12' TO 18'	4 x 4 x 1/4	4 x 4 x 1/4

NOTE: TUBES CAN BE ROUND OR SQUARE CORNERS

**DESIGN LOADS:**

ROOF LIVE LOAD.....	20 PSF
ROOF DEAD LOAD.....	5 PSF
EARTHQUAKE LOADS	
2018 SC BUILDING CODE (ASCE7-16)	
RISK CATEGORY.....	I
SEISMIC DESIGN CATEGORY.....	C
Ss.....	0.279
Si.....	0.106
SOIL PROFILE TYPE.....	D
R.....	3
Cd.....	3
IMPORTANCE FACTOR.....	1.0
SDs.....	0.293
SDl.....	0.168
WIND LOADS (ULTIMATE)	
BASIC WIND SPEED.....	115
IMPORTANCE FACTOR.....	1.0
EXPOSURE.....	C

**NOTES:**

1. CONCRETE TO BE 3000 PSI
2. REBAR TO BE (GRADE 60) 60 KSI
3. ALUMINUM TUBE 6061-T6
4. ROOF DECK, TRIM AND SIDE PANEL COLOR TO BE TNE MEC FOUNTAINBLEU (25BL) OR ReWa APPROVED EQUAL.
5. DESIGN LOADS MAY BE ADJUSTED TO SITE SPECIFIC VALUES.



ELECTRICAL PANEL CANOPY  
NOTES, SCHEDULES & ANGLE  
CONNECTION DETAIL

DETAIL No.  
S-8

11/12/21  
REV DATE

N.T.S.  
SCALE

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# APPENDIX II

## STANDARD SPECIFICATIONS

**TECHNICAL SPECIFICATIONS**

**DIVISION 1 – FRONT END DOCUMENTS**

<b><u>SECTION</u></b>	<b><u>TITLE</u></b>
01 05 00	Field Engineering/Surveying
01 41 10	Regulatory Requirements
01 57 13	Temporary Erosion and Sediment Control
01 66 00	Materials Storage, Handling and Protection
01 72 00	Record Documents

**DIVISION 2 – EXISTING CONDITIONS**

<b><u>SECTION</u></b>	<b><u>TITLE</u></b>
02 22 26	Utility Removal and Abandonment

**DIVISION 3 – CONCRETE**

<b><u>SECTION</u></b>	<b><u>TITLE</u></b>
03 30 00	Cast-in-Place Concrete
03 60 00	Grouting

**DIVISION 26 – ELECTRICAL**

<b><u>SECTION</u></b>	<b><u>TITLE</u></b>
26 00 00	Electrical
26 32 13	Standby Electrical Power System

**DIVISION 31 – EARTHWORK**

<b><u>SECTION</u></b>	<b><u>TITLE</u></b>
31 10 00	Site Clearing
31 22 00	Site Grading
31 23 16.13	Trenching
31 23 16.16	Excavation and Backfill for Structures
31 23 19	Dewatering
31 37 16.13	Riprap

**DIVISION 32 – EXTERIOR IMPROVEMENTS**

<b><u>SECTION</u></b>	<b><u>TITLE</u></b>
32 12 16	Asphalt Paving
32 31 13	Chain Link Fences and Gates

**DIVISION 33 – UTILITIES**

<b><u>SECTION</u></b>	<b><u>TITLE</u></b>
33 01 30	Corrosion Protection for Concrete Wastewater Structures
33 01 30.11	Television Inspections of Sewers
33 01 30.45	Temporary Bypass Pumping
33 01 32	Sewer and Manhole Testing
33 05 07.23	Utility Boring and Jacing
33 05 61	Concrete Manholes
33 05 63	Concrete Vaults and Chambers
33 05 75	Polymer Concrete Manholes and Wetwells
33 05 97	Identification and Signage for Utilities
33 31 11	Public Sanitary Sewerage Gravity Piping
33 31 23	Sanitary Sewer Force Main Piping
33 32 10	Submersible Sewage Pumping Station
33 32 13	Packaged Wastewater Pumping Stations

**DIVISION 40 – PROCESS INTERCONNECTIONS**

<b><u>SECTION</u></b>	<b><u>TITLE</u></b>
40 05 78.23	Air/Vacuum Valves for Wastewater Service
40 05 81.26	Freeze-Proof Yard Hydrants

PART 1 GENERAL

1.1 GENERAL

- A. CONTRACTOR shall establish baselines, benchmarks, and horizontal control points for the construction of the Project. The CONTRACTOR shall provide proper facilities and assistance for clearing and grading where required to complete the field survey. The CONTRACTOR shall notify the OWNER in advance for the establishment of the baselines and benchmarks.
1. Baselines for gravity pipeline contracts shall be defined by stakes set at each manhole and a benchmark shall be defined as an elevation established on each stake.
  2. Baselines of pressure pipeline contracts shall be defined by stakes set at each angle-point on private rights-of-way or other key points as determined by the CONTRACTOR, and all benchmarks will be established by the CONTRACTOR where other than the normal elevation of the pressure line is required.
  3. Baselines for all other construction contracts shall be defined by two (2) lines established by four (4) stakes referenced to the proposed construction. Benchmarks for such construction will be established by elevations placed on the stakes terminating the baselines.
- B. CONTRACTOR shall establish base lines for the Project and bench marks for use by CONTRACTOR.
- C. CONTRACTOR shall:
1. Provide civil, structural or other professional engineering services specified, or required to execute CONTRACTOR's construction methods.
  2. Develop and make all detail surveys and measurements needed for construction including slope stakes, batter boards, piling layouts and all other working lines, elevations and cut sheets.
  3. Keep a transit and leveling instrument on the site at all times and a skilled instrument technician available whenever necessary for layout of the Work.
  4. Provide all material required for bench marks, control points, batter boards, grade stakes, and other items.
  5. Be solely responsible for all locations, dimensions and levels. No data other than written orders of the OWNER shall justify departure from the dimensions and levels required by the Drawings.
  6. Safeguard all points, stakes, grade marks, monuments, corners, baselines, pins and bench marks made or established on the Work. Re-establish same by a Professional Surveyor licensed in the State of South Carolina if disturbed and rectify all Work improperly installed because of not maintaining, not protecting or removing without authorization such established points, stakes, marks, monuments, corners, pins and benchmarks.
  7. When requested by OWNER, provide such facilities and assistance as may be necessary for OWNER to check line and grade points placed by CONTRACTOR. CONTRACTOR



shall do no excavation or embankment work until all cross-sectioning necessary for determining pay quantities has been completed and checked by the OWNER.

1.2 QUALIFICATIONS OF CONTRACTOR'S SURVEYOR OR ENGINEER

- A. Qualified engineer or registered land surveyor, acceptable to CONTRACTOR and OWNER.
- B. Registered professional engineer of the discipline required for the specific service on the Project, licensed in the State of South Carolina.

1.3 RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.
  - 1. CONTRACTOR shall keep neat legible notes of all measurements and calculations made by CONTRACTOR while surveying and laying out the Work.
  - 2. Two copies of all notes shall be furnished to the OWNER with other records upon final completion.
- B. CONTRACTOR shall utilize the state plane coordinates and elevations to provide survey accurate data for all sanitary sewer and water main appurtenances and facilities installed for this project. This information shall be incorporated into the as-built drawings of the work and submitted to the OWNER in both electronic (.PDF and AutoCAD®) and paper format. Electronic format shall be a database file and shall contain the following information: point description, X-coordinate (easting), Y-coordinate (northing), and elevation. Points shall be appurtenances installed in this project to include, but not be limited to: top of casting and all pipe inverts for manholes, junction chambers and storm catch basins; sewer lateral wyes/tees; ends of casings for tunnels, and deflection points (horizontal/vertical) for water mains. Any point that will be covered, such as laterals, ends of casings, and deflection points, shall be located prior to being covered by three horizontal reference points approximately 120 degrees apart. The reference points shall be nails, stakes, or other fixed points that will enable the reestablishment of the horizontal location of the point after the item is covered. Elevations of each point shall be determined prior to covering the point.

The following is a sample table with sample point descriptions:

POINT DESCRIPTION	X-COORDINATE	Y-COORDINATE	ELEVATION
MANHOLE INVERT, PIPE DIA., ORIENTATION (NO. XX-0001)			
MANHOLE CASTING (NO. XX-0001)			
JUNCTION CHAMBER INVERT (NO. XX-0001)			
JUNCTION CHAMBER CASTING (NO. XX-0001)			
CATCH BASIN INVERT (STA XX+XX)			
CATCH BASIN CASTING (STA XX+XX)			

SEWER LATERAL AT MAIN (STA XX+XX)			
END OF TUNNEL CASING (STA XX+XX)			
TOP OF WATER PIPE AT CENTERLINE OF TEE, BEND, OR FITTING (STA XX+XX)			

1.4 SUBMITTALS

- A. Submit name and address of surveyor or engineer to OWNER.
- B. On request of OWNER, submit documentation to verify accuracy of field engineering work.
- C. When requested by the OWNER, submit certificate signed by registered engineer or surveyor certifying that elevations and locations of Work are in conformance with Contract Documents. Explain all deviations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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## PART 1 - GENERAL

### 1.1 SCOPE

- A. All work shall comply with applicable codes and standards of, but not limited to, the following:
- a. U.S. Army Corps of Engineers (USACE)
  - b. U.S. Environmental Protection Agency (EPA)
  - c. South Carolina Department of Health and Environmental Control (SC DHEC)
  - d. Occupational Safety and Health Act (OSHA)
  - e. South Carolina Department of Transportation (SC DOT)
  - f. County, City, and Local Governments
  - g. Water and Sewer Municipalities and Districts
  - h. Local Utility Providers (gas, power, telecom, etc.)
- B. Permits and Responsibilities:
- The Contractor shall, at no additional cost to the Owner, be responsible for obtaining all necessary licenses and permits, including building permits, and for complying with any applicable federal, state, county and municipal laws, ordinances, codes and regulations, in connection with the performance of the work. Copies of permits already obtained by the Owner will be provided no later than the pre-construction conference.
- C. The Contractor shall take proper safety and health precautions to protect the work, the workers, the public and the property of others.
- a. In addition to other requirements stated elsewhere herein, the Contractor shall solely responsible for compliance with the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (PL 91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL 91-54).
  - b. All chemicals used during project construction or furnished for project operations whether herbicide, pesticide, disinfectant, polymer, reactant, paints, solvents, cleaner or of other classification must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be the Contractor's responsibility and shall be in strict accordance with instructions and applicable local, state and federal regulation
- D. Prior to commencing any work, the Contractor shall submit a job-specific Health and Safety Plan to the Owner for their records.

- E. Contractor shall comply with all Sediment and Erosion Control, Wetlands, Floodplain and Water Quality requirements of the applicable jurisdictions.
- F. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the work.
- F. The Contractor shall post a copy of the approved construction permit in a conspicuous location on site.

## 1.2 REFERENCES

- A. Reference to technical societies, institutions or governmental standards is made in the specifications in accordance with the following abbreviations:
  - a. AASHTO – American Association of State Highway and Transportation Officials
  - b. ACI – American Concrete Institute
  - c. ACPA – American Concrete Pipe Association
  - d. AIA - American Institute of Architects
  - e. ANSI – American National Standards Institute
  - f. ASTM – American Society for Testing and Material
  - g. AWWA – American Water Works Association
  - h. NAAMM – National Association of Architectural Metal Manufacturers
  - i. NSF – National Sanitation Foundation
  - j. OSHA – Occupational Safety and Health Act
  - k. SCDHEC – South Carolina Department of Health and Environmental Control
  - l. SCDOT – South Carolina Department of Transportation

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 DESCRIPTION**

- A. Work Included: Provide protection of the environment during the construction of the project to reduce soil erosion and siltation to the lowest reasonably achievable level. Provide protection of wetlands, stream buffers, bed and bank areas outside of work limits.

### **1.2 GENERAL**

- A. Exercise every reasonable precaution, throughout the life of the project, to prevent the eroding of soil and the silting of rivers, streams, lakes, reservoirs, other water impoundments, ground or roadway surfaces, or other property. Erosion control practices to be used for this project are shown on the drawings and are to conform to South Carolina Department of Health and Environmental Control regulations.
- B. Contractor shall comply with the requirements of the NPDES General Permit for Stormwater Associated with Construction Activities, SRC10000, and the Stormwater Pollution Prevention Plan for the project.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Erosion control products shall comply with SCDHEC and/or Local MS4 standards.
- B. Contractor shall provide submittals for each erosion control device / product for review and approval prior to ordering and installation.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

- A. Construct and maintain all erosion control measures until the substantial completion of the project.

### **3.1 MAINTENANCE**

- A. Place all erosion control devices or measures prior to any land disturbing activity within the drainage area they are located.
- B. Periodically check erosion control devices and clean or otherwise remove silt build-up as necessary to maintain them in proper working order.

### **3.2 REMOVAL**

- A. Remove temporary structures after protected areas have been stabilized when authorized by the Engineer.

### **3.3 INSPECTION**

A. Contractor shall be in accordance with the approved Stormwater Pollution Prevention Plan for the project.

**END OF SECTION**

## **PART 1 - GENERAL**

### **1.1 SCOPE**

The work under this section includes, but is not necessarily limited to, the furnishing of all labor, tools and materials necessary to properly store and protect all materials, equipment, products and the like, as necessary for the proper and complete performance of the work.

### **1.2 DELIVERY AND HANDLING**

All materials shall be handled carefully and in such a manner as to preserve their quality. Materials damaged during delivery or handling shall not be used without approval from the Owner. Contractor shall also comply with any manufacturer specific delivery and handling requirements.

### **1.3 STORAGE AND PROTECTION**

#### **A. Storage**

1. The Contractor is responsible for obtaining any material storage site that is required. Storage of materials on the project site is subject to the approval of the Owner within the project limits and approved easements.
2. Maintain ample way for foot traffic at all times, except as otherwise approved by the Engineer.
3. All property damaged by reason of storing of material shall be properly replaced at no additional cost to the Owner.
4. Packaged materials shall be delivered in original unopened containers and so stored until ready for use.
5. All materials shall meet the requirements of these specifications at the time that they are used in the work.
6. Store products in accordance with manufacturer's instructions.

#### **B. Protection**

1. Use all means necessary to protect the materials, equipment and products of every section before, during and after installation and to protect the installed work and materials of all other trades.
2. All materials shall be delivered, stored and handled to prevent the inclusion of foreign materials and damage by water, breakage, vandalism or other causes.
3. Substantially constructed weather tight storage sheds, with raised floors, shall be provided and maintained as may be required to adequately protect those materials and products stored on the Site which may require protection from damage by the elements.



- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary for the approval of the Engineer and at no additional cost to the Owner.
- D. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports. Items such as pipe, structural steel and sheet construction products shall be stored with one end elevated to facilitate drainage.
- E. Tarps and other coverings shall be supported above the stored equipment or materials on wooden strips to provide ventilation under the cover and minimize condensation. Tarps and covers shall be arranged to prevent ponding of water.

#### **1.4 EXTENDED STORAGE**

In the event that certain items of major equipment such as air compressors, pumps and mechanical aerators have to be stored for an extended period of time, the Contractor shall provide satisfactory long-term storage facilities which are acceptable to the Engineer and Owner. The Contractor shall provide all special packaging, protective coatings, power, nitrogen purge, desiccants, lubricants and exercising necessary or recommended by the manufacturer to properly maintain and protect the equipment during the period of extended storage.

#### **1.5 OWNER FURNISHED EQUIPMENT**

The Contractor shall provide storage and protection for all Owner furnished equipment and materials, including extended storage as specified above.

**END OF SECTION**

PART 1 GENERAL

2.1 GENERAL

- A. CONTRACTOR shall maintain and provide record documents as specified in the General Conditions. The General CONTRACTOR shall have the responsibility of ensuring that each of the other prime CONTRACTORS maintains the record documents specified herein.
- B. Maintenance of Documents:
1. Maintain in each prime CONTRACTOR's field office in clean, dry, legible condition complete sets of the following: Drawings, Specifications, Addenda, approved Shop Drawings, Samples, photographs, Change Orders, other modifications of Contract Documents, test records, survey data, Field Orders, and all other documents pertinent to CONTRACTOR's Work.
  2. Provide files and racks for proper storage and easy access. File in accordance with filing format of Construction Specification Institute (CSI), unless otherwise approved by the OWNER.
  3. Make documents available at all times for inspection by the OWNER.
  4. Record Documents shall not be used for any other purpose and shall not be removed from the CONTRACTOR's office without OWNER's approval.
- C. Marking System: Provide colored pencils or felt tipped pens for marking changes, revisions, additions and deletions, to the record set of Drawings.
1. Use following color code for all structures and systems except underground utilities, unless otherwise approved by the OWNER.
    - a. Process and Mechanical: Red.
    - b. Architectural: Blue.
    - c. Structural: Purple.
    - d. Plumbing: Brown.
    - e. HVAC: Green.
    - f. Electrical: Orange.
    - g. Other Printed Notations: Black.
  2. For underground utilities use the following color coding system.

Sanitary Sewer - Green	Phone - Orange
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Storm Sewer - Green

CATV - Orange

Electric - Red

Water - Blue

Gas - Yellow

D. Recording

1. Label each document "PROJECT RECORD" in 2-inch high printed letters.
2. Keep record documents current.
3. Do not permanently conceal any Work until required information has been recorded.
4. CONTRACTOR shall utilize dimensional measurements, state plane coordinates, and elevations to provide survey accurate data for all sanitary sewer and water appurtenances and facilities installed for this project. This information shall be incorporated into the as-built drawings of the Work. Any point that will be covered, such as lateral wyes/tees, ends of casings, and deflection points for water mains, shall be located prior to being covered by three horizontal reference points approximately 120 degrees apart. The points shall be nails, stakes, or other fixed points that will enable the reestablishment of the horizontal location of the point after the item is covered. Elevations of each point shall be determined prior to covering the point.

2.2 DRAWINGS

A. Comply with the Renewable Water Resources Rules and Regulations and legibly mark to record actual construction including but not limited to:

1. Depths of various elements of foundation/construction in relation to NAD 83 datum.
2. Horizontal location of all underground utilities and appurtenances referenced to permanent surface improvements.
3. Horizontal locations referenced to the State Plane Coordinate System.
4. Prepare additional drawings as necessary.
5. Information to be recorded shall include but not be limited to:
  - a. Physical location of manholes, bends, hydrants, and valves by horizontal control to two permanent surface objects and by State Plane Coordinates,
  - b. Angles between lines,
  - c. Lengths of spans, and
  - d. Elevations of all pipe inverts and tops of manholes.

- e. Location of internal utilities and appurtenances concealed in construction referenced to visible and accessible features of structure.
  - f. Field changes of dimensions and details.
  - g. Changes made by Amendment or Field Order.
  - h. Material description of each pipe installed.
  - i. Details not on original Drawings.
6. All sanitary manholes, lampholes and water valves shall be located with a minimum of two (2) horizontal dimensions. The two (2) dimensions shall not be on the same line to the appurtenance or on the same line on either side of the appurtenance. The angles between dimension lines should be between 20 and 160 degrees.
  7. All record location dimensions shall be measured in feet and tenths of a foot and shall not exceed 100 feet in length.
    - a. The character height of numbers shall be between 0.125 inches minimum and 0.5 inches maximum.
    - b. Dimension lines shall be shown on each drawing except where they would add substantial confusion in interpreting the drawing. In those cases, a detail shall be included on the same plan sheet. The detail shall include the dimensions and an arrow pointing to the area of the drawing represented by the detail.
    - c. Dimensions shall be from centerline to centerline of each object except for house corners and catch basins (see paragraph 6 below).
  8. Dimensions shall be level distances unless noted under special conditions.
  9. The following shall be required on all record drawings:
    - a. Measured distance between valves within each intersection and at each tee and cross. These dimensions shall be in addition to the two (2) required dimension locations.
    - b. Measured distance between fire hydrants and fire hydrant valves.
    - c. Measured distances between sanitary manholes, and between a sanitary sewer and a lamphole, shall be shown on the plan. Length of span, grade size of pipe, pipe material and invert elevations shall be shown in the profile.
    - d. The plan view of pipe length and location on the plan and profile drawing shall be changed for any constructed span length or horizontal location that differs more than five (5) feet from the design. The span length on both the plan and profile shall be labeled with the constructed length.

- e. The profile view on the plan and profile drawing shall be changed for any constructed sanitary or storm sewer invert elevation that differs more than 0.5 feet from the design elevation. The invert elevations shall be labeled with the constructed invert elevations.
  - f. The plan view of a constructed water main shall be changed for any horizontal location that differs more than five (5) feet from the design location.
10. The following is a list of objects that are acceptable for as-built dimension references, in order of preference:
- a. Fire Hydrant.
  - b. Curb. All curb dimensions shall be to the back of the curb and shall not be to any curb or extended curb lines with a radius.
  - c. Catch basins. Dimensions shall be to the nearest corner of the street edge on the street side. The street name and reference corner on the catch basin shall be indicated.
  - d. Sanitary Manhole may be used for valve locations.
  - e. Permanent Utility Pole (pole number shall be included).
  - f. House Corner. The house street address shall be indicated when a dimension to a house corner is used. Show the entire outline of the house and designate the reference corner for the measured dimension.
  - g. Corner of a drive. The house street address shall be indicated when a dimension to a driveway corner is used.
11. OWNER will possess copies of all vendor and CONTRACTOR Electronic drawing files at the end of the project. The Electronic drawing files shall be provided in AutoCAD® (latest approved version). This includes but is not limited to: PLC control panels, motor control centers, motor starters, switchgear, automatic and manual transfer switches, panels and switchboards, mobile and permanent generators, and any other equipment provided for this project.

## 2.3 SPECIFICATIONS AND ADDENDA

- A. Legibly mark up each Section to record:
- 1. Manufacturer, trade name, catalog number, and supplier of each product and item of equipment actually installed.
  - 2. Changes made by Amendment or Field Order.
  - 3. Other matters not originally specified.

2.4 DATABASE

- A. See Section 01 05 00, Field Engineering/Surveying for additional requirements related to database submission.

2.5 GRADE CERTIFICATION

- A. Grade Certification: Grade certifications shall be prepared, signed, dated and sealed by a State of South Carolina Registered Surveyor or Engineer. The certifications shall be in a tabular format. Rows shall be manhole numbers. Columns shall include:

1. Upstream Manhole Number
2. Inlet Pipe diameter (inches)
3. Invert elevation (feet)
4. Elevation difference (feet)
5. Span length (feet)
6. Grade (%)
7. Top of Casting elevation (feet)
8. Northing (state plane coordinate)
9. Easting (state plane coordinate)
10. Comments

PART 2 PRODUCTS

2.6 SUBMITTALS

- A. Upon Substantial Completion of the Work, deliver Record Documents to the OWNER. Final payment will not be made until satisfactory Record Documents are received by the OWNER. Record Documents shall include the following:
1. One marked paper copy of the design drawings with as-built information.
  2. One (1) original signed copy of the grade certification.
  3. One database table as specified in Section 01 05 00.
- B. Accompany submittal with transmittal letter containing:
1. Date.
  2. Project title and number.
  3. CONTRACTOR's name and address.

4. Title and number of each record document.
5. Certification that each document as submitted is complete and accurate.
6. Signature of CONTRACTOR, or his authorized representative.

PART 3 EXECUTION (NOT USED)

END OF SECTION

## PART 1 – GENERAL

### 1.1 SUMMARY

- A. Work includes the removal and abandonment of utility piping and related structures.

### 1.2 REFERENCE STANDARDS

- A. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

## PART 2 – PRODUCTS

Not Used

## PART 3 – EXECUTION

### 3.1 REMOVAL

- A. Completely remove and dispose of pipe and appurtenances, and structures to full depth as shown on the plans. Trench widths shall be limited to widths as specified for new pipeline installation. Voids resulting from removed structures and piping shall be filled with acceptable fill material and trench shall be back-filled and compacted in accordance with compaction requirements in Section 31 23 16.13 - Trenching.

### 3.2 ABANDONMENT OF MANHOLES

- A. Remove the upper portion of structures to a depth of at least 1 foot below subgrade in paved and foundation areas. For all other areas, remove to a depth of 3 feet below finished or existing grade, whichever is lower. The bottom of structures shall be broken or perforated to prevent the entrapment of water. See ReWa standard drawings for additional manhole abandonment details.
- B. Seal all pipes and conduits connecting to structures or ends of conduit to be abandoned with a wall of concrete not less than 6 inches thick or an 8-inch wall of brick and mortar.
- C. Fill structural voids with flowable fill or crushed stone compacted to 90% (unpaved) or 95% (paved) of maximum density at optimum moisture content as defined by ASTM D698.

### 3.3 ABANDONMENT OF PIPELINES

- A. Water, Sewer, and Storm drain lines shall only be abandoned in place where shown on plans or as directed by a ReWa representative. Pipes owned by other entities shall only be abandoned where authorized by that utility.
- B. Pipes shall be drained and water properly disposed prior to capping.
- C. Open ends of pipes to be abandoned shall be capped with concrete plugs. See ReWa standard drawings for additional pipe capping details.



3.4 SALVAGED PARTS

- A. Developer/Contractor to notify Owner of all grates, rings, covers, and other steel/metal components of removed or abandoned structures. Owner will determine if items are to be salvaged and delivered to their yards or be disposed of legally by Developer/Contractor.

END OF SECTION 02 22 26

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Work Included: Provide cast-in-place concrete, including formwork and reinforcement, where shown on the Drawings, as specified herein, and as needed for a complete and proper installation.
- B. Related Work:
  - 1. Concrete mix designs provided on Structural Drawings or project specific specifications shall take precedence over these specifications.

### 1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.
- B. Reference Standards: Comply with the following codes, specifications and standards, except as otherwise shown or specified:
  - 1. American Concrete Institute (ACI) Publications:
    - a. ACI 301 Specification for Structural Concrete for Buildings
    - b. ACI 305 Recommended Practice for Hot Weather Concreting
    - c. ACI 306 Recommended Practice for Cold Weather Concreting
    - d. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures
    - e. ACI 318 Building Code Requirements for Reinforced Concrete
    - f. ACI 347 Recommended Practice for Concrete Framework
  - 2. American Society for Testing and Materials (ASTM) Publications:
    - a. A185 Welded Steel Wire Fabric for Concrete Reinforcement
    - b. A615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement
    - c. C31 Making and Curing Concrete Test Specimens in the Field
    - d. C33 Concrete Aggregates
    - e. C39 Compressive Strength of Cylindrical Concrete Specimens
    - f. C94 Ready-Mixed Concrete
    - g. C150 Portland Cement
    - h. C260 Air-Entraining Admixtures for Concrete
  - 3. Concrete Reinforcing Steel Institute (CRSI):
    - a. "Manual of Standard Practice"
  - 4. American Welding Society (AWS) Publication
    - a. D12.1-61 Welding Reinforcement Steel, Metal Inserts and Connections in Reinforced Concrete

- C. Testing Agency: A testing laboratory will be retained and paid for by the Owner to perform material evaluation tests required by these specifications.
- D. Qualifications of contractors performing concrete work: Minimum of two (2) years experience on comparable concrete projects.
- E. Plant Qualification: Plant equipment and facilities shall meet all requirements of the Check List for Certification of Ready Mixed Concrete Production Facilities of the National Ready Mixed Concrete Association and ASTM C94.

### 1.3 SUBMITTALS

- A. Comply with the pertinent provisions of Section 01 33 00 Submittal Procedures.
- B. Proportions of proposed mix shall be determined by means of laboratory tests of concrete made with the cement and aggregate proposed for use.
- C. Provide report in detail from an approved testing laboratory showing 7-day and 28-day strengths obtained using materials proposed.
- D. Required average strength above specified strength:
  - 1. Determinations of required average strength above specified strength ( $f'c$ ) shall be in accordance with ACI 318 and ACI 301.
  - 2. Establish the required average strength of the design mix using the materials proposed to be employed. Standard deviations shall be determined by thirty tests. Average strength used for selecting proportions shall exceed specified strength ( $f'c$ ) by at least:

400 psi	Standard deviation is less than 300
550 psi	Standard deviation is 300 to 400
700 psi	Standard deviation is 400 to 500
900 psi	Standard deviation is 500 to 600
1200 psi	Standard deviation is above 600 or unknown
  - 3. When the ready-mix producer does not have a record of past performance, the combination of materials and the proportions selected shall be selected from trial mixes having proportions and consistencies suitable for the work using at least three (3) different water/cement ratios which will produce a range of strengths encompassing those required.
  - 4. Cost of this work shall be borne by the Contractor.
- E. Manufacturer's Data: Submit manufacturer's specification with application instructions for proprietary materials and items, including curing compound, form release agents, admixtures, patching compounds, and others as required by the Engineer.
- F. Shop drawings: Submit the following shop drawings to the Engineer for approval before work is started.

1. Reinforcing Steel Drawings: Refer to structural drawings for reinforcing steel requirements. Prepare in accordance with ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, dimensions and details of bar reinforcing and accessories.

## PART 2 - PRODUCTS

### 2.1 FORMS

- A. Use form materials conforming to ACI 347.
- B. Form Lumber: Use lumber of sufficient quality and grade, size and stiffness to adequately support the work and ensure dimensional accuracy.
- C. Form Ties: Use form ties which do not leave an open hole through the concrete and which permit neat and solid patching at every hole.
  1. Use ties with cones that allow a 1" break back and facilitate patching.
  2. On structures containing water or other liquid or below grade structures, use embedded rod ties with integral water stops in addition to cones.
  3. Wire ties and wood spreaders will not be permitted.
- D. Form Coatings: Form release coating shall be neat oil with surface wetting agent or chemical release agent which effectively prevents absorption of moisture, prevents bonding with concrete, is non-staining to concrete and leaves the concrete with a paintable surface.
  1. On surfaces to receive an applied coating, use a residual free chemical form release agent which is compatible with the applied coating and will not prevent the applied finish from satisfactorily bonding to the concrete.
- E. Chamfer Strips: Chamfer strips shall be wood or polyvinyl strips or approved equal, designed to be nailed in the forms to provide a 3/4" chamfer (unless indicated otherwise) at all exposed edges and corners of concrete members.

### 2.2 REINFORCEMENT

- A. Comply with the following as minimums:
  1. Bars: ASTM A615, Grade 60, unless otherwise shown on the drawings, using deformed bars for Number 3 and larger.
  2. Welded Wire Fabric: ASTM A185.
    - a. Use sheet (mat) welded wire fabric only.
    - b. Welded wire fabric supplied in rolls will not be accepted.
  3. Bending: ACI 315 and ACI 318.

- B. Fabricate reinforcement to the required shapes and dimensions, within fabrication tolerances stated in the CRSI "Manual of Standard Practices".
- C. Do not use reinforcement having any of the following defects:
  - 1. Bar lengths, depths, or bends exceeding the specified fabricating tolerances.
  - 2. Bends or kinks not indicated on the Drawings or required for this work.
  - 3. Bars with excessive rust, scale, dirt, oil or other defects which will reduce the bond or the effective cross section of the bar.
- D. Furnish all support bars, tie bars, chairs, bolsters, etc. required for properly supporting and spacing bars in the forms.
  - 1. For slabs on grade, use supports with stand plates or horizontal runners where wetted base materials will not support chair legs. Other supports must be approved by the Engineer.
  - 2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are hot-dip galvanized, plastic protected or stainless steel.
  - 3. Supply supports for welded wire fabric as follows:

Welded Wire Reinforcement (diameter)	Welded Wire Spacing (inches)	Maximum Support Spacing (feet)
W9 or larger	12 and greater	4
W5 to W8	12 and greater	3
W9 and larger	Less than 12	3
W4 to W8	Less than 12	2
Less than W4	Less than 12	1.5

- E. Tie Wire: FS QQ-W-461, annealed steel, black, 16 gauge minimum.
- F. Welding Electrodes: AWS A5.1, low hydrogen, E70 series.
- G. Splice Devices: Shall be sized to develop one hundred twenty-five (125%) percent of yield strength of bar.

2.3 CONCRETE MATERIALS

- A. Cement: Use Portland Cement: ASTM C150, Type I, Type I-P or Type II, low alkali.
  - 1. Where concrete will be exposed to sewage, use Type II or I-P cement.
  - 2. Fly ash shall conform to ASTM C618, Class C or F.
  - 3. Fly ash content shall not exceed 20% by weight of the total amount of cementations materials (Portland cement plus fly ash).
- B. Aggregates:
  - 1. Fine Aggregate: Conform to ASTM C33.
  - 2. Coarse Aggregate: Conform to ASTM C33, Size #57.

- C. Water: Clean and potable and free from injurious amounts of deleterious materials.
- D. Admixtures
  - 1. Air entraining admixture: ASTM C260.
  - 2. Water reducing, set controlling admixture: Conform to ASTM C494.
    - a. Type A - water reducing.
    - b. Type D - water reducing and retarding.
  - 3. Superplasticizers: Conform to ASTM C494, Types F and G.
    - a. Use superplasticizers in thin section placements and in areas of congested reinforcing and/or embedded items, or where otherwise approved by the Engineer.
    - b. Use where conventional consolidation techniques are impractical.
  - 4. Do not use admixtures containing calcium chloride.
- E. Fiber Reinforcing
  - 1. Use fiber reinforcing where indicated on the drawings.
  - 2. Provide polypropylene or co-polymer fibers as manufactured by High Tech Fibers, Inc., Fibermesh Company or an approved equal.
  - 3. Where required, use fiber reinforcing at a rate of 2.0 lbs. per cubic yard unless another rate is indicated on the drawings.
- F. Curing Compounds
  - 1. On all vertical and formed surfaces, construction joints, basin slabs, surfaces to receive an applied coating or finish, and other surfaces except as otherwise indicated or specified, use a non-residual, non-staining curing compound conforming to ASTM C309 Type 1 and 1D. Acceptable products are:
    - a. L&M Cure by L&M Construction Chemicals, Inc.
    - b. Horn WB-75 by A.C. Horn Company.
    - c. Sonosil by Sonneborn, Inc.
    - d. Approved equal.
  - 2. On building floor slabs not otherwise receiving an applied coating or finish and on other flatwork as indicated on the Drawings, provide an acrylic copolymer curing and sealing compound conforming to ASTM C309 Type 1 and the following:
    - a. Non-yellowing.
    - b. Minimum 20% solids.
    - c. Maximum unit moisture loss in accordance with ASTM C156 - 0.40 kg./sq.m at 72 hours.
    - d. Acceptable products are Dress & Seal by L&M Construction Chemicals, Inc., Clear Seal Standard by A. C. Horn Company, Kure-N-Seal 0800 by Sonneborn, Inc., or approved equal.

## 2.4 CONCRETE MIXES

- A. Provide concrete with the compressive strengths shown on the drawings. When such strengths are not shown on the drawings, provide the following 28-day strengths as minimum:

All structural concrete unless otherwise indicated on the Drawings:	4000 psi
All sidewalks, curbs and gutters, and unreinforced foundations:	3000 psi
Thrust blocking, backfill or encasement for piping, and concrete fill:	2500 psi
Prestressed or precast concrete:	5000 psi

- B. Maximum Water Cement Ratios

4000 psi concrete	0.5
3000 psi concrete	0.53
2500 psi concrete	0.67

- C. Entrained Air

3000 and 4000 psi concrete	5% ± 1%
2500 psi concrete	Not Required

- D. Slump

3000 and 4000 psi concrete	4" ± 1"
2500 psi concrete	5" ± 1"

- E. Production of Concrete

1. General: Concrete shall be ready mixed and shall be batched, mixed and transported in accordance with ASTM C94 except as otherwise indicated.
2. Monitor time and mix proportions by plant delivery slips.
3. Air Entraining Admixtures: Add air-entraining admixture into the mixture as a solution and measure by means of an approved mechanical dispensing device.
4. Water reducing and retarding admixture: Add water reducing and retarding admixture and measure as recommended by the manufacturer.
5. Addition of water to the mix upon arrival at the job site shall not exceed that necessary to compensate for a 1" loss in slump, nor shall the design maximum water-cement ratio be exceeded. Water shall not be added to the batch at any later time.
6. Weather Conditions: Control temperature of mix as required by ACI 306 "Cold Weather Concreting" and by ACI 305 "Hot Weather Concreting".

## PART 3 - EXECUTION

### 3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
- B. Water, mud, organic, and other detrimental material shall be removed from excavations before concrete is deposited.

- C. Notify the Engineer prior to placing concrete and place no concrete until the formwork, reinforcing and embedded items have been inspected by the Engineer.

### 3.2 FORMWORK

#### A. General

1. Construct forms in conformance with ACI 347.
2. Design, erect, support, brace and maintain formwork so it will safely support vertical and lateral loads which might be applied until such loads can be supported safely by the concrete structure.
3. Construct forms to the exact sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb work in the finished structure.
4. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and prevent fins.

#### B. Form Construction and Erection

1. Construct forms in conformance with ACI 347.
2. Provide for openings, offsets, keyways, recesses, moldings, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts and other embedded items as required.
3. Hold inner and outer forms for vertical concrete together with combination steel ties and spreaders approved by the Engineer.
4. Unless specifically stated otherwise, provide 3/4" chamfer at all exposed edges of concrete.
5. Provide temporary openings in the formwork where necessary to facilitate cleaning and inspection of the formwork.
6. Coat form contact surfaces with approved form coating compound prior to placing reinforcing steel.
7. Do not allow excess form coating material to accumulate in the forms or to come in contact with reinforcing surfaces which will bond to fresh concrete.
8. Side forms for footings may be omitted, and concrete may be placed directly against excavation only when requested by the Contractor and approved by the Engineer.
9. Provide a positive means of adjustment of shores and struts and ensure that all settlement is taken up during concrete placing.
10. Construct blockouts and formed openings of sufficient size and proper location to permit final alignment of items within it or passing through it.
  - a. Allow sufficient space for grouting, packing or sealing around any items penetrating the opening as may be required to ensure watertightness.
  - b. Provide openings with continuous keyways with waterstops where required, and provide a slight flare to facilitate grouting and the escape of entrapped air during grouting.
  - c. Provide only blockouts or openings that are shown on the drawings or otherwise approved by the Engineer.

- C. Formwork Reuse: Reuse only forms that are in good condition and which maintain a uniform surface texture on expose concrete surfaces.



1. Apply a light sanding as necessary to obtain a uniform texture.
2. Plug unused tie holes and penetrations flush with the form surface.

D. Removal of Forms

1. Do not disturb or remove forms until the concrete has hardened sufficiently to permit form removal with complete safety. Do not remove shoring until the member has acquired sufficient strength to support its own weight, the load upon it, and the added load of construction.
2. Do not remove forms before the following minimum times without prior approval from the Engineer:

a. Sides of footings or slabs on grade	24 hrs
b. Walls not supporting load	48 hrs
c. Vertical sides of beams	48 hrs
d. Columns not supporting load	48 hrs
e. Suspended slabs or beam bottoms (forms only)	10 days
3. In determining the minimum stripping times, consider only the cumulative time during which the ambient temperature of the air surrounding the concrete is above 50°.
4. Do not remove shoring for suspended slabs or beams until the concrete has reached 75% of the specified 28-day strength.
5. When reshoring or backshoring is permitted or required, plan the operations in advance and submit procedures to the Engineer for approval.
  - a. Design and plan all reshoring operations to support all construction loading and in accordance with ACI 347.
6. Exercise care in removing forms from finished concrete surfaces so that surfaces are not marred or gouged and that corners are true, sharp and unbroken.
7. Do not permit steel spreaders, form ties, or other metal to project from or be visible on any concrete surface except where so shown on the drawings.
8. Whenever the formwork is removed during the curing period, continue to cure the exposed concrete by one of the methods specified herein.

3.3 EMBEDDED ITEMS

- A. Embedded Items: Set anchor bolts and other embedded items accurately and securely in position in the forms until the concrete is placed and set.
  1. Use templates where practical for all anchor bolts.
  2. Check locations of all anchor bolt and special castings prior to placing concrete and verify locations after concreting.
- B. Piping Cast in Concrete
  1. Install and secure sleeves, wall pipes and pipe penetrations before placing concrete.
  2. Do not weld or otherwise attach piping to reinforcing steel.
  3. Support piping to be encased in concrete securely and on firm foundation so as to prevent movement or settlement during concreting.

- C. Locate electrical conduit so that it will not impair the strength of the construction.
  - 1. Do not use conduits running within (not passing through) a slab, wall or beam that are larger in outside diameter than 1/2" the overall concrete thickness unless otherwise approved by the Engineer.
  - 2. Do not space conduits closer than three conduit diameters apart unless otherwise approved by the Engineer.

### 3.4 REINFORCEMENT

- A. General: Comply with the specified codes and standards and Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars" for details and methods of reinforcement placement and supports and as herein specified.
  - 1. Clean reinforcement and remove loose dust and mill scale, earth, and other materials which reduce or destroy bond with concrete.
  - 2. Position and secure reinforcement against displacement by forms, construction, and the concrete placement operations.
  - 3. Use adequate number of ties to secure reinforcing.
  - 4. Do not weld or field bend reinforcing without prior approval by the Engineer.
- B. Placing Reinforcing
  - 1. Provide and install all chairs, runners, bolsters, standees and other accessories in sufficient quantities to satisfactorily position the reinforcing and hold it in place during concrete placement.
  - 2. Support reinforcing for slabs on ground on chairs or bolsters with stand plates or a properly sized concrete cube.
    - a. Use concrete bricks as supports only as approved by the Engineer.
  - 3. Secure and tie dowels in place prior to placing concrete. Do not press dowels into wet concrete.
- C. Concrete Cover: Unless otherwise indicated on the drawings or specified herein, install reinforcing with clear concrete coverage in conformance with ACI 318.
  - 1. All reinforcement, regardless of size, exposed to water or sewage shall have 2" cover.
  - 2. Place reinforcement a minimum of 2" clear of any openings or metal pipe or fittings.
- D. Splicing Reinforcement: Splice reinforcement steel in accordance with the latest revisions of ACI 318 "Building Code Requirements for Reinforced Concrete" unless shown otherwise on the drawings.
  - 1. All splices at wall corners or intersections and at wall and foundation intersections shall be Class B tension splices.
  - 2. All other splices of vertical or horizontal steel in walls shall be Class B tension splices as per ACI 318.

3. Horizontal ring steel in circular, non-prestressed concrete tanks shall be Class B tension splices and the splices shall be staggered so that no more than 50% of the bars are spliced at any one location.
  4. All welded or mechanical splicing devices shall develop 125% of the yield strength of the bar.
  5. Column vertical bars shall lap 30 bar diameters with dowels at the base of the column unless otherwise noted. Dowels shall be the same size and quantity as column vertical bars unless otherwise noted.
  6. All splices not otherwise shown or specified shall be Class B tension lap splices.
- E. Tolerances: Place bars in the locations indicated within the tolerances conforming to the CRSI "Manual of Standard Practice".
- F. Welded Wire Mesh: Install welded wire fabric in as long of a length as practicable and lay flat before placing concrete.
1. Use only mat welded wire fabric. Do not use welded wire fabric from rolls.
  2. Support and tie mesh to prevent movement during concrete placement.
  3. Lap adjoining pieces at least one full mesh and lace splices with wire.
  4. Provide, at a minimum, supports for welded wire fabric according to the Table in Section 2.2.D.3. Confirm the adequacy of the support spacings listed therein for the anticipated construction loads. Increase the number of supports, if necessary, to assure that the final position of the welded wire fabric will conform to that shown on the drawings.
  5. Do not place welded wire fabric on the subbase surface and then hook or "pull up" the reinforcement during concrete placement.
  6. Do not lay welded wire fabric on top of the freshly placed concrete and then "walk it" into place.

### 3.5 PLACING CONCRETE

#### A. Preparation

1. Remove foreign matter accumulated in the forms.
2. Rigidly close openings left in the formwork.
3. Wet wood forms sufficiently to tighten up cracks. Wet other material sufficiently to maintain workability of the concrete.
4. Use only clean tools.
5. Provide and maintain sufficient tools and equipment on hand to facilitate uninterrupted placement of the concrete.
6. Before commencing concrete, inspect and complete installation of formwork, reinforcing steel and all items to be embedded or cast-in.

#### B. Conveying

1. Transport and handle concrete from the truck to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients to maintain the quality of the concrete.
2. Provide equipment for lifting, dumping, chuting, pumping or conveying the concrete, of such size and design as to insure a practically continuous flow of concrete at the delivery and without separation of materials.

3. Use hoppers and elephant trunks where necessary to prevent the free fall of concrete for more than 8'.
4. Do not use concrete that is not placed within 1 1/2 hours after water is first introduced into the mix unless the slump is such that it meets the specified limits without the addition of water to the batch.

C. Placing

1. Deposit concrete as nearly as practicable in its final location so as to avoid separation due to rehandling and flowing.
2. Deposit concrete in horizontal layers not deeper than 2', avoiding inclined layers.
3. Place concrete at such a manner that concrete upon which fresh concrete is deposited is still plastic.
4. Bring slab surfaces to the correct level with screeds set to the proper elevation.

D. Hot Weather Placement: Place concrete in hot weather in accordance with ACI 305 "Hot Weather Concreting" and as specified herein.

1. Do not place concrete whose temperature exceeds 100°F.
2. Thoroughly wet forms and reinforcing prior to placement of concrete.
3. Use additional set retarder as necessary to increase set time.
4. Limit the size of the pour where it may reduce the likelihood of cold joints due to reduced set time.
5. Shade the fresh concrete as soon as possible after placing.
6. Start curing as soon as the concrete is sufficiently hard to permit without damage.

E. Cold Weather Placement: Place concrete in cold weather in accordance with ACI 306 and as specified herein.

1. Except when authorized specifically by the Engineer, do not place concrete when the atmospheric temperature is below 40°F.
2. When cold weather placement is approved by the Engineer, heat either the mixing water or aggregate or both so that the concrete temperature is between 65°F and 85°F.
3. Protect the freshly placed concrete by adequate housing or covering and provide heat to maintain a temperature of not less than 50°F for not less than four days.
4. Do not add salts, chemicals, or other materials to the concrete mix to lower the freezing point of the concrete.

F. Consolidation

1. Consolidate each layer of concrete immediately after placing, by use of internal concrete vibrators supplemented by hand spading, rodding, or tamping.
  - a. Use vibrators having a 2" head diameter and a minimum frequency of 8000 vibrations per second.
  - b. Provide sufficient number of vibrators to properly consolidate the concrete, keeping up with placement operations.
  - c. Provide at least one spare vibrator on site.
2. Insert and withdraw vibrators at points approximately 18" apart.
3. Do not vibrate forms or reinforcement.
4. Do not use vibrators to transport concrete inside the forms.

### 3.6 PROTECTION

- A. Protect the surface finish of newly placed concrete from damage by rainwater or construction traffic.
- B. Do not apply design loads to structures until the concrete has obtained the specified strength.
  - 1. Do not backfill against walls until they have reached the specified strength and all supporting or bracing walls, slabs, etc. have also reached the specified strength, unless otherwise permitted by the Engineer.
  - 2. Protect structures from construction overloads.

### 3.7 CURING

- A. Beginning immediately after placement, protect concrete from premature drying, excessively hot and cold temperatures and mechanical injury.
- B. Continuously cure concrete for a period of not less than 7 days after placement.
  - 1. When seven-day cylinder breaks indicate, in the opinion of the Engineer, the possibility of low strength concrete, provide additional curing as per the request of the Engineer.
  - 2. When temperatures during the curing period fall below 40°F, provide additional curing time as directed by the Engineer.
- C. Unless otherwise directed by the Engineer, cure concrete not in contact with forms in accordance with one of the following procedures:
  - 1. Ponding or Sprinkling: Keep entire concrete surface wet by continuously sprinkling or by allowing water to pond, covering all surfaces.
  - 2. Wet Burlap: Thoroughly wet and cover all concrete surfaces with wet burlap mats as soon as the concrete has set sufficiently to avoid marring the surface.
    - a. Keep the burlap continuously wet during the curing period.
  - 3. Curing Blankets: Thoroughly wet concrete surfaces to be cured and cover with curing blankets as soon as the concrete has set sufficiently to avoid marring the surface.
    - a. Weight the blankets down to maintain close contact with the concrete surface.
    - b. Use sheets of waterproof Kraft paper with the joints between sheets taped continuously; or
    - c. Use sheets of 4 mil or thicker polyethylene with the joints between sheets continuously taped.
  - 4. Wet Sand: Apply a layer of sand over the entire surface and keep it continuously wet.
  - 5. Curing Compound: Apply curing compound immediately after completion of the finish on unformed surfaces and within two hours after removal of forms on formed surfaces.
    - a. Spray the entire surface with two coats of liquid curing compound, applying the second coat in the direction of 90° to the first coat.
    - b. Apply compound in accordance with the manufacturer's instructions to cover the surface with a uniform film which will seal thoroughly.

- D. Hot Weather: When necessary, provide wind breaks, shading, fog spraying, sprinkling, ponding or wet covering with a light colored material applying as quickly as concrete hardening and finishing operations will allow.

### 3.8 CONCRETE FINISHING

- A. Finish Schedule: Unless otherwise indicated on the drawings, finish all concrete surfaces in accordance with the following schedule:
1. Form Finish: Formed surfaces not ordinarily exposed to view, including:
    - a. Interior walls of open tanks below a line one foot lower than the lowest normal water level.
    - b. The underside of slabs not exposed to view.
    - c. Walls below grade.
  2. Cementations Coating: All formed surfaces exposed to view including:
    - a. Interior walls of tanks above a line one foot lower than the lowest normal water level.
    - b. The underside of slabs, soffits, etc. exposed to view.
  3. Float Finish: Slab surfaces not exposed to view or not receiving an applied thin finish, including:
    - a. Bottom slabs of tanks or structures containing water sewage or other liquid.
    - b. Foundations not exposed to view.
    - c. Roof slabs to be covered with insulation and/or built-up roofing.
  4. Trowel Finish: Interior slab surfaces exposed to view or to receive an applied thin film coating or floor finish, including:
    - a. Interior, indoor slabs and floors of buildings.
    - b. Surfaces on which mechanical equipment moves.
    - c. Floors receiving vinyl tile, resilient flooring, carpet, paint, etc.
  5. Broom Finish: Exterior, outdoor slabs exposed to view including:
    - a. Outdoor floor slabs and walkways.
    - b. Other floors which may become wet or otherwise require a non-skid surface.
    - c. Sidewalks and concrete pavements.
  6. Scratch Finish: Surfaces which are to receive a thick topping or additional concrete cast against them including:
    - a. Surfaces receiving concrete equipment pads.
    - b. Floors receiving concrete topping.
    - c. Construction joints not otherwise keyed.
  7. Edge Finish: Exposed edges of slabs not receiving chamfer including:
    - a. Sidewalk edges and joints.
    - b. Pavement edges and joints.
    - c. Other slab edges not chamfered.
- B. Finishing Procedures

1. Form Finish
  - a. Repair defective concrete.
  - b. Fill depressions deeper than 1/2".
  - c. Fill tie holes.
  - d. Remove fins exceeding 1/2" in height.
  
2. Cementations Finish
  - a. Patch all tie holes and defects and remove all fins.
  - b. Within one day of form removal, fill all bug holes, wet the surfaces and rub with carborundum brick until a uniform color and texture are produced; or
  - c. Dampen surfaces, brush apply a grout slurry consisting of 1 part portland cement to 1 1/2 parts sand, and rub the surface vigorously with a stone. Remove all excess grout.
  
  - d. Provide a two coat cement base waterproofing, sealing finish of Thoroseal and Thoroseal Plaster Mix as manufactured by Standard Dry Wall Products, Inc. or an approved equal.
    - 1) Patch all tie holes and defects and removal all fins, and clean surface of all dirt, laitance, grease, form treatments, curing compounds, etc.
    - 2) Key coat: Apply key coat of Thoroseal at a rate of two (2) lbs. per sq.yd. by fiber brush. Mix material using one part of Acryl 60 to three parts clean water. Should material start to drag during application, dampen surface with water. During hot weather periods, dampen surfaces with water prior to application of key coat material. Key coat shall be allowed to cure for five (5) days before applying finish coat.
    - 3) Apply a finish coat consisting of a four (4) to six (6) lbs. per sq.yd. application of Thoroseal Plaster Mix using steel trowel or spray gun. Color shall be pearl gray unless otherwise noted. Mix dry material using one (1) part Acryl 60 to three (3) parts clean water. Firmly press the mix into all voids and level with a steel trowel. When surface is set so that it will not roll or lift, float it uniformly using a sponge float.
  
3. Float Finish
  - a. Begin floating when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation.
  - b. Cut down all high spots and fill all low spots and float the slab to a uniform sandy texture.
  
4. Trowel Finish
  - a. Float finish as specified herein.
  - b. Power trowel to a smooth surface free of defects.
  - c. After the surface has hardened sufficiently, hand trowel until a ringing sound is produced as the trowel is moved over the concrete surface.
  
5. Broom Finish
  - a. Float finish as specified herein.
  - b. Provide a scored texture by drawing a broom across the surface.
  
6. Scratch Surface
  - a. Screed the surface to the proper elevations.
  - b. Roughen with rakes or stiff brushes.

7. Edge Finish: Tool slab edges and joints with a 3/8" radius edging tool.

### 3.9 SURFACE REPAIR

#### A. Patching Mortar

1. Make a patching mortar consisting of 1 part Portland cement to 2 1/2 parts sand by damp loose volume.
2. Mix the mortar using one part acrylic bonding admixture to two parts water.

#### B. Tie Holes: Clean and dampen all tie holes and fill solidly with patching mortar.

#### C. Surface Defects

1. Remove all defective concrete down to sound solid concrete.
2. Chip edges perpendicular to the concrete surface or slightly undercut, allowing no feather edges.
3. Dampen surfaces to be patched.
4. Patch defects by filling solidly with repair mortar.

#### D. Allow the Engineer to inspect the work before placing the patching mortar.

#### E. Repair defective areas greater than 1 sq.ft. or deeper than 1 1/2" as directed by the Engineer using materials approved by the Engineer at no additional expense to the Owner.

### 3.10 JOINTS

#### A. Construction Joints

1. Unless otherwise approved by the Engineer, provide construction joints as shown on the drawings.
2. If additional construction joints are found to be required, secure the Engineer's approval of joint design and location prior to start of concrete placement.
3. Continue all reinforcing across construction joints and provide 1 1/2" deep keyways unless indicated otherwise on the drawings.
  - a. Form keyways in place.
4. Provide water stops in all construction joints of liquid containing structures, structures below grade or other structures as shown on the drawings.

#### B. Expansion Joints

1. Provide expansion joints of size, type and locations as shown on the drawings.
2. Do not permit reinforcement or other embedded metal items that are being bonded with concrete (except smooth dowels bonded on only one side of the joints, where indicated on the drawings) to extend continuously through any expansion joint.
3. Provide water stops where required.



C. Control or Contraction Joints

1. Locate and construct control and contraction joints in accordance with the drawings.
2. Where no specific joint pattern is indicated in slabs on grade or concrete pavements, submit a proposed joint layout to the Engineer for approval.
3. Where no specific joint details are shown on the drawings, joints may be tooled, pre-formed or saw-cut.
4. Saw-cut joints as soon as the concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw.

3.11 FIELD QUALITY CONTROL

A. Concrete Cylinder Tests

1. During construction, prepare test cylinders for compressive strength testing, using 6" diameter by 12" long single use molds, complying with ASTM C31.
  - a. Make a set of three test cylinders from each pour of 50 cubic yards or less, plus one additional set of cylinders for each additional 50 cubic yards or fraction thereof.
  - b. Identify each and tag cylinder as to date of pour and location of concrete which it represents.
  - c. Deliver cylinders to testing lab selected by the Owner.
  - d. Cost for preparation, delivery and testing of cylinders shall be borne by the by the Owner. Costs associated with re-testing failed tests shall be borne by the Contractor.
2. Should strengths shown by test cylinders fail to meet specified strengths for the concrete represented, then:
  - a. Engineer shall have the right to require changes in the mix proportions as he deems necessary on the remainder of the work.
  - b. Additional curing of those portions of the structure represented by the failed test cylinders shall be accomplished as directed by the Engineer.
  - c. Upon failure of the additional curing to bring the concrete up to specified strength requirements, strengthening or replacement of those portions of the structure shall be as directed by the Engineer.
  - d. The Engineer may require additional testing of concrete in question by either non-destructive methods such as the Swiss Hammer, Windsor Probe or Ultrasonics or by coring and testing the concrete in question in accordance with ASTM C42. Such testing shall be performed at no additional cost to the Owner.

B. Other Field Concrete Tests

1. Slump tests: Either the Engineer or a testing laboratory representative will make slump tests of concrete as it is discharged from the mixer.
  - a. Slump test may be made on any concrete batch at the discretion of the Engineer.
  - b. Failure to meet specified slump requirements (prior to addition of any superplasticizers) will be cause for rejection of the concrete.
2. Temperature: The concrete temperature may be checked at the discretion of the Engineer.

3. Entrained Air: Air content of the concrete will be checked by a representative of the testing laboratory at the discretion of the Engineer.
- C. Coordination of Laboratory Services: The Contractor shall be responsible for coordination of laboratory services.
1. Maintain a log recording quantities of each type of concrete placed, date and location of pour.
  2. Inform the testing laboratory of locations and dates of concrete placement and other information as required to be identified in the laboratory's test reports.
- D. Tests required because of extensive honeycombing, poor consolidation of the concrete or any suspected deficiency in the concrete will be paid for by the Contractor.
- E. Dimensional Tolerances
1. Dimensional tolerances for allowable variations from dimensions or locations of concrete work, including the locations of embedded items shall be as given in ACI 301.
  2. Where anchor bolts or other embedded items are required for equipment installation, comply with the manufacturer's tolerances if more stringent than those stated in ACI 301.
- F. Watertight Concrete
1. All liquid containing structures, basements or pits below grade shall be watertight.
  2. Any visible leakage or seepage shall be repaired as instructed by the Engineer at no expense to the Owner.
  3. Where physical evidence of honeycombing, cold joints or other deficiencies which may impair the watertightness of a structure exists, the Engineer may at his discretion call for leak testing of the structure.
    - a. Fill the structure with water and allow to stand for not less than 48 hours.
    - b. Make repairs on the structure until all visible leaks are sealed and the leakage rate of the water in the structure is less than 0.1% of the volume held in the structure per day.
    - c. The cost of testing and repairs shall be performed at no expense to the Owner.
- G. Concrete which fails to meet strength requirements, dimensional tolerances, watertightness criteria, or is otherwise deficient due to insufficient curing, improper consolidation or physical damage shall be replaced or repaired as instructed by the Engineer at no expense to the Owner.

END OF SECTION 03 30 00

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## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Portland cement grout.
2. Rapid-curing epoxy grout.
3. Non-shrink cementitious grout.

#### B. Related Requirements:

1. Section 03 30 00 - Cast-in-Place Concrete: Cast-in-place or in-situ concrete for structural building frames, slabs on fill or grade, and other concrete components.

### 1.2 REFERENCE STANDARDS

#### A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete for Buildings.
2. ACI 318 - Building Code Requirements for Structural Concrete.

#### B. ASTM International:

1. ASTM C33 - Standard Specification for Concrete Aggregates.
2. ASTM C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
3. ASTM C150 - Standard Specification for Portland Cement.
4. ASTM C191 - Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle.
5. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
6. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
7. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
8. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.

#### C. U. S. Army Corps of Engineers Concrete Research Division (CRD):

1. CRD-C621 - Non-Shrink Grout.

### 1.3 SUBMITTALS

#### A. Product Data: Submit manufacturer information regarding grout.

- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Manufacturer Instructions: Submit instructions for mixing, handling, surface preparation, and placing epoxy-type and non-shrink grouts.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

#### 1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years' experience.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 66 00 – Materials Storage Handling and Protection
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

### PART 2 - PRODUCTS

#### 2.1 PORTLAND CEMENT GROUT

- A. Portland Cement: Comply with ASTM C150, Type I and II.
- B. Water:
  - 1. Potable.
  - 2. No impurities, suspended particles, algae, or dissolved natural salts in quantities capable of causing:
    - a. Corrosion of steel.
    - b. Volume change increasing shrinkage cracking.
    - c. Efflorescence.
    - d. Excess air entraining.

- C. Fine Aggregate:
  - 1. Washed natural sand.
  - 2. Gradation:
    - a. Comply with ASTM C33.
    - b. Represented by smooth granulometric curve within required limits.
  - 3. Free from injurious amounts of organic impurities according to ASTM C40.
- D. Mix:
  - 1. Portland cement, sand, and water.
  - 2. Do not use ferrous aggregate or staining ingredients in grout mixes.

## 2.2 NON-SHRINK CEMENTITIOUS GROUT

- A. Manufacturers:
  - 1. Sika Corporation, Quickrete, Euclid Chemical or equal.
  - 2. Furnish materials according to manufacturer standards.
- B. Description:
  - 1. Pre-mixed and ready-for-use formulation requiring only addition of water.
  - 2. Non-shrink, non-corrosive, non-metallic, non-gas forming, and no chlorides.
- C. Performance and Design Criteria:
  - 1. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to CRD-C621 for Type D non-shrink grout:
    - a. Setting Time:
      - 1) Initial: Approximately two hours.
      - 2) Final: Approximately three hours.
      - 3) Comply with ASTM C191.
    - b. Maximum Expansion: 0.10 to 0.40 percent.
    - c. Compressive Strength:
      - 1) One-Day: 4,000 psi.
      - 2) Seven-Day: 7,000 psi.
      - 3) 28-Day: 10,000 to 10,800 psi.
      - 4) Comply with CRD-C621.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify areas to receive grout with Engineer.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Remove defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces by brushing, hammering, chipping, or other similar means until sound and clean concrete surface is achieved.
- C. Roughen concrete lightly, but not to interfere with placement of grout.
- D. Remove foreign materials from metal surfaces in contact with grout.
- E. Align, level, and maintain final positioning of components to be grouted.
- F. Saturate concrete surfaces with clean water, and then remove excess water.
- G. Follow manufacturer's requirements for specific weather and temperature conditions.

### 3.3 INSTALLATION

- A. Formwork:
  - 1. Construct leakproof forms anchored and shored to withstand grout pressures.
  - 2. Install formwork with clearances to permit proper placement of grout.
  - 3. As specified in Section 03 10 00 - Concrete Forming and Accessories.
- B. Mixing:
  - 1. Portland Cement Grout:
    - a. Use proportions of two parts sand and one part cement, measured by volume.
    - b. Prepare grout with water to obtain consistency to permit placing and packing.
    - c. Mix water and grout in two steps:
      - 1) Premix using approximately 2/3 of water.
      - 2) After partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing two to three minutes.

- d. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
  - e. Do not add additional water after grout has been mixed.
  - f. Minimum Compressive Strength: 2,000 psi in 28 days.
2. Non-shrink Cementitious Grout:
    - a. Mix and prepare according to manufacturer instructions.
    - b. Minimum Compressive Strength: 10,000 psi in 28 days.
    - c. When 2" or less clearance provide only grout and water.
    - d. Where clearance/depth is greater than 2" addition of stone is allowed in accordance with manufacturer's recommendations.
    - e. Strictly follow manufacturer's recommendations for adding water.
    - f. Mechanically mix in accordance with manufacturer's recommendations.
    - g. Retempering of grout is not permitted.
  3. Mix grout components in proximity to Work area and transport mixture quickly and in manner not permitting segregation of materials.

C. Placing of Grout:

1. Place grout material quickly and continuously.
2. Do not use pneumatic-pressure or dry-packing methods.
3. Apply grout from one side only to avoid entrapping air.
4. Do not vibrate placed grout mixture or permit placement if area is being vibrated by nearby equipment.
5. Thoroughly compact final installation and eliminate air pockets.
6. Do not remove leveling shims for at least 48 hours after grout has been placed.
7. After shims have been removed, fill voids with grout.

D. Curing:

1. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or by using wet burlap method.
2. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
3. After grout has attained its initial set, keep damp for minimum three days.

### 3.4 FIELD QUALITY CONTROL

A. Testing:

1. Comply with ACI 318.
2. Submit proposed mix design to Engineer of Record for review prior to commencement of Work.
3. Tests of grout components may be performed to ensure compliance with specified requirements in ACI 318.



END OF SECTION 03 60 00

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. The contractor shall provide electrical equipment and materials as shown on the plans and as specified herein, including all items which may be reasonably implied in order to provide a complete and operational system.
- B. All work shall be in accordance with the most current edition of the National Electric Code, as well as local inspection department requirements that has jurisdiction.
- C. All work must be performed using a licensed electrician.
- D. Obtain necessary permits and pay associated fees prior to starting work.
- E. Make necessary arrangements with the utility for power service and arrange for temporary power as required.

### 1.2 SUBMITTALS

- A. Shop Drawings shall be submitted for review and shall include the following:
  - 1. Materials list of items proposed to be provided under this Section.
  - 2. Manufacturer's specifications, other data and shop drawings needed to prove compliance with the specified requirements. Provide the following approval drawings:
    - a. Service Entrance Disconnect Switch
    - b. Main Breaker.
    - c. Automatic Transfer Switch
    - d. Manual Transfer Switch
    - e. Combination Power Center.
    - f. Wiring devices and cover plates.
    - g. Conduit and fittings.
    - h. Conductors.
    - i. Connectors.
    - j. Lighting fixtures.
    - k. Surge Suppression Device.
    - l. Test Instruments to be used for ground resistance test and insulation tests.
  - 3. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.
- B. Manual: Upon completion of this portion of the Work and as a condition of its acceptance, provide operation and maintenance manuals in accordance with these Specifications. Include within each manual:

1. Copy of the approved Record Documents for this portion of the Work indicating actual as-built conditions.
2. Copies of all circuit directories.
3. Copies of all warranties and guaranties.

### 1.3 WARRANTY

- A. Provide standard one (1) year warranty on all labor and materials.
- B. Provide a five (5) year warranty on all LED fixtures.
- C. Provide minimum five (5) year warranty on Surge Protection Devices, incorporating unlimited replacements of suppressor parts if destroyed by transients during the warranty period.
- D. Provide standard five (5) year parts and labor warranty on automatic transfer switch.

### 1.4 POWER SUPPLY

- A. Three phase power is required for all sites unless otherwise approved by ReWa.
- B. For pump stations utilizing pumps 20 hp and less, a 120/208 volt, 3 phase service shall be provided unless otherwise approved by ReWa.
- C. For pump stations utilizing pumps great than 20 hp, a 277/480 volt, 3 phase service shall be provided unless otherwise approved by ReWa.

## PART 2 - PRODUCTS

### 2.1 GENERAL

- A. Provide only materials that are new, of the type and quality specified. Where Underwriters' Laboratories, Inc. have established standards for such materials, provide only materials bearing the UL label. Materials called for are to be considered as standard that, however, implies no right on the part of the Contractor to substitute other materials and methods without written authority from the Engineer.

### 2.2 RACEWAYS

- A. Applicable Standards:
  1. ANSI C80.5: Rigid Aluminum Conduits.
  2. ANSI/NEMA FB1: Fittings and Supports for Conduit and Cable Assemblies.
  3. UL 651-2011: Schedule 40 PVC and schedule 80 Rigid PVC Conduit.
  4. UL 514B: Flexible conduit fittings.

5. NEMA FB 1: Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable.
  6. ASTM F512: Polyvinyl Chloride (PVC) Conduit.
  7. FS-WW-C-540C: Federal Specification for Rigid Aluminum Conduit.
  8. FS WW-C 566: Federal Specification for Flexible Metal Conduit.
- B. Provide conduit and fittings conforming to the above standards.
- C. Rigid aluminum conduit:
1. Provide threaded type fittings and form 8 conduit bodies with material to match conduit.
  2. Provide seal fittings for rigid aluminum conduit where indicated on the plans equal to Crouse-Hinds series EYSX. Provide sealing compound and fiber by Crouse-Hinds or approved equal:
    - a. Sealing Compound: Chico A.
    - b. Sealing Fiber: Chico X.
  3. Provide thread type fittings and conduit bodies with matching material.
  4. Provide standard aluminum electric conduit couplings
    - a. Do not use pipe couplings or sleeves.
  5. Provide aluminum fittings.
  6. Do not imbed aluminum conduit concrete containing chlorides, unwashed beach sand, sea water, or coral bearing aggregates without PVC coating, heat shrink or two coats of bitumastic.
  7. Use strap wrenches for tightening aluminum conduit.
    - a. Do not use Pipe wrenches, channel locks, chain wrenches, pliers, etc.
  8. Clean and coat all threads on aluminum conduit and fittings with “No-Oxide” compound before using.
  9. Completely cover Aluminum conduit installed in concrete or below grade with two (2) coats of bitumastic paint or PVC coating.
  10. Terminate aluminum conduit entering below grade pullboxes with grounding type bushings and connected to a 3/4" x 10" copperclad rod with a #6 bare copper wire.
  11. All risers from underground, concrete pads:
    - a. Provide heat shrink tubing (Raychem or equal), PVC coating or two coats of bitumastic paint to a point not less than 6 inches above grade or surface of slab.
- D. Provide watertight aluminum flexible conduit for flexible installations.
- E. Conduit/Cable supports – properties:
1. Provide aluminum supports for all exposed metallic conduit as manufactured by Unistrut or approved equal.

F. All conduits to conform to the following specifications:

1. Installations under concrete slab: Schedule 40 PVC
2. Exposed locations: Rigid aluminum conduit.
3. Installations in concrete-encased duct banks: Schedule 40 PVC.
4. Installations underground exposed to earth: Rigid aluminum conduit with PVC or other coating.

## 2.3 CONDUCTORS

A. Applicable standards:

1. NEMA WC 3: Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
2. NEMA WC 5: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
3. UL 44 – 2018: Rubber-Insulated Wires and Cables.
4. UL 83 – 2017: Thermoplastic-Insulated Wires and Cables.
5. UL 854 – 2004: Service Entrance Cables.

B. Conductors Acceptable Manufacturers:

1. Okonite.
2. Pirelli.
3. Southwire.
4. Superior Essex.
5. Belden.

C. Connectors Acceptable Manufacturers:

1. ILSCO
2. Polaris

D. Conductor types:

1. Low voltage conductors (0 to 600V):
  - a. For secondary service entrance, feeders, underground, under floor, in damp or wet locations, and to any process associated equipment provide copper, 600V, 90°C, Type XHHW.
  - b. For all other low voltage conductors, provide copper, 600V, 75°C, Type THWN.
  - c. Provide stranded conductors for sizes #12 and larger.
  - d. Provide same type of equipment grounding conductors as specified above.
  - e. Provide all branch circuit wiring installed within ballast compartment of light fixtures rated 90°C, Type THHN.
  - f. Analog Control/Communications (TSP or TST) – Provide tinned copper, polyethylene insulated, twisted pair or triplet, aluminum-polyester, overall shield with 20-gauge drain.
  - g. Provide analog signal conductors sized as shown on drawings with minimum size of 18-gauge.

- h. For all discrete signal conductors, provide copper stranded, 600V, Type THWN with a minimum size of #14, unless otherwise noted.
  - i. For all control conductors installed in underground conduits provide cable listed as suitable for direct burial.
2. Splices, Connections and Terminations (0 to 600V):
- a. For #8 AWG, use solderless pressure connectors with insulating covers for copper wire splices and taps. Use insulated spring wire connectors with plastic caps for #10 AWG and smaller.
  - b. Use insulated, mechanical connectors for copper wire splices and taps, #6AWG and larger. Tape connectors with electrical tape to prevent moisture infiltration.
  - c. Where connections are located in manholes or handholes use insulated submersible type.

## 2.4 GROUNDING AND BONDING

### A. Applicable standards:

- 1. UL 467-2013: Grounding and Bonding Equipment.
- 2. NFPA 70: National Electrical Code.
- 3. ANSI/IEEE 32: Requirements, Terms and Test Procedures for Neutral Grounding Devices.
- 4. IEEE 80: Guide for Safety in Substation Grounding.
- 5. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- 6. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Associates).

### B. Grounding electrodes (Rod type):

- 1. Acceptable Manufacturers:
  - a. LTV Copperweld.
  - b. Line Material.
- 2. Material: Copper-clad steel.
- 3. Diameter: 3/4".
- 4. Length: 10'-0"
- 5. Type: Sectional.

### C. Mechanical connectors:

- 1. Acceptable Manufacturers:
  - a. Burndy.
  - b. Robbins.
  - c. Harger.
- 2. Material: Bronze.

D. Exothermically-welded connections:

1. Acceptable Manufacturers:
  - a. Cadweld.
  - b. Or Approved Equal

E. Grounding Electrode Conductor:

1. Material: Bare, soft-drawn, stranded, copper.
2. Minimum size: Meet NFPA 70 requirements.

F. Bonding Material:

1. Material: Bare, soft-drawn, stranded, copper.
2. Minimum size: Meet NFPA 70 requirements.

G. Regulatory requirements:

1. Products: Listed and classified by UL as suitable for the purpose specified and indicated.

H. Ground Access Wells:

1. Provide 12"x12"x12" polymer concrete ground access well where indicated on plans.
2. Provide engraved cover with "ground" indicator.
3. Rated for a minimum of 20,000 lbs.
4. Provide Harger GAW series or approved equal.

## 2.5 SURGE PROTECTIVE DEVICE

A. Applicable standards:

1. UL SPD Type 4CA
2. IEC 61643-11 2011
3. EN 61643-11 2012

B. Acceptable Manufacturers:

1. Phoenix Contact.
2. Maxivolt.
3. Or Approved Equal.

C. Surge Protective Device:

1. Install Surge Protective Device on din rail in NEMA 4X 316 stainless steel enclosure
2. Provide din rail mounted input fusing and maintenance disconnect.
3. Lead lengths shall not exceed 18".
4. Installation shall be in accordance with manufacturer's instructions.
5. Provide SPD with one set of NO/NC dry contacts.
6. Provide SPD with protection-indicating LED's.

7. Provide UL nominal discharge current rating of 20KA.
8. Provide SPD that meets or exceeds the following criteria:
  - a. Maximum UL Suppression Voltage Rating (SVR) and Maximum Operating Voltage (MCOV):

System Voltage	L-N	L-G	N-G	L-L	MCOV
208/120V 3Ø	175	175	150	350	175
480/277V 3Ø	320	320	260	640	335

## 2.6 OUTLET BOXES/RECEPTACLES/SWITCHES

### A. Applicable standards:

1. ANSI/NEMA OS 1: Sheet-steel Outlet Boxes, Device Boxes, Covers and Box Supports.
2. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
3. NEMA FB 1: Type FD, Cast Ferrous Alloy Boxes.
4. UL 508: UL Standard for Safety Industrial Control Equipment.

### B. Types and properties:

1. Outlet boxes:
  - a. Cast aluminum boxes where exposed. (NEMA FB1; deep type, gasketed cover, threaded hubs).
  - b. Provide rubber or neoprene gasketed covers of similar metal.

### C. Pull and junction boxes:

1. Sheet metal boxes:
  - a. Outdoor location installations: Provide NEMA 4X 316 stainless steel.

### D. Receptacles/Switches:

1. Hubbell Cat. No. GF-5362, Pass & Seymour equivalent, Leviton equivalent, or equal, for 20A, 120V, duplex, ground fault circuit interrupting type.
2. Wall Switches, Single Pole, 20 A, 120-277V equivalent to Hubbell No. 1221, Pass & Seymour No. 20AC1, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3031, Hubbell equivalent, Pass & Seymour equivalent, or equal.

## 2.7 LIGHTING

### A. Applicable standards:

1. FS W-F-414: Fixture, Lighting.



B. Canopy fixtures:

1. Provide 4' enclosed wet location surface mounted fixture with stainless steel mounting bracket and latches.
2. Nominal lumens: 6200
3. Minimum CRI & CCT: 82 CRI, 5000K.
4. H.E. Williams 96-4-L62/850-HIAFR-DRV-UNV or equal.

C. Flood lights:

1. Provide LED wide area floodlight (107 degrees) with wet location listing
2. Nominal lumens: 7400
3. Minimum CRI & CCT: >70 CRI, 5000K.
4. Cree #C-FL-A-RTF1-7L-50K-DB or equal

## 2.8 DISCONNECT SWITCHES

A. Applicable standards:

1. FS W-S-865: Switch, box (enclosed), surface-mounted.
2. NEMA KS 1: Enclosed switches.

B. Acceptable manufacturers – disconnect/safety switches:

1. General Electric.
2. Square D.
3. Eaton.

C. Disconnect Switches:

1. Non-fusible (disconnect) switch assemblies: NEMA KS 1; type HD; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position.
  - a. Provide override screw to permit opening front cover with switch in ON position.
  - b. Provide the handle lockable in OFF position.
  - c. Provide enclosure types as indicated on Drawings.

D. Provide NEMA 4X 316 stainless steel enclosures.

E. Service entrance disconnect switch shall be suitable for service entrance.

## 2.9 MAIN CIRCUIT BREAKERS

A. Applicable standards:

1. FS W C 375: Circuit Breakers, Molded Case, Branch Circuit and Service.
2. NEMA AB 1 93: Molded Case Circuit Breakers and Molded Case Switches.
3. UL-489: Molded Case Circuit Breakers and Circuit Breaker Enclosures.

4. UL-50: Cabinets and Boxes.
5. NEMA-250: Enclosures for Electrical Equipment.

B. Acceptable manufacturers:

1. General Electric.
2. Square D.
3. Eaton.

C. Enclosed Circuit Breakers:

1. Enclosed Molded-Case Circuit Breaker: NEMA AB 1, lockable handle. Handle lockable in OFF position. Provide enclosures type as indicated on Drawings.
2. Provide frame size, trip rating, interrupting rating, and auxiliary devices as required for application.
3. Provide NEMA 4X 316 stainless steel enclosures.

## 2.10 COMBINATION POWER CENTERS

A. Applicable standards:

1. UL 1062: Standard for Unit Substations.

B. Acceptable manufacturers:

1. General Electric.
2. Square D.
3. Eaton.

C. The combination power center consists of an encapsulated dry type transformer, primary and secondary main circuit breakers, and secondary panelboard all in one enclosure.

1. Transformer Rating: KVA, primary voltage, secondary voltage, frequency and number of phases shall be as shown on the Drawings.
2. Branch Circuits: Molded case circuit breakers, plug in thermal magnetic type with number of poles and trip ratings as shown on the Drawings.
3. Enclosure: Weatherproof, NEMA 3R, stainless steel.

## 2.11 MANUAL TRANSFER SWITCH

A. Applicable standards:

1. UL 50: Standard for Enclosures for Electrical equipment.

B. Acceptable manufacturers:

1. Trystar or approved equal.

C. Rotary Manual Transfer Switch:

1. Docking Station shall have integrated Rotary Manual Transfer Switch (MTS).
  - a. MTS shall be three positions. Stationary Generator-Off-Portable Generator.
  - b. MTS shall be located behind pad lockable door to prevent any tampering by unauthorized personnel.
  - c. MTS shall be fully rated for manual transfer under load. MTS' that require a no load manual transfer do not meet these specifications.

D. Enclosures:

1. Surface mount, NEMA 3R rain-tight, aluminum enclosure with rake system for cable entry at the bottom.
2. Cable entry area at the bottom of the enclosure shall be covered by a hinged trap door.
  - a. It shall be possible to close and lock the front door to the enclosure with the trap door open, and power cables connected through the bottom of the enclosure. The enclosure shall maintain NEMA 3R integrity with power cables connected.
3. Front Cover:
  - a. Hinged.
  - b. Gasketed.
  - c. Pad-lockable latch.
4. Finishes:
  - a. Paint after fabrication. Powder coated Hammer Gray.

E. Phase, Neutral, and Ground Buses:

1. Material: Silver-plated, Tin-plated or Hard-drawn copper, specified upon order.
2. Equipment Ground Bus: bonded to box.
3. Isolated Ground Bus: insulated from box.
4. Ground Bus: 25%, 50% or 100% of phase size.
5. Neutral Bus: Neutral bus rated 100 percent of phase bus.
6. Round edges on bus.

F. Inputs connectors shall be Camlok style mounted on 45° angle plate or on gland plate.

G. Output connectors shall be broad range set-screw type, located behind an aluminum barrier.

H. Lockable rake system with reinforced support struts to reduce cable theft.

I. Voltage & Phase shall be as shown on project one-line drawing. Camlocks provided for incoming generator power shall be color coded as appropriate for the specified voltage.

J. Amperage rating shall be as shown on project one-line drawing.

- K. Provide auxiliary contacts on switch to switch start signal from stationary generator to portable generator.

2.12 AUTOMATIC TRANSFER SWITCH – Furnished by Generator Supplier

A. Applicable standards:

1. UL 1008: Standard for Automatic Transfer Switches.
2. NFPA 70: National Electrical Code.
3. NFPA 99: Essential Electrical Systems for Health Care Facilities.
4. NFPA 110: Emergency and Standby Power Systems.
5. IEEE 446: IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
6. NEMA ICS10-2005: AC Automatic Transfer Switches.

B. Acceptable manufacturers:

1. American Switch Company (ASCO).
2. Caterpillar.

- C. The following specifications are based on the Caterpillar series power transfer switch and should be considered as a minimum for features and quality.

- D. Provide a stand-alone automatic transfer switch rated for site voltage (277/480 volt or 120/208 volt, 3-phase, 4-wire, wye, 60 Hz). Provide unit enclosures as shown on drawings with NEMA 4X 304 stainless steel as a minimum.

- E. Provide switch as true double throw, mechanically held, electrically operated, utilizing a reliable field proven, single-solenoid operator with contacts easily accessible for inspection and preventive maintenance.

- F. Provide 3-pole switch with solid neutral as shown on drawings.

- G. Provide amperage and voltage ratings as shown on drawings.

H. Provide the following features:

1. Microprocessor Controls.
2. Optically isolated RS-485 Serial Communication Interface.
3. In-phase Monitor.
4. Selective Load Disconnect.
5. Engine Exerciser.
6. Solid Neutral.
7. Switch Position Lights.
8. Source Availability Lights.
9. Source Availability Contacts.
10. Test Switch.
11. Time Delay Bypass Switch.
12. One (1) NO and one (1) NC Contacts Rated 10 amps 250VAC.

13. 60 or 50 Hz Selectable.
14. 3- phase or 1- phase Selectable.
15. Two (2) NO and two (2) NC Auxiliary Contacts.
16. Manual Transfer Option.
17. Strip Heater with Thermostat.
18. Deluxe Exerciser.
  
19. Time Delay Adjustments:
  - a. Override Momentary Normal Outage - 1-3 Seconds.
  - b. Transfer to Emergency - 0-5 Minutes.
  - c. Override Momentary Emergency Outage - 4 Seconds.
  - d. Retransfer to Normal - 1 Second – 30 Minutes.
  - e. Unloaded Running Time Cool Down - 5 Minutes.
  
20. Voltage and Frequency Settings:
  - a. Normal Source Voltage:
    - 1) PU - 90%-95%.
    - 2) DO - 70%-85%.
  - b. Emergency Source Voltage:
    - 1) PU - 90%.
    - 2) DO - 75%.
  - c. Emergency Source Frequency:
    - 1) PU - 95%.
    - 2) DO - 85%.

## 2.13 LABELING

- A. Mark all electrical equipment with black phenolic material having engraved letters with white core having one-half inch (1/2") engraved lettering to match designations on one-line diagram.
- B. Mark all electrical 480, 208 and 240-volt equipment with red laminated plastic nameplates having one-half inch (1/2") engraved lettering, reading 480 VOLTS, 208 VOLTS, or 240 VOLTS.
- C. Attach plates to equipment with weatherproof, UV resistant adhesive transfer tape 3M VHB or equal
- D. Arc Flash Labels: Provide labels as required by NFPA 70E.

## PART 3 - EXECUTION

### 3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Coordination:

1. Coordinate as necessary with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.
2. Coordinate the installation of electrical items with the schedule for work of other trades to prevent unnecessary delays in the total Work.

3.3 ELECTRICAL SERVICE

- A. Verify location of utility transformer pad and install per utility company specifications, providing all materials and labor required for a complete installation. Verify location of utility company secondary delivery point and report any discrepancies to the Engineer immediately.

3.4 TRENCHING AND BACKFILLING

- A. Perform trenching associated with the work of this Section in strict accordance with the provisions of the National Electric Code.

3.5 CONDUCTORS

- A. Terminate #14 AWG stranded conductors where indicated for control, using insulated compression-type spade lugs.
- B. Terminate #12 AWG stranded conductors using insulated compression-type spade lugs.
- C. The conductor lengths for parallel circuits must be made equal.
- D. Neatly train and lace all wiring inside boxes, equipment, and panel boards.

3.6 COLOR CODE AND MARKERS

- A. Provide color-coding for #12 and #10 conductors as follows:

	<b>277/480-Volt</b>	<b>120/208(240)-Volt</b>
Phase "A"	Brown	Black
Phase "B"	Orange	Red
Phase "C"	Yellow	Blue
Neutral	White with Tracer	White
Ground	Green	Green

- B. Mark all conductors #8 and larger and all feeders with plastic tape to match the above color-coding.

### 3.7 SPLICES, CONNECTIONS, AND TERMINATIONS IN 600V. CONDUCTORS

- A. Splice only in accessible junction boxes.
- B. Thoroughly clean wires before installing lugs and connectors.
- C. Terminate spare conductors with electrical tape or wire nuts.

### 3.8 RACEWAYS AND FITTINGS

- A. Apply thread compound to all field-cut threads prior to installation.
- B. Cut all conduits square using a saw or pipe cutter and de-burr cut ends.
- C. Install the conduit to the shoulder of fittings and couplings and fastened securely.
- D. Use conduit hubs, or sealing locknuts, for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.
- E. No more than the equivalent of three 90-degree bends may be installed between boxes.
- F. Use conduit bodies to make sharp changes in direction, as around beams.
- G. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2" size.
- H. Size all conduits for conductor type installed with 3/4" being the minimum size conduit allowed.
- I. Provide suitable pull string or #12 AWG insulated conductor in empty conduit, except sleeves and nipples.
- J. Install exposed raceways on channel so as to provide a minimum spacing of 1/2" between raceway and the surface to which it is mounted.
- K. Bends:
  - 1. Where emerging from concrete slabs, all conduit bends shall be made entirely within the structure (i.e.: the conduit shall emerge perpendicular to the surface and the bend shall be covered).
- L. Refer to National Electric Code for minimum cover of underground conduits.
- M. Sealing Conduit:
  - 1. Install watertight conduit hubs on all conduits terminating in the top or sides of NEMA 3R, 4 or 4X enclosures.

2. Use a sealing locknut having an integral gasket on conduits terminating in the bottom of NEMA 3R or 4X enclosures.
  3. Seal all conduits terminating in NEMA 3R or 4X enclosures with duct seal.
  4. Install sealing compound and fiber, per manufacturer's recommendation, in hazardous location conduit sealing fittings. Tighten plugs per manufacturer's recommended torque.
- N. Conduit installations in hazardous locations as defined by Article 500 of the NEC must conform to the special requirements of Articles 501, 502, and 503 of the NEC.
- O. Ensure all threads are fully installed into fittings, boxes, enclosures and equipment per NEC and UL listing requirements to provide mechanical integrity, grounding and sealing. Provide fittings and adapters to ensure full length of conduit or conduit fitting threads are installed per code and listing requirements.
- P. Provide plastic threaded type bushings for all conduits terminated in enclosures.

### 3.9 CONDUIT SUPPORTS

- A. Provide UL listed vinyl end caps for all ends of strut-type metallic conduit supports.
- B. Provide all miscellaneous materials and supports as required by the NEC and these specifications to provide support for conduits, raceways, boxes, fittings and equipment.

### 3.10 GROUNDING AND BONDING

- A. Ground and bond the electrical system and motors in accordance with Article 250 of the NEC.
- B. Install electric bond around panels, cabinets, pull boxes, enclosures, etc., to incoming and outgoing sub-feed raceways by use of grounding type bushings.
- C. Provide separate, insulated, green equipment grounding conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- D. Provide grounding type bushings for conduits 1" or larger and bond to ground bar or lug of enclosure.
- E. Bond neutral and ground at service entrance only.
- F. Provide exothermic-type weld grounding connections that are buried or otherwise normally inaccessible, and excepting specifically those connections for which access is required for periodic testing.
- G. Make each grounding connection strictly in accordance with the manufacturer's written instructions. Failure to follow manufacturer's written instructions shall result in immediate rejection.



- H. Welds which have "puffed up" or which show convex surfaces, indicating improper cleaning, are not acceptable. Provide grounding connection devices compatible with the conductor(s) and/or rods being joined.
- I. Maximum acceptable resistance to earth ground is 5 Ohms. Provide testing of the service entrance system ground and verify the resistance to earth ground is within the specified requirements. If the existing service entrance ground does not meet the specified requirements, install additional rod electrodes as required to achieve specified resistance to ground.

### 3.11 MOUNTING OF CONTROL PANELS AND ELECTRICAL EQUIPMENT

- A. Mount floor and wall mounted equipment utilizing Type 316 stainless steel anchors and fasteners of the size and number recommended by the manufacturer.
- B. Provide 316 stainless steel fasteners for all other installation types.
- C. Install and check all equipment in accordance with the manufacturer's recommendations.
- D. Ensure that equipment mounting pad locations are level to within 0.125 inches per three foot of distance in any direction. Notify Engineer immediately if any discrepancies are found in the field.
- E. Ensure that all equipment bus bars are torqued to the manufacturer's recommendations.
- F. Assemble all equipment shipping sections, remove all shipping braces and connect all shipping split mechanical and electrical connections.
- G. Provide typed circuit directory with protective plastic sleeve secured to inside of panel door for each branch circuit panelboard.

### 3.12 TESTING AND INSPECTION

- A. Test all 600-Volt service entrance and feeder wiring using an instrument, which applies a voltage of approximately 500 volts DC to provide a direct reading of resistance.
- B. Perform test on ground system utilizing Fall-Of-Potential method. Meg grounding systems to measure ground resistance, and provide not more than 5 ohms resistance, adding ground rods as necessary to achieve that level.
- C. Conduct all tests in presence of ReWa's representative. Identify and properly record all readings. Submit readings to ReWa for acceptance.
- D. Test system in the presence of the Engineer and operate to his complete satisfaction in accordance with true intent of plans and specifications. Defray cost of all adjustments necessary to bring system up to standards set forth by Contract Documents at no additional cost.
- E. Thoroughly indoctrinate the Owner's operation and maintenance personnel in the contents of the operations and maintenance manual.

3.13 HAZARDOUS LOCATIONS

- A. Wiring and equipment in hazardous locations, as defined by the NEC, shall conform to the special requirements of the NEC, unless otherwise indicated or specified.

3.14 CLEANING AND PAINTING

- A. Collect and remove from the premises all debris, scraps and other waste material after completion of work.
- B. Tamp and level all trench work.
- C. Remove excess dirt and debris, when and as directed by the Engineer.
- D. Thoroughly clean all electrical equipment, lighting fixtures, exposed conduit, enclosures and boxes of all foreign materials and touch up in accordance with manufacturer recommendations otherwise.
- E. Clean any exposed threaded area of raceway of cutting oil and paint with a cold galvanizing compound prior to final finish painting.

END OF SECTION 26 00 00

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## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Work included: Provide an engine driven standby electric generator system, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to:
1. Diesel engine.
  2. Engine instruments and controls.
  3. Alternator.
  4. Control panel.
  5. Exhaust silencer.
  6. Weather-protective, sound attenuated, non- walk-in enclosure.
  7. Associated accessories and other items and services required to complete the system whether particularly mentioned or not.
  8. Fuel tank (filled on site).
  9. Automatic transfer switch (Specified in 26 00 00)
- B. Related work:
1. Section 26 00 00 – Electrical.
- C. Applicable Standards
1. NFPA 70: National Electrical Code
  2. NFPA 110: Standard for Emergency and Standby Power Systems
  3. UL508: Standard for Industrial Control Equipment
  4. UL2200: Standard for Stationary Engine Generator Assemblies
  5. UL142: Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids
  6. CSA C22.2 No. 14: Industrial Control Equipment
  7. CSA C282: Emergency Electrical Power Supply for Buildings
  8. CSA C22.2 No. 100: Motors and Generators
  9. EN61000-6: Electromagnetic Compatibility
  10. EN55011: Limits and Methods of Measurement of Radio Disturbance Characteristics of Industrial, Scientific and Medical (ISM) Radio-frequency Equipment
  11. FCC Part 15 - Radio Frequency Devices - Subpart B-Unintentional Radiators
  12. ISO 8528: Reciprocating Internal Combustion Engine Driven Alternating Current Generating Sets
  13. IEC 61000: Electromagnetic Compatibility

### 1.2 SUBMITTALS

- A. Shop Drawings shall be submitted for review and shall include the following:
1. Materials list of items proposed to be provided under this Section.
  2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

3. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades.
4. Manufacturer's recommended installation procedures which, when approved by the ReWa's representative, will become the basis for accepting or rejecting actual installation procedures used on the Work.
5. Load Calculations: Generator shall be sized for both pumps running fully loaded (step started). Base computations on reduced-voltage starters with 350% current limit setting and variable frequency drives with 6-pulse rectifiers. The maximum voltage drop shall be 20%.

### 1.3 WARRANTY

- A. There shall be one source responsibility for warranty; parts and service through a local representative with factory trained service personnel. Extended Warranty Coverage shall be provided for a period of 4 years and shall include no deductible. Extended Warranty Coverage provides for 100 percent of usual and customary parts and labor costs for failures due to defects in materials and workmanship to the "as shipped consist" from the factory, excluding filters, fluids, vee belts, hoses, power take-offs, paint, batteries and clutches. Provide for a rental power unit due to unscheduled failures causing unexpected downtime to the customer in excess of 48 hours from the time of diagnoses. All repairs will be performed by factory trained dealer service personnel and allows for repairer travel and mileage for all repairs up to 8 hours and 320 miles per incident.
  1. Upon placing the generator in service provide a 30-day initial operating period.
  2. The warranty will begin upon successful completion of the initial operating period.

### 1.4 RULES AND PERMITS

- A. The entire installation shall be in accordance with NFPA, and all local codes.
- B. Furnish the Owner with certificate of inspection and final approval from all authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 APPROVED MANUFACTURERS

1. Caterpillar
2. Detroit Diesel

### 2.2 GENERAL

- A. Provide new and current system equipment consisting of:
  1. Engine driven electric generating set to provide standby power.
  2. Engine start-stop control system mounted on the generating set.

3. Mounted accessories as specified.

## 2.3 SYSTEM

- A. Provide generator rated for continuous standby service at site voltage, 3-phase, 4-wire wye. Continuous standby service constitutes full load operation without interruption for a minimum period of 14 days.

## 2.4 ENGINE

- A. Provide fuel filter and fuel transfer pump at engine.
- B. Provide water-cooled with mounted radiator, fan and water pump.
- C. Provide intake and exhaust valves made of heat resisting alloy steel with exhaust valve seat inserts.
- D. Supply full pressure lubrication by lube oil pumps.
- E. Provide air cleaner, fuel and oil filters with replaceable elements, and lube oil cooler.
- F. Govern engine speed by electronic governor to maintain the alternator frequency within one (1) hertz from no load to full load alternator output.
- G. Provide remote, 2-wire starting by a solenoid shift, electric starter.
- H. Directly connect the starter to the engine flywheel housing.

## 2.5 ALTERNATOR

- A. Provide brushless, 4-pole, revolving field design with temperature compensated solid-state voltage regulator and rotating rectifier exciter system.
  1. Provide rotor driven through a semi-flexible driving flange to ensure permanent alignment.
  2. Provide alternator with frequency regulation not exceeding 3 Hz from no load to rated load.
  3. Provide alternator with voltage regulation within +/-2% of rated voltage, from no load to full rated load.
  4. Provide alternator with recovery to stable operation occurring within 2 seconds.
    - a. Stable operation is defined as operation with terminal voltage remaining constant +/-1% of rated voltage.
  5. Provide alternator with a rheostat providing a minimum of +/-5% voltage adjustment from rated value.
  6. Provide alternator with temperature rise within NEMA MG1-22 definition.
  7. Provide alternator utilizing 3-phase filtered sensing voltage regulation and having an independent power supply for the excitation system (i.e. permanent magnet generator, Auxiliary Winding, Regulator Exciter Principle (AREP) and series boost type excitation system).

8. Provide alternator with a sub-transient reactance of 0.12 per unit, or lower, based on steady-state rating.
9. Provide alternator with Class H insulation.
10. Provide alternator producing a voltage waveform for proper operation of variable frequency PWM drives that produce line to neutral total harmonic distortion to 5% maximum with a maximum 3% distortion in any single harmonic order.
11. Equip alternator with a single-phase space heater. Coordinate voltage with electrical installation.

## 2.6 CONTROLS

- A. Provide a fully solid-state, microprocessor based, generator control panel wired, tested and shock mounted on the generating set by the manufacturer of the generating plant.
- B. Provide the following functionality integral to the control panel:
  1. A minimum 64 x 240 pixel (28mm x 100mm) white backlight graphical display with text based alarm/event descriptions.
  2. A minimum of 3-line data display.
  3. Audible horn for alarm and shutdown with horn silence switch.
  4. Standard ISO labeling
  5. Multiple language capability
  6. Remote start/stop control
  7. Local run/off/auto control integral to system microprocessor
  8. Cooldown timer
  9. Speed adjust
  10. Lamp test
  11. Push button emergency stop button
  12. Voltage adjust
  13. Voltage regulator V/Hz slope – adjustable
  14. Power Factor Control for paralleling units
  15. Password protected system programming
- C. Provide the panel with the following Digital indications:
  1. AC voltage, 3-phase (L-L and L-N)
  2. AC amps (3-phase and total)
  3. KW (total and per phase)
  4. KVA (total)
  5. KVAR (total)
  6. KWHR (total)
  7. KVARHR (total)
  8. PF (average total and 3-phase)
  9. % of rated (total)
  10. Frequency
  11. DC voltage
  12. System diagnostic
  13. Excitation voltage
  14. Excitation current
  15. Engine oil pressure

16. Engine oil temperature
17. Engine coolant temperature
18. Engine RPM
19. Battery volts
20. Engine hours
21. Engine crank attempt counter
22. Engine successful start counter
23. Service maintenance interval
24. Real time clock
25. Oil filter differential pressure
26. Fuel temperature
27. Fuel pressure
28. Fuel filter differential pressure
29. Fuel consumption rate
30. Total fuel consumed
31. Engine intake manifold temperature
32. Engine intake manifold pressure
33. Engine crankcase pressure
34. Air filter differential pressure
35. Boost pressure
36. Oil filter differential pressure

D. Provide alarm indication and subsequent shutdown for the following conditions (Store in the control panel the first and last occurrences of all alarms and shutdowns with a time, date, and engine hour stamp):

1. Low oil pressure alarm/shutdown
2. High coolant temperature alarm/shutdown
3. Loss of coolant shutdown
4. Overspeed shutdown
5. Overcrank shutdown
6. High intake manifold temperature alarm/shutdown
7. High exhaust manifold temperature alarm/shutdown
8. High crankcase pressure alarm/shutdown
9. High air inlet temperature alarm/shutdown
10. Emergency stop depressed shutdown
11. Low coolant temperature alarm
12. Low battery voltage alarm
13. High battery voltage alarm
14. Control switch not in auto position alarm
15. Battery charger failure alarm
16. Generator over voltage
17. Generator under voltage
18. Generator over frequency
19. Generator under frequency
20. Generator reverse power
21. Generator overcurrent
22. Loss of excitation alarm/shutdown
23. Instantaneous over excitation alarm/shutdown
24. Time over excitation alarm/shutdown
25. Rotating diode failure



26. Loss of sensing
  27. Loss of PMG
- E. Provide the ability to accept six (6) programmable digital input signals.
- F. Provide accessible through a single electronic service tool all engine, voltage regulator, control panel and accessory units. Provide the following maintenance functionality:
1. Engine running hours display
  2. Service maintenance interval (running hours or calendar days)
  3. Engine crank attempt counter
  4. Engine successful starts counter
  5. 20 events are stored in control panel memory
  6. Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 14 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:
    - a. Day of week
    - b. Time of day to start
    - c. Duration of cycle
- G. Provide an annunciator to meet the requirements of NFPA 110, Level 1.
1. Network directly to the generator set control
  2. Include a lamp test pushbutton, alarm horn and alarm acknowledge pushbutton
  3. Provide the following individual light indications for protection and diagnostics:
    - a. Overcrank
    - b. Low coolant temperature
    - c. High coolant temperature warning
    - d. High coolant temperature shutdown
    - e. Low oil pressure warning
    - f. Low oil pressure shutdown
    - g. Overspeed
    - h. Low coolant level
    - i. EPS supplying load
    - j. Control switch not in auto
    - k. High battery voltage
    - l. Low battery voltage
    - m. Battery charger AC failure
    - n. Emergency stop
    - o. Spare
    - p. Spare
- H. Equip unit with factory mounted terminal blocks and strips for all power, signal and control wiring connections.
- I. Provide the following dry contacts to interface with ReWa's RTU:
1. Generator Running
  2. Generator Alarm

## 2.7 GENERATING SET MOUNTING

- A. Equip generator set with vibration isolators and mount on a welded steel base that will provide suitable mounting to any level surface.
- B. Equip unit with a reinforced sheet steel, minimum 16 gauge, sound attenuating, non-walk-in weather-protective housing.
  - 1. Reinforce to be vibration-free in the operating mode.
  - 2. Provide housing with lockable removable panels on each side of the housing to access generator with a hinged door to access instrument panel.
  - 3. Provide housing complete with accessories listed below, be rust treated and painted standard color of manufacturer.
  - 4. Provide peaked roof for drainage.
  - 5. Provide corrosion resistant fasteners.
  - 6. Extend coolant and oil drain line connections outside of enclosure.
  - 7. Insulate enclosure to limit unit noise to 75 db at 7m.
  - 8. Mount enclosure over an integral welded steel base fuel tank complete with all fuel fittings, level indicator, vent, exterior lockable fill port and drains, etc., and necessary galvanized steel support framing so that the weight of the generator is not supported by the tank. Size tank to run the generator at full load for a minimum of 2 days.
    - a. Enclose tank in a welded steel secondary containment vessel having an audible spill alarm system powered from the generator battery system and alarmed on the generator control panel.
    - b. All welds, cuts, openings, etc., in the steel material, shall be cold galvanized as a minimum after fabrication.
  - 9. Provide tank underwriter's labeled (UL).

## 2.8 ACCESSORIES

- A. Provide the plant with all accessories needed for proper operation to include, but not be limited to:
  - 1. A critical type silencer of schedule 40 steel mounted inside enclosure.
  - 2. Stainless steel flexible exhaust connection.
  - 3. Sufficient exhaust piping of aluminized schedule 40 steel pipe and fittings, including end rain cap.
  - 4. Provide a 10-amp, automatic "float" type battery charger to maintain the batteries at normal capacity.
    - a. Provide 120V input with 12 or 24 VDC output to battery(s).
    - b. Provide cables, battery rack, AC compensation, current limit, DC ammeter to show battery voltage, equalizing switch, fused AC input and DC output, complete isolation of AC input and DC output.
    - c. Design as not to discharge the battery in event of failure.
  - 5. Provide engine mounted, thermostatically controlled, immersion type heater to ensure a minimum coolant temperature of 120° F in a minimum ambient temperature of -15° F.

6. Engine Block Heaters sized per manufacturer's requirements. Coordinate voltage with electrical installation.
- B. Radiator coolant shall be all weather, all season, environment friendly 50% solution antifreeze.
- C. Provide adequate fuel to fill tank
- D. Overcurrent Protection:
  1. Furnish the engine/generator set with overcurrent output protection per the latest edition of NEC 445-4 at the engine/generator set.
  2. Provide Ground-Fault Protection of service entrance disconnects 1000 amperes or more at 277/480V per NEC 70 Part 230-95.

### PART 3 - EXECUTION

#### 3.1 SURFACE CONDITIONS

- A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

#### 3.2 TESTING AND INSPECTION

- A. Provide personnel and equipment, make required tests, and secure required approvals from the governmental agencies having jurisdiction.
- B. Provide a service engineer to complete the initial start-up, make proper and complete adjustments of all adjustable devices, load switches, etc., and to also verify and approve all connections prior to any test operation of said equipment.
- C. An operational test of the standby power system shall be conducted by a representative of the manufacturer of this equipment in the presence of ReWa's representative. It shall be demonstrated during these tests that the voltage sensitive and time delay devices perform at their specified settings.
- D. Perform 2 hour load bank test for generator at full load.

#### 3.3 TRAINING

- A. Upon completion of the work of this Section, provide 2 hours of training for ReWa personnel on operation and maintenance of the generator and the automatic transfer switch.

END OF SECTION 23 32 13

## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Work Includes:

1. Removing and disposing of surface debris.
2. Removing and disposing of designated trees, shrubs, and other plant life.
3. Stripping of topsoil.

#### B. Related Sections:

1. Section 02 22 60 – Erosion and Sediment Control
2. Section 02 22 26 – Utility Removal and Abandonment

### 1.2 SUBMITTALS

- #### A. Product Data:
- Submit data for herbicide. Indicate compliance with applicable codes for environmental protection.

### 1.3 QUALITY ASSURANCE

- #### A. Conform to all local and regional codes and ordinances.
- #### B. Perform Work in accordance with the contract Drawings and specifications.
- #### C. Maintain erosion and sedimentation control documents on site.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- #### A. Herbicide:
- Shall be of the type intended for its use and approved by authority having jurisdiction.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- #### A. Verify existing plant life designated to remain is tagged or identified.
- #### B. Identify stockpile area for placing removed materials as approved by the Owner.

### 3.2 PREPARATION

- A. Call Local Utility Line Information service at 811 not less than 2 working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Storage of materials shall be selected so as to prevent damage to remaining trees or property owner improvements.

### 3.3 PROTECTION

- A. Protect all existing utilities indicated to remain, from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping.
- C. Take proper precautions to avoid the unnecessary removal of trees, unnecessary interference with natural or installed drainage systems, landscaping or fencing.
- D. Prevent erosion of the area, silting of nearby streams or lakes, and avoid the possibility of damage arising from the work performed during and after construction.
- E. Protect benchmarks from damage or displacement.
- F. Operations shall be conducted with full consideration of all proper and legal rights of the property owner, adjacent property owners and the public, and with the least possible amount of inconvenience to them.

### 3.4 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs as indicated on the drawings.
- C. Clear undergrowth, deadwood, stumps and roots without disturbing subsoil. Grinding materials will be allowed within limits of the R/W. Temporary and Final stabilization shall be in accordance with the approved SWPPP. Owner reserves the right to require additional grassing or other stabilization measures if mulching doesn't provide sufficient stabilization.

### 3.5 REMOVAL

- A. Remove and dispose of debris, rock, and extracted plant life from site.
- B. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- C. Do not burn or bury materials on site. Leave site in clean condition.

3.6 TOPSOIL EXCAVATION

- A. Excavate topsoil from the top 3” to 6”, without mixing with foreign materials, for use in finish grading.
- B. Do not excavate wet topsoil.
- C. Stockpile in area designated on site and approved by the Owner. Protect stockpile area from erosion.
- D. Remove excess topsoil not intended for reuse, from site.

3.7 COMPLETION

- A. Remove all construction equipment, excess materials, tools, debris, etc. from the site(s) and leave the same in a neat orderly condition deemed acceptable by the Owner.
- B. Grade all project areas to shed water to natural drainage areas. All areas shall be raked to a uniform surface free from rocks, clods of earth or other irregularities.

END OF SECTION 31 10 00

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## **PART 1 - GENERAL**

### **1.1 DESCRIPTION**

- A. Work Included: Cut, fill, excavate, backfill, compact and grade the site as necessary to bring drives, pump station sites, paved areas and open areas to the lines and grades shown on the drawings.
1. The work includes, but is not necessarily limited to:
    - a. Pump Station site preparation.
    - b. Roadway, parking area, drive, and walk subgrade preparation.
    - c. Excavations and formations of embankments.
    - d. Dressing of graded areas, shoulders, and ditches.
    - e. Construction and lining of treatment basins.
  2. Definitions:
- B. Related Work:
1. Section 01 57 13 – Erosion and Sediment Control
  2. Section 01 22 26 – Utility Removal and Abandonment
  3. Section 31 10 00 – Site Clearing
  4. Section 31 23 16.13 – Trenching
  5. Section 31 23 16.16 – Excavation and Backfill for Structures
  6. Section 31 23 19 - Dewatering
  7. Section 31 37 00 – Riprap
- C. Definitions:
1. Open areas: Open areas shall be those areas that do not include building sites, paved areas, street right-of-way, and parking areas.
  2. Maximum Density: Maximum weight in pounds per cubic foot of a specific material.
  3. Optimum moisture: Percentage of water in a specific material at maximum density.
  4. Rock excavation: See Section 31 23 16.16 – Excavation and Backfill for Structures
  5. Unsuitable Material: See Section 31 23 16.16 – Excavation and Backfill for Structures
  6. Suitable (Common) Material: See Section 31 23 16.16 – Excavation and Backfill for Structures
  7. Select Material: See Section 31 23 16.16 – Excavation and Backfill for Structures
  8. Washed Stone (gravel): Washed stone shall be SCDOT No. 57 aggregate or equal



conforming to ASTM C-33.

9. Excavation: Excavation is defined as unclassified excavation of every description regardless of materials encountered.

- D. The contractor must determine for himself the volume of material required by the site.

## 1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.
- B. Comply with requirements of governmental agencies having jurisdiction.
- C. A testing laboratory retained by the owner will make such tests as are deemed advisable. The contractor shall schedule his work so as to permit a reasonable time for testing before placing succeeding lifts of fill material and shall keep the laboratory informed of his progress. The cost of the initial tests shall be paid for by the owner. Subsequent tests required as a result of improper compaction shall be paid for by the contractor.

## 1.3 PRODUCT HANDLING

- A. Comply with pertinent provisions of Section 01 66 00.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. Soil material used as fill, backfill, subgrade for structures or pavements, embankments, or site grading shall consist of suitable material as found available on site until such supply of on-site material is depleted. Refer to Section 31 23 16.16 for soil material definitions and requirements.
- B. Should the quantity of suitable on-site material be insufficient to complete the work, suitable borrow material as approved by the engineer shall be provided by the contractor at no additional expense to the owner.
- C. Select materials may be provided from on-site if acceptable material as approved by the engineer is available on site. Otherwise approved select material shall be provided by the contractor from an off-site source.

### 2.2 TOPSOIL

- A. Use topsoil consisting of material removed from the top 3" to 6" of existing on-site soils.
- B. Use topsoil containing no stones, roots, or large clods of soil.
- C. Stockpile topsoil separate from other excavated material.

### **2.3 SPECIAL SOIL MATERIALS**

- A. Provide basin liner soils consisting of fine grained soils selected from excavated area or approved borrow sites, stockpiled and then placed and compacted in areas to receive liner.
- B. Sufficient material for the liner, as selected by the engineer, shall be stockpiled, kept separate from other excavated materials and piled free of undesirable materials.

### **2.4 WEED KILLER**

- A. Provide a dry, free-flowing, dust free chemical compound, soluble in water, capable of inhibiting growth of vegetation and approved for use on this work by governmental agencies having jurisdiction.

### **2.5 EQUIPMENT**

- A. Use equipment adequate in size, capacity and numbers to accomplish the work in a timely manner without undue waste or damage of material.

## **PART 3 - EXECUTION**

### **3.1 SURFACE CONDITIONS**

- A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

### **3.2 PREPARATION**

- A. Clearing and Grubbing: Clear and grub areas to be graded prior to commencement of the grading operations.
- B. Where so directed by the owner, protect and leave standing designated desirable trees.
- C. Complete any demolition and/or removal work as may be required prior to grading operations.
- D. Dispose of all clearing, grubbing and demolition debris and other deleterious material off the project site. Vegetation, roots, brush, rubbish, stumps, etc. may be burned on-site where permitted by local authorities and regulations and approved by the Engineer.
- E. Topsoil: Strip topsoil to a depth of 3" to 6" without contamination from the subsoil and stockpile topsoil separate from other excavated materials.
  - 1. Transport and deposit topsoil in storage piles convenient to areas that are to receive topsoil or in other locations as indicated or approved by the engineer.
  - 2. Deposit topsoil in areas that are already graded and will not be disturbed by on-going construction.

3. Dispose of unsuitable or unusable stripped material off-site or as otherwise directed by the engineer.
- F. Sampling and Preliminary Testing:
1. Prior to beginning the grading operations, the contractor shall submit to the engineer his proposed sequence of excavation operations.
  2. Based upon the sequence of excavation, samples of the fill materials will be obtained as excavation proceeds and tested for grain size permeability and moisture density relationship using the Standard Proctor Method (ASTM D698, Method A).
  3. Allow sufficient time for completion of laboratory tests before any fill operations begin, using the soils being tested.

### **3.3 FINISH ELEVATIONS AND LINES**

- A. Construct areas outside of building or structure lines true to grades shown.
1. Where no grade is indicated, shape finish surface to drain away from buildings or structures, as approved by the engineer.
- B. Degree of finish shall be that ordinarily obtainable from blade grader, supplemented with hand raking and finishing.
- C. Finish surfaces to within 0.10' above or below the established grade or approved cross section.

### **3.4 GENERAL PROCEDURES**

- A. Existing Utilities:
1. Unless shown to be removed, locate and protect active utility lines shown on the drawings or otherwise made known to the contractor prior to excavating. If damaged, repair or replace at no additional cost to the owner.
  2. If active utility lines are encountered and are not shown on the drawings or otherwise made known to the contractor, promptly notify the engineer and take necessary steps to assure that service is not interrupted.
  3. If service is interrupted as a result of work under this section, immediately restore service by repairing the damaged utility at no additional cost to the owner.
  4. If existing utilities are found to interfere with the permanent facilities being constructed under this section, immediately notify the engineer and secure his instructions.
  5. Do not proceed with permanent relocation of utilities until written instructions are received from the engineer.

- B. Protection of Persons and Property:
  - 1. Barricade open holes and depressions occurring as part of this work, and post warning lights on property adjacent to or with public access.
  - 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
  - 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this section.
- C. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- D. Maintain access to adjacent areas at all times.
- E. Excavate and backfill in a manner and sequence that will provide proper drainage at all times

### **3.5 EXCAVATING (CUTS)**

- A. Perform excavating of every type of material encountered within the limits of the work to the lines, grades and elevations indicated and specified herein.
- B. Suitable excavated materials:
  - 1. Use all suitable materials removed from the excavation as far as practicable in the formation of the embankments, subgrades, shoulders, building sites, and other places as directed.
  - 2. Unless otherwise indicated on the drawings or approved by the engineer, surplus suitable material shall be removed from the site and disposed of by the contractor.
- C. Unsuitable Excavated Material: Remove from the site and dispose of all unsuitable material unless otherwise approved by the engineer.
- D. Rock Excavation:
  - 1. Notify the engineer upon encountering rock or similar material which cannot be removed or excavated by conventional earth moving or ripping equipment. Refer to Section 31 23 16.16 – Excavation and Backfill for Structures, Paragraphs 3.1 & 3.2 for definitions and procedures for rock excavation.
  - 2. Payment for Rock Excavation shall be as described in bid documents.
- E. Unauthorized Excavation:
  - 1. Excavation of material to depths below the grades indicated, unless so directed by the engineer will be deemed unauthorized excavation.
  - 2. Unauthorized over-excavation shall be backfilled and compacted without any

additional expense to the owner.

F. Authorized Over-Excavation:

1. In the event that it is necessary to remove unsuitable material to a depth greater than that shown on the drawings or otherwise specified, the contractor, upon receiving direction from the engineer, shall remove, replace and compact such material as directed by the engineer at the unit prices indicated in the bid form.

**3.6 FILLING AND BACKFILLING**

A. Use fills formed of suitable material placed in layers of not more than 8" in depth measured loose and rolled and/or vibrated with suitable equipment until compacted.

B. Do not place rock that will not pass through a 6" diameter ring within the top 12" of the surface of the completed fill or rock that will not pass through a 3" diameter ring within the top 6" of the completed fill.

C. Do not use broken concrete or asphaltic pavement in fills.

D. Selection of Borrow Material:

1. Material in excess of that available on the site shall be suitable material furnished by the contractor from private sources selected by the contractor. The material shall be approved by the engineer before use. All expenses involved in securing, developing, transporting and placing the material shall be borne by the contractor.

E. Placing and Compacting:

1. Place backfill and fill materials in layers not more than 8" in loose depth.
2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content.
3. Compact each layer to required percentage of maximum density for the area.
4. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
5. Place backfill and fill materials evenly adjacent to structures, to required elevations.
6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structures to approximately the same elevation in each lift.

F. Moisture Control:

1. Do not use soil material that is either too dry or too wet to achieve proper compaction.
2. Where subgrade or layer of soil material is too dry to achieve proper compaction,

uniformly apply water to surface of soil material such that free water does not appear on the surface during or subsequent to compacting operations.

3. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting to the specified density.
4. Soil material that has been removed because it is too wet to permit compacting may be stockpiled or spread and allowed to dry. Assist drying by dicing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value as determined by moisture-density relation tests approved by the engineer.

G. Compaction Requirements:

1. Unless otherwise specified on architectural drawings, structural drawings, or directed by the geotechnical engineer, compact soils to not less than the following percentages of maximum dry density as determined in accordance with ASTM D698, Method A (Standard Proctor).
2. Fill beneath structures and beneath an area extending 10' beyond the limits of the foundation:
  - a. Top 12" of subgrade 98%
  - b. All other fill material 95%
3. Fill beneath roadway:
  - a. Top 12" of subgrade 100%
  - b. All other fill material 95%
4. Embankments:
  - a. Top 12" of subgrade 98%
  - b. All other fill material 95%
5. Fill beneath walkways:
  - a. Top 12" of subgrade 95%
  - b. All other fill material 90%
6. Lawn and unpaved open areas:
  - a. All other fill material 90%

### 3.7 PLACING SPECIAL MATERIALS

A. Placing Impervious Liner Materials:

1. Place selected fine grain soils on bottom and side slopes of the basin to the indicated depth.
2. Inspect and proofroll the stripped and grubbed subgrade prior to placement of any liner material, as specified hereinafter.
3. Spread liner material in 8" maximum, loose lift thickness to provide a 6" compacted lift thickness.
4. Adjust soil moisture content to 1 to 3 percentage points "wet" of the optimum moisture contents.
5. Compact at 98% of maximum density.
6. Maintain liner material sufficiently moist to prevent drying and cracking, until such time as the basin is filled.

### **3.8 FINISH GRADING**

#### **A. General:**

1. Uniformly grade the areas within limits of grading under this section, including adjacent transition areas.
2. Smooth the finished surfaces within specified tolerance.
3. Grade with uniform levels or slopes between points where elevations are shown on the drawings, or between such points and existing grades.
4. Where a change of slope is indicated on the drawings, construct a rolled transition section having a minimum radius of approximately 8'0", unless adjacent construction will not permit such a transition, or if such a transition defeats positive control of drainage.

#### **B. Grading Adjacent to Structures: Grade areas adjacent to buildings to achieve drainage away from the structures and to prevent ponding.**

#### **C. Ditches and Gutters and Swales:**

1. Cut accurately to the cross sections, grades and elevations shown.
2. Maintain excavations free from detrimental quantities of leaves, sticks, trash and other debris until completion of the work.
3. Dispose of excavated materials as specified herein; do not in any case deposit materials within 3'0" of the edge of a ditch.

### **3.9 FIELD QUALITY CONTROL**

- #### **A. Secure the engineer's inspection and approval of subgrades and fill layers before subsequent construction is permitted thereon.**

- B. Field density determinations will be made, at no cost to the contractor, to insure that the specified densities are being obtained. Field density tests will be performed as determined by the engineer, considering the following:
1. At areas to receive paving, at least one field density test for every 5,000 sq.ft. of subgrade area, but not less than three tests.
  2. In each compacted fill layer, one field density test for every 5,000 sq.ft. of overlaying paved area, but not less than three tests.
  3. In fill beneath structures, one field density test for every 2,500 sq.ft. in each layer.
  4. Other tests as deemed necessary by the engineer.
- C. If, in the engineer's opinion based on reports of the testing laboratory, subgrade or fills which have been placed are below specified density, provide additional compacting and testing until specified requirements are met.
1. Additional testing will be provided by the owner's selected testing laboratory and all costs for the additional testing will be borne by the contractor.
- D. Proofrolling:
1. The contractor shall proofroll subgrade of areas to receive paving, structures on fill or impervious lining material.
    - a. Make not less than 3 passes of a 25 to 50 ton rubber tired roller over the full area.
    - b. Unstable, soft or otherwise unsuitable materials revealed by the proofrolling shall be removed and replaced with satisfactory materials, compacted as specified herein.

### **3.10 PLACING TOPSOIL**

- A. Upon completion of site grading and other related site work, topsoil shall be uniformly spread over the graded or improved areas. Topsoil shall be evenly distributed to conform to final grade elevations shown on the plans.
- B. Place, level and lightly compact topsoil to a depth of not less than 3".
- C. Maintain topsoil free of roots, rocks, debris, clods of soil and any other objectionable material which might hinder subsequent grassing or mowing operations.
- D. Any surplus materials shall be disposed of in approved areas on the site.

### **3.11 MAINTENANCE**

- A. Protection of Newly Graded Areas:
1. Protect newly graded areas from traffic and erosion, and keep free from trash and



weeds.

2. Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.
- B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

**END OF SECTION**

## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Excavating trenches for utilities from 5 feet outside building to utility service.
2. Compacted fill from top of utility bedding to subgrade elevations.
3. Backfilling and compaction.

#### B. Related Sections:

1. Section 31 23 16.16 – Excavation and Backfill for Structures
2. Section 31 37 00 – Riprap
3. Section 33 31 11 – Public Sanitary Sewerage Gravity Piping
4. Section 33 31 23 – Sanitary Sewer Force Main Piping

### 1.2 REFERENCES

#### A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

#### B. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>).
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

#### C. SCDOT Standard Specifications:

1. Standard Specifications for Highway Construction, 2007 or latest edition, published by the South Carolina Department of Transportation.

### 1.3 DEFINITIONS

- #### A. Utility: Any buried pipe, duct, conduit, or cable.

- B. Rock excavation: See Section 31 23 16.16 – Excavation and Backfill for Structures
- C. Unsuitable Material: See Section 31 23 16.16 – Excavation and Backfill for Structures
- D. Suitable (Common) Material: See Section 31 23 16.16 – Excavation and Backfill for Structures
- E. Select Material: See Section 31 23 16.16 – Excavation and Backfill for Structures
- F. Washed Stone (gravel): Washed stone shall be SCDOT No. 57 aggregate or equal conforming to ASTM C-33.
- G. Excavation: Excavation is defined as unclassified excavation of every description regardless of materials encountered.
- H. Bedding: Select Material placed to bring trench bottom up to grade (bottom of pipe).
- I. Haunching: Granular Material placed from the top of bedding to the pipe springline. Where coarse material with voids (i.e. washed stone or pea gravel) is used for bedding, the same material shall be used for haunching.
- J. Initial Backfill: Suitable, Select, or Granular Material placed from the springline to a specified distance at or above the crown of the pipe. See standard details for specific requirements.
- K. Final Backfill: Suitable or Select Materials placed from the top of Initial Backfill to the top of finished grade or pavement/structure subgrade. Final Backfill beneath roadways or structures may require use of Granular Materials or Flowable Fill, as directed by ReWa or other agency (i.e. SCDOT, County, City, etc.).

#### 1.4 SUBMITTALS

- A. Provide submittals in accordance with requirements set forth in the project manual.
- B. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.
- C. Product Data: Submit data for washed stone, shoring design (if required), concrete, geotextile fabric indicating fabric and construction, and other items as required by the Engineer or Owner's Representative.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

#### 1.5 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Comply with requirements of governmental agencies having jurisdiction.

- C. Testing: A testing laboratory retained by the Owner will make such tests as are deemed advisable.
  - 1. Schedule fill and backfill operations so as to permit a reasonable time for inspection and testing before placing succeeding lifts and keep the laboratory and Engineer informed of progress.
  - 2. Notify the Engineer and allow sufficient time for inspection and/or testing of foundation subgrades prior to commencing any work on the exposed excavation.
- D. Work performed within SCDOT right-of-ways shall be in accordance with Division 200 of SCDOT Standard Specifications.

#### 1.6 QUALIFICATIONS

- A. When applicable, prepare excavation protection plan under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of South Carolina.

#### 1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to installation.

#### 1.8 COORDINATION

- A. Coordination and project conditions:
  - 1. Coordinate scheduling, submittals, and Work of various Sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.
  - 2. Verify that utility requirements and characteristics of operating equipment are compatible with related utilities. Coordinate Work of various Sections having interdependent responsibilities for installing, connecting to, and placing operating equipment in service.
  - 3. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practical; place runs parallel with lines of building. Use spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
  - 4. Coordinate trench width, depth, and bedding types with ReWa standard detail drawings and as specified in Sections 33 31 11 and 33 31 23.
- B. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

## PART 2 - PRODUCTS

### 2.1 EXCAVATED MATERIALS

- A. Perform all excavation of every description and of whatever substances encountered to depths indicated or specified.
- B. Pile material suitable for backfilling in an orderly manner at safe distance from banks or trenches to avoid overloading and to prevent slides or cave-ins.
- C. Remove and deposit unsuitable or excess materials as directed by the Engineer.

### 2.2 FILL MATERIALS

- A. Provide from materials excavated for installation of utility.
  - 1. Use "Select" soil material free from organic matter and deleterious substances, containing no rocks or lumps over 2" in greatest dimension for backfill up to 12" above top of utility being covered.
  - 2. Do not permit rocks larger than 2" in greatest dimension in top 6" of backfill.
- B. Backfill in accordance with details shown on Contract Drawings utilizing "suitable" or "select" as specified or directed by the Engineer or Owner's Representative.

### 2.3 OTHER MATERIALS

- A. Concrete: Conforming to Section 701 of the SCDOT Standard Specifications
- B. Flowable Fill: Per SCDOT Standard Specifications.
- C. Per the Contract Drawings.

## PART 3 - EXECUTION

### 3.1 LINES AND GRADES

- A. Lay pipes to lines and grades indicated on Drawings.
  - 1. Engineer and/or Owner reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- B. Use laser-beam instrument with qualified operator to establish lines and grades.

### 3.2 PREPARATION

- A. Call Local Utility Line Information service indicated on the drawings not less than three (3) working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Protect plant life, lawns, rock outcropping and other features remaining as portion of final landscaping.
- D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities indicated to remain.
- F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

### 3.3 TRENCHING

- A. Excavate subsoil required for utilities.
- B. Remove lumped subsoil, boulders, and rock up of 1'-6" cubes, measured by volume. Remove Rock as specified in Paragraph 3.3.C below.
- C. Rock Excavation:
  - 1. See Section 31 23 16.16 – Excavation and Backfill for Structures, for classification of rock and methods for rock removal.
- D. Unauthorized Excavation:
  - 1. Excavation of material to depths below the grades indicated unless so directed by the Engineer will be deemed unauthorized excavation.
  - 2. Backfill and compact unauthorized excavation at no expense to the Owner.
  - 3. In wet excavations or excavations below normal groundwater elevations: Washed stone or lean concrete as directed by the Engineer.
  - 4. In dry excavations above normal groundwater elevations: Use compacted suitable material.
- E. Perform excavation within 24 inches of existing utility services, other than ReWa, in accordance with individual utility's requirements.
- F. Do not advance open trench more than 200 feet ahead of installed pipe.
- G. Cut trenches to width indicated on Drawings and/or sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.

- H. Excavate bottom of trench to dimensions shown on Drawings based on the size of pipe being installed.
- I. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
- J. Do not interfere with 45 degree bearing splay of foundations.
- K. When subsurface materials at bottom of trench are loose or soft, excavate to greater depth as directed by Engineer until suitable material is encountered.
- L. Cut out soft areas of subgrade not capable of compaction in place. Backfill with Fill Type "Suitable" or "Select" and compact to density equal to or greater than requirements for subsequent backfill material.
- M. Bell Holes: Hand trim for bell and spigot pipe joints. Remove loose matter.
- N. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Architect/Engineer.
- O. Remove excess subsoil not intended for reuse, from site.

#### 3.4 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches more than **5 feet** deep, or as required by OSHA regulations, excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

#### 3.5 DEWATERING

- A. Perform dewatering in accordance with Section 31 23 19. Detailed /designed dewatering plan may be required depending on site specific conditions.
- B. Where groundwater or wet/unsuitable soil is encountered, trench bottom shall be over excavated until stable in-situ soil is encountered. Depth to be determined in field by engineer and/or ReWa inspector. Unsuitable soil shall be removed from trench and replaced with granular material to provide acceptable pipe foundation.

3.6 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen and unsaturated fill materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Place geotextile fabric as detailed on Drawings or as directed by the Owner's Representative prior to placing subsequent fill materials.
- D. Place material in layers as shown on standard details depending on the type of pipe installation being performed (i.e. gravity sewer, force main, etc.).
  - 1. Bedding (#57 Washed Stone):
    - a. Evenly distribute across trench width and length. Consolidate stone to provide uniform bedding surface beneath pipe.
  - 2. Haunching (#57 Washed Stone):
    - a. Consolidate stone beneath haunches by slicing with shovels. Ensure pipe is uniformly supported by stone material. Ensure pipe alignment is maintained while placing material.
  - 3. Initial Backfill:
    - a. Gravity Sewer or Force Main:
      - 1) Ductile Iron Pipe:
        - a) Place Select/Suitable compacted fill from top of haunching, to centerline of pipe. Uniformly consolidate fill around pipe. Place Select/Suitable material "Cover" from top of Select/Suitable compacted fill to a distance of at least 12" above the crown of pipe. Utilize heavy duty mechanical tampers and compact Cover to the following densities per ASTM D-698 (Standard Proctor). Use caution when compacting Cover to protect pipe until suitable Cover depth is provided.
        - b) Open Space (lawns, right-of-ways, etc.)..... as determined by Eng.
        - c) Beneath private driveways or sidewalks..... 95%
        - d) Beneath public roadways or structures\*:..... 98%
      - 2) PVC:
        - a) Place #57 stone from top of haunching to a distance of 6" min. above the crown of pipe.
  - 4. Final Backfill:
    - a. Place final backfill that is free of debris, rocks, roots. Utilize heavy duty mechanical tampers and compact to the following densities per ASTM D-698 (Standard Proctor).
      - 1) Open Space (lawns, right-of-ways, etc.)..... as determined by Eng.
      - 2) Beneath private driveways or sidewalks..... 95%
      - 3) Beneath public roadways or structures\* ..... 98%



\*Where trenches are constructed near buildings, or other structures, more stringent compaction requirements, stone, or flowable fill may be required. See Section 31 23 16.16 – Excavation and Backfill for Structures. Design engineer may provide more restrictive requirements as necessary to meet project specific conditions.

- E. Maximum placement depths of various backfill materials for final backfill are as follows:
  - 1. Suitable (Common) Fill: Maximum **8 inches** compacted depth.
  - 2. Select Fill: Maximum **8 inches** compacted depth.
  - 3. Washed Stone: Maximum **12 inches** consolidated depth.
- F. Employ placement method that does not disturb or damage foundation perimeter drainage, and utilities in trench.
- G. Maintain optimum moisture content of fill materials to attain required compaction density as determined by the Geotechnical Engineer.
- H. Do not leave more than 50 feet of trench open at end of working day.
- I. Protect open trench to prevent danger to Owner and the public.

### 3.7 TOLERANCES

- A. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.
- B. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

### 3.8 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with ASTM D698.
- B. Perform in place compaction tests in accordance with the following:
  - 1. Density Tests: ASTM D1556, ASTM D2167, or ASTM D2922.
  - 2. Moisture Tests: ASTM D3017.
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.
- D. Frequency of Tests:
  - 1. Field density determinations will be made, at no cost to the contractor, to ensure that the specified densities are being obtained. Field density tests will be performed as determined by the engineer, considering the following:
    - a. In each compacted backfill layer, at least one field density test for every 1,000 linear ft. max. or 200 cy of backfill, but not less than three tests.
    - b. Other tests as deemed necessary by the engineer.

2. If, in the engineer's opinion based on reports of the testing laboratory, subgrade or fills which have been placed are below specified density, provide additional compacting and testing until specified requirements are met.
  - a. Additional testing will be provided by the owner's selected testing laboratory and all costs for the additional testing will be borne by the contractor.

3.9 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.10 SCHEDULE

- A. Sanitary Piping:
  1. Unpaved Areas: Compact uniformly to minimum 85 percent standard proctor of maximum dry density.
  2. Paved (private) Areas: Compact uniformly to minimum 95 percent standard proctor of maximum dry density.
- B. Structures:
  1. Compact uniformly to minimum 95 percent standard proctor of maximum dry density.
- C. Roadways:
  1. Compact in accordance with SCDOT or local municipality requirements.

END OF SECTION 31 23 16.13

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## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Excavating, backfilling, compacting and grading to build the structures as shown on the Drawings, as specified herein, and as needed to meet the requirements of the construction shown in the Contract Documents.

#### B. Related Requirements:

1. Section 31 23 16.13 - Trenching: Excavating as required for utilities

#### C. Classification:

1. All excavation is unclassified regardless of material encountered, except solid rock as defined below.

### 1.2 REFERENCE STANDARDS

#### A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

#### B. ASTM International:

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>).
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

#### C. Occupational Safety and Health Administration:

1. Trenching and Excavation Safety (OSHA 2226-10R 2015)
2. 1926 Subpart P, App B "Sloping and Benching"

#### D. SCDOT Standard Specifications:

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating, backfilling, compacting and grading to build the structures as shown on the Drawings, as specified herein, and as needed to meet the requirements of the construction shown in the Contract Documents.

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2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. Occupational Safety and Health Administration:

1. Trenching and Excavation Safety (OSHA 2226-10R 2015)
2. 1926 Subpart P, App B "Sloping and Benching"

D. SCDOT Standard Specifications:

1. Standard Specifications for Highway Construction, 2007 or latest edition, published by the South Carolina Department of Transportation.
- E. Local utility standards when working within 24 inches of utility lines.

### 1.3 DEFINITIONS

- A. Open areas: Open areas shall be those areas that do not include building sites, paved areas, street right-of-way, and parking areas.
- B. Maximum density: Maximum weight in pounds per cubic foot of a specific material.
- C. Optimum moisture: Percentage of water in a specific material at maximum density, as determined by the compaction test.
- D. Rock excavation: Excavation of any hard natural substance which requires the use of explosives and/or special impact tools such as jack hammers, sledges, chisels or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavating machinery. To be considered as rock excavation, the material shall be continuous having a standard penetration resistance as determined by ASTM D158; individual boulders or rocks in soil will not be considered rock excavation. Any material occupying an original volume of more than 1 cubic yard which cannot be excavated with a single-tooth ripper drawn by a crawler tractor having a minimum draw bar pull rating not less than 56,000 pounds usable pull (Caterpillar D-8K) or a large track mounted backhoe (CAT-325 or larger) is considered rock.
- E. Muck: Materials unsuitable for foundation because of organic content, saturation to the extent that it is somewhat fluid and must be moved by dragline, dredge, or other special equipment, are designated as muck. No extra payment will be made for muck removal.
- F. Unsuitable material: Unsuitable material is defined as earth material unsatisfactory for its intended use and as classified by the soils technicians. In addition to organic matter, sod, muck, roots, and rubbish, highly plastic clay soils of the CH and MH descriptions, and organic soils of the OL and OH descriptions, as defined in the Unified Soil Classification System shall be considered as unsuitable material.
- G. Suitable material (Common Fill): Where the term suitable material is used in specification sections pertaining to earthwork, it means earth or materials designated as being suitable for their intended use by soils technicians or the Engineer. Suitable material shall be designated as meeting the requirements of the Unified Soil Classification System types SW, GW, GC, SC, SM, ML, CL or as designated in these specifications.
- H. Select material: Select material is defined as granular material to be used where indicated on the drawings or where specified herein consisting of soils conforming to the Unified Soil Classification types SW, SM, GW, or GM or as otherwise approved by the Engineer as select fill. Select material shall contain no stones or rubble larger than 1½ inch in diameter.
- I. Washed stone (gravel): Crushed stone shall be No. 57 aggregate or equal conforming to ASTM C-33.

- J. Excavation: Excavation is defined as unclassified excavation of every description regardless of materials encountered, other than solid rock.

#### 1.4 SUBMITTALS

##### A. Shop Drawings:

1. Indicate soil densification grid for each size and configuration footing requiring soil densification.
2. Excavation Protection Plan:
  - a. Describe sheeting, shoring, and bracing materials and installation, as required, to protect excavations and adjacent structures and property and in accordance with OSHA standards;
  - b. Submit signed and sealed Shop Drawings with design calculations and assumptions to support plan.
3. Product Data: Submit data for washed stone, shoring design (if required), concrete, geotextile fabric indicating fabric and construction, and other items as required by the Engineer or Owner's Representative.

#### 1.5 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Comply with requirements of governmental agencies having jurisdiction.
- C. Testing: A testing laboratory retained by the Owner will make such tests as are deemed advisable.
  1. Schedule fill and backfill operations so as to permit a reasonable time for inspection and testing before placing succeeding lifts and keep the laboratory and Engineer informed of progress.
  2. Notify the Engineer and allow sufficient time for inspection and/or testing of foundation subgrades prior to commencing any work on the exposed excavation.
- D. Perform Work in accordance with Division 200 of SCDOT Standard Specifications.

#### 1.6 JOB CONDITIONS

- A. If conditions encountered during construction warrant additional removal of unsuitable material below foundation subgrades, then remove unsuitable material and replace it as specified at no additional expense to the Owner.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. Soil material used as fill, backfill or subgrade for structures shall consist of suitable material.
  - 1. Provide suitable material free from organic matter and deleterious substances, containing no rocks or lumps over 6" in greatest dimension, and with not more than 15% of the rocks or lumps larger than 2" in their greatest dimension.
  - 2. Do not permit rocks having a dimension greater than 1" in the upper 6" of fill or subgrade.
- B. Where select material is indicated on the drawings or specified, use select granular material as defined herein and approved by the Engineer.
- C. Where indicated on the drawings or specified, use gravel or crushed stone as defined herein.
- D. Where indicated on the drawings, provide a lean concrete "mud slab" beneath foundations.
  - 1. Use 2000 psi concrete and a minimum thickness of 2".
  - 2. With prior approval of the Engineer, a "mud slab" may be substituted for gravel base material except where the gravel base is required for drainage or for use with pressure relief valves.

## PART 3 - EXECUTION

### 3.1 EXCAVATION

- A. Protection of persons and property:
  - 1. Protect structures, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this Section.
  - 2. Unless shown to be removed, locate and protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.
  - 3. If active utility lines are encountered and are not shown on the drawings or otherwise made known to the Contractor, promptly notify the Engineer and take necessary steps to assure that service is not interrupted.
  - 4. Barricade open holes and depressions occurring as part of this work, and post warning lights on property adjacent to or with public access. Operating warning lights during hours from dusk to dawn each day and as otherwise required.



5. Side slopes: Slope, bench and/or shore sides of excavations and trench walls to maintain stability of the wall or sides. Pile materials obtained from the excavation a minimum of four feet from the edge of the excavation in accordance with OSHA standards.
  6. Shoring and sheeting: Where necessary, shore and sheet excavations with members of sizes and arrangement sufficient to prevent injury to persons, damage to structures or injurious caving or erosion.
    - a. Furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of excavations, to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction, and to protect adjacent structures from undermining or other damage. Any movement or bulging which may occur shall be corrected immediately by the Contractor. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and compacted.
    - b. Take all precautions to prevent distress of existing structures because of sheeting installation or removal. Where the removal of sheeting may cause damage to existing or newly constructed structures, such sheeting shall be left in place at no expense to the Owner.
    - c. All sheeting and shoring operations and maintenance thereof shall be the responsibility of the Contractor.
- B. Excavating: Perform excavating of every type of material encountered to the lines, grades and elevations indicated or as necessary for construction of the structures shown.
1. Conform to elevations and dimensions shown within a tolerance of 0.10', and extending a sufficient distance from footings and foundations to permit placing and removing concrete formwork, installation of services, other construction required and for inspection.
  2. Where earth will stand, shallow footing excavations may be cut to the exact size of the footing.
  3. Separate suitable materials and stockpile for future use.
  4. Dispose of unsuitable material and excess suitable material at no additional cost to the owner.
- C. Foundation subgrades: Excavate foundations and footings to a level bottom in firm, solid, suitable material.
1. Take care not to disturb the bottom of the excavation unless further compaction of the subgrade is required.
  2. Notify the Engineer in due time to permit inspection of the completed excavation prior to performing work on the foundation subgrade.

3. Should unsuitable or soft material be encountered at subgrade elevation, remove such material and replace with compacted suitable material or crushed stone from firm earth up to the indicated elevation.
    - a. In wet excavations or where groundwater is normally present, replace unsuitable material with crushed stone or lean concrete.
    - b. In dry excavations above the normal groundwater level, replace unsuitable material with compacted suitable material.
    - c. Unsuitable material shall be removed and replaced at no expense to the Owner.
  4. Where rock is encountered at foundation level:
    - a. Use drilling, picking, wedging or similar methods leaving the foundation rock in an entirely solid and unshattered condition.
    - b. Roughen approximately level surfaces to provide satisfactory bond with concrete.
    - c. Cut steps or benches in sloped surfaces to provide satisfactory bond.
- D. Drainage: Provide drainage and control grading in the vicinity of the work to prevent drainage into the excavation.
- E. Rock excavation:
1. Notify the Engineer upon encountering rock or similar material which cannot be removed or excavated by conventional earth moving or ripping equipment as specified in Part 1.1, Paragraph D.4.
  2. Do not use explosives without written permission from ReWa. See Paragraph 3.2 below for blasting requirements.
  3. When explosives are permitted, use only experienced powdermen or persons who are licensed or otherwise authorized to use explosives. Store, handle and use explosives in strict accordance with all regulatory bodies and the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.
  4. The Contractor shall be solely responsible for any damage resulting from the use of explosives.
  5. The Contractor is responsible for securing all permits required in performing this work.
- F. Unauthorized excavation:
1. Excavation of material to depths below the grades indicated unless so directed by the Engineer will be deemed unauthorized excavation.
  2. Backfill and compact unauthorized over excavation at no expense to the Owner.

- a. In wet excavations or excavations below normal groundwater elevations: Use crushed stone or lean concrete as directed by the Engineer.
- b. In dry excavations above normal groundwater elevations: Use compacted suitable material.

### 3.2 BLASTING

#### A. General Requirements:

1. Do not use blasting adjacent to existing buildings or structures. Remove rock at such locations using jack hammers and bull points.
2. Blasting shall be performed in accordance with all laws, regulations, and ordinances in effect at the time of blasting and required by the authority having jurisdiction thereover. Contractor shall engage the services of a qualified blasting engineer to develop blasting procedures and of an independent firm to perform pre-blast and post-blast surveys and assist in monitoring blasting operations. Contractor shall notify all affected adjacent property occupants at least 24 hours prior to any blasting. Contractor shall be responsible for all damage caused by blasting operations and shall be responsible for responding to and resolving all complaints.
3. Blasting contractor shall prepare and submit a blasting plan for ReWa review at least 2 weeks prior to planned blasting. Blasting plan shall include at a minimum:
  - a. List of blasting personnel and qualifications. Chief blaster shall possess a South Carolina blasting license and shall be on-site for blast.
  - b. Drilling logs showing depth to rock, soil profiles, rock densities / composition, rippable vs. non-rippable, etc.
  - c. Methods for confining materials (blast mats, etc.) lifted by blasting within the limits of the excavation or trench.
  - d. Proposed blast monitoring (see paragraph 3.2.C.)
  - e. Type and quantity of explosives, charge pattern / layout, timing
  - f. Pre-Blast survey documentation (see Paragraph 3.2.B).
4. All rock which cannot be handled, crushed, processed, and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed.
5. Blasting or other use of explosives for excavation adjacent to existing utilities, structures, and other facilities shall be in conformity with the requirements of the local ordinance and the authority having jurisdiction there over and shall not cause damage to any adjacent structures. Contractor shall consult with and obtain written approval for blasting procedures from the appropriate utility or agency before blasting adjacent to their utilities, structures, or other facilities. Certain utilities, including gas pipelines and fiber optics, and agencies have requirements that will not permit blasting adjacent to or within a minimum distance from their utilities or structures, including utilities and structures outside the construction easements or on the opposite side of the street, if applicable.

6. The blasting procedures shall be in conformity with the requirements of the utility, if applicable. Prior to blasting, Contractor shall submit to Owner, through Engineer, a copy of the blasting procedures sealed by the blasting engineer for record purposes.
7. Contractor shall be responsible for obtaining all required blasting permits from the city, county, state and federal agencies and shall provide sufficient prior notice as specified by code, ordinance or other regulation to the county engineer, county sheriff, fire districts, police departments, and all other appropriate agencies and authorities where the blasting is to be performed. A copy of the blasting permit shall be on the site before and during the blasting operations. Contractor shall furnish to Owner a copy of all blasting permits at least 7 days prior to blasting.

B. Pre-blast Survey:

1. Contractor shall perform a pre-blast survey of all utilities, structures, and other facilities adjacent to the blast sites to determine the conditions of each utility, house, building, bridge, overpass, and other structures and facilities susceptible to damage from blasting operations. The preblast survey shall include all structures and utilities within a minimum of 500 feet radius of the area to be blasted. The survey notification to all property owners, tenants, utilities, and other agencies and the area of survey shall be in conformity with the requirements of the authority having jurisdiction thereover or as determined by Contractor's insurance company if no local ordinance applies. Contractor shall submit the pre-blast survey report for record purposes, to Owner at least 30 days prior to blasting.
2. Provide pre-blasting drill logs for rock profiling to confirm presence and characteristics of rock.

C. Blast Monitoring:

1. Prior to the start of Contractor's blasting, Contractor shall measure background ground vibrations.
2. Seismographs shall be placed on the ground adjacent to structures subjected to ground shock to measure peak particle velocity components in three mutually perpendicular directions during blasting operations.
3. The peak particle velocity, defined as the maximum of the three velocity components of vibration, at any location shall not exceed values that will cause damage to the adjacent structures. Air overpressure shall be measured at adjacent structures. Air overpressure at adjacent structures shall not exceed values that will cause damage to the adjacent structures or personnel. The maximum peak particle velocity and air overpressure values that will not cause damage shall be determined by the blasting engineer retained by Contractor and shall be stated in the blasting procedures.
4. Contractor shall submit measurement records of the blast monitoring to Owner for record purposes within 24 hours after each blast.

D. Post-blast Survey:

1. Contractor shall perform a post-blast survey of the same utilities, structures, and other facilities surveyed in the pre-blast survey to determine the effect of the blasting operations. Contractor shall submit the post-blast survey report to Owner for record purposes within 14 days after completion of blasting.

3.3 DEWATERING

- A. Perform dewatering in accordance with Section 33 23 19. Detailed /designed dewatering plan may be required depending on site specific conditions.

3.4 BACKFILLING, FILLING AND COMPACTION

- A. Use suitable material for all filling and backfilling operations.
- B. Fill under structures: Deposit suitable material in layers not exceeding 8" in depth and compact each layer using proper equipment.
1. Do not place rock that will not pass through a 6" diameter ring within the top 12" of the surface of the completed fill or rock that will not pass through a 3" diameter ring within the top 6" of the completed fill.
  2. Do not place broken concrete, bricks, or asphaltic pavement in fills.
  3. Where indicated on the drawings, provide select granular material.
- C. Backfill excavations as promptly as progress of the Work permits, but not until completion of the following:
1. Inspection and acceptance of construction below finish grade including, where applicable, damp proofing and waterproofing.
  2. Inspecting, testing, approving and recording locations of underground utilities.
  3. Removing concrete formwork.
  4. Removing shoring and bracing, and backfilling of voids with satisfactory materials.
  5. Removing trash and debris.
  6. Foundation walls have been in place seven days.
- D. Placing and compacting:
1. Place backfill and fill materials in layers not more than 8" in loose depth.
  2. Before compacting, moisten or aerate each layer as necessary to provide the optimum moisture content within +/-2%.

3. Compact each layer to required percentage of maximum density for area.
4. Do not place backfill or fill material on surfaces that are muddy, frozen, or containing frost or ice.
5. Place backfill and fill materials evenly adjacent to structures, to required elevations.
6. Take care to prevent wedging action of backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.
7. Do not operate heavy equipment closer to foundation or retaining walls than a distance equal to height of backfill above the footing.
  - a. Compact remaining area using power driven hand tampers.
8. Where the construction includes basement or other underground walls having structural floors over them, do not backfill such walls until the structural floors are in place and have attained sufficient strength to support the walls.

E. Compaction requirements:

1. Compact soils to not less than the following percentages of maximum dry density as determined in accordance with ASTM D698 (Standard Proctor). Where percentages cannot be achieved, compacted stone may be used as directed by the Engineer.
2. Existing in place subgrade below structures where subgrade has been disturbed by water, improper dewatering, or construction traffic.
  - a. Top 12" of subgrade 98%
  - b. Below top 12" of subgrade 95%
3. Fill beneath structures and beneath an area extending 10 feet beyond the limits of the foundation:
  - a. Top 12" of subgrade 98%
4. Compaction of suitable material used to replace unsuitable material below foundation subgrades:
  - a. Top 12" of subgrade 98%
  - b. Below top 12" of subgrade 95%

3.5 FIELD QUALITY CONTROL

- A. Secure the Engineer's inspection and approval of subgrades and fill layers before subsequent construction is permitted thereon.

- B. Field density determinations will be made, at no cost to the Contractor, to ensure that the specified densities are being obtained. Field density tests will be performed as determined by the Engineer, considering the following:
  - 1. At areas to receive paving, at least one field density test for every 5000 sq.ft. of subgrade area, but not less than three tests.
  - 2. In each compacted fill layer, one field density test for every 5000 sq.ft. of overlaying paved area, but not less than three tests.
  - 3. In fill beneath structures, one field density test for every 2,500 square feet in each layer.
  - 4. Other tests as deemed necessary by the Engineer.
- C. If the Engineer's opinion based on reports of the testing laboratory, subgrade or fills that have been placed are below specified density; provide additional compacting and testing until specified requirements are met.
  - 1. Additional testing will be provided by the Owner's selected testing laboratory and all costs for the additional testing will be borne by the Contractor.
- D. Proofrolling:
  - 1. Upon request by the Engineer, proofroll the subgrade of structure foundations.
  - 2. Make not less than three passes of a 25 to 50 ton rubber tired roller over the full area.
  - 3. Unstable, soft or otherwise unsuitable materials revealed by the proofrolling shall be removed and replaced with satisfactory material and compacted as specified herein.

### 3.6 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation and maintain soil stability.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- C. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that may be created by earth operations.

END OF SECTION 31 23 16

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## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This section shall apply to all excavation.
- B. Construct all permanent work in areas free from water. Design, construct and maintain all dikes, levees, cofferdams and diversion and drainage channels as necessary to maintain the areas free from water and to protect the areas to be occupied by permanent work from water damage. Remove temporary works after they have served their purpose.
- C. The Contractor shall be responsible for the stability of all temporary and permanent slopes, grades, foundations, materials and structure during the course of the Contract. Repair and replace all slopes, grades, foundations, materials and structures damaged by water, both surface and subsurface, to the lines, grades and conditions existing prior to the damage, at no additional cost to the Owner.
- D. No additional compensation shall be paid to the contractor for dewatering activities.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS SUPPLIED BY CONTRACTOR

- A. Furnish well points, pumps, tile drains or other approved methods of the type normally used in dewatering operations. Well points shall be provided where required at no additional cost to the Owner.

## PART 3 - EXECUTION

### 3.1 CARE OF WATER

- A. Contractor is responsible for adhering to latest discharge requirements of ReWa Pretreatment Department for sewer discharge, and acquiring & maintaining compliance all permits required to discharge the water and shall protect waterways from turbidity and discharge-related contamination during the operation.
- B. Except where the excavated materials are designated as materials for permanent work, material from required excavation may be used for dikes, levees, cofferdams and other temporary backfill provided the material meets suitability requirements for these structures.
- C. Furnish, install, maintain and operate necessary pumping and other equipment for dewatering the various parts of the work and for maintaining the foundation and other parts free from water as required for constructing each part of the work.
- D. Install all drainage ditches, sumps and pumps to control excessive seepage on excavated slopes, to drain isolated zones with perched water tables and to drain impervious surfaces at final excavation elevation.

- E. Dewater by means which will insure dry excavations, preserve final lines and grades, and not disturb or displace adjacent soil.
- F. All pumping and drainage shall be done with no damage to roadways, property or structures and without interference with the rights of the public or owners of private property.
- G. Do not overload or obstruct existing drainage facilities.
- H. After they have served their purpose, remove all temporary protective work at a satisfactory time and in a satisfactory manner. All diversion channels and other temporary excavations in areas where the compacted fill or other structures will be constructed shall be cleaned out, backfilled and processed under the same Specifications as those governing the compacted fill.

### 3.2 DEWATERING

- A. By the use of well points, pumps, tile drains or other approved methods, the Contractor shall prevent the accumulation of water in excavated areas. Should water accumulate, it shall be promptly removed.
- B. Excavations shall be continuously dewatered to maintain a ground water level no higher than three to four feet below the lowest point in the excavation. Dewatering shall be accomplished well enough in advance of excavation to ensure that groundwater is already lowered prior to completing the final excavation to finish sub-grade.
- C. All destabilized sub-grade conditions caused by inadequate or untimely dewatering operations shall be undercut and backfilled with suitable backfill material at no additional cost to the Owner.
- D. Where the presence of fine-grained subsurface materials and a high groundwater table may cause the upward flow of water into the excavation with a resulting quick or unstable condition, the Contractor shall install and operate a well point system to prevent the upward flow of water during construction. Water pumped or drained from excavations, or any sewers, drains or water courses encountered in the work, shall be disposed of in a suitable manner without injury to adjacent property, the work under construction, or to pavements, roads, drives, and water courses. No water shall be discharged to sanitary sewers. Sanitary sewage shall be pumped to sanitary sewers or shall be disposed of by an approved method.
- E. Material disturbed below the foundation subgrade due to improper dewatering shall be removed and replaced with crushed stone or lean concrete at no expense to the Owner.

### 3.3 DEWATERING TRENCH EXCAVATIONS

- A. Dewater excavation continuously to maintain a water level two feet below the bottom of the trench.

- B. Control drainage in the vicinity of excavation so the ground surface is properly pitched to prevent water from running into the excavation.
- C. There shall be sufficient pumping equipment, in good working order, available at all times, to remove any water that accumulates in excavation. Where the pipe line crosses natural drainage channels, the Work shall be conducted in such a manner that unnecessary damage or delays in the prosecution of the Work will be prevented. Provisions shall be made for the satisfactory disposal of surface water to prevent damage to public or private property.
- D. In all cases, accumulated water in the trench shall be removed before placing bedding or haunching, laying pipe, placing concrete or backfilling.
- E. Where dewatering is performed by pumping the water from a sump, crushed stone shall be used as the medium for conducting the water to the sump. Sump depth shall be at least two feet below the bottom of the trench. Pumping equipment shall be of sufficient quantity and/or capacity to maintain the water level in the sump two feet below the bottom of the trench. Pumps shall be a type such that intermittent flows can be discharged. A standby pump shall be required in the event the operating pump or pumps clog or otherwise cease operation.
- F. Dewater by use of a well point system when pumping from sumps does not lower the water level two feet below the bottom of the trench. Where soil conditions dictate, the Contractor shall construct well points cased in sand wicks. The casing, 6" to 10" in diameter, shall be jetted into the ground, followed by the installation of the well point, filling casing with sand and withdrawing the casing.

END OF SECTION 33 23 19

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Riprap
- B. Related Requirements:
  - 1. Section 31 23 16.13 - Trenching: Trenching and backfilling for Site utilities.

1.2 REFERENCES

- A. SCDOT Standard Specifications:
  - 1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer information regarding size distribution and types for rock for riprap.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

1.4 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout Work of this Section.
- B. Perform Work according to SCDOT Standard Specifications.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Riprap:

1. Description:

- a. Riprap shall meet requirements of SCDOT Standard Specifications for Highway Construction, Section 804.

2. Materials:

- a. Use stone that is suitable in all respects for the purpose intended and obtained from a source listed on the most recent edition of SCDOT Qualified Product List 2.

3. Size:

- a. Use SCDOT Class A, B or C as designed by the Engineer.

Riprap Class	Rock Size (Feet)	Rock Size <sup>(2)</sup> (Lbs.)	Percent of Riprap Smaller Than
A	0.75	37	100
	0.5 (D <sub>50</sub> )	11	50
	0.2	0.7	15
B <sup>(1)</sup>	1.33	200	100
	1.0	75	85
	0.75 (D <sub>50</sub> )	37	50
	0.42	5	10
C <sup>(1)</sup>	1.8	500	100
	1.3 (D <sub>50</sub> )	200	50
	0.4	5	10
(1) Based on AASHTO Gradations			
(2) Specific Gravity > 2.6			

B. Filter Fabric:

1. Description:

- a. Non-woven geotextile filter fabric placed beneath riprap

2. Materials:

- a. Filter Fabric shall meet requirements of SCDOT Standard Specifications Section 804.2.11 from a source listed on the most recent edition of SCDOT Qualified Product List 44.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Place geotextile fabric over substrate. Fabric shall be Mirafi 700X or approved equal.
- B. Place riprap at culvert pipe ends, embankment slopes, and where indicated on Drawings.
- C. Place riprap into position and remove foreign material from surfaces.
- D. Do not place riprap over frozen or spongy subgrade surfaces.
- E. Average Installed Thickness: As indicated on Drawings or 12 inches minimum.

3.2 INSTALLATION

- A. The slope upon which the riprap is to be placed shall be worked to provide a consistent slope from the top of bank to the bottom of the bank. Depressions shall be filled in and properly compacted.
- B. Riprap placement shall begin at the toe of the slope and progress upward. Each piece shall be placed by hand perpendicular to the slope and shall be firmly embedded against the slope and adjoining pieces. The spaces between the larger pieces shall be filled with spalls of suitable size which shall be rammed into place. The finished surface shall present an even, tight surface true to line, grade and section.

END OF SECTION 31 37 16.13

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## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Asphalt materials.
2. Aggregate materials.
3. Aggregate subbase.
4. Asphalt paving base course, binder course, and wearing course.
5. Asphalt paving overlay for existing paving.

### 1.2 REFERENCE STANDARDS

#### A. SCDOT Standard Specifications:

1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation.

#### B. American Society of Testing Materials

1. ASTM D2950 - Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods

### 1.3 SUBMITTALS

#### A. Product Data:

1. Submit product information for asphalt and aggregate materials.
2. Submit mix design with laboratory test results supporting design.

#### B. Manufacturer's Certificate: Certify Products are produced at a plant approved by SCDOT and that meet or exceed specified requirements.

### 1.4 QUALITY ASSURANCE

#### A. Mixing Plant: Conform to Division 400 of SCDOT Standard Specifications.

#### B. Obtain materials from same source throughout.

#### C. Perform Work in accordance with SCDOT and/or Local Municipality standards.

#### D. Maintain one copy of each document on site.

- E. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

#### 1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum three years documented experience approved by manufacturer.

#### 1.6 AMBIENT CONDITIONS

- A. Do not place asphalt mixture when ambient air or base surface temperature is less than 50 degrees F, or surface is wet or frozen.
- B. Place asphalt mixture when temperature is not more than 15 degrees F less than initial mixing temperature.

### PART 2 - PRODUCTS

#### 2.1 ASPHALT PAVING

- A. Performance / Design Criteria:
  - 1. Paving: Design for light duty commercial vehicles.
- B. Asphalt Paving Materials:
  - 1. Prime Coat
    - a. The work covered under this section of this specification shall be performed in strict conformance with SCDOT Section 305.4.6 & 401.4.18.
  - 2. Tack Coat
    - a. The work covered under this section of this specification shall be performed in strict conformance with SCDOT Section 401.4.18.
  - 3. Aggregate Base Course
    - a. The work covered under this section of this specification shall be performed in strict conformance with SCDOT Section 305
  - 4. Asphalt Intermediate Course (Type B)
    - a. The work covered under this section of this specification shall be performed in strict conformance with SCDOT Section 402.
  - 5. Asphalt Surface Course (Type C)
    - a. The work covered under this section of this specification shall be performed in strict conformance with SCDOT Section 403.

#### 2.2 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

## 2.3 SOURCE QUALITY CONTROL

- A. Submit proposed mix design of each class of mix for review prior to beginning of Work.
- B. Test samples in accordance with Section 401 of SCDOT Standard Specifications.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
- B. Verify compacted subgrade subbase is dry.
  - 1. Proof roll subbase with steel wheel 2-axle tandem roller in minimum two perpendicular passes to identify soft spots.
  - 2. Remove soft subbase and replace with compacted fill.
- C. Verify gradients and elevations of base are correct.
- D. Verify manhole frames are installed in correct position and elevation.

### 3.2 PREPARATION

- A. Prepare subbase in accordance with SC DOT Standards.

### 3.3 DEMOLITION

- A. Saw cut and notch existing paving as indicted on Drawings.
- B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.
- C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

### 3.4 INSTALLATION

- A. Subbase:
  - 1. Prepare subbase in accordance with SCDOT Standard Specifications.
- B. Primer:
  - 1. Apply primer on aggregate subbase at uniform rate of 0.25-0.30 gal/sq yd.
  - 2. Use clean sand to blot excess primer.
- C. Tack Coat:
  - 1. Apply tack coat on asphalt and concrete surfaces over subgrade surface at uniform rate.

- a. New or Existing Asphalt Surfaces: 0.05 – 0.15 gal/sq yd.
  2. Apply tack coat to contact surfaces of curbs, gutters and concrete pads.
  3. Coat surfaces of manhole] frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.
- D. Double Course Asphalt Paving:
1. Place asphalt binder course within 24 hours of applying primer or tack coat.
  2. Place binder course to thickness indicated on Drawings.
  3. Place wearing course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
  4. Place wearing course to thickness indicated on Drawings.
  5. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
  6. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.
- E. Asphalt Paving Overlay
1. Apply tack coat to existing paving surface at rate recommended by geotextile fabric manufacturer.
  2. Install geotextile fabric in accordance with manufacturer's instructions to permit asphalt saturation of fabric. Lap fabric edge and end joints 4 inches.
  3. Place wearing course to thickness indicated on Drawings.
  4. Compact overlay by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
  5. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.
- F. Curbs:
1. Install extruded asphalt curbs as indicated on Drawings.
- 3.5 TOLERANCES
- A. Flatness: Maximum variation of 1/8 inch measured with 10 foot straight edge.
  - B. Scheduled Compacted Thickness: Within 1/4 inch.
  - C. Variation from Indicated Elevation: Within 1/2 inch.
- 3.6 FIELD QUALITY CONTROL
- A. Perform Contractor Quality Control Program in accordance with Appendix C of the SCDOT Construction Manual, May 2004 (or most recent), published by the South Carolina Department of Transportation.
  - B. Asphalt Paving Mix Temperature: Measure temperature at time of placement.

- C. Asphalt Paving Density: ASTM D2950 nuclear method; test one location for every 1000 square yards compacted paving.

3.7 PROTECTION

- A. Immediately after placement, protect paving from mechanical injury for seven days or until surface temperature is less than 140 degrees F.

END OF SECTION 32 12 16

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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fence framework, fabric, and accessories.
2. Excavation for post bases.
3. Concrete foundation for posts and center drop for gates.
4. Manual gates and related hardware.

1.2 REFERENCES

A. ASTM International:

1. ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
5. ASTM A817 - Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire.
6. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
7. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
8. ASTM F552 - Standard Terminology relating to Chain Link Fencing.
9. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
10. ASTM F626 - Standard Specification for Fence Fittings.
11. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
12. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
13. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
14. ASTM F1345 - Standard Specification for Zinc - 5% Aluminum -Mischmetal Alloy-Coated Steel Chain-Link Fence Fabric.

B. Chain Link Fence Manufacturers Institute:

1. CLFMI - Product Manual.

C. SCDOT Standard Specifications:

1. Standard Specifications for Highway Construction, latest edition, published by the South Carolina Department of Transportation (SCDOT).

1.3 SYSTEM DESCRIPTION

- A. Fence Height: as indicated on Drawings.
- B. Line Post Spacing: As indicated on Drawings, not exceeding 10 feet.
- C. Fence Post and Rail Strength: Conform to ASTM F1043 Light Industrial / Commercial Fence quality.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
- B. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.
- C. Manufacturer's Installation Instructions: Submit installation requirements including post foundation anchor bolt templates if required.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.
- B. Operation and Maintenance Data: Procedures for submittals.

1.6 QUALITY ASSURANCE

- A. Supply material according to CLFMI - Product Manual.
- B. Perform installation according to ASTM F567.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years documented experience.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.
- B. Identify each package with manufacturer's name.
- C. Store fence fabric and accessories in secure and dry place.



## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Framing (Steel): ASTM F1083 Schedule 40 galvanized steel pipe, welded construction, minimum yield strength of 50 ksi; coating conforming to ASTM F1043 Type A on pipe exterior and interior.
- B. Fabric Wire (Steel): ASTM A392 Class 1 zinc coated steel wire.
- C. Barbed Wire: ASTM A121 Coating Type Z, galvanized steel; 12 gage thick wire, 2 strands, 4 points at 3 inch on center.
- D. Concrete: Class 2500 concrete in accordance with SCDOT Standard Specifications with 2500 psi compressive strength at 28 days.

### 2.2 COMPONENTS

- A. Line Posts: 2.5 inch diameter.
- B. Corner and Terminal Posts: 2.875 inch.
- C. Gate Posts: 4.0 inch diameter.
- D. Top and Brace Rail: 1.625 inch diameter, plain end, sleeve coupled.
- E. Gate Frame: 1.925 inch diameter for welded fabrication.
- F. Tension Wire: 6 gage thick steel, single strand.
- G. Tension Band: 3/16 inch thick by 3/4 inch wide steel.
- H. Tie Wire: Aluminum alloy steel wire, 9-gage or 11-gage as indicated.

### 2.3 ACCESSORIES

- A. Caps: Cast steel galvanized, galvanized pressed steel, malleable iron galvanized, or aluminum alloy; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.
- C. Extension Arms: Cast steel galvanized or galvanized pressed steel to accommodate 3 strands of barbed wire, single arm, for placing vertical or sloped to 45 degrees as indicated on Drawings.
- D. Gate Hardware: Fork latch with gravity drop or center gate stop and drop rod; two 180 degree gate hinges for each leaf and hardware for padlock keyed to match hardware as directed by Architect/Engineer.

## 2.4 GATES

### A. General:

1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings.
2. Factory assemble gates.
3. Design gates for operation by one person.
4. Finish is to be galvanized, aluminum coated, or PVC coated to match fence.

### B. Swing Gates:

1. Fabricate gates to permit 180 degree swing.
2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.

## 2.5 FINISHES

- A. Components and Fabric: Galvanized to ASTM A123/A123M for components; ASTM A153/A153M for hardware; ASTM A392 for fabric; 1.8 oz/sq ft coating.
- B. Hardware: Galvanized to ASTM A153/A153M, 2.0 oz/sq ft coating.
- C. Accessories: Same finish as framing.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install framework, fabric, accessories, and gates according to ASTM F567.
- B. Set intermediate, terminal, gate, and corner posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- C. Line Post Footing Minimum Depth Below Finish Grade: 3 feet.
- D. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: 3.5 feet.
- E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.
- F. Install top rail through line post tops and splice with 6 inch long rail sleeves.
- G. Install center and bottom brace rail on corner gate leaves.
- H. Do not stretch fabric until concrete foundation has cured 28 days.
- I. Install bottom tension wire stretched taut between terminal posts.
- J. Install support arms sloped-outward and attach barbed wire; tension and secure.

- K. Support gates from gate posts. Do not attach hinged side of gate from building wall.
- L. Install gate with fabric and barbed wire overhang to match fence. Install three hinges on each gate leaf, latch, catches, and foot bolts and sockets.
- M. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.
- N. Connect to existing fence at new terminal post or an existing line post converted to terminal post by installation of brace rails and brace rods.
- O. Install posts with 6 inches maximum clear opening from end posts to buildings, fences and other structures.
- P. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.
- Q. Center and align posts. Place concrete around posts, and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.
- R. Extend concrete footings 1 inches above grade, and trowel, forming crown to shed water.
- S. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

### 3.2 ERECTION TOLERANCES

- A. Maximum Variation From Plumb:  $\frac{1}{4}$  inch.
- B. Maximum Offset From Indicated Position: 1 inch.
- C. Minimum distance from property line: 6 inches.

END OF SECTION 32 31 13

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## PART 1 - GENERAL

### 1.1 SUMMARY

- A. This specification covers all labor, materials, equipment, and services necessary to complete the installation of corrosion protection for concrete and masonry wastewater structures as herein specified. This specification to be used as an alternate to Section 33 05 75 – Polymer Concrete Manholes, Wetwells and Structures, where recommended by design engineer or ReWa.
- B. Related Sections:
  - 1. Section 33 05 61 – Concrete Manholes
  - 2. Section 33 05 63 – Concrete Vaults and Chambers
  - 3. Section 33 32 10 – Submersible Sewage Pumping Station
  - 4. Section 33 32 13 – Packaged Wastewater Pumping Stations

### 1.2 REFERENCES

- A. ACI – The published standards of the American Concrete Institute, Farmington Hills, MI.
  - 1. ACI 506.2-77 – Specifications for Materials, Proportioning, and Application of Shotcrete.
- B. ASCE – The published Manuals and Reports on Engineering Practices of the American Society of Civil Engineers, Reston, VA.
  - 1. ASCE Manual No. 92 – Manuals and Reports on Engineering Practice; Manhole Inspection and Rehabilitation (2008 Update).
- C. ASTM – The published standards of the American Society for Testing and Materials, West Conshohocken, PA.
  - 1. ASTM D638 – Tensile Properties of Plastics.
  - 2. ASTM D790 – Flexural Properties of Unreinforced and Reinforced Plastics.
  - 3. ASTM D695 - Compressive Properties of Rigid Plastics.
  - 4. ASTM D4541 – Pull-off Strength of Coatings Using a Portable Adhesion Tester.
  - 5. ASTM D7234 – Pull-off Adhesion Strength of Coatings on Concrete Using Portable Pull-off Adhesion Testers.
  - 6. ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.
  - 7. ASTM D2584 - Volatile Matter Content.

8. ASTM D543 – Resistance of Plastics to Chemical Reagents.
  9. ASTM D4358 – Standard Practice for Surface Cleaning Concrete.
  10. ASTM D4259 – Standard Practice for Abrading Concrete
  11. ASTM C109 – Compressive Strength Hydraulic Cement Mortars
  12. ASTM C579 – Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars.
- D. ICRI – The published standard of the International Concrete Repair Institute, Des Plaines, IL.
1. ISRI Technical Guideline No. 03732 – Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
- E. Los Angeles County Sanitation District – Evaluation of Protective Coatings for Concrete (otherwise known as the “Redner Test”).
- F. NACE – The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.
1. NACE RPO 188-99 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
- G. SSPC – The published standards of the Society of Protective Coatings, Pittsburgh, PA.
1. SSPC-SP 1 – Solvent Cleaning
  2. SSPC-SP 5 – White Metal Blast Cleaning
  3. SSPC-SP 10 – Near White Metal Blast Cleaning
  4. SSPC-SP 12 – Surface Preparation and Cleaning of Metals by Water jetting prior to Recoating
  5. SSPC-SP 13 / NACE No. 6 – Surface Preparation of Concrete
  6. SSPC-PA 9 – Measurement of Dry Coating Thickness on Cementitious Substrates using Ultrasonic Gages.
- H. SSPWC – Standard Specifications for Public Works Construction “Greenbook”, 2009.
1. SSPWC 210-2.3.3 & 211-2 - Chemical Resistance Test (Pickle Jar Test).
  2. SSPWC 500-2 – Manhole and Structure Rehabilitation.

### 1.3 SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions of the Contract.
- B. Product Data:
  - 1. Technical data sheet for each repair and coating product to be used; including application, cure time, surface preparation procedures, and certification from coating project manufacturer as to the compatibility of the repair material(s) and coating system.
  - 2. Material Safety Data Sheet (MSDS) for each project to be used.
  - 3. Copies of independent testing performed on the coating product indicating the product meets the requirements as specified herein. Coating product physical properties shall be substantiated through submittal of testing results as documented by an accredited third party laboratory and shall be representative of the actual field applied product including cure mechanism(s) as to be employed in the field.
  - 4. Five (5) references of manufacturer indicating successful coating system performance greater than five (5) years in age of the submitted coating product(s) within the municipal wastewater environment.
- C. Contractor Data:
  - 1. Current documentation from repair and coating product manufacturer(s) certifying Contractor's training and equipment complies with the Quality Assurance requirements specified herein.
  - 2. Five (5) references of Contractor indicating successful coating system installation performance greater than five years in age of coating product (2) of the same material type as specified herein, applied by spray application within the municipal wastewater environment.
  - 3. Documentation of requirements in this Section.

### 1.4 QUALITY ASSURANCE

- A. Coating and repair product(s) shall be capable of being installed and curing properly within the specified environment(s); specifically within environmental conditions of a typical sanitary sewer. Coating product(s) shall be resistant to all forms of chemical or bacteriological attack found in municipal sanitary sewer systems.
- B. Coating and Repair product(s) shall be fully compatible; including ability to bond effectively to each other and/or the host substrate, forming a composite system.
- C. Contractor shall utilize equipment for the application of the coating and repair product(s) which has been approved by the product manufacturer; and Contractor shall have received training on the operation and maintenance of said equipment from the product manufacturer. Written certification of such approval(s) and training shall be submitted by the coating and repair product manufacturer(s).

- D. Contractor and contractor personnel shall be certified by , or have their training approved and certified by, the coating and repair product(s) manufacturer(s) for the handling, mixing , application and inspection of the product(s) to be used as specified herein. Written certification of such training shall be submitted by the coating and repair product manufacturer(s) and shall include the individual contractor personnel to be employed on the project.
- E. Inspectors shall be trained in the use of testing or inspection instrumentation and knowledgeable of the proper use, preparation and installation of the product(s) to be used as specified herein.
- F. Contractor shall initiate and enforce quality control procedures consistent with the coating product(s) manufacturer recommendations and applicable NACE, SSPC, ICRI or other standards as referenced herein.
- G. Pre-construction meeting shall take place no less than two weeks prior to Contractor mobilization. All parties to have physical presence on the project during construction shall be present. At this meeting responsibilities and authorities during construction shall be discerned; comments and questions regarding materials and execution of these specifications shall be presented and addressed.

#### 1.5 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this Section with minimum five (5) years of experience.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Materials are to be kept dry, protected from weather, and stored under cover.
- B. Coating and repair materials are to be stored between 50 degree F and 90 degree F. Do not store near flame, heat, or strong oxidants.
- C. All materials are to be handled according to their material safety data sheets.

#### 1.7 SITE CONDITIONS

- A. Contractor shall conform to all local, state, and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.
- B. Confined space entry program and other required safety training certifications shall be submitted by Contractor to Owner as necessary to perform the specified work.
- C. Flow diversion and/or bypass plans shall be submitted by Contractor to Owner as necessary to perform the specified work.



## 1.8 WARRANTY

- A. Contractor shall warrant all work against defects in materials and workmanship for a period of one (1) year, unless otherwise noted, from the date of final acceptance of the project. Contractor shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said one (1) year period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to the Owner.
- B. Coating and repair product supplier(s) shall warrant all coating materials for a period of one (1) year from the date of final acceptance, unless otherwise noted, to be free of manufacturing defects; and products will meet current published physical properties when applied and tested in accordance with the manufacturer's standards. If, within said one (1) year period, any product does not meet the physical properties or is defective in manufacture the manufacturer will either replace the defective product or refund the purchase price.

## PART 2 - PRODUCTS

### 2.1 EXISTING PRODUCTS

- A. Standard Portland cement or new concrete must cure a minimum of 28 days prior to application of the coating product(s) or surfaces must be prepared and coating materials applied according to the coating product manufacturer's recommendations for such conditions.
- B. Existing coatings shall be removed which may affect the performance and adhesion of the specified coating product(s). Contractor is to maintain strict adherence to the protective coatings manufacturer's recommendations with regard to proper surface preparation and compatibility with existing coatings.
- C. Thoroughly clean and prepare existing products/surfaces to affect a seal with and promote the adhesion of the coating product(s).

### 2.2 REPAIR PRODUCTS

- A. Approved coating product manufacturers:
  - 1. Raven Lining Systems,
  - 2. Sherwin Williams,
  - 3. or Approved Equal
- B. Repair products shall be used to fill voids or bugholes, smooth transitions between components, replace lost mortar in masonry structures, smooth rough surfaces, and rebuild severely deteriorated substrates and/or to remediate infiltration prior to the installation of the coating product(s).
  - 1. Repair materials must be supplied by the coating product(s) manufacturer or shall be expressly approved by the coating product(s) manufacturer in writing for compatible with the specified coating product(s).

2. All materials shall be mixed, applied, and cured in accordance with the manufacturer's recommendations.
  3. Repair product physical properties shall be substantiated through submittal of accredited third party testing results and shall be representative of the actual field applied product and cure mechanism(s) to be employed in the field.
- C. 100% solids, solvent-free epoxy grout; specifically the specified coating product(s) by Raven Lining Systems, enhanced with Raven 200 polyolefin fiber filler or other approved manufacturer.
- D. Factory blended, rapid setting, high-early strength, non-shrink, calcium aluminate repair mortar to be trowel or pneumatically spray applied to the entire surface.
1. Manufacturer:
    - a. Raven Lining Systems,
    - b. AW Cook (Sherwin Williams system),
    - c. Or approved equal
  2. Product: Raven 705CA Cement Mortar, or approved equal having the following characteristics:
    - a. Product Type: Calcium aluminate mortar
    - b. Tensile Strength, psi (ASTM C496): >600
    - c. Compressive Strength, psi (ASTM C109): >8,000@ 28 days
    - d. Flexural Strength, psi (ASTM C293): >900
    - e. Shrinkage @ 90% R.H., % (ASTM C596): 0
    - f. Adhesion to Concrete, psi (ASTM C882): >2000 psi
    - g. Adhesion to Concrete, psi (ASTM D7234): >150 psi
    - h. Freeze/Thaw (ASTM C666): 100 Cycles, no visible damage
    - i. Density of wet mix: 129-139 lbs./ft<sup>3</sup>
    - j. Applied Density: 135 lbs/ft<sup>3</sup> (+/- 5 lbs).
- E. Factory blended, high strength, non-shrink, cementitious repair mortar to be troweled or otherwise manually applied to repair/fill minor surface defects from featheredge to ¼" in thickness.
1. Manufacturer:
    - a. Raven Lining Systems,
    - b. AW Cook (Sherwin Williams system),
    - c. or approved equal

2. Product: Raven 710-Cement Mortar or approved equal having the following characteristics:
  - a. Product Type: Calcium aluminate mortar
  - b. Compressive Strength, psi (ASTM C109): >5,000 @ 28 days
  - c. Shrinkage @ 90% R.H., % (ASTM C596): 0
  - d. Adhesion to Concrete, psi (ASTM C882): >16000 psi
  - e. Adhesion to Concrete, psi (ASTM D7234): >150 psi
  
- F. Factory blended, high-early strength, non-shrink, cementitious repair mortar to be trowel applied to fill large voids or repair bench and inverts.
  1. Manufacturer:
    - a. Raven Lining Systems,
    - b. AW Cook (Sherwin Williams system),
    - c. or approved equal
  
  2. Product: Raven 700 Cement Mortar or approved equal having the following characteristics:
    - a. Product Type: Calcium aluminate mortar
    - b. Compressive Strength, psi (ASTM C109): >1,800 @ 24 hrs
    - c. Adhesion to Concrete, psi (ASTM C882): >1,600 psi
    - d. Adhesion to Concrete, psi (ASTM D7234): >150 psi
    - e. Density of wet mix: 100 – 110 lbs./ft<sup>3</sup>.
  
- G. Factory blended, non-shrink, hydraulic cement to be used for infiltration remediation.
  1. Manufacturer: As recommended by coating product manufacturer
  
  2. Product: Hydraulic cement having the following characteristics:
    - a. Product Type: Hydraulic cement
    - b. Compressive Strength, psi (ASTM C109): >1,000 @ 1 hour, >2500 psi @ 24 hrs
    - c. Shrinkage @ 90% R.H., % (ASTM C596): 0
  
- H. Hydrophobic or Hydrophilic injectable urethane chemical grout to be used for the remediation of high volume infiltration or crack repair and/or soil stabilization and void filling.
  1. Manufacturer: As recommended by coating product manufacturer

2. Product: Urethane chemical grout as appropriate for infiltration, crack repair and soil stabilization.
- I. (OPTIONAL) Fiberglass woven roving cloth using E-Glass, 9 oz/yd<sup>2</sup> minimum weight; typical of Hexcel or BFG Industries style #7500.

### 2.3 COATING PRODUCTS

- A. Coating product shall be applied to all interior surfaces to protect the host substrate and repair materials from all forms of chemical or bacteriological attack typically found in municipal sanitary sewer systems and to impart a degree of structural enhancement.
- B. Coating product physical properties shall be substantiated through submittal of accredited third party testing results and shall be representative of the actual field applied product and cure mechanism(s) to be employed in the field.
- C. 100% Solids, Solvent-Free, Ultra-High Build Epoxy Coating to be spray applied to all interior surfaced of exposed concrete above the spring line or as otherwise detailed.
  1. Manufacturer:
    - a. Raven Lining Systems
    - b. Sherwin Williams
    - c. or approved equal
  2. Product: Raven
    - a. Raven 405, Sherwin Williams Duraplate 6100 Epoxy, or approved equal – 100% solids, solvent-free ultra high-build epoxy system exhibiting the following characteristic:
      - b. Product Type: amine cured epoxy
      - c. VOC Content (ASTM D2584): 0%
      - d. Compressive Strength, psi (ASTM D695): 18,000 (minimum)
      - e. Tensile Strength, psi (ASTM D638): 7,500 (minimum)
      - f. Flexural Modulus, psi (ASTM D790): 700,000 (minimum)
      - g. Adhesion to Concrete, psi/mode of failure (ASTM D4541/7234): 200 psi (minimum) with substrate (concrete) failure
      - h. Chemical Resistance (ASTM D543/G20) immersion service for:
        - 1) Municipal sanitary sewer environment
        - 2) Sulfuric Acid, 30%
        - 3) Sodium Hydroxide, 10%

- 4) Sodium Hypochlorite, 12.5%
  - i. Successful Pass: Sanitation District of L.A. County Coating Evaluation Study and SSPWC 210.2.3.3 (Greenbook "Pickle Jar" Chemical Resistance test)
- D. Coating product primer to be applied as recommended by the coating product manufacturer as installation conditions warrant.
  - 1. Manufacturer:
    - a. Raven Lining Systems,
    - b. Sherwin Williams
    - c. or approved equal
  - 2. Product: Raven 155 or approved equal – Water borne epoxy primer having the following characteristics:
    - a. Product Type: amine cured, waterborne epoxy primer
- E. 100% Solids, Solvent-Free, Ultra-High Build Epoxy Coating to be manually or spray applied to interior surfaces of exposed concrete below the typical flow line; specifically designed for accelerated cure and suitable for release of flow in less than 45 minutes at normal service temperatures or as otherwise detailed.
  - 1. Manufacturer:
    - a. Raven Lining Systems
    - b. Sherwin Williams
    - c. or approved equal
  - 2. Product: Raven 405 FS or approved equal – 100% solids, solvent-free ultra-high build epoxy system.

#### 2.4 PRODUCT APPLICATION EQUIPMENT

- A. Cementitious repair products for spot repair may be mixed and applied using hand and/or power tools.
- B. Cementitious repair products to be spray applied shall be mixed and applied using manufacturer approved batch mixing and low velocity spray devices.
- C. Coating product primer may be applied using hand tools or other convention/airless spray application device(s).
- D. Coating product to be spray applied shall be mixed and applied using manufacturer approved heated plural component spray equipment.
- E. Coating product application too hard to reach areas or for touch-up may be performed using hand tools.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Appropriate action shall be taken by Contractor to comply with local, state, and federal regulatory and other applicable agencies with regard to environment, health, and safety during work.
- B. All structures to be coated shall be readily accessible to Contractor.
- C. New Portland cement concrete structures shall have endured a minimum of 28 days since manufacture prior to commencing coating installation. Should earlier coating be required, coating product manufacturer shall recommend specifications including appropriate cure assessment testing and use of specialty primers and sealers.
- D. Any active flows shall be dammed, plugged, or diverted as required to ensure all liquids are maintained below or away from the surfaces to be coated until final applications are cured as recommended by manufacturer.
- E. Temperature of the surface to be coated should be maintained between 40 and 120 deg F.
- F. Specified surfaces should be shielded to avoid exposure of direct sunlight, other intense heat source or, where cementitious products are employed, excessive ventilation. Where varying surface temperatures do exist, coating installation should be scheduled when the temperature is falling versus rising.
- G. Prior to commencing surface preparation, Contractor shall inspect all surfaces specified to receive the coating and notify Owner, in writing, of any noticeable disparity in the site, structure or surfaces which may interfere with the work, use of materials or procedures as specified herein.

#### 3.2 REPAIRS AND SURFACE PREPARATION

- A. Excessive debris, sediment, root intrusion or other foreign materials which may impact the effectiveness of the surface preparation process shall be removed prior to the commencement thereof.
- B. Offset structural components, lids, covers, frames, etc. shall be repaired, replaced, or reset prior to the commencement of surface preparation.
- C. External soil/fill voids shall be remediated and/or stabilized by replacement or injection of stabilizing grout as determined appropriate by the engineer.
- D. Oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants which may affect the performance and adhesion of the coating to the substrate shall be removed in accordance with SSPC-SP 1-Solvent Cleaning.
- E. Choice of surface preparation method(s) should be based upon the condition of the structure and concrete or masonry surface, potential contaminants present, access to perform work, and

required cleanliness and profile of the prepared surface to receive the repair and/or coating product(s).

- F. Surface preparation method, or combination of methods, that may be used include high-pressure water cleaning, water jetting, abrasive blasting, shotblasting, grinding, scarifying, detergent water cleaning, hot water cleaning and others as referenced in industry accepted standards such as:
1. SSPC SP-13?NACE No. 6 Surface Preparation of Concrete
  2. ASTM D-4258 Standard Practice for Surface Cleaning Concrete for Coating and ASTM-D-4259 Standard Practice for Abrading Concrete
  3. ICRI Technical Guideline No. 03732 Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
  4. NACE/SSPC Standards for the surface preparation of steel.
- G. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound, clean, and neutralized surface suitable for the specified coating product(s).
1. Resulting surface profile of the prepared concrete substrate shall be (as described in ICRI Technical Guideline No. 03732):
    - a. For application of cementitious materials; at least a CSP2
    - b. For application of coating products; at least a CSP4.
  2. Concrete and/or mortar damaged by corrosion, chemical attack or other means of degradation shall be removed so that sound substrate remains,
    - a. In conditions where severe chemical/microbiological attack has occurred the prepared substrate shall exhibit a pH of 8-12. Additional cleaning and/or contaminated substrate removal may be required to achieve the specified pH level.
  3. Steel surfaces to be coated shall be abrasive blast cleaned.
    - a. Blast air shall be free of oil and water.
    - b. Abrasive shall be as required to produce the specified level of cleanliness and profile in an efficient and uniform manner. Abrasive shall not be recycled.
    - c. Abrasive blasting shall not be performed when the air or steel temperature is below 40 deg F, when the relative humidity exceeds 80%, or when the steel is less than 5 deg F warmer than the dew point. The Contractor will provide dehumidification, and/or temperature control as necessary to meet these conditions.
    - d. Blast cleaning shall be in accordance with SSPC-SP 5, White Metals Blast Cleaning for immersion service of the coated areas. Blast cleaning for other surfaces shall be in accordance with SSPC-SP 10, near White Blast Cleaning. Anchor profile shall be 2.5-5.0 mils and relative to the coating thickness specified.

- e. Alternatively, surfaces to be recoated may be cleaned according to SSPC-SP 12/NACE No. 5 Surface Preparation and Cleaning of Metals by Water jetting prior to Recoating.
  - 1) Preparation shall be to SSPC-SP 12, WJ-1, Clean to Bare Substrate using a minimum of High-Pressure Water Jetting (10,000 psi – 30,000 psi).
  - 2) Water jetting does not produce an etch or profile of the magnitude currently recognized by the coatings industry. Rather, it exposes the original abrasive-blasted surface profile if one exists. An anchor profile of at least 2.5 mils is required to be exposed. If sufficient profile does not exist, abrasive blasting shall be performed as specified in section 3.2D.
  - 3) At the time of the recoating, the amount of flash rust shall be no greater than “No Flash Rust” as defined in SSPC-SP 12.
  - 4) If inhibitors are to be used with the standard jetting water, the coatings manufacturer shall be consulted to ensure the compatibility of inhibitors with the coatings.

H. Prior to the application of the coating product repairs shall be completed to ensure the following:

- 1. All inflow and infiltration shall be eliminated by use of appropriate repair material(s), such as hydraulic cements and/or chemical grouts as described in Section 2.2. Structures shall be tested for leakage in accordance with Section 33 01 32 - Sewer and Manhole Testing.
- 2. All repairs to joints, pipe seals, steps, mechanical penetrations, benches, inverts, pipes or other appurtenances to be coated shall be completed and repaired surfaces prepared according to this section.
  - a. Bench or other horizontal surfaces shall have adequate slope (1” rise per lineal foot minimum) to minimize the retention of debris following surcharge.
  - b. Inverts or flow channels shall be smooth without lips, rough edges or other features which may cause debris to collect; contoured to minimize turbulent flow; and be sloped to promote adequate flow from the inlet(s) to the outlet pipe.
  - c. All joints, pipe seals, steps or other penetrations shall be sealed against inflow, infiltration and exfiltration and be adequately filled, smoothed and contoured to promote monolithic coating application.

- I. Areas where reinforcing steel has been exposed shall be repaired in accordance with the Project Engineer’s recommendations or at the minimum all exposed steel shall be prepared in accordance with Section 3.2 prior to coating with the coating product specified or other approved primer as specified by the coating product manufacturer.

### 3.3 APPLICATION OF REPAIR AND RESURFACING PRODUCTS

- A. Repair products shall be used to fill voids, bugholes, and other surface defects which may affect the performance or adhesion of the coating product(s).



- B. Repair products shall be used to repair, smooth or rebuild surfaces with rough profiles to provide a concrete or masonry substrate suitable for the coating product(s) to be applied. These products shall be installed to ½” minimum thickness or as recommended within manufacturers published guidelines. Should structural rebuild be necessary, these products shall be installed to a thickness as specified by the Project Engineer.
- C. Repair products shall be used to remediate all active inflow, infiltration, and/or external soil/fill voids.
- D. All Repair products shall be handled, mixed, installed, and cured in accordance with manufacturer guidelines.
- E. All repaired or resurfaced substrates shall be inspected for cleanliness and suitability to receive the coating product(s). Additional surface preparation may be required prior to coating application.
- F. (OPTIONAL) Fiberglass woven roving cloth may be rolled into the coating for added tensile and flexural strength where desired and/or required.
  - 1. A tack coat of minimum of 20-30 mils shall be applied and allowed to cure to a tack free state, followed by an additional coat of 20-30 mils of coating into which the fiberglass matte shall be inlaid and rolled while wet, an additional 50-60 mil coat minimum shall be applied over the fiberglass inlay as part of the overall coating application.
  - 2. Fiberglass matte shall be woven roving cloth with an approximate weight of 9 oz/yd<sup>2</sup>. Fiberglass matte shall be rolled into the epoxy tack coat(s) using a notched roller fully relieving trapped air and wrinkles. The final topcoat shall encapsulate all fiberglass strands. Care should be taken to ensure adequate cure time between applications above 100 mils to relieve exothermic heat in order to avoid thermal degradation of the coating.

#### 3.4 APPLICATION OF COATING PRODUCT(S)

- A. Application procedures shall conform to the recommendations of the coating product(s) manufacturer, including environmental controls, product handling, mixing, application equipment, and methods.
- B. Spray equipment shall be specifically designed to accurately ratio and apply the coating product(s) and shall be in proper working order.
- C. Contractors qualified in accordance with these specifications shall perform all aspects of coating product(s) installation.
- D. Prepared surfaces shall be coated via spray application of the coating product(s) described herein unless otherwise recommended by the coating product manufacturer.
- E. Coating thickness shall be in relation to the profile of the surface to be coated as recommended by the coating product manufacturer.

- F. In all cases the coating product(s) shall be applied to a minimum dry film thickness of 80 mils to surface profiles of CSP-4 to CSP-5 or 125 mils minimum DFT to surface profiles of CSP-6 or greater.
  - 1. For resistance to ground water head pressure the coating shall be a minimum of 80 mils for depths up to 15' and 125 mils minimum for depths from 15' to 80'. For depths greater than 80' consult the coating manufacturer for recommendations.
- G. Subsequent top coating or additional coats of the coating product(s) shall occur within the product's recoat window or 24 hours whichever is less. Additional surface preparation procedures will be required if this recoat window is exceeded.
- H. Coating product(s) shall interface with adjoining construction materials/components throughout the manhole structure to effectively seal and protect substrates from attack by corrosive elements and to ensure the effective elimination of infiltration into the sewer system.
- I. Procedures and materials necessary to affect the interface between dissimilar materials and the coating product shall be as recommended by the coating product(s) manufacturer.
- J. Termination points of the coating product(s) shall be made at the manhole frame and chimney joint (or other man way as it present), 1" below normal flow levels at the bench or within the invert, and a minimum of 1" interfacing within each pipe penetration.
- K. Sewage flow shall be stopped, bypassed, or diverted as necessary for application of the coating product(s) to the invert and interface with pipe materials.

### 3.5 TESTING AND INSPECTION

- A. Coating system thickness shall be inspected to ensure compliance with the specification herein.
  - 1. During application a wet film thickness gauge, meeting ASTM D44140-Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used. Measurements shall be taken, documented, and attested to by Contractor for submission to Owner
  - 2. After the coating product(s) have cured in accordance with manufacturer recommendations, coating system thickness may be measured according to SSPC-PA 9-Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages.
- B. High voltage holiday detection for coating systems installed in corrosive environments, when it can be safely and effectively employed, shall be performed to ensure monolithic protection of the substrate. After the coating product(s) have cured in accordance with manufacturer recommendations, all surfaces shall be inspected for holidays in accordance with NACE RPO 188-99 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates or ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates. All detected holidays shall be marked and repaired according to the coating product(s) manufacturer's recommendations.
  - 1. Test voltage shall be minimum of 100 volts per mil of coating system thickness.

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2. Detection of known or induced holiday in the coating product shall be confirmed to ensure proper operation of the test unit.
  3. All areas repaired shall be retested following cure of the repair material(s).
  4. In instances where high voltage holiday detection is not feasible a close visual inspection shall be conducted and all possible holidays shall be marked and repaired as described above.
  5. Documentation of areas tested, equipment employed, results, and repairs made shall be submitted to the Owner/Engineer by Contractor.
- C. Adhesion of the coating system to the substrate shall be confirmed in a minimum of 10% of the manholes coated, or for large structures once every 1000 square feet of coated area. After the coating product(s) have cured in accordance with manufacturer recommendations, testing shall be conducted in accordance with ASTM D7234 Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
1. For each test manhole a minimum of three 20mm dollies shall be affixed to the coated surface; one at the cone area, one at the mid-section and one near the bottom of the structure.
  2. For larger structures a minimum of three 20mm dollies shall be affixed to the coated surface at random locations within each 1000 square foot area or as otherwise agreed upon.
  3. The adhesive used to attach the dollies to the coating shall be rapid setting with tensile strengths in excess of at least twice the anticipated failure point (generally at least 1000 psi) and permitted to cure in accordance with manufacturer recommendations. The coating and dollies shall be adequately cleaned and prepared to receive the adhesive. Failure of the dolly adhesive shall be deemed a non-test and require retesting.
  4. Prior to performing the pull test, the coating shall be scored to the substrate, or within 10 mils of the substrate surface, by mechanical means without disturbing the dolly or coating system bond within the test area.
  5. Two of the three adhesion pulls in each test area shall exceed 200 psi and shall include substrate adhered to the back of the dolly or no visual signs of the coating product in the test hole. Pulls tests with results between 150 and 200 psi may be acceptable if more than 50 percent of the substrate in the test adheres to the dolly.
  6. Should a structure, or are, fail to achieve two successful pulls as described above, additional testing shall be performed at the discretion of the Owner or Project Engineer. Any areas detected to have inadequate bond strength shall be evaluated by the Project Engineer. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by the Contractor.
  7. All adhesion testing shall be performed by qualified personnel using calibrated equipment as specified by the applicable ASTM standard(s).
  8. All adhesion testing shall be documented and submitted in consistent format detailing location, test values, description of the failure point/mode, scoring method employed,

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adhesive used, cure time of coating and adhesive and other data as deemed necessary by the owner/engineer.

9. All adhesion test location shall be repaired by the Contractor at no cost to the Owner.
  
- D. Visual inspection shall be made by the Project Engineer and/or Inspector. Any deficiencies in the finished coating affecting the performance of the coating system or the operational functionality of the structure shall be marked and repaired according to the recommendations of the coating product(s) manufacturer.
  
- E. The municipal sewer system may be returned to full operational service as soon as the final inspection has taken place and all coating materials have been adequately cured according to the coating product(s) manufacturer's recommendations.

END OF SECTION 33 01 30

## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Pipeline flushing and cleaning.
2. Television inspection of sewer pipelines.
3. Audio-video recording of pipeline interior.

#### B. Related Requirements:

1. Section 33 31 11 - Public Sanitary Sewerage Gravity Piping: Pipe materials, manholes, and accessories normally encountered with gravity sewerage piping.

### 1.2 DEFINITIONS

- #### A. Flash drive: A USB compatible device containing flash memory.

### 1.3 SCHEDULING

- #### A. Furnish Work schedule for periods of time when sewer piping section is out of service for joint sealing.
- #### B. Schedule Work of this Section to coincide with relining sewers and/or joint sealing.

### 1.4 SEQUENCING

- #### A. Sequence Work as directed by Engineer.

### 1.5 SUBMITTALS

#### A. Flash Drive:

1. Submit three copies of completed narrated color Flash Drive identified by Project name, street name, right-of-way property name, and manhole numbers.
2. Flash Drives become property of Owner.

#### B. Inspection Logs:

1. Submit cleaning and television inspection logs for each section of sewer line to be rehabilitated.
2. Include following minimum information:
  - a. Stationing and location of lateral services, wyes, or tees.
  - b. Date and clock time references.

- c. Pipe joints.
  - d. Infiltration/inflow defects.
  - e. Cracks.
  - f. Leaks.
  - g. Offset joints.
- C. Submit specific detailed description of proposed bypass pumping system, including written description of plan addressing schedule, quantity, capacity, and location of pumping equipment.
- D. Submit spill plan to address any spills that might occur.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statement:
- 1. Submit qualifications for applicator.
- 1.6 QUALITY ASSURANCE
- A. Perform Work according to PACP/NASSCO standards.
- 1.7 QUALIFICATIONS
- A. Applicator: Company specializing in performing Work of this Section with minimum three years' documented experience.

## PART 2 - PRODUCTS

### 2.1 FLASH DRIVES

- A. Description: Provide digital video files and other TV inspection records on flash drives.
- B. Provide audio track containing simultaneously recorded narrative commentary and evaluations of videographer, describing in detail condition of pipeline interior.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify location of sewer pipelines to be inspected.

### 3.2 PREPARATION

- A. Flush and clean pipeline to remove sludge, dirt, sand, stone, grease, and other materials to ensure clear view of interior conditions.

B. Debris:

1. Intercept flushed debris at next downstream manhole using weir or screening device.
2. Remove and dispose of debris off Site.

C. Bypassing:

1. Furnish temporary bypass pumping system around Work area for time required to complete television inspection.
2. Provide standby pump of equal or greater capacity at bypass location.
3. Provide safety precautions, including barricades, lights, and flaggers as required.

3.3 APPLICATION

A. Closed-Circuit Television (CCTV) Camera System:

1. Use cameras specifically designed and constructed for closed-circuit sewer line inspection.
2. Use camera equipment with pan-and-tilt capability to view each lateral connection at multiple angles.
3. Use camera capable of moving both upstream and downstream with minimum 1,000 feet horizontal distance within one setup and using direct-reading cable position meter.

3.4 FIELD QUALITY CONTROL

A. Pipeline Inspection:

1. Audio-video record sections of sewer pipeline between designated manholes.
2. Identify and record locations of flat grades, dips, deflected joints, open joints, broken pipe, protrusions into pipeline, and points of infiltration.
3. Locate and record service connections.
4. Record locations of pipeline defects, connection horizontal distance in feet, and direction from manholes.
5. Video-record with pipe section plugged to view 100 percent of pipe ID.
6. Use flow-control methods as specified for bypass pumping system to eliminate surcharging and to reduce flow.

END OF SECTION 33 01 30.11

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PART 1 – GENERAL

1.01 GENERAL TEMPORARY BYPASS PUMPING REQUIREMENTS

- A. Under this item the Contractor is required to design and furnish all materials, labor, equipment, power, fuel, fuel storage, maintenance, pipe ramps, valves, controls, appurtenances, etc. to implement a temporary pumping system for the purpose of diverting the existing flow around the work area for the Project, on a daily basis, for the duration of the project. The Contractor's Bid shall include all temporary structures and facilities required to facilitate the bypass pumping plan to include temporary manholes and temporary wastewater storage tanks to minimize service disruptions. The bid should include pricing for continuous bypass pumping as part of the primary bid and an alternate for temporary bypass pumping in the event that temporary bypass pumping is approved by the owner.
- B. The Contractor is advised that the Owner and Engineer will be strictly enforcing the bypass specifications and requirements throughout this Contract. Saluda Lake is downstream of the project site and is a drinking water source for Easley Combined Utilities. Sewer system overflows will not be tolerated.
- C. The design, installation, maintenance and operation of the temporary bypass pumping system shall be the Contractor's responsibility throughout the duration required. Bypass equipment shall not be located within 100 LF of any residence unless granted permission from the Owner and Engineer. No equipment shall be stored within the floodplain.
- D. The following stations are the minimum required locations to be used as setup locations for bypass equipment. No equipment shall be stored at the bypass setup locations for more than three (3) days without site fencing and screening being installed. Additional and alternative locations may be considered by the Owner and Engineer during review of bypass pumping plan submittal:
  - 1. \_\_\_\_\_ (provide project specific locations)
  - 2. \_\_\_\_\_ (provide project specific locations)
  - 3. \_\_\_\_\_ (provide project specific locations)
- E. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction. Contractor shall also be responsible for any fines imposed by local, state, and/or federal agencies for failure to maintain flows. All costs associated with fines and/or mitigation actions as a result of spills and/or overflows shall be the responsibility of the Contractor at no additional cost to the Owner. The Owner will impose special damages up to \$25,000 per spill reportable to regulatory authorities, above and beyond any potential fines imposed by regulatory agencies and any cleanup costs (including costs related to public relations efforts related to any spill). Owner reserves the right to withhold a portion of the retainage until any potential fines by regulatory agencies are fully understood.
- F. The Contractor shall implement best management practices to prevent and minimize erosion and resultant sedimentation during all bypass pumping activities in accordance with SCDHEC Stormwater Regulations.

- G. Contractor's Bid shall be based on maintaining operation of the bypass pumping operation at all times during active construction of project.
- H. Contractor shall be responsible for maintaining the existing gravity sewers in service without wastewater spills during the entirety of the construction period when the bypass pumping system is NOT in operation.
- I. The Contractor has the option to provide either intermittent or continuous temporary bypass pumping Paragraphs 1.01.J and 1.01.K.
- J. Intermittent bypass pumping for making local sewer connections to the new gravity sewer that can be completed within the workday shall only be operated between the hours of 7:00 a.m. and 5:00 p.m., Monday through Friday, when the Contractor is on-site and working.

At the end of each work day, the Contractor shall test the new sewer lines installed and re-connect the existing sewer line to the new sewer line to re-establish gravity flow through the entire system. Connection between existing and new sewer lines shall be made with couplings and/or sleeves for a solid, leak-tight connection. The procedure for re-connecting the existing sewer line to the new sewer line is as follows:

1. Install the bypass system and pump(s)
  2. Install the new pipe per the drawings.
  3. Inspect the new pipe and perform all tests specified elsewhere in the specifications.
  4. Contractor to provide all test results and red line drawings to the engineer for review.
  5. Obtain DHEC partial permit to operate prior to any laterals / mains being placed back into service in accordance with "DHEC Regulation 61.67 Standards for Wastewater Facility Construction".
- K. Continuous bypass pumping is required where the work being performed does not allow for reconnecting to the existing sewer service within the same workday. Continuous bypass pumping shall be performed in accordance with the specifications below.

When continuous bypass pumping is suspended, the Contractor shall re-connect the existing sewer line to the new sewer line to re-establish gravity flow through the entire system. Connection between existing and new sewer lines shall be made with couplings and/or sleeves for a solid, leak-tight connection.

Requests for review must be submitted to the engineer prior to 5:00 PM, Wednesday for the system to be approved by Friday. The procedure for re-connecting the existing sewer line to the new sewer line is as follows:

1. Install the bypass system and pump(s)
2. Install the new pipe per the drawings.

3. Inspect the new pipe and perform all tests specified elsewhere in the specifications.
4. Contractor to provide all test results and red line drawings to the engineer for review.
5. Obtain DHEC partial permit to operate prior to any laterals / mains being placed back into service in accordance with “DHEC Regulation 61.67 Standards for Wastewater Facility Construction”.

#### 1.02 VENDOR REQUIREMENTS

- A. The vendor shall demonstrate the bypass pumping equipment is automated and is capable of functioning without the assistance of an operator. The vendor shall have a minimum experience of 5 years designing and supplying wastewater bypass systems.
- B. The vendor shall demonstrate sufficient service and repair parts in stock to fulfill any service or repair of all rental equipment within three hours of any service call. All backup or spare equipment shall meet the same requirements as the primary equipment as specified in these documents.
- C. The vendor shall demonstrate sufficient service staff, trucks, and inventory to mobilize to repair, service, or replace equipment within one hour of a service call, twenty-four hours per day, seven days per week. Longer service time calls may be considered if it is demonstrated that sufficient spare parts for filters, priming parts, batteries, pipe repair clamps pipe repair fittings are kept on the project site.
- D. The contractor shall provide a list of mobile phone numbers to call for twenty-four-hour service, to include the general contractor as well as the bypass pumping vendor.
- E. The above requirements in section 1.02 of these specifications shall apply to the Contractor should the Contractor supply their own bypass pumping equipment without the use of a vendor.

#### 1.03 SUBMITTALS

- A. Bypass Pumping Plan: The Contractor shall submit to the Engineer for review and approval detailed drawings and descriptions outlining all provisions and precautions to be taken by the Contractor regarding the handling of existing wastewater flows. The plan must be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials, and all other incidental items necessary and/or required to ensure proper protection of the facilities, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in these Contract Documents. The Plan shall be required for both continuous and intermittent bypass pumping. No construction shall begin until all provisions and requirements have been reviewed by the Engineer. If changes are necessary to the most recent approved bypass pumping plan then a complete resubmittal shall be made. The plan shall include, but is not limited to, the following details:
  1. Staging areas for pumps
  2. Plugging methods and types of plugs
  3. Documentation that pumps meet or exceed Final Tier 4 emissions as specified by

the Environmental Protection Agency standards. Shop test results may be requested at the Engineers discretion at no additional cost to the Owner. The components of laterals and collector systems connections will be required to meet or exceed Final Tier 4 emissions as specified by the Environmental Protection Agency for setups longer than thirty days. For setups thirty days or less, Tier 3 emissions will be accepted.

4. Number and size of pumps and basis of selection
5. Number, size, material, method of installation, and location of suction piping
6. Number, size, material, method of installation, and location of discharge piping
7. Bypass pump sizes, capacity, number of each size to be on site, and power requirements
8. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range are to be submitted). All hydraulic calculations and drawings shall be provided by the Bypass Pumping Vendor and stamped by a registered Professional Engineer licensed in the State of South Carolina.
9. Method of protecting discharge manholes or structures from erosion and damage
10. Method of protecting pumping equipment and securing the bypass pumping site from theft, damage and general safety concerns. Site fencing shall ensure safety of the general public as well as secure the site from theft and/or damage. Include proposed gate dimensions and location.
11. Sections showing suction and discharge pipe depth, embedment, select fill, special backfill, and restraint.
12. Method of noise control for each pump.
13. Any temporary pipe supports and anchoring required.
14. Design for access to bypass pumping locations.
15. Selection of bypass pumping pipe size and material (include method of connections to pump and other piping)
16. Schedule for installation of and weekly maintenance of bypass pumping lines
17. Describe how bypass pumping system will be monitored and alarmed.
18. Describe how bypass pumping system will be controlled.
19. Demonstrate upstream manholes will not overflow from surcharging and that upstream service connections will not be surcharged. Provide proposed locations and elevations for floats and associated equipment.
20. Demonstrate how bypass piping will be identified and protected in the field from

accidental damage from equipment operators.

21. Show discharge from force main will not surcharge downstream discharge manhole.
22. Show 100% redundancy for pumps, power, and controls. Redundant suction and discharge piping shall be stored onsite so that it's available for immediate installation if necessary.
23. Show force main pipe material and thickness can withstand all normal operating and surge pressures with a safety factor of 1.5.
24. Denote any conditions that will cause pumps to lose suction lift (prime) and describe procedures to rectify.
25. Show that the emergency switchover from primary to secondary pumping will be automatic should equipment fail.
26. Show emergency plan to be used if flooding occurs at work site.
27. Show suction and discharge piping is protected from possible damage from varying creek flows and construction activities.
28. Show any planned shifting of bypass equipment during construction.
29. A list of staff who have been trained in the operation of the equipment and will be available to inspect the system daily. As part of the near term schedules to be submitted during the construction, the Contractor shall identify who will be performing the inspections for the upcoming period.
30. Sequence of Construction Plan:
  - a. Contractor's Sequence of Construction defining work to be performed, including the following items:
    - i. Definition of the start date, duration and end date.
    - ii. Define activities to be performed by or witnessed by the Owner and date on which these activities are to be performed.
    - iii. Scheduling/timing of manufacturers field services, as specified.
    - iv. Scheduling/timing of when partial permits to operate would be required from DHEC.
  - b. Interruption of the operation of the existing sanitary sewer is required to perform the Work. Define the purpose for the interruption, date and time of interruption, and duration of interruption.
  - c. Provide complete list of equipment and material that is required to perform each segment of work.

31. Sewer Spill Response Plan: Should a sewer spill occur, the procedure below shall be followed by the Contractor and be included as part of the bypass pumping plan. The Contractor is responsible to routinely provide a communication update on the status of the spill containment activities throughout completion of the clean-up.
- a. Notification Sequence:
    - i. Call the ReWa Emergency Line at 864-299-4004. Notify project representatives or their substitute:
      - 1. \_\_\_\_\_  
(Insert ReWa Project Manager Contact Information)
      - 2. \_\_\_\_\_  
(Insert Applicant Engineer Contact Information)
  - b. When to notify: Immediately upon discovery.
  - c. What information to provide:
    - i. Initial Information:
      - 1. The location of the spill
      - 2. When it was discovered
      - 3. What is the plan for containment
  - d. Containment:
    - i. Time containment was achieved.
    - ii. Pictures that were taken at arrival and containment
  - e. Repair/Replacement:
    - i. Actions taken to repair/replace the system
    - ii. What measures are being implemented to prevent a reoccurrence
  - f. Other:
    - i. Always photograph the site at arrival, once contained, and after cleanup.
    - ii. Drone video showing overhead view of the cleaned site.
    - iii. If a property owner or citizen discovers the spill, provide their contact information and any details they have about the spill.
    - iv. Service report(s) on failed equipment from vendors as applicable

to demonstrate causation.

- g. Do Not Provide:
  - i. Any information other than listed above
  - ii. Any information that you did not witness
  - iii. Any information about amount of sewer spilled (this can be calculated by Re-Wa based on information/pictures provided above.

32. Daily Inspection Form to include the following information at a minimum (see example at end of this section):

- a. Date and time of inspection
- b. Whether the inspector has been trained on the system's operation.
- c. System provider
- d. Date of last inspection by system provider
- e. Pump runtime
- f. Items inspected (pumps, controls, floats, transducers, pipe, hose, valves, flowmeters, power and communication cables, SCADA, etc.)
- g. Whether or not there is a process schematic onsite for the current setup.
- h. Unusual noise or vibration
- i. Unusual heat, smoke, smells, etc.
- j. Leaks at connections
- k. Sufficient cell phone service at autodialer
- l. Fluid levels (oil, fuel, coolant)
- m. Gauge checks (oil pressure, voltage, temperature)
- n. System secure from tampering / vandalism, or evidence of tampering / vandalism.
- o. Test pumps in manual and auto mode and return system to auto
- p. Test floats to confirm it triggers an autodialer alert, return float to operational position.
- q. Correct pressure of blowup plugs

- r. Emergency contact list onsite
- s. Suction and discharge clear and functioning
- t. Floats / level indicators clear from debris
- u. Area around the system passable and free from obstacles
- v. Pipe connections secured to prevent accidental disconnection.
- w. Walk entire system from suction to discharge
- x. Confirm system is in auto.

## PART 2 -- PRODUCTS

### 2.01 PUMPING EQUIPMENT

#### A. General:

1. This sanitary sewer is part of a regional system that must be kept in service at all times. It is essential to the operation of the existing wastewater system that there shall be no interruption in the conveyance of wastewater throughout the duration of the project. To this end, the Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the wastewater flow before it reaches the point where it would interfere with the work, carry it past the work and return it to the existing system downstream of the work.
2. It is the Contractor's responsibility to provide equipment that is adequate for the performance of the Work under this Contract within the time specified. All equipment shall be kept in satisfactory operating condition, shall be capable of safely and efficiently performing the required Work, and shall be subject to review by the Owner's representative at any time within the duration of the Contract. All Work hereunder shall conform to the applicable requirements of the OSHA Standards for Construction.
3. Wastewater system operational requirements take precedence over Contractor activities. Therefore, interruption of wastewater system operations must be coordinated and are subject to the operational requirements of the Owner. Contractor shall assume that any interruption of wastewater system operations may be delayed by the Owner for up to one (1) week from the requested time due to operational constraints at no additional cost to the Owner.
4. The Contractor shall provide for utilities and services for its own operations. The Contractor shall furnish, install and maintain all temporary utilities during the contract period including removal upon completion of the Work.
5. The pumps shall be low-sulfur diesel powered and shall be equipped with sound



attenuation equipment capable of reducing noise to no more than 80 dB as measured within close proximity (+/- 30') to the pumping equipment. The Contractor shall take any and all additional measures as necessary to maintain this maximum decibel level for each and every bypass pumping location.

6. Contractor shall be responsible for providing and storing a sufficient quantity of low-sulfur diesel fuel on-site to continually operate the pumps for the duration of the temporary bypass pumping period. All fuel shall be stored outside of the floodplain in locations approved by the Engineer and Owner.
7. Contractor shall check the pump fuel levels and shall re-fill the tanks to full capacity -as needed to maintain compliance with the approved bypass pumping plan.
8. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of the flows.
9. Each pump and driver shall be rated for continuous duty operation over the specified range of conditions without cavitating or overheating, and without excessive vibration or noise. In addition, each pump and driver shall be rated to operate intermittently at shut-off head against a closed discharge valve for periods of not less than 5 minutes without excessive cavitation, overheating, or vibration.
10. Furnish each pump with the necessary stop/start controls.
11. Contractor will not be permitted to stop or impede the main flows under any circumstances.
12. All pumps shall be equipped with a contractor or vendor provided control/monitoring system and a Mission MyDro M850 as a ReWa backup monitoring system.
13. All backup and spare equipment, as required by these specifications, shall meet the same requirements of the primary equipment.

B. Bypass Pumping Requirements: The Contractor is responsible for the construction, maintenance and operation of the bypass pumping facilities as described. Requirements for the bypass pumping system is as follows:

1. Bypass pumping system is required to be operated continuously during daily construction activities while the existing sanitary sewer is modified. Contractor shall be responsible for maintenance of the system to include cleaning suction and discharge manholes and removal of debris to ensure proper operation of the bypass pumping system.
2. Contractor shall determine the number of pumps required to convey the bypass pumping flows listed in this Section. Contractor shall provide a 100% redundant separate backup system for all components (pumps, power, controls, communications, etc.) of the bypass pumping system *as detailed in Section 1.03. A. 22 above*. The backup pump shall be piped into the suction and discharge headers and shall be on-line, isolated from the primary system by a valve. The

bypass pumping equipment shall be capable of pumping raw wastewater at the project site to convey the following range of flows:

- a. Location 1: \_\_\_\_\_  
*(provide project specific location)*
  - i. Average Daily Flow: \_\_\_\_\_ gpm
  - ii. Diurnal Flow Range: 0 gpm to \_\_\_\_\_ gpm
  - iii. Peak Wet Weather Flow: \_\_\_\_\_ gpm
  
- b. Location 2: \_\_\_\_\_  
*(provide project specific location)*
  - iv. Average Daily Flow: \_\_\_\_\_ gpm
  - v. Diurnal Flow Range: 0 gpm to \_\_\_\_\_ gpm
  - vi. Peak Wet Weather Flow: \_\_\_\_\_ gpm

*(provide additional project specific locations as necessary)*

- 4. Due to varying ranges of flow from average to peak, variable speed or staged pumps will be required to avoid surcharging the lines and to avoid sewer backups in system. At no time should depth exceed 3 feet in the manhole being pumped from. Install risers as needed to ensure adequate depth available within manhole being pumped from or at any manhole location upstream of this pumping location to prevent sewer overflows from the bypass pumping operation.
- 5. No manhole less than six (6) feet deep shall be used to pump from unless riser sections are installed to raise the structure to the height specified by the engineer. Contractor shall low pressure test line in accordance with Contract Documents prior to placing segment of line back in service. Manholes shall be vacuum tested immediately following line test. For intermittent bypassing, Contractor will have by-pass pumping facilities manned at all times during operation.
- 6. Provide all pipeline plugs, pumps of adequate size to handle the specified wet weather flow, pumps that meet current operation and environmental standards (SCDHEC Emission Standards), and temporary discharge piping to ensure that the total sanitary sewer flow can be safely diverted around the work area while the sanitary sewer is modified.
- 7. The Contractor shall make all arrangements for bypass pumping during the time when the sanitary sewer is being modified for any reason.
- 8. Discharge piping shall be constructed of hard piping (steel, ductile iron, or polyethylene pipe with positive, restrained joints). It is required that the Contractor provide personnel with adequate knowledge and experience for fusing/connecting pipe. All pipe fusion data logging reports shall be submitted to the Engineer for review and approval prior to commencing bypass operations. Under no

circumstances will aluminum “irrigation” type piping, lay flat piping or glued PVC pipe be allowed for main bypass pipe. Discharge hose will only be allowed in short sections and by specific permission from the Engineer.

9. Operation: The bypass pumps are to have variable capacity by controlling the speed of the diesel engine. Each pump shall have a separate control panel. The bypass pumping system shall be equipped with a Mission Box Product MyDro M850. At a minimum, the follow function descriptions shall be included as part of the control system for each pump:
  - a. Pump On Status,
  - b. Pump Off Status,
  - c. High Water Alarm,
  - d. High High Water Alarm,
  - e. Float Elevations,
  - f. Flow Rate,
  - g. Flow Meter Alarm,
  - h. Discharge Pressure,
  - i. Discharge Pressure Alarm.
10. High alarms shall require, at a minimum, a high float and high-high float.
11. Provide pressure and vacuum gauges on the suction and discharge headers.
12. Flowmeter shall be installed on the discharge pipe as close to the discharge point as possible
13. Provide pressure switches to start and stop the pumps and a pressure transmitter to vary the speed of the pumping units.
14. Provide flowmeter, telemetry, and automatic transfer switch to change from primary to secondary pump for all lines 8” or larger, or setups that will be bypassed for more than two weeks.
15. The Owner and Engineer will have full access to telemetry data locally as may be requested.
16. The bypass pumping plan will address how services will be kept in operation until construction operations can reconnect them to the system. All temporary facilities associated with services shall be submitted to the Engineer for review and approval prior to commencing bypass operations for services.

## PART 3 -- EXECUTION

### 3.01 PREPARATION

- A. The Contractor is responsible for locating any existing utilities in the area where the Contractor

selects to locate the bypass pumps and pipelines. The Contractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the Owner and the Engineer. All costs associated with relocating utilities and obtaining all approvals shall be paid by the Contractor under the Bypass Pumping payment item.

- B. During bypass pumping operations, the Contractor shall protect the wastewater system, including the sanitary sewer and manholes, from damage inflicted by his equipment. The Contractor shall be responsible for all physical damage to the wastewater system caused by human or mechanical failure.
- C. Contractor shall keep spare parts for pumps and piping on-site as requested. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

### 3.02 INSTALLATION AND REMOVAL

- A. The Contractor shall install pipe sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access location and as may be required to provide an adequate suction conduit.
- B. The temporary bypass pumping system shall be tested before placing the system in operation. Testing periods shall occur only between the hours of 8:30 a.m. and 3:00 p.m., Monday through Thursday. Testing of bypass pumping system shall NOT be allowed Friday through Sunday, on the Owner's scheduled Holidays, or on the day immediately prior to an Owner's scheduled Holiday. In addition, testing of bypass pumping system shall only be performed during the Owner's normally scheduled work days. Testing shall include leakage testing, pressure testing, and operational testing. All testing shall be witnessed by the Owner and/or its engineer.
  - 1. Leakage and pressure test: Contractor shall perform leakage and pressure testing for a minimum of two (2) hours on the pump duty suction piping and duty discharge piping in accordance with Article 3.03, Paragraph A. Contractor shall then remove the duty piping and shall install the standby suction piping and standby discharge piping and perform the same test for an additional two (2) hours.
  - 2. Operation test: Contractor shall operate the temporary bypass pumping system for as long as necessary to demonstrate reliable operation of the entire system, including but not limited to pumps and controls, to the satisfaction of the Owner.
- C. Plugging or blocking of wastewater flows shall incorporate primary and secondary plugging devices. When plugging or blocking is no longer needed for performance of the work, the plugs are to be removed in a manner that permits the wastewater flow to slowly return to normal without surge, surcharging, or causing other major disturbances downstream.
- D. During operation of the bypass system, pump controls shall be locked out to prevent vandalism or unnecessary pump stoppages.
- E. At the conclusion of the bypass pumping operation and once written permission is granted by the Owner and Engineer, Contractor shall remove all temporary bypass components and restore the site to original conditions to the satisfaction of the Owner and Engineer.
- F. Relocation of the bypass pump station components require a retesting of the system as described above.

### 3.03 QUALITY CONTROL AND MAINTENANCE

- A. Testing: Contractor shall perform leakage and pressure tests of the bypass pump suction and discharge piping using clean water prior to actual operation. For the leakage test, the pipe is to be filled with clean water and inspected for leaks. The Engineer shall be given 24 hours notice prior to testing. Hydrostatic testing shall also be conducted in accordance with AWWA C600. The suction and discharge piping shall be tested at 150 percent of normal operating pressure (minimum 10 psi).
- B. Inspection: During days the Contractor is on site and performing work under normal working days, the Contractor shall inspect in person the bypass pumping system a minimum of twice (2) per day, approximately twelve (12) hours apart to ensure that the system is working correctly. For non-working days, the Contractor shall inspect the bypass pumping system in person a minimum of twice (2) per day, at least twelve (12) hours apart or as often as necessary to ensure full fuel tanks for the bypass pumps. For all inspections, the Contractor shall digitally log into the mission box as well as keep a written copy of the bypass system inspection results in accordance with the inspection form provided at the end of this section. SCADA checks shall be performed daily and system maintenance checks at least weekly. The Owner and Engineer reserve the right to attend the inspection with the Contractor as well as review any inspection reports.
- C. The Contractor shall provide all inspection logs to the Owner and Engineer at least weekly. Failure to do so could result in withholding monthly applications for payment
- D. Maintenance Service: Contractor shall ensure that the temporary pumping system is properly maintained and a responsible and competent mechanic/operator shall be on call at all times.

### 3.04 SEQUENCE OF CONSTRUCTION

- A. Contractor shall propose a Sequence of Construction incorporating all constraints detailed in this Section and shall secure concurrence of Owner prior to starting work.
- B. The Contractor shall submit a construction plan and schedule, which details the methods, means, techniques, and sequences to be used to establish a base element of surety against a wastewater spill, to the Engineer for review and approval by the Owner at least two (2) weeks prior to any connections to existing pipes or structures. Such plan shall provide assurance against a wastewater spill, with at least one level of backup. Any and all fines or fees imposed upon the Owner resulting from spills or process interruptions shall be assessed solely upon Contractor. One week prior to connections being made to existing structures or pipes, a coordination meeting shall be held between the Contractor, Construction Manager, Engineer, and Owner to discuss the construction plan previously submitted by the Contractor.
- C. Schedule of construction, interconnecting details, and other revisions necessary for proper interfacing of the Work are to be subsequently modified by Contractor accounting for results of said coordination meeting. The Engineer and Owner are to be notified 24 hours prior to any actual interruptions or connections being made. Begin no work prior to securing Owner's approval of respective connection plan and work schedule.



Inspection  
Template

# Long Term ByPass Pumping Inspection Checklist

## Inspection Log

Log Date of Inspection: \_\_\_\_\_

Log Time of Inspection: \_\_\_\_\_

Have you been trained on the system's operations – Mechanical & Controls/Alarms  
(Circle what Applies)

YES

NO

*\*If you have not been properly trained contact a supervisor and/or General/Regional  
Superintendent to request training prior to any future inspections and document contact.*

System Provider: \_\_\_\_\_

Hour Reading: \_\_\_\_\_

- Attached Photo to the Inspection Report
- What is the intent of the system? (Check which applies)
  - Continuous By-Pass Pumping
  - Intermittent Shutdown/Bypass Pumping

What components are part of the system and involved in this inspection? (Check all that Apply)

- Pumps
- Pump Controls
- Floats
- Transducers
- Pipe
- Hose
- Valves
- Flowmeters
- Mission RTU
- Other (List what they are)

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Is there a bypass schematic clearly posted? (Circle what Applies)

YES

NO

*\*If the answer is NO contact your supervisor and document*

Document: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

### Sub/Supplier/Contractor/Maintenance Inspections

- Is the bypass system supplier executing weekly inspections of the pumping system (If yes, check the box)
- Mechanical Fitness
  - Float/Transducer Fitness
  - Auto-Dialer Stimulation
  - Pipping Connections

Have you logged the pump supplier's weekly checklist? (Circle what Applies)

YES

NO

**Operational Check**

Is the system operating without unusual noise? (Circle what Applies)

YES

NO

*\*If the answer is no contact your supervisor and document observations.*

Observations: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Is the system operating without unusual vibrations? (Circle what Applies)

YES

NO

*\*If the answer is no contact your supervisor and document observations.*

Observations: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Is the system operating without leaks at pipe/pump connections?

YES

NO

*\*If the answer is no contact your supervisor and document efforts to eliminate leaks.*

Efforts: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Are the following hoses/power cables functioning/undamaged? (Check if the answer is yes)

- Suction Clear
- Discharge Clear
- Power Cable



Is there sufficient cellular service at the auto-dialer? (Circle the appropriate answer)

YES

NO

*\*If the answer is no contact your supervisor and document contact in response*

Contact: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Has the fluid been filled in the following areas? (Check if it has)

- Oil
- Fuel
- Coolant

Have the following gauges been checked? (Check if it has)

- Oil Pressure
- Voltage
- Temperature

Is the system secure from tampering (ie: no keys left in place and controls secured, ect..)  
(Circle what Applies)

YES

NO

Have you tested the pumps in manual and auto mode and returned the system back to auto?  
(Circle what Applies)

YES

NO

Have you tested the floats to confirm it triggers an auto-dialer alert and returned the float to  
operational position? (Circle what Applies)

YES

NO

If blow up plugs are part of the system, have you confirmed the pressure is correct?  
(Circle what Applies)

YES

NO

Record Pressure: \_\_\_\_\_

**Visual Check**

Are emergency contacts clearly noted on the system? (Circle what Applies)

YES

NO

Is the point of suction free of debris and functioning? (Circle what Applies)

YES

NO

*\*If the answer is no contact your supervisor and document your efforts to clear the debris*

Efforts: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Is the discharge clear and functioning? (Circle what Applies)

YES

NO

Are the floats/level indicators clear from debris at point of suction? (Circle what Applies)

YES

NO

*\*If the answer is no contact your supervisor and document your efforts to clear the debris*

Efforts: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Are there any unusual items of note (heat/smoke/smells/ect..) indicating a potential mechanical problem? (Circle what Applies)

YES

NO

*\*If the answer is yes contact your supervisor and document your observations*

Observations: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Is the area around the system passable and free from obstacles? (Circle what Applies)

YES

NO

Is there any evidence of external tampering to the system? (Circle what Applies)

YES

NO

Have pipe connections been secured to prevent accidental disconnection? (Circle what Applies)

YES

NO

*\*If the answer is yes contact your supervisor and document your steps to secure pipe connections.*

Observations: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Final Check**

- Walk the entire system from suction to discharge and identify any issues found & list them

Issues: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Is the system in auto? (Circle what Applies)

YES

NO

*\*If the answer is no contact your supervisor and get the system back in auto ASAP*

**- END OF SECTION -**

## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Gravity Sewer Testing:
  - a. Low-pressure Air Test
  - b. Exfiltration Test
  - c. Infiltration Test
2. Deflection Testing of Plastic Piping
3. Testing of Pressure Piping
4. Manhole Testing
  - a. Vacuum Test
  - b. Exfiltration Test
5. Pump Station Wetwell Testing
  - a. Leakage Test

#### B. Related Sections:

1. Section 03 05 61 – Concrete Manholes
2. Section 33 05 63 – Concrete Vaults and Chambers
3. Section 33 31 11 – Public Sanitary Sewer Force Main Piping
4. Section 33 31 23 – Sanitary Sewer Force Main Piping

### 1.2 REFERENCES

#### A. American Concrete Institute

1. ACI-350.1-01 – Tightness Testing of Environmental Engineering Concrete Structures

#### B. American Water Works Association:

1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

#### C. ASTM International:

1. ASTM F1417 – Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air.
2. ASTM C1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test.
3. ASTM D2122 – Test Method for Determining Dimensions of Thermoplastic Pipe Fittings.

### 1.3 SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions of the Contract.
- B. Submit the following prior to start of testing:
  - 1. Testing procedures.
  - 2. List of test equipment.
  - 3. Testing sequence schedule.
  - 4. Provisions for disposal of flushing and test water.
  - 5. Certification of test gauge calibration.
  - 6. Deflection mandrel drawings and calculations.
- C. Test Reports: Indicate results of manhole and piping tests.

### PART 2 - PRODUCTS – NOT USED

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Flush and clean piping.
- B. Verify pressure piping mechanical restraint system is installed.
- C. Verify trenches are backfilled.

#### 3.2 PIPING PREPARATION

- A. Flush and clean piping.
- B. Contractor to lamp new gravity piping.
  - 1. Engineer will witness lamping operation by shining lights at one end of each pipe section between manholes; observe light at other end; reject pipe not installed with uniform line and grade.
  - 2. Remove and install rejected pipe sections; re-clean and assist engineer with re-lamping.
- C. Plug outlets, wye-branches, and laterals; brace plugs to resist test pressures.

#### 3.3 FIELD QUALITY CONTROL

- A. Notify Engineer 72 hours in advance of tests and have witness tests.

#### 3.4 TESTING GRAVITY SEWER PIPING

- A. Low-pressure air test:

1. Perform test in accordance with applicable portions of ASTM F1417.
2. Test each section of gravity sewer piping between manholes.
3. Introduce air pressure slowly to approximately 4 psig.
4. Determine groundwater elevation above spring line pipe. For every 1'-0" of groundwater above spring line of pipe, increase starting air test pressure by 0.43 psig; do not increase pressure above 10 psig.
5. Allow pressure to stabilize for at least five minutes. Adjust pressure to 3.5 psig or increased test pressure as determine above when groundwater is present for at least 2 minutes. Start test.
6. Determine test duration for sewer section with single pipe size from the following table. Do not make allowance for laterals.

Nominal Pipe Size (inches)	Length for Minimum Time, ft	Minimum Test Time <sup>(1)</sup> (min / 100'-0")
4	597	1:53
6	398	2:50
8	298	3:47
10	239	4:43
12	199	5:40
15	159	7:05
18	133	8:30
21	114	9:55
24	99	11:20
27	88	12:45
30	80	14:10
33	72	15:35
36	66	17:00
(1) See Table 2 of ASTM F-1417 for additional times by pipe length.		

7. Record drop in pressure during test period; when air pressure has dropped more than 0.5 psig during test period, piping has failed; when 0.5 psig air pressure drop has not occurred during test period, discontinue test and piping is accepted.
8. When piping fails, determine source of air leakage, make corrections and retest; test section in incremental stages until leaks are isolated; after leaks are repaired, retest entire section between manholes.

**B. Exfiltration Test:**

1. Test pipe larger than 36" diameter with exfiltration test not exceeding 100 gallons for each 1" of pipe diameter for each mile per day for each section under test. Perform test with minimum positive head of 2'-0".

**C. Infiltration Test:**

1. Use only when gravity piping is submerged in groundwater minimum of 4'-0" above crown of pipe for entire length being tested.
2. Maximum Allowable Infiltration: 100 gallons per 1" of pipe diameter for each mile per day for section under test; include allowances for leakage from manholes. Perform test with minimum positive head of 2'-0".

### 3.5 DEFLECTION TESTING OF PLASTIC PIPING

- A. Perform vertical ring deflection testing on PVC sewer piping after backfilling has been in place for at least 30 days, but no longer than 12 months.
- B. Allowable maximum deflection for installed plastic sewer pipe is limited to 5% of original vertical internal diameter.
- C. Furnish rigid ball or mandrel with diameter not less than 95% of base or average inside diameter of pipe as determine by ASTM standard to which pipe is manufactured. Measure pipe in compliance with ASTM D2122.
- D. Perform deflection testing using properly sized rigid ball or “Go, No-Go” mandrel.
- E. Perform test without mechanical pulling devices.
- F. Locate, excavate, replace, and retest pipe exceeding allowable deflection.

### 3.6 TESTING OF PRESSURE PIPING:

1. Test system according to AWWA C600 and following:
  - a. Pipe trench shall be backfilled prior to testing.
  - b. Hydrostatically test each portion of pressure piping, including valved section, at 1.5 times working pressure of piping, based on elevation of lowest point in piping corrected to elevation of test gage.
  - c. Conduct hydrostatic testing for at least two hours.
  - d. Slowly fill with water portion of piping to be tested, expelling air from piping at high points.
  - e. Install corporation cocks at high points.
  - f. Close air vents and corporation cocks after air is expelled.
  - g. Raise pressure to specified test pressure.
  - h. Maintain pressure within plus or minus 5.0 psi of test pressure.
  - i. Leakage is defined as quantity of water supplied to piping necessary to maintain test pressure during period of testing.
  - j. Compute maximum allowable leakage using following formula:
    - 1)  $L = \frac{SD\sqrt{P}}{148,000}$
    - 2) L = testing allowance (makeup water), gph.
    - 3) S = length of pipe tested, feet.
    - 4) D = nominal diameter of pipe, inches.
    - 5) P = average test pressure during hydrostatic testing, psig.
    - 6) C = 148,000.
    - 7) If pipe undergoing testing contains sections of various diameters, calculate allowable leakage from sum of computed leakage for each pipe size.
2. If testing of piping indicates leakage greater than that allowed, locate source of leakage, make corrections, and retest until leakage is within acceptable limits.
3. Correct visible leaks regardless of quantity of leakage.



3.7 TESTING MANHOLES

A. General:

1. Air testing shall be the primary means of testing manholes. Exfiltration testing shall only be used at the approval of a ReWa representative.
2. Test using vacuum whenever possible prior to backfilling to assist in locating leaks. Make joint repairs on both outside and inside of joint to ensure permanent seal. Test manholes with manhole frame set in place, or as approved by ReWa.

B. Vacuum Test:

1. All manholes shall be tested via vacuum testing per ASTM C-1244 except that the minimum test times shall be as defined in the table below (test times modified from those in ASTM C-1244). The vacuum test unit shall be placed at the top of the manhole structure to include the frame/cone interface/seal in the test. A plate test unit will likely be required to perform the test. Bladder units can be used as long as the bladder does not cover the interface of the frame and the cone section.
2. Vacuum tests shall be performed by placing the testing unit at the top of the manhole in accordance with the manufacturer’s recommendations. A vacuum of 10 inches of mercury shall be drawn on the manhole, the valve on the vacuum line of the test unit closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of mercury. The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the test times indicated in Table 2 below. The test times in the table below are modified from those in ASTM C-1244. If the actual manhole diameter falls between those listed in the table below, use the test times for the next larger diameter. This table shall be included on the Contractor’s test reports. Refer to ASTM C-1244 for further requirements.

MINIMUM VACUUM TEST TIMES FOR VARIOUS MANHOLE DIAMETERS									
Manhole Depth (feet)	Manhole Diameter (inches)								
	36	42	48	54	60	66	72	84	96
	Test Time (seconds)								
8	60	60	60	60	60	60	66	72	78
10	60	60	60	60	66	72	82	98	114
12	60	60	60	70	78	86	98	118	138
14	60	60	70	82	92	102	114	136	158
16	60	68	80	92	104	116	132	160	188
18	64	76	90	104	118	130	148	178	208
20	70	84	100	116	130	144	162	194	226
22	78	92	110	128	144	158	178	212	246
24	84	102	118	140	156	174	194	232	270
26	92	110	128	150	170	188	210	250	290
28	98	118	138	162	182	202	226	270	314
30	106	126	148	174	196	216	242	288	334

C. Exfiltration Test:

1. Plug pipes in manhole; remove water in manhole; observe plugs over period of not less than two (2) hours to ensure there is no leakage into manhole.
2. Determine groundwater level outside manhole.
3. Fill manhole with water to within 4” of top of cover frame. Prior to test, allow manhole to soak from minimum of 4 hours to maximum of 72 hours; after soak period, adjust water level inside manhole to within 4” of top of cover frame.

4. Measure water level from top of manhole frame; at end of 4 hour test period, again measure water level from top of manhole frame; compute drop in water level during test period.
5. Manhole exfiltration test is considered satisfactory when drop in water level is less than values listed in table below:

Manhole Depth (feet)	Allowable Leakage (inches for Manhole Diameter)		
	4'-0"	5'-0"	6'-0"
4	0.11	0.14	0.17
6	0.17	0.21	0.26
8	0.23	0.29	0.35
10	0.28	0.35	0.42
12	0.34	0.43	0.51
14	0.40	0.50	0.60
16	0.45	0.56	0.68
18	0.51	0.64	0.77
20	0.57	0.71	0.86
22	0.62	0.78	0.93
24	0.68	0.85	1.02
26	0.74	0.93	1.11
28	0.79	0.99	1.19
30	0.85	1.06	1.28

6. When unsatisfactory test results are achieved, repair manhole and retest until result meets criteria; repair visible leaks regardless of quantity of leakage.

### 3.8 TESTING PUMP STATION WETWELLS

- A. General: Test using water whenever possible prior to backfilling to assist in locating leaks. Make joint repairs on both outside and inside of joint to ensure permanent seal. Test wetwells with top slab set in place, prior to backfilling, and prior to installing wetwell protective coating, as approved by Engineer.
- B. Leak testing shall be in accordance with ACI-350.1-01. ACI Tightness Criteria designations are shown below:

Designation	Tightness Criterion (Acceptable Leakage)
HST-NML	No measurable loss
HST-025	0.025% per day
HST-050	0.050% per day
HST-075	0.075% per day
HST-100	0.100% per day
HST-VIO	Visual inspection only

- C. Leak Testing Schedule

1. Pump Station Wetwells: HST-100

D. Leak Testing Procedure:

1. Fill hydraulic structure to be subjected to leakage tests with water at a rate not to exceed 4 feet per hour. Structure shall be filled to the design maximum liquid level line or 4 inches below any fixed overflow level, whichever is lower. Repair any running leaks which appear during filling before continuing.
2. The water shall be kept at the test level of unlined concrete tanks for at least three days prior to the actual test.
3. Perform the HST-VIO test for 24 hours. If no flow or seepage of water from the structure is present on the exterior surfaces, proceed with the designated test. If the structure does not pass the HST-VIO test, repair all visible leakage and repeat this step until the structure passes.
4. Measure the vertical distance from a fixed point on the structure to the water surface at 24-hour intervals for a five-day period. Record the water temperature at a depth of 18 in. below the water surface at the time of water surface measurement. In uncovered tanks, evaporation and precipitation shall be measured.
5. During the test period, examine all exposed portions of the structure and mark all visible leaks or damp spots. Such leaks or damp spots shall be repaired later.
6. If the drop in water surface in a 24-hour period, when adjusted for evaporation and precipitation, exceeds the tightness criterion for, the structure shall be considered to have failed the test. The structure shall also be considered to have failed the test if water is observed flowing or seeping from the structure or if moisture can be transferred from the exterior surface to a dry hand.
7. If the structure fails the test, drain the structure, repair leaks and damp spots, refill the structure, and repeat the test. Continue this process until the drop in water surface in a 24-hour period meets the tightness criterion.
8. Repair all visible spots, whether leakage is excessive or not, in a manner satisfactory to the Engineer.
9. Repairs and additional tests shall be made by the Contractor at no additional cost to the Owner.
10. Apply specified coatings only after acceptance of leakage testing by the Engineer.

END OF SECTION 33 01 32.00

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## PART 1 – GENERAL

### 1.1 SUMMARY

- A. Work included: Provide and install casing pipes or tunnels under roadways or railways, where indicated, as specified herein, and as needed for a complete and proper installation.
- B. Where utility boring and jacking is performed within Railroad or SCDOT right-of-ways, any specific requirements from those agencies shall supersede these specifications.

### 1.2 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. If work is sub-contracted, then sub-contractor personnel shall also be properly trained and experienced in performing utility boring and jacking. Documentation of experience and/or training may be requested by ReWa.
- B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.
- C. Utilize the latest version of standards referenced herein.

### 1.3 SUBMITTALS

- A. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
  - 1. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

### 1.4 PRODUCT HANDLING

- A. Comply with manufacturers' recommendations.

## PART 2 – PRODUCTS

### 2.1 CASING PIPE FOR DRY BORES EXECUTION

- A. Steel complying with ASTM A139 for Grade B with minimum yield strength of 35,000 psi.
- B. Provide ends suitable for field welding.
- C. Minimum wall thickness as follows:

Pipe Diameter, inches	Casing Diameter, inches	Wall Thickness, inches
6	14	0.250
8	18	0.312
10	18	0.312
12	20	0.375
14	24	0.438
15	24	0.438
16	24	0.500
18	30	0.500
20	32	0.500
24	36	0.563
30	42	0.563
36	48	0.625

Engineer shall be responsible for verifying casing thickness design based on specific site conditions, geotechnical conditions, and/or specific permitting requirements (i.e. SCDOT).

## 2.2 PIPELINE CASING SPACERS

- A. For piping installed in casing provide pipeline casing spacers.
- B. Provide a minimum of 1 spacer per ten linear feet of pipe for ductile iron pipe and a minimum of 1 spacer per six linear feet for PVC pipe.
- C. Provide spacer with shell of 14 gauge T-304 stainless steel.
- D. Provide shell liner of .090" thick PVC, 85-90 durometer.
- E. Provide 5/16" stainless steel connecting bolts and lock nuts, minimum three (3) per flange.
- F. Runners from 2" wide ultra high molecular weight polymer with a high resistance to abrasion and a coefficient of friction of 0.11 -0.13 in accordance with ASTM D 1894.
- G. Support runners on 14 gauge reinforced T-304 stainless steel risers welded to shell.
- H. All metal surfaces to be fully passivated.
- I. The diameter as measured over the runners shall exceed the pipeline bell or coupling outside diameter.
- J. Provide pipeline casing spacers as manufactured by Cascade Manufacturing, Pipeline Seal and Insulator, Inc. or approved equal.

## 2.3 END SEALS

- A. Provide 1/8" thick rubber end seal to seal each end of the casing.
- B. Secure to casing and carrier pipe with T-304 stainless steel bands.
- C. Acceptable manufacturers: Cascade Manufacturing, Pipeline Seal and Insulator, Inc. or approved equal.

### PART 3 – EXECUTION

#### 3.1 SAFETY

- A. Provide all necessary bracing, bulkheads and shields to ensure complete safety to all traffic, persons and property at all times during the work. Perform the work in such a manner as to not permanently damage the roadbed or interfere with normal traffic over it.
- B. Observe all applicable requirements of the regulations of the authorities having jurisdiction over this site. Conduct the operations in such a manner that all work will be performed below the level of the roadbed.

#### 3.2 ENTRY PITS

- A. Locate to avoid interference with traffic, adjacent structures, etc., to such extent possible.
- B. Excavate to required depth, providing sheeting and shoring necessary for protection of the Work and for safety of personnel.
- C. Maintain in dry condition by use dewatering in accordance with Section 33 23 19. Detailed /designed dewatering plan may be required depending on site specific conditions.

#### 3.3 INSTALLATION

- A. Interpretation of soil investigation reports and data, investigating the site and determination of the site soil conditions prior to bidding is the sole responsibility of the Contractor. Any subsurface investigation by the Bidder or Contractor must be approved by the appropriated authority having jurisdiction over the site. Rock and/or water, if encountered, shall not entitle the Contractor to additional compensation.
- B. Install casings by dry-boring through the casing while simultaneously jacking the casing.
- C. Any proposed alternate method shall be approved in writing by the Engineer.
- D. Casing construction shall be performed so as not to interfere with, interrupt or endanger roadway surface and activity thereon, and minimizing subsidence of the surface, structures, and utilities above and in the vicinity of the casing. Support the ground continuously in a manner that will prevent loss of ground and keep the perimeters and face of the casing, passages and shafts stable. The Contractor shall be responsible for all settlement resulting from casing operations and shall repair and restore damaged property to its original or better condition at no cost to the Owner.
- E. Face Protection: The face of the excavation shall be protected from the collapse of the soil into the casing.

- F. Casing Design: Design of the bore pit and required bearing to resist jacking forces are the responsibility of the Contractor. The excavation method selected shall be compatible with expected ground conditions. The lengths of the casing shown on the Drawings are the minimum lengths required. The length of the casing may be extended for the convenience of the Contractor, at no additional cost to the Owner.
- G. Weld joints to provide a watertight joint.
- H. Casings for gravity sanitary sewer, storm drainage or shown to be installed to grade, shall not vary more than 3/32" per foot of length from the indicated grade.
  - 1. Remove and replace any improperly installed or otherwise defective casing at no additional cost to the Owner.
- I. Railroad and Highway Crossings:
  - 1. The Contractor shall be held responsible and accountable for the coordinating and scheduling of all construction work within the highway right-of-way. Now work shall be performed until all necessary permits are obtained and approval to commence work has been granted by the department.
  - 2. Work along or across the railroad or highway department rights-of-way shall be subject to inspection by such department.
  - 3. All installations shall be performed to leave free flows in drainage ditches, pipes, culverts or other surface drainage facilities of the railroad, highway, street or its connections.
  - 4. No excavated material or equipment shall be placed on the pavement or shoulders of the roadway without the express approval of the highway department.
  - 5. In no instance will the Contractor be permitted to leave equipment (trucks, backhoes, etc.) on the railroad right-of-way, road pavement or shoulder overnight. Construction materials to be installed, which are placed on the right-of-way in advance of construction, shall be placed in such a manner as not to interfere with the safe operation of the corridor.
  - 6. When blasting is necessary, the Contractor shall be responsible for obtaining a blasting permit in a timely manner.
- J. DEWATERING
  - 1. Perform dewatering in accordance with Section 33 23 19.

### 3.4 INSTALLING PIPE IN CASING

- A. General:
  - 1. Inspect carefully, ensuring that all foreign material is removed from the casing and the casing meets alignment criteria for the type of carrier pipe being used.



2. For pressure systems, the casing deflection shall not exceed the maximum deflection recommended by the carrier pipe.
3. Install casing spacers on the carrier pipe per the manufacturer's instructions.
4. For sanitary sewer lines, provide spacer sizing and length necessary to obtain the pipe slope and elevations as shown on the plans.
5. Carrier pipe shall generally be centered within the casing.
6. Install the carrier pipe in the casing ensuring each joint is pushed "home" before the joint is installed into the casing.
6. Provide restrained joint carrier pipe for all joints inside of casing.

### 3.5 CASING ENDS

- A. Install rubber end seals in accordance with manufacturer's instructions.

END OF SECTION 33 05 07.23

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## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Modular precast concrete manholes and structures with tongue-and-groove joints and masonry transition to cover frame, covers, anchorage, and accessories.
2. Modular precast structure sections with masonry transition to cover frame, covers, anchorage, and accessories.
3. Cast-in-place concrete manholes and structures with masonry transition to cover frame, covers, anchorage, and accessories.
4. Doghouse manhole connections to existing sanitary sewer lines.
5. Bedding and cover materials.
6. Vertical adjustment of existing manholes and structures.

#### B. Related Requirements:

1. Section 33 01 32 - Sewer and Manhole Testing: Testing requirements for manholes.
2. Section 33 31 11 - Public Sanitary Sewerage Gravity Piping: Piping connections to manholes.
3. Section 33 01 30 - Corrosion Protection for Concrete Wastewater Structures

### 1.2 DEFINITIONS

- #### A. Bedding: Specialized material placed under manhole prior to installation and subsequent backfill operations.

### 1.3 REFERENCE STANDARDS

#### A. American Association of State Highway Transportation Officials:

1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
2. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

#### B. American Concrete Institute:

1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.

#### C. ASTM International:

1. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
2. ASTM C55 - Standard Specification for Concrete Building Brick.
3. ASTM C361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
4. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.

5. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
6. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.
7. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
8. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
9. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
10. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
11. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

D. South Carolina Department of Health and Environmental Control

1. Regulation 61-67 – Standards for Wastewater Facility Construction

1.4 COORDINATION

- A. Coordinate Work of this Section with Related Requirements listed in Paragraph 1.1.B

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer information for manhole covers, component construction, features, configuration, and dimensions.
- B. Shop Drawings:
1. Indicate structure locations and elevations.
  2. Indicate sizes and elevations of penetrations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- F. Qualifications Statement:
1. Submit qualifications for manufacturer.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of manholes and connections, and record invert elevations.

1.7 QUALITY ASSURANCE

- A. Perform Work according to ASTM, AWWA, and SCDHEC standards.
- B. Perform Work according to NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
- B. Manufacturer shall be certified by the National Precast Concrete Association (NPCA).

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Handling: Comply with precast concrete manufacturer instructions for unloading and moving precast manholes and drainage structures.
- C. Storage:
  - 1. Store materials according to manufacturer instructions.
  - 2. Store precast concrete manholes and drainage structures to prevent damage to Owner's property or other public or private property.
  - 3. Repair property damaged from materials storage.
- D. Protection:
  - 1. Provide protection according to manufacturer instructions.

1.10 AMBIENT CONDITIONS

- A. Cold Weather Requirements: Comply with ACI 530/530.1.

1.11 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

- A. Furnish 10 year manufacturer's warranty for concrete manholes.

PART 2 - PRODUCTS

2.1 CONCRETE PRECAST MANHOLES

- A. Manufacturers
  - 1. Tindall Corporation,
  - 2. MST Concrete Products,
  - 3. Or Approved Equal
- B. Manhole Sections:
  - 1. Materials:
    - a. Reinforced Precast Concrete: Comply with ASTM C478.
    - b. Gaskets: Comply with ASTM C923.
  - 2. Joints:
    - a. Comply with ASTM C913.
- C. Mortar and Grout:
  - 1. Mortar:
    - a. Type: S.
- D. Reinforcement:
  - 1. Comply with requirements of ASTM-A1064.
- E. Shaft and Eccentric Cone Top Sections:
  - 1. Pipe Sections: Reinforced precast concrete.
  - 2. Joints:
    - a. Lipped male/female.
  - 3. Openings to receive pipe shall include rubber boot
- F. Shape: Cylindrical.
- G. Clear Inside Dimensions:
  - 1. As indicated on Drawings.
- H. Design Depth:
  - 1. As indicated on Drawings.
- I. Cover Opening:
  - 1. As indicated on Drawings.
- J. Pipe Entry: Furnish openings as indicated on Drawings.

- K. Structure Joint Gaskets Joint Sealant shall be either by butyl rubber ring joint, 1-inch diameter, conforming to ASTM C990, or rubber O-ring gaskets conforming to ASTM C443, latest revision. Cement mortar joints will not be acceptable, except that each joint shall be wiped inside the manhole with cement mortar after assembly.
- L. Exterior Joint Wrap
  - 1. The joints and/or joining surfaces of the structures shall be sealed with a butyl-rubber-based tape. The butyl component of the tape shall consist of 50% (min.) butyl rubber, shall contain 2% or less volatile matter, and shall be .050" (1.3 mm) thick. The backing component shall be high-density polyethylene film. A release paper may be utilized.
  - 2. For manholes, the tape width shall be 6" (150 mm) wide. The tape shall be overlapped at least twice its width. The tape shall not be stretched during application. Primer and/or adhesive as recommended by the tape supplier shall be employed for adverse, critical, or other applications. Testing of joints and compliance with construction requirements shall be conducted in strict conformance with the requirements of the sealant supplier.

## 2.2 CAST IRON RINGS AND COVERS

- A. Uses: Cast iron rings and covers shall be used on standard manhole installations. Composite rings and covers as specified in Paragraph 2.3 or ductile iron hinged covers as specified in Paragraph 2.4 shall be used on 30" and larger openings or on a case-by-case basis when directed by the Engineer or ReWa.
- B. Manufacturers:
  - 1. U.S. Foundry (Eagle Manufacturing)
  - 2. Substitutions: As approved by ReWa.
- C. Rings and Covers:
  - 1. Material:
    - a. Cast iron.
    - b. Comply with ASTM A48/A48M, Class 35B.
  - 2. Cover:
    - a. Bearing Surface: Machined flat.
    - b. Configuration: Non-penetrating pick-hole unless otherwise specified.
    - c. Security: as specified
  - 3. Cover Design: Standard removable or hinged
- D. Grade Rings:
  - 1. Thickness of 2 to 6 Inches:
    - a. Precast concrete or Expanded Polypropylene (EPP)
    - b. Comply with ASTM C478 (concrete), or ASTM D3575 and D4819-13 (EPP)

- c. Grade adjustment greater than 6" not allowed with grade rings.
  - d. Comply with AASHTO M306, HS-20 and HS-25 load rating
- 2. Thickness Less Than 2 Inches:
  - a. Cast iron.
  - b. Comply with AASHTO M306, HS-20 and HS-25 load rating
- E. Clay Brick Units:
  - 1. Comply with ASTM C32.
- F. Concrete Cradle:
  - 1. As specified in Section 03 30 00 - Cast-in-Place Concrete.
  - 2. Description:
    - a. Type: Reinforced
    - b. Strength: 4,000 psi at 28 days.
    - c. Finish: Rough troweled.

## 2.3 COMPOSITE RINGS AND COVERS

- A. Uses: Cast iron rings and covers shall be used on standard manhole installations. Composite rings and covers as specified in Paragraph 2.3 or ductile iron hinged covers as specified in Paragraph 2.4 shall be used on 30" and larger openings or on a case-by-case basis when directed by the Engineer or ReWa.
- B. Manufacturers:
  - 1. GMI Manufacturing (East Jordan Iron Works)
    - a. 30" GMI 3200 (EJ 1480)
    - b. 36" GMI 3800 (EJ 1581)
  - 2. Substitutions: As approved by ReWa
- C. Rings and Covers:
  - 1. Material:
    - a. Composite products shall be manufactured from fiber reinforced polymer (FRP). It shall consist of a FRP matrix consisting of between 45% to 70% fiber reinforcement by weight. Fiber reinforcement shall consist of fiberglass, carbon, aramid, basalt and/or natural fibers. The polymer matrix shall be thermoset consisting of a polyester, vinylester, epoxy, polyurethane, and/or hybrid chemical composition. The resin matrix must be thermoset.
  - 2. Cover:
    - a. Bearing Surface: Machined flat.
    - b. Configuration: Non-penetrating pickhole unless otherwise specified
    - c. Security: ¼ turn paddle lock,



- D. Grade Rings:
  - a. See paragraph 2.2.D

## 2.4 DUCTILE IRON HINGED COVERS

- A. Uses: Cast iron rings and covers shall be used on standard manhole installations. Composite rings and covers as specified in Paragraph 2.3 or ductile iron hinged covers as specified in Paragraph 2.4 shall be used on 30” and larger openings or on a case-by-case basis when directed by the Engineer or ReWa.
- B. Manufacturers:
  - 1. PAMREX Municipal Castings
    - a. Model: PAMREX 600 Operation D400 Class (VD40RENPMX415)
  - 2. Substitutions: As approved by ReWa
- C. Rings and Covers:
  - 1. Material:
    - a. Frame: Ductile Iron EN GJS 400-15 with water base coating.
    - b. Ring in elastomer.
  - 2. Cover:
    - a. Hinged cover and ergonomic handling box.
    - b. Ventilated.
    - c. Rated for heavy traffic zones and frequent visits.
    - d. Security: anti-theft pins, quarter-turn locking system, mudpan.

## 2.5 MATERIALS

- A. Bedding, Backfill and Cover:
  - 1. Bedding: Use “Washed Stone” material as specified in Section 31 23 16.13 – Trenching.
  - 2. Backfill and Cover: Use “Suitable” or “Select” material as specified in Section 31 23 16.13 – Trenching.

## 2.6 ACCESSORIES

- A. Steps (only where shown on drawings or where directed by ReWa):
  - 1. Steps shall meet requirements of OSHA Standard 1910.24 – Steps bolts and Manhole Steps.
  - 2. See ReWa standard details for additional dimensions and requirements.
  - 3. Manhole Steps shall be of composite plastic steel construction. Minimum design live load of steps shall be a single concentrated load of 300 pounds. Steps shall have nonskid top surfaces, and shall be designed so that the foot cannot slip off the end.
  - 4. Steps shall have a minimum cross-sectional dimension of 1-inch, and a minimum width of 10 inches. Steps shall be evenly spaced on 16-inch centers with each step embedded in the wall a minimum of 3 inches. Each step shall project a minimum of 4 inches from the

wall as measured from the point of embedment. Composite steel steps shall consist of a 1/2-inch deformed steel reinforcing rod encapsulated in copolymer plastic. Reinforcing rods shall conform to ASTM A615.

5. Top Surface: Level.

B. Strap Anchors (where required):

1. Shape: Bent steel stainless steel
2. Size: as specified on drawings.
3. Finish: Galvanized.

C. Joint Sealant: Comply with ASTM C990.

D. Fasteners: Stainless steel; ASTM F593.

E. Geotextile Filter Fabric:

1. As designed by Engineer for the application.

## 2.7 FINISHES

A. Interior Manhole Coating:

1. Downstream of force main discharges or other locations required by ReWa: In accordance with Section 33 01 30 - Corrosion Protection for Concrete Wastewater Structures.
2. All other manholes: No interior coating.

## 2.8 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that items provided by other Sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location and are ready for roughing into Work.

- C. Verify that excavation base is ready to receive Work and excavations and that dimensions and elevations are as indicated on Drawings.

### 3.2 PREPARATION

- A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.
- B. Coordinate placement of inlet and outlet pipe or duct sleeves as required by other Sections.
- C. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.
- D. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.

### 3.3 INSTALLATION

- A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.
- B. Correct over-excavation with coarse aggregate.
- C. Remove large stones or other hard matter impeding consistent backfilling or compaction.
- D. Protect manhole from damage or displacement while backfilling operation is in progress.
- E. Excavating:
  - 1. In accordance with OSHA regulations and in indicated locations and depths shown on drawings.
  - 2. Provide clearance around sidewalls of manhole or structure for construction operations, granular backfill, and placement of geotextile filter fabric if specified.
  - 3. If ground water is encountered, prevent accumulation of water in excavations; place manhole or structure in dry trench.
  - 4. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation as approved by Engineer.
- F. Precast Concrete Manholes (on new sewer lines): Each section shall be handled and installed in such a manner and by such means as to prevent damage. All manhole sections damaged during handling and installation will be rejected as directed by the Engineer, and replaced at no additional cost to the Owner. All lifting holes shall be plugged and sealed watertight as recommended by the manufacturer.
  - 1. Base sections shall be installed on a firm 6-inch washed stone foundation so prepared to prevent settlement and misalignment. Pipe openings shall be placed at the exact elevation and location to receive entering pipes. Base section shall be set such that the center of the

manhole will coincide with the intersection of the incoming and outgoing pipes. The resulting angle shall be no less than 90 degrees and so constructed that both halves of the trough shall be of equal length and radius. Manhole bases set off center shall be removed and reset.

2. Riser and top sections shall be installed plumb and such that all manhole steps are in alignment. Joint sealant shall be of the type specified above. Joints shall be made in accordance with the manufacturer's recommendations, and to insure a watertight installation. Each joint inside the manhole shall be wiped with cement mortar plaster after installation.
3. Pipe connections to manhole shall be made by a flexible synthetic rubber boot mechanically clamped to the manhole and to the pipe to provide a watertight seal and designed to accommodate pipe movement up to 2 inches radially or 22 degrees angularly in any direction. The synthetic rubber boot shall have a minimum wall thickness of 3/8 inch. The synthetic rubber material shall conform to ASTM C-923 (latest version). Bands, clamps and other metal accessories shall be of Series 304 stainless steel.

G. Precast Concrete Manholes (cut in on existing sewer lines):

1. Stake out location and burial depth of existing sewer line in area of proposed manhole or structure.
2. Carefully excavate around existing sewer line to adequate depth for foundation slab installation.
3. Protect existing pipe from damage.
4. Cut out soft spots and replace with granular fill compacted to 95 <percent maximum density.
5. Bear firmly and fully on compacted crushed stone bedding.
6. Install precast concrete manhole or structure around existing pipe according to applicable Paragraphs in this Section.
7. Grout pipe entrances as shown on Drawings
8. Block upstream flow at existing manhole or structure with expandable plug.
9. Use hydraulic saw to cut existing pipe on either side of the proposed manhole location.
10. Install manhole in an accordance with Paragraph 3.3.J above.
11. Connect manhole stub-out pipe to existing sewer pipe with coupling as shown in ReWa standard detail for "Connection of Existing Sewer to New Manhole".

H. Doghouse Manholes and Structures:

1. Stake out location and burial depth of existing sewer line in area of proposed manhole or structure.
2. Carefully excavate around existing sewer line to adequate depth for foundation slab installation.
3. Protect existing pipe from damage.
4. Cut out soft spots and replace with granular fill compacted to 95 <percent maximum density.
5. Bear firmly and fully on compacted crushed stone bedding.
6. Install precast concrete manhole or structure around existing pipe according to applicable Paragraphs in this Section.
7. Grout pipe entrances as shown on Drawings
8. Block upstream flow at existing manhole or structure with expandable plug.
9. Use hydraulic saw to cut existing pipe at manhole or structure entrance and exit and along pipe length at a point halfway up OD on each side of pipe.

10. Bottom half of pipe is to remain as manhole flow channel.
11. Saw cut to smooth finish with top half of pipe flush with interior of manhole or structure.
12. Grout base of manhole or structure to achieve slope to manhole or structure channel and trowel smooth.

- I. Backfilling: As specified in Section 31 23 16.13 – Trenching.
- J. Coating: Coat interior in accordance with Section 33 01 30 – Corrosion Protection for Concrete Wastewater Structures, if specified by Engineer or ReWa.
- K. Sanitary Manhole Drop Connections: As indicated on Drawings.

### 3.4 FIELD QUALITY CONTROL

- A. Testing:
  1. In accordance with Section 33 01 32 – Sewer and Manhole Testing.
- B. Equipment Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

### 3.5 ADJUSTING

- A. Vertical Adjustment of Existing Manholes and Structures:
  1. If required, adjust top elevation of existing manholes and structures to finished grades as indicated on Drawings.
  2. Frames, Grates, and Covers:
    - a. Remove frames, grates, and covers cleaned of mortar fragments.
    - b. Reset to required elevation according to requirements specified for installation of castings.

END OF SECTION 33 05 61

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## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Precast concrete wetwell structures.
2. Access hatches
3. Access hatch Safety Grate

#### B. Related Requirements:

1. Section 33 01 32 – Sewer and Manhole Testing
2. Section 33 01 30 – Corrosion Protection for Concrete Wastewater Structures
3. Section 33 31 11 - Public Sanitary Sewerage Gravity Piping
4. Section 33 31 23 - Sanitary Sewerage Force Main Piping: Piping connections

### 1.2 REFERENCE STANDARDS

#### A. American Concrete Institute:

1. ACI 311
2. ACI 301
3. ACI 318  
ACI 347

#### B. ASTM International:

1. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

#### C. National Precast Concrete Association:

1. NPCA Plant Certification Program.
2. NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.

#### D. South Carolina Department of Health and Environmental Control

1. Regulation 61-67 – Standards for Wastewater Facility Construction

### 1.3 SUBMITTALS

#### A. Product Data: Submit manufacturer information regarding frames and covers, component construction, features, configuration, and dimensions.

#### B. Shop Drawings:

1. Indicate Precast structure location, elevations, sections, equipment supports, piping, conduit, and sizes and elevations of penetrations.

2. Indicate design, construction and installation details, typical reinforcement and additional reinforcement at openings and for each type, size, and configuration.
- C. Submit concrete mix design for each different mix.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Design Submittals: Submit signed and sealed Shop Drawings with design calculations, buoyancy calculations, and assumptions for custom fabrications.
- F. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- G. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.
- H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- I. Qualifications Statements:
  1. Submit qualifications for manufacturer, installer, and licensed professional.
  2. Submit manufacturer's approval of installer.

#### 1.4 QUALITY ASSURANCE

- A. Perform structural design according to ACI 318.
- B. Perform Work according to NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.
- C. Material and Fabrication:
  1. Other Structures: Comply with ASTM C913.
- D. Maintain one copy of each standard affecting Work of this Section on Site.

#### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Plant to be certified under the P.C.I. Plant Certification Program

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Concrete Products: Do not deliver products until concrete has cured five days or has attained minimum 75 percent of specified 28-day compressive strength.
- B. Inspection: Accept materials on Site for damage.
- C. Handling:



1. Comply with manufacturer instructions for unloading, storing, and moving Precast structures.
2. Lift Precast Structure from designated lifting points.

D. Storage:

1. Store Precast Structure according to manufacturer instructions.
2. Store to prevent damage to Owner's property or other public or private property.
3. Repair property damaged from materials storage.

E. Protection:

1. Provide additional protection according to manufacturer instructions.

1.7 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.8 WARRANTY

- A. Furnish five-year manufacturer's warranty for concrete structures

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

1. Walkway Traffic:
  - a. Comply with ASTM C857; A-0.3.
  - b. Maximum Loading: 300 psf.

2.2 PRECAST CONCRETE WETWELL STRUCTURES

A. Fabricator List:

1. MST Concrete Products, Inc.;
2. Tindall Corporation;
3. Or Equal.

- B. Material of Construction: Reinforced precast concrete or Polymer Concrete (as directed by ReWa) .

C. Foundation Slab:

1. Precast concrete of type as shown on drawings.
2. Design Engineer to provide slab design to resist floatation. Engineer to provide signed & sealed buoyancy calculations for ReWa information prior to fabrication.

## 2.3 FRAMES AND COVERS

1. See Section 33 05 61 – Concrete Manholes for frame and cover specifications.

## 2.4 ACCESS HATCHES

### A. Manufacturers:

1. Halliday Products;
2. The Bilco Company;
3. U.S. Foundry;
4. Or Approved Equal.

### B. Description:

1. Materials of Construction: Aluminum
2. Size: As indicated on Drawings.
3. Door Configuration: As shown on drawings.
4. Cover:
  - a. Fabrication: Diamond Plate ¼” Thick
  - b. Reinforce with structural stiffeners as required to support indicated loads of 300 PSF.
  - c. Double Leaf Construction
5. Frame:
  - a. Extruded cast in place aluminum.
6. Hinge Material: Stainless steel and Hardware with Tamper Proof Fasteners
7. Lift Handle:
  - a. Recessed
8. Lifting Mechanism:
  - a. Compression Springs: T-316 Stainless steel.
  - b. Furnish automatic hold-open and dead stop to retain cover in open position.
  - c. Cover springs to prevent contact by personnel entering structure.
9. Latch Mechanism:
  - a. Lock: T-316 Stainless steel slam lock
  - b. Furnish removable external handle and permanent internal release mechanism.
10. Hardware: Stainless steel.

11. Fall Protection Grate

- a. Protective grating panel shall be 1 inch (25 kg.) aluminum “I” bar grating with Safety Orange powder-coated finish. Grating shall be hinged with tamper proof stainless steel bolts, and shall be supplied with a positive latch to maintain unit in an upright position. Grating shall have a 6-in. (152mm) viewing area on each lateral unhinged side for visual observation and limited maintenance. Grating support ledges on 300 lbs. psf (1464 kg. per sq. meter) loaded access covers shall incorporate nut rail with a minimum of four (4) stainless steel spring nuts. A padlock hasp for owner-supplied padlock shall be provided.
  - 1) Secondary protective grating panel shall be 1 inch (25mm) thick aluminum “I” bar grating.
  - 2) Grating panel color and finish shall be Safety Orange powder- coating.
  - 3) Grating panel shall be hinged with tamper proof stainless steel bolts, and shall be supplied with positive latch to maintain unit in an upright position.
  - 4) A 6-in. (152mm) viewing area shall be provided on each lateral unhinged side of grating panel, for visual observation and limited maintenance procedures.
  - 5) The grating support ledges shall incorporate nut rail feature supplied with minimum of four stainless steel spring nuts for mounting pump brackets and/or cable holders.
  - 6) A padlock hasp for owner-supplied padlock shall be provided.

2.5 MATERIALS

A. Concrete Reinforcement:

1. Provide Reinforcement, accessories and connection materials required in accordance with the final design as approved by the engineer.

2.6 FABRICATION

A. Comply with ACI 318 and NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.

B. Fabricate Structure and openings to size and configuration as indicated on Drawings.

C. Reinforcing:

1. Provide reinforcing in accordance with ASTM-C748, ASTM A-185(Wire) and A0615 (Bar).

2.7 MIXES

A. Concrete:

1. Normal Weight: Select proportions according to ACI 2111.1 and 318.
2. Concrete Criteria:
  - a. Compressive Strength: 5,000 psi at 28 days.
  - b. Mix Design as approved by Engineer.
  - c. Reinforcing Steel ASTM A615, Grade 60

2.8 FINISHES

A. Concrete:

1. Formed Surfaces Not Exposed to View: As formed.
2. Unformed Surfaces:
  - a. Finish with vibrating screed or hand float.
  - b. Items Permitted: Color variations, minor indentations, chips, and spalls.
  - c. Items Not Permitted: Major imperfections, honeycomb, or other such defects.
3. Exposed-to-View Finishes:
  - a. Trowel Surfaces.

B. Steel:

1. T316 Stainless Steel

C. Joint Sealants and Joint Gaskets:

1. Gasket Joints for Circular Concrete Pipe:
  - a. Comply with ASTM C443.
  - b. Gaskets: Oil-resistant rubber.
2. External Sealing Bands:
  - a. Comply with ASTM C877.
  - b. Material: Type I, rubber and mastic

D. Pipe Entry Connectors: Link-Seal, or approved equal.

E. Grout:

1. Cement Type: Portland cement, sand, and water mixture with stiff consistency to suit intended purpose.
2. Nonshrink Type:

- a. Comply with ASTM C1107/C1107M.
- b. Minimum Compressive Strength: 2,400 psi in 48 hours, and 7,000 psi in 28 days.

F. Interior Coatings:

1. Provide interior wetwell protective coatings, on precast pump station wetwells in accordance with Section 33 01 30 – Corrosion Protection for Concrete Wastewater Structures.

2.9 SOURCE QUALITY CONTROL

A. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that items provided by other Sections of Work are properly sized and located.
- B. Verify correct size and elevation of excavation.
- C. Verify that subgrade and bedding are properly prepared, compacted, and ready to receive Work of this Section.

3.2 INSTALLATION

- A. According to ASTM C891.
- B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.
- C. While lowering structure into excavations and joining pipe to units, take precautions to ensure that interiors of pipeline and structure remain clean.
- D. Install Precast Structure to elevation and alignment as indicated on Drawings.
- E. Excavating:
  1. Excavate to indicated locations and depths as shown on drawings.
- F. Base and Alignment:

1. Install Structure supported at proper grade and alignment on compacted crushed-stone bedding and support system as indicated on Drawings.
- G. Assembly of Multi-section Structures:
1. Lower each section into excavation.
  2. Clean joint surfaces.
  3. Install watertight joint seals according to manufacturer instructions.
- H. Connections:
1. Connect pipe to structure and seal watertight.
  2. Cut pipe flush with interior of structure.
- I. Backfill excavations for vaults and chambers Suitable or Select material as specified in Section 31 23 16.13 – Trenching.

### 3.3 FIELD QUALITY CONTROL

- A. Testing:
1. Hydrostatic Exfiltration Test: According to Section 33 01 32 – Sewer and Manhole Testing.
  2. Testing shall be performed prior to application of protective coating specified in Paragraph 2.8.F.

END OF SECTION 33 05 63

## PART 1 - GENERAL

### 1.1 SCOPE

#### A. Section Includes:

1. This specification covers polymer concrete manholes intended for use in sanitary sewer manholes, wetwells and structures where corrosion resistance is required. This specification is the preferred method of corrosion protection of precast structures. Refer to Section 33 01 30 - Corrosion Protection for Concrete Wastewater Structures for alternate corrosion protection measures for non-polymer concrete structures.

### 1.2 REFERENCES

- A. ASTM C 33 Standard specification for concrete aggregates
- B. ASTM C 478 Standard Specification for Precast Reinforced Concrete Manhole Sections.
- C. ASTM C 443 Standard Specification for Joints for Concrete Pipe and Manholes Using Rubber Gaskets.
- D. ASTM C 497 Test Methods for Concrete Pipe, Manhole Sections, or Tile.
- E. ASTM C 580 Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
- F. ASTM C 579 Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic, Surfacing, and Polymer Concretes.
- G. ASTM C 857 Standard Practice for Minimum Structural Design Loading for Underground Utility Structures.
- H. ASTM C 923 Standard Specifications for Resilient Connectors between Concrete Manholes Structures and Pipe.
- I. ASTM C 990 Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections using Performed Flexible Joint Sealants.
- J. ACI 350-06 Code Requirements for Environmental Engineering Concrete Structures & Commentary.
- K. ACI 440.1R-15 Guide for Design and Construction of Structural Concrete Reinforced with Fiber-Reinforced Polymer (FRP) Bars.
- L. ACI 548.6R-96 Polymer Concrete-Structural Applications State-of-the-Art Report

- M. ASTM D 648 Test Method for Deflection Temperature of Plastics Under Flexural Load in Edgewise Position.
- N. ASTM D 6783 Standard Specification for Polymer Concrete Pipe.
- O. ASTM D 2584 Test Method for Ignition Loss of Cured Reinforced Resins.

### 1.3 SUBMITTALS

- A. Conform to bid document requirements.
- B. Submit manufacturer's data and details of following items for approval:
  - 1. Shop drawings of manhole sections, base units and construction details, jointing methods, materials, reinforcement details, rim and invert elevations, and dimensions.
  - 2. Summary of criteria used in structure design including, as minimum, material properties, loading criteria, and dimensions assumed. Include certification from manufacturer that polymer concrete manhole design meets or exceeds the load and strength requirements of ASTM C 478 and ASTM C 857, reinforced in accordance with ACI 440.1R-15.
  - 3. Frames, grates, rings, and covers
  - 4. Materials to be used in fabricating pipe drop connections
  - 5. Materials to be used for pipe connections
  - 6. Materials to be used for stubs and stub plugs, if required
  - 7. References of 10 previous polymer concrete projects including scope in the last 5 years performed with both owner and contractor for reference and review by owner

## PART 2 - PRODUCTS

### 2.1 POLYMER CONCRETE STRUCTURES

- A. Provide polymer concrete manhole sections, monolithic base sections and related components referencing to ASTM C 478. ASTM C 478 material and manufacturing is allowed compositional and dimensional differences required by a polymer concrete product manufacturer.
- B. Provide base riser sections, unless shown otherwise on plans.
- C. Provide riser sections joined with bell and spigot / ship-lap design seamed with butyl mastic and or rubber gaskets (ASTM C 990) so that on assembly, manhole base, riser and top section make a continuous and uniform manhole structure.
- D. Construct riser sections for polymer concrete manholes from standard polymer concrete manhole sections of the diameter indicated on drawings. Use various lengths of polymer concrete manhole sections in combination to provide correct height with the fewest joints.
- E. Design wall sections for depth and loading conditions with wall thickness as designed by polymer concrete manufacturer. For manholes with 4' or 5' diameters, reduced wall thicknesses



(compared to ASTM C 478) may be allowed provided manufacturer provides supporting justification and design calculations to support reduced wall thicknesses.

- F. Provide tops to support AASHTO HS-20 loading or loads as required and receiving cast iron frame covers or hatches, as indicated on drawings.

## 2.2 ACCESSORIES

### A. Manhole Frames and Covers

- 1. See Paragraphs 2.2 and 2.3, Section 33 05 61 – Concrete Manholes for manhole frame and cover requirements.

### B. Grade Rings:

- 1. Thickness of 2 to 6 Inches:
  - a. Expanded Polypropylene (EPP)
  - b. ASTM D3575 and D4819-13 (EPP)
  - c. Grade adjustment greater than 6” not allowed with grade rings.
  - d. Comply with AASHTO M306, HS-20 and HS-25 load rating
- 2. Thickness Less Than 2 Inches:
  - a. Cast iron.
  - b. Comply with AASHTO M306, HS-20 and HS-25 load rating

### C. Steps, Ladders and Handholds

- 1. Unless otherwise required by ReWa, steps and ladders will not be installed in wetwells or manholes. Where shown on project specific drawings or where requested by ReWa for a specific application, steps and ladders shall meet specific polymer concrete structure manufacturer’s recommendations for product style and anchoring requirements.
- 2. Where shown on drawings or where directed by ReWa, corrosion resistant handholds may be required on the interior riser sections to provide a stabilization point for operators being lowered into structures by tripod and harness. Specific handhold design to be coordinated with ReWa and the polymer concrete manufacturer.

## 2.3 DESIGN CRITERIA:

- A. Polymer Concrete Manhole risers, cones, flat lids, grade rings and manhole base sections shall be designed by manufacturer to meet the intent of ASTM C 478 with allowable compositional and sizing differences as designed by the polymer concrete manufacturer.
  - 1. AASHTO HS-20 design or as required loading applied to manhole cover and transition and base slabs.
  - 2. Polymer manholes will be designed based upon live and dead load criteria in ASTM C 857 and ACI 350-06.

3. Minimum unit soil weight of 120 pcf located above portions of manhole, including base slab projections.
4. Internal liquid pressure based on unit weight of 63 pcf.
5. Dead load of manhole sections fully supported by polymer concrete manhole base.

2.4 DESIGN:

- A. Polymer concrete manhole risers, cones, flat lids, grade rings and manhole base sections shall be designed by manufacturer to meet loading requirements of ASTM C 478, ASTM C 857 and ACI 350-06 as modified for polymer concrete manhole design as follows:
1. Polymer Concrete Mix Design shall consist of thermosetting resin, sand, and aggregate. No Portland cement shall be allowed as part of the mix design matrix. All sand and aggregate shall be inert in an acidic environment
  2. Reinforcement – Shall use acid resistant reinforcement (FRP Bar) in accordance with ACI 440.1R-06 as applicable for polymer concrete design; or steel reinforced per ASTM C 478. Manholes shall have a monolithic base slab unless otherwise approved. Manholes shall have engineered and rated lifting devices that shall not penetrate through the wall.
  3. The wall thickness of polymer concrete structures shall not be less than that prescribed by the manufacturer's design by less than 95% of stated design thickness.
  4. Thermosetting Resin - The resin shall have a minimum deflection temperature of 158° F when tested at 264 psi (1.820 mPa) following Test Method D 648. The resin content shall not be less than 7% of the weight of the sample as determined by test method D 2584. Resin selection shall be suitable for applications in the corrosive conditions to which the polymer concrete manhole structures will be exposed.
  5. Each polymer concrete manhole component shall be free of all defects, including indentations, cracks, foreign inclusions and resin starved areas that, due to their nature and degree or extent, detrimentally affect the strength and serviceability of the component part. Cosmetic defect shall not be cause for rejection. The nominal internal diameter of manhole components shall not vary more than 2%. Variations in height of two opposite sides of risers and cones shall not be more than 5/8 inch. The under run in height of a riser or cone shall not be more than ¼ in/ft of height with a maximum of ½ inch in any one section.
  6. Marking and Identification - Each manhole shall be marked with the following information - Manufacturer's name or trademark, Manufacturer's location and Production Date.
  7. Manhole joints shall be assembled with a bell/spigot or shiplap butyl mastic and/or gasketed joint so that on assembly, manhole base, riser and top section make a continuous and uniform manhole. Joint sealing surfaces shall be free of dents, gouges and other surface irregularities that would affect joint integrity.
  8. Manufacturer shall provide specifications for appropriate sealant to be used to seal joints from infiltration/exfiltration.
  9. Minimum clearance between wall penetrations and joints shall be per manufacturer's design.
  10. Construct invert channels to provide smooth flow transition with minimal disruption of flow at pipe-manhole connections. Invert slope through manhole is as indicated on drawings. All precast manhole base sections to be cast monolithically. Pump Station wetwells may be cast monolithically or with a polymer concrete insert (as approved by ReWa). Polymer bench and channel are to be constructed with all polymer concrete material. Extended ballast slab requirements for buoyancy concerns can be addressed with cementitious concrete material on exterior of manhole.

11. Provide resilient connectors conforming to requirements of ASTM C 923 or other options as available. All connectors are to be water tight. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions

## 2.5 QUALITY CONTROL

- A. All fabrication will take place in an all polymer concrete fabrication facility. At no time will the polymer concrete fabrication facility share the facility with a cementitious precast product production facility. Polymer concrete shall be cast in a polymer only facility and shall not be manufactured in a cementitious concrete facility.

## 2.6 GROUTING

- A. All materials needed for grouting and patching will be a commercially available polyester or resin compound provided by the manufacturer or an approved equal by the manufacturer. Standard cementitious grouts are not allowed on polymer concrete structures.

## 2.7 MANUFACTURER

- A. U.S. Composite Pipe, Inc (Thompson Pipe Group), [www.uscompositепipe.com](http://www.uscompositепipe.com)
- B. Armorock LLC, [www.armorock.com](http://www.armorock.com)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that items provided by other Sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location and are ready for roughing into Work.
- C. Verify that excavation base is ready to receive Work and excavations and that dimensions and elevations are as indicated on Drawings.

### 3.2 PREPARATION

- A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.
- B. Coordinate placement of inlet and outlet pipe or duct sleeves as required by other Sections.
- C. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.

- D. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.

### 3.3 INSTALLATION

- A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.
- B. Correct over-excavation with coarse aggregate.
- C. Remove large stones or other hard matter impeding consistent backfilling or compaction.
- D. Protect manhole from damage or displacement while backfilling operation is in progress.
- E. Excavating:
  - 1. In accordance with OSHA regulations and in indicated locations and depths shown on drawings.
  - 2. Provide clearance around sidewalls of manhole or structure for construction operations, granular backfill, and placement of geotextile filter fabric if specified.
  - 3. If ground water is encountered, prevent accumulation of water in excavations; place manhole or structure in dry trench.
  - 4. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation as approved by Engineer.
- F. Precast Polymer Concrete Manholes (on new sewer lines): Each section shall be handled and installed in such a manner and by such means as to prevent damage. All manhole sections damaged during handling and installation will be rejected as directed by the Engineer, and replaced at no additional cost to the Owner. All lifting holes shall be plugged and sealed watertight as recommended by the manufacturer.
  - 1. Base sections shall be installed on a firm 6-inch washed stone foundation so prepared to prevent settlement and misalignment. Pipe openings shall be placed at the exact elevation and location to receive entering pipes. Base section shall be set such that the center of the manhole will coincide with the intersection of the incoming and outgoing pipes. The resulting angle shall be no less than 90 degrees and so constructed that both halves of the trough shall be of equal length and radius. Manhole bases set off center shall be removed and reset.
  - 2. Riser and top sections shall be installed plumb and such that all manhole steps are in alignment. Joint sealant shall be of the type specified above. Joints shall be made in accordance with the manufacturer's recommendations, and to insure a watertight installation. Each joint inside the manhole shall be wiped with cement mortar plaster after installation.
  - 3. Pipe connections to manhole shall be made by a flexible synthetic rubber boot mechanically clamped to the manhole and to the pipe to provide a watertight seal and designed to accommodate pipe movement up to 2 inches radially or 22 degrees angularly in any direction. The synthetic rubber boot shall have a minimum wall thickness of 3/8 inch. The synthetic rubber material shall conform to ASTM C-923 (latest version). Bands,

clamps and other metal accessories shall be of Series 304 stainless steel. Void space shall be sealed with approved grout (see Paragraph 2.6.A).

- G. Precast Polymer Concrete Manholes (cut in on existing sewer lines):
1. Stake out location and burial depth of existing sewer line in area of proposed manhole or structure.
  2. Carefully excavate around existing sewer line to adequate depth for foundation slab installation.
  3. Protect existing pipe from damage.
  4. Cut out soft spots and replace with granular fill compacted to 95 <percent maximum density.
  5. Bear firmly and fully on compacted crushed stone bedding.
  6. Install precast concrete manhole or structure around existing pipe according to applicable Paragraphs in this Section.
  7. Grout pipe entrances as shown on Drawings
  8. Block upstream flow at existing manhole or structure with expandable plug.
  9. Use hydraulic saw to cut existing pipe on either side of the proposed manhole location.
  10. Install manhole in an accordance with Paragraph 3.3.J above.
  11. Connect manhole stub-out pipe to existing sewer pipe with coupling as shown in ReWa standard detail for “Connection of Existing Sewer to New Manhole”.
- H. Backfilling: As specified in Section 31 23 16.13 – Trenching.
- I. Sanitary Manhole Drop Connections: As indicated on Drawings.

### 3.4 FIELD QUALITY CONTROL

- A. Testing:
1. In accordance with Section 33 01 32 – Sewer and Manhole Testing.
- B. Equipment Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

### 3.5 ADJUSTING

- A. Vertical Adjustment of Existing Manholes and Structures:
1. If required, adjust top elevation of existing manholes and structures to finished grades as indicated on Drawings.
  2. Frames, Grates, and Covers:
    - a. Remove frames, grates, and covers cleaned of mortar fragments.
    - b. Reset to required elevation according to requirements specified for installation of castings.

END OF SECTION 33 05 75

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## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Plastic utility markers.
2. Plastic ribbon tape for placement above direct-buried utility.
3. Trace wire for placement above direct-buried utility.

#### B. Related Requirements:

1. Section 31 23 16.13 - Trenching: Backfilling considerations for installation of underground pipe markers.
2. Section 33 31 11 - Public Sanitary Sewerage Gravity Piping: Piping, valves, and appurtenances requiring identification marking.
3. Section 33 31 23 - Sanitary Sewerage Force Main Piping: Pipe, valves, and appurtenances requiring identification marking.

### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer catalog information for each specified product.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Qualifications Statement:
  1. Submit qualifications for manufacturer.

### 1.3 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged valves.

### 1.4 QUALITY ASSURANCE

- A. Perform Work according to AWWA and SCDHEC standards.

### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

## PART 2 - PRODUCTS

### 2.1 TEMPORARY MARKER POSTS

1. Provide temporary PVC marker posts at service lateral cleanout locations. See ReWa standard Drawings for additional information.

### 2.2 RIBBON TAPE

- A. Detection Tape: Detectable mylar encased aluminum foil marking tape will be installed over all sewer pipe and sewer laterals. Tape will be "safety orange" in color, at least 1-1/2-inches wide and shall bear the printed identification "Caution Buried Sewer Line Below" (reverse printed), so as to be readable through the mylar. Surface printing on the tape shall equal to Lineguard Type II Detectable.

### 2.3 TRACE WIRE

- A. Description: Sewer Lines and Force Mains require installation of tracer wire. Tracer wire shall be 12 AWG Solid UL/UF and run along the top of pipe, in a continuous length between valves, air release valves, and stub outs. The tracer wire shall be secured to the pipe in intervals of 10' (maximum) with wire or tape. Splices shall be made using crimped copper sleeves. Twisting wires together shall not be allowed. A minimum of 2' of extra wire shall be coiled in valve boxes and valve vaults. Tracer wire is to be certified by a licensed electrical contractor or corrosion contractor for continuity. Final acceptance will not be granted until certification is received by inspector and/or engineer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Pipeline Marker Posts, Utility Markers, and Marking Flags: According to manufacturer instructions.
- B. Ribbon Tape and Trace Wire:
  1. Continuous over top of pipe.
  2. If multiple pipes occur in common trench, locate tape above centerline of trench.
  3. Coordinate with trench Work as specified in Section 312316.13 – Trenching.

END OF SECTION 33 05 97



## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Gravity Sewer Piping
  - 2. Bedding and Cover Materials
- B. All ductile iron pipe and restrained gaskets shall be domestically manufactured in the United States. Pipe shall be cast, cleaned, lined, coated, fabricated, tested, and certified at a USA manufacturing facility.
- C. Related Requirements:
  - 1. Section 31 23 16.13 - Trenching: Execution requirements for trenching required by this Section.
  - 2. Section 33 01 32 – Sewer and Manhole Testing: Testing of gravity-flow sewerage piping.
  - 3. Section 33 05 61 - Concrete Manholes: Manholes for sanitary sewerage piping.

### 1.2 DEFINITIONS

- A. ABS: Acrylonitrile butadiene styrene.
- B. Bedding: Fill placed under, beside, and directly over pipe, prior to subsequent backfill operations.
- C. EPDM: Ethylene-propylene-diene terpolymer.

### 1.3 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials:
  - 1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International:
  - 1. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  - 2. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
  - 3. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
  - 4. Reference Standards of the American National Standards Institute (ANSI), the American Society of Testing of Materials (ASTM), and the American Waterworks Association (AWWA).

5. ASTM A-746, ANSI A21.50 (AWWA C150) and of ANSI A21.51 (AWWA C151) Ductile Iron Pipe with a standard outside coating of coal tar or asphalt base material
6. ANSI A21.11 (AWWA C111). ANSI A21.10 (AWWA C110) or ANSI A21.53 (AWWA C153) joints for ductile iron pipe and fittings
7. ASTM D638 – Test Method for Tensile Properties of Plastics.
8. ASTM D3034 or D3033 PVC gravity wastewater pipe and fittings
9. ASTM D2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications
10. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
11. ASTM D3262 - Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe.
12. ASTM D3681 – Standard Test Method for Chemical Resistance of “Fiber glass” Pipe
13. ASTM D4161 - Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

#### 1.4 COORDINATION

- A. Coordinate Work of this Section with ReWa
- B. Notify ReWa at least 72 hours prior to construction.

#### 1.5 PRECONSTRUCTION MEETING

- A. Schedule Meeting a minimum one week prior to commencing Work of this Section.
- B. Attendance Roster shall include at minimum: Project Manager/(Engineer), RPR, Consulting Engineer, Contractor and the Project foreman, Any Subcontractors involved with project.

#### 1.6 SUBMITTALS

- A. Product Data: Submit manufacturer’s information indicating proposed materials, accessories, details, and construction information.
- B. Permits: Submit 4 copies of State construction permit, roadway open cut permit, soil erosion permit.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Test and Evaluation Reports: Submit reports indicating field tests made and results obtained.
- E. Manufacturer Instructions:
  1. Indicate special procedures required to install specified products.
  2. Submit detailed description of procedures for connecting new sewer to existing sewer line and directional drilling installation.

1.7 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, manholes, and service lateral locations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

- A. Perform Work according to AWWA and SCDHEC standards.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience or approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Storage:
  - 1. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SANITARY SEWERAGE PIPING

- A. Ductile-Iron Pipe (4"-48"):

1. Comply with AWWA C150 or AWWA C151.
  2. Minimum Pressure Class: 150.
  3. Internal Lining:
    - a. Type: Cement Mortar Lining
    - b. Minimum Uniform Thickness: 40 mil
    - c. Comply with AWWA Standards
  4. PE Encasement (if required): Comply with AWWA C105.
  5. Fittings:
    - a. Material: Ductile iron, Class 50 or greater.
    - b. Comply with AWWA C153 or AWWA C110.
    - c. Lining: Cement Mortar lining in accordance with AWWA C104
  6. External Coating:
    - a. Coat pipe and fittings exposed inside of structures with asphaltic coating in accordance with AWWA C151.
  7. Joints:
    - a. Rubber gasket joint devices.
    - b. Comply with AWWA C111.
- B. Plastic Pipe (4"-15"):
1. Material: PVC.
  2. Comply with ASTM D3034, SDR-26.
  3. Inside Nominal Diameter: 4"-15"
  4. End Connections: Bell-and-spigot style, with rubber-ring-sealed gasket joint.
  5. Fittings: PVC.
  6. Joints:
    - a. Elastomeric gaskets.
    - b. Comply with ASTM F477.
    - c. Reinforced concrete pipe.
- C. Plastic Pipe (18"-48"):
1. Material: PVC
  2. Comply with ASTM F679.
  3. Inside Nominal Diameter: 18"- 48" inches.
  4. End Connections: Bell-and-spigot style, with rubber ringed gasket joint.
  5. Fittings:
    - a. Material: PVC.
    - b. Comply with ASTM D2466.
  6. Joints:

- a. Elastomeric gaskets.
- b. Comply with ASTM F

D. Pipe Greater Than 48”:

- 1. Materials: FRP
- 2. Comply with ASTM D3262.
- 3. Pipe thickness and bedding to be designed by Engineer to suit specific project conditions.

2.2 MANHOLES

- A. As specified in Section 330561 - Concrete Manholes.

2.3 FLEXIBLE COUPLINGS

A. Description:

- 1. Material: Resilient, chemical-resistant, elastomeric PVC.
- 2. Attachment: Two Series-300 stainless-steel clamps, screws, and housings.

2.4 FLEXIBLE PIPE BOOTS FOR MANHOLE PIPE ENTRANCES

A. Description:

- 1. Material: EPDM
- 2. Comply with ASTM C923.
- 3. Attachment: Series-300 stainless-steel clamp and hardware.

2.5 CONCRETE ENCASUREMENT AND CRADLES

A. Concrete:

- 1. As specified in Section 03 30 00 - Cast-in-Place Concrete.
- 2. Strength: 4,000 PSI at 28 days.
- 3. Air entrained.
- 4. Finish: Rough troweled.

- B. Concrete Reinforcement: As shown on Standard Details.

2.6 MATERIALS

A. Bedding and Cover:

- 1. Bedding: as specified in Section 31 23 16.3 – Trenching
- 2. Cover: Fill Type as specified in Section 31 23 16.3 – Trenching
- 3. Soil Backfill from Above Pipe to Finish Grade:

- a. Soil Type as specified in Section 31 23 16.3 – Trenching
- b. Subsoil with no rocks more than 6 inches in diameter, frozen earth, or foreign matter.

## 2.7 MIXES

- A. Grout: Non-Shrink

## 2.8 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of pipe.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that excavation base is ready to receive Work of this Section.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

### 3.2 PREPARATION

- A. Correct over-excavation with #57 washed stone or other approved by Engineer
- B. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.
- C. Protect and support existing sewer lines, utilities, and appurtenances.
- D. Utilities:
  - 1. Maintain profiles of existing utilities.
  - 2. Coordinate with other utilities to eliminate interference.
  - 3. Notify Engineer if crossing conflicts occur.

### 3.3 INSTALLATION

- A. Bedding:
  - 1. Excavate pipe trench as specified in Section 312316.13 - Trenching
  - 2. Excavate to lines and grades as indicated on Drawings
  - 3. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
  - 4. Provide sheeting and shoring as specified in Section 312316.13 - Trenching

5. Placement:
  - a. Place bedding material at trench bottom.
  - b. Level materials in continuous layer not exceeding 8" compacted depth.
  - c. Compact to 95% percent of maximum density. Maintain optimum moisture content of fill materials to attain required compaction density as determined by the Geotechnical Engineer.
  
- B. Piping:
  1. Bedding: As indicated on Drawings.
  2. Lay bell-and-spigot pipe with bells upstream.
  3. PE Pipe Encasement: Comply with AWWA C105, Method A.
  4. Backfill and compact as specified in Section 31 23 16.13 - Trenching.
  5. Do not displace or damage pipe when compacting.
  6. Connect pipe to existing manhole or use a doghouse manhole connection.
  7. Pipe Markers: Refer to standard detail.
  8. Cleanout: Refer to standard detail.
  
- C. Manholes: As specified in Section 330561 - Concrete Manholes.
  
- D. Connections to Existing Manholes:
  1. Drilling:
    - a. Core drill existing manhole to clean opening.
    - b. Use of pneumatic hammers, chipping guns, and sledge hammers are not permitted.
  2. Install watertight boot and seal with non-shrink concrete grout.
  3. Prevent construction debris from entering existing sewer line when making connection.
  
- E. Wye Branches and Tees:
  1. Concurrent with pipe-laying operations, install wye branches and pipe tees at locations indicated on Drawings.
  2. Use standard fittings of same material and joint type as sewer main.
  3. Maintain minimum 5 foot separation distance between wye connection and manhole.
  4. Use saddle wye or tee with stainless-steel clamps for taps into existing piping.
  5. Mount saddle and secure with metal bands.
  6. Lay out holes with template and cut holes with mechanical cutter.
  
- F. Sanitary Laterals:
  1. Construct laterals from wye branch to terminal point at right-of-way.
  2. Where depth of main pipeline warrants, construct riser-type laterals from wye branch.
  3. Minimum Depth of Cover over Piping: 2 feet
  4. Minimum Separation Distance between Laterals: 10 foot
  5. Install glue on cap plug, braced to withstand pipeline test pressure thrust, at termination of lateral.
  6. Lateral Marker:

- a. Install temporary 4"-6" PVC pipe extending from end of lateral to 2' above finished grade.
- b. Paint top 12" inches of Pipe with fluorescent green paint.

G. Backfilling:

1. Backfill around sides and to top of pipe with cover fill in minimum lifts of 8".
2. Tamp fill in place and compact to 95 percent of maximum density. Maintain optimum moisture content of fill materials to attain required compaction density as determined by the Geotechnical Engineer.
3. Place and compact material immediately adjacent to pipes to avoid damage to pipe and prevent pipe misalignment.
4. Maintain optimum moisture content of bedding material as required to attain specified compaction density.

### 3.4 FIELD QUALITY CONTROL

A. Testing:

1. Pipe Testing:

- a. Pressure Testing: As specified in Section 33 01 32 – Sewer and Manhole Testing. Low-pressure air testing shall be used for gravity sewer lines;
- b. Infiltration and Exfiltration Testing: As specified in Section 33 01 32 – Sewer
- c. Manhole Testing Deflection Testing: As specified in Section 33 01 32 – Sewer and Manhole Testing
- d. Gravity sewer lines will be inspected by Closed-Circuit Television and all pipe shall show a true line between manholes without defects in conditions, grade or alignment

2. Compaction Testing:

- a. Comply with ASTM D698.
- b. Testing Frequency:

### 3.5 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.
- B. Cap open ends of piping during periods of Work stoppage.

END OF SECTION 33 31 11



## PART 1 - GENERAL

### 1.1 SUMMARY

#### A. Section Includes:

1. Force mains.
2. Bedding and cover materials.

#### B. All ductile iron pipe and restrained gaskets shall be domestically manufactured in the United States. Pipe shall be cast, cleaned, lined, coated, fabricated, tested, and certified at a USA manufacturing facility.

#### C. Related Requirements:

1. Section 31 23 16.13 - Trenching
2. Section 31 23 16.16 – Excavation and Backfill for Structures Fill
3. Section 33 01 32 – Sewer and Manhole: Pressure testing of completed force mains.
4. Section 33 05 61 - Concrete Manholes: Connection to sanitary sewerage system.
5. Section 33 05 97 - Identification and Signage for Utilities: Pipe markers.

### 1.2 REFERENCE STANDARDS

#### A. American Association of State Highway and Transportation Officials:

1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

#### B. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
5. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm), for Water Transmission and Distribution.

#### C. ASTM International:

1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>).
2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>).
3. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.3 COORDINATION

- A. Coordinate Work of this Section with ReWa requirements.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer information indicating pipe material used, pipe accessories, valves, restrained joint details and materials.
- B. Shop Drawings:
  - 1. Indicate piping piece.
  - 2. Indicate restrained joint.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for restrained joints, including establishing lengths of restrained joint piping required.
- E. Manufacturer Instructions: Submit special procedures required to install specified products.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statement:
  - 1. Submit qualifications for manufacturer, installer, and licensed professional.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record invert and centerline elevations and actual locations of pipe runs and connections.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Perform Work according to AWWA Standards and SCDHEC R.61-67. standards.
- B. Maintain one copy of each standard affecting Work of this Section on Site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.
- C. Licensed Professional: Professional engineer 3 experienced in design of specified Work and licensed in State of SC.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Storage:
  - 1. Store materials according to manufacturer instructions.
  - 2. Do not place materials on private property without written permission of property owner.
  - 3. Do not stack pipe higher than recommended by pipe manufacturer.
- C. Protection:
  - 1. Provide additional protection according to manufacturer instructions.

#### 1.9 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

### PART 2 - PRODUCTS

#### 2.1 FORCE MAIN

- A. Ductile-Iron Pipe:
  - 1. Comply with AWWA C151.
  - 2. Interior coating: Protecto 401 Ceramic Epoxy Lining
  - 3. Exterior coating: Asphaltic Coating according to AWWA C151.
  - 4. Minimum Pressure Classes:
    - a. Sizes 3 to 12 Inches 350 psi
    - b. Sizes 14 to 20 Inches 250 psi
    - c. Size 24 Inches 200 psi
    - d. Sizes 30 to 48 Inches 150 psi
- B. Ductile-Iron Fittings:
  - 1. Comply with AWWA C110.
  - 2. Pressure Rating: 350 psi

3. Interior coating: Protecto 401 Ceramic Epoxy Lining, outside coated with asphaltic coating according to AWWA C110 and C153.

C. Joints:

1. Comply with ANSI/ AWWA C111/A21.11 as modified by ANSI/AWWA C151/A21.51. Use rubber gaskets and lubricant complying with ANSI/AWWA C111/A21.11.
2. Type: push on.
3. Joint Restraint:
  - a. Provide retainer glands for use with mechanical joint pipe and fittings.
  - b. Provide wedge type.
  - c. Provide ductile iron gland conforming to ASTM A536-80. Provide split gland where standard gland cannot be installed.
  - d. Provide ductile iron set screws, heat treated to a minimum hardness of 370 BHN with twist-off nuts and permanent standard hex head remaining.
  - e. Provide for the following rated pressure with minimum 2 to 1 safety factor; 3" - 16" 350 psi, 18" - 48" 250 psi.
  - f. Provide tee-head bolts conforming to ANSI/AWWA C111/A21.11 latest revision.

D. Rubber Gaskets, Lubricants, Glands, Bolts, and Nuts: Comply with AWWA C111.

## 2.2 PVC PIPE

A. PVC Pressure Sewer Pipe and Fittings, 4" – 48":

1. Comply with AWWA C900.
2. Minimum Class 200 (DR 18) or as designed by engineer.
3. Joints: elastomeric-gasket bell-end pipe.
4. Joint Restraint:
  - a. Provide restraint for C900 PVC pipe by mechanical means separate from the mechanical joint gasket sealing gland.
  - b. Restraint device to be a two-piece configuration with a serrated inside surface to provide contact around full pipe circumference.
  - c. Restraint device body to be manufactured from steel (ASTM A285 Grade C) with fusion epoxy coated surfaces except the serrations.
  - d. Comply with AWWA C111, ANSI 21.11.
  - e. Pressure rating to match PVC pipe on which it is used with capability to withstand test pressure of 2 times rated pressure.
  - f. Finish fusion applied epoxy coating per AWWA C-213.

## 2.3 MATERIALS

A. Bedding and Cover:

1. Bedding: Fill Type as specified in Section 31 23 16.13 – Trenching
2. Cover: Fill Type, as specified in Section 31 23 16.13 – Trenching
3. Soil Backfill from above Pipe to Finish Grade: Soil Type as specified in Section 31 23 16.13 – Trenching.

4. Subsoil: No rocks more than 6 inches in diameter, frozen earth, or foreign matter.

#### 2.4 MIXES

- A. Concrete: As specified by Engineer.

#### 2.5 ACCESSORIES

- A. Pipe Markers: As specified in Section 33 05 97 - Identification and Signage for Utilities.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that trench cut and excavation base is ready to receive Work.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

#### 3.2 PREPARATION

- A. Correct over-excavation with aggregate approved by engineer.
- B. Remove large stones or other hard matter capable of damaging pipe or of impeding consistent backfilling or compaction.

#### 3.3 INSTALLATION

##### A. Bedding:

1. Excavate pipe trench as specified in Section 31 23 16.13 – Trenching.
2. Place bedding material at trench bottom.
3. Level materials in continuous layers not exceeding 8 inches in depth.
4. Maintain optimum moisture content of bedding material to attain required compaction density.

##### B. Piping:

1. Install pipe, fittings, and accessories as indicated on Drawings.
2. Route piping in straight line.
3. Install bedding at sides and over top of pipe to minimum compacted thickness of 12 inches
4. Backfilling and Compacting:
  - a. As specified in Section 31 23 16.13 – Trenching.
  - b. Do not displace or damage pipe while compacting.

5. Connect to existing sewer system.
  6. Pipe Markers: As specified in Section 33 05 97 - Identification and Signage for Utilities.
- C. Thrust Restraints:
1. Provide pressure pipeline with restrained joints at pumps, bends, tees, and changes in direction.
- D. Cradles and Encasements: Provide concrete cradles and encasements for pipelines where indicated on Drawings.

### 3.4 FIELD QUALITY CONTROL

- A. Pressure Testing:
1. As specified in Section 33 01 32 - Sewer and Manhole Testing.
- B. Compaction Testing:
1. As specified in Section 31 23 16.13 – Trenching.

### 3.5 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 33 31 23

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. The contractor shall provide pumps, pump controls, above ground valve package, and appurtenances as shown on the plans and as specified herein. The pumps and controls shall be furnished by one supplier. The above ground valve package may be offered by a secondary supplier but the entire valve package itself must be provided by a single supplier. All materials and equipment shall be U.L. listed for its intended application in this project, including but not limited to all motor controls and operator control panels.

### 1.2 REFERENCE STANDARDS

- A. American Bearing Manufacturers Association:
  - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. ASTM International:
  - 1. ASTM A48 - Standard Specification for Gray Iron Castings.
  - 2. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - 3. ASTM A153/ (A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware).
  - 4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
  - 5. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort.
  - 6. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
  - 7. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- C. National Electrical Manufacturers Association:
  - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code (NEC).
- E. UL, Inc.
  - 1. UL 83 - Thermoplastic-Insulated Wires and Cables.

### 1.3 SUBMITTALS

- A. Shop Drawings:

1. Shop drawings shall be submitted for review and shall include complete data to show function, physical description and compliance with the Plans and Specifications, including outline drawings showing equipment and shipping dimensions and weights, location of accessories, and clearances required; wiring and schematic diagrams including accessories, spare parts list, materials, written functional control description, functional control schematic, description of all components, characteristic pump curves and motor efficiency rating. Any changes to structures and other features which are necessary to accommodate the equipment supplied by the Contractor shall be clearly shown on the submittal and marked as a change.

## PART 2 - PRODUCTS

### 2.1 SUBMERSIBLE PUMPS:

- A. Raw wastewater submersible pumps shall be provided and installed as shown on the plans, complete with motors, controls and all appurtenances required for an operational system. A third identical pump with motor and power leads shall be provided and delivered to the Owner as a spare. All pumps shall be by one manufacturer supplied by an authorized distributor in South Carolina. The controls shall be provided by the pump manufacturer or the controls to be used must be approved by the pump manufacturer.
  1. The pumps shall be KSB, Sulzer/ABS, Flygt, Gorman-Rupp, approved equal.
  2. Pump shall be submersible non-clog wastewater pumps and motors.
  3. List reference standards included within text of this Section, with designations, numbers, and complete document titles.
  4. LEED requires compliance with specific editions of referenced standards. Comply with the latest reference standard edition, except when a specific date is required by code. Consider including publication dates for referenced standards in this Section to ensure the correct standard is used for LEED compliance.
  5. Each pump, shall have necessary characteristics to meet the following conditions:
    - a. Pumping capacity of \_\_\_\_\_ GPM at \_\_\_\_\_ feet of head (TDH).
    - b. Overall minimum efficiency of 50% at above conditions.
    - c. Maximum pump speed of 1800 RPM
    - d. Minimum solids passage 3 inches in diameter
    - e. Minimum motor efficiency 85%
    - f. Minimum L10 bearing life shall be 50,000 hours at any point along the usable portion of the pump curve at maximum motor speed.
    - g. Primary design operating point to fall within the Preferred Operating Range (POR). Refer to ReWa Development Manual for further detail.
  6. Volute/Casing and Impeller: All major parts of the pumping units including the volute, impeller motor frame and discharge elbow shall be constructed of gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The



volute shall be of non-concentric design with smooth passages large enough to pass minimum 3-inch solids that may enter the impeller. All exposed bolts and nuts shall be stainless steel or brass. The impellers shall be dynamically balanced. The impellers design may be single or multi-vane design having a long throughlet without acute turns. Impellers shall be keyed to the shaft or have a slip fit connection onto the motor shaft, driven by a shaft key. All units utilizing wear rings shall be equipped with a single or dual replaceable stainless steel wear ring.

7. Pump Design shall allow the pump to be automatically and firmly connected to the discharge elbow, guided stainless steel guide bar(s) extended from the top of the station to the discharge elbow. There shall be no need for personnel to enter the wet-well. No portion of the pump shall bear directly on the sump floor.
8. Pump Seal: Provide two totally independent mechanical shaft seals, installed in tandem, each with its own independent single spring system acting in a common direction. Install the upper seal in an oil-filled chamber with drain and inspection plug (with positive anti-leak seal) for easy access from external to the pump. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced. Provide seals which are non-proprietary in design, with replacements available from a source other than the pump manufacturer or its distributors. Do not provide seals with the following characteristics: conventional double mechanical seals with single or multiple springs acting in opposed direction; cartridge-type mechanical seals; seals incorporating coolant circulating impellers, seals with face materials other than those specified.
9. Motor shall be 460 volt, 3 phase, 60 Hz, induction type with a squirrel cage rotor, shell type design, housed in an air-filled, watertight chamber. Provide a motor which is squirrel cage, induction in design, housed in a completely watertight and air filled chamber, with a min 1.15 service factor. The motor shall be adequately sized and rated for continuous operation at a maximum fluid temperature of 104° F (40° C). The motor stator shall be wound using Class H monomer-free polyester resin insulation resulting in an overall motor rating of 311 Degrees F (155 degrees C), Class F insulation. The stator windings shall be trickle impregnated resulting in a winding fill factor of at least 95%. The use of a multiple step “dip and bake” type stator insulation method shall not be acceptable. The rotor bars and short circuit rings shall be made of aluminum. The motor and pump set complete shall be designed and manufactured by the same company. Provide adequately rated motor with sufficient surface area for ambient only cooling suited for the intermittent mode of operation in wet well wastewater applications, submerged or partially submerged, without damage. Motors containing di-electric oils used for motor cooling and/or bearing lubrication or motors where the pumped media or externally provided fresh water is directed through the motor shell for cooling are not acceptable. Provide motors which are FM listed for use in Class I Division 1 Groups C&D hazardous locations as defined by the National Electric Code.
10. Motor and Detector Cables shall be suitable for submersible pump applications. Provide\_\_\_\_\_ ft of power/control cable with each pump, suitable for submersible wastewater application, sized in accordance with NEC requirements. Provide cable terminal box on side or top of motor housing, with cable entry sealed to insure that no entry of moisture is possible into the high-voltage motor/ terminal area even if the cable is damaged or severed below water level. Cable seal shall include a compressed rubber grommet to seal the cable exterior and epoxy fill or grommet system to seal the interior passages. A strain relief device, in direct contact with both the cable and the cast iron

entry housing, shall be provided. The cable entry shall be rated by Factory Mutual (or UL) for submerged operating depths to 65 feet.

11. Protection:

- a. Thermal Protection: Each pump motor shall incorporate three normally closed thermal sensors (switches or thermostats) imbedded in the windings to detect temperature. These sensors shall be wired in series. If the pump motor temperature should rise to a level which could cause damage, an open sensor contact shall cause the motor starter to drop out and cause the appropriate amber pump failure light and alarm to activate. The pump shall remain locked out until the motor has cooled and the circuit has been manually reset.
- b. Moisture Detection: Each motor shall also include a system to detect moisture in the stator housing and/or seal chamber which shall be connected to the pump controls. Moisture detection shall cause the motor starter to drop out and cause the appropriate amber moisture detection light and alarm to activate.
- c. Seal Leak Detection: Provide a detector in the motor's stator cavity which allows a control panel mounted relay to indicate leakage into the motor. In addition, on motors 80HP and larger provide a stainless steel float switch in a separate leakage collection chamber to indicate leakage past the inner mechanical seal prior to its entrance into either the motor stator cavity or the lower bearing. Electronic probes which depend on sensing resistance value changes in seal oil will not be acceptable as seal leak indicators.
- d. Motor Sensor Monitoring Relay: The pump supplier shall furnish all relays required for monitoring all motor sensors. The relays shall be installed by others in the motor control panel and properly wired in accordance with pump manufacturer's instructions. Relays shall mount in standard 12-pin socket bases (provided) and shall operate on available control voltage of 24-240 VAC. If relays require an input voltage that is not available in the motor control panel an adequate transformer (with fused input) shall be provided by the pump supplier. Relays shall have a power consumption of no more than 2.8 watt, and shall be UL approved. Relays shall be modular in design, with each relay monitoring no more than two motor sensor functions.

12. Finishes

- a. Factory Finished Components: Pumps, discharge elbows and other factory components shall be coated with shop primer, intermediate coat, and final factory standard epoxy or polyurethane coating suitable for submerged wastewater service. The coating shall be corrosion, moisture, oil, and solvent resistant when completely dry. The factory finish shall allow for over-coating and touch-up for 6 months after coating. Thereafter, it will generally require sanding to accept a top-coat or touch-up coating. Color for components within the manufactured package shall be the manufacturer's standard colors.
- b. Field installed components: Piping, valves, and exposed steel components shall be coated in accordance with the following schedule:
  1. Surface Prep: SSPC-1
  2. Prime Coat: Red Epoxy Primer, Dry Film Thickness (DFT), as recommended by paint manufacturer.

3. Intermediate Coat: Tnemec Series 66, 3-6 mils DFT, Color; Gray (33GR). Sherwin-Williams equivalent also acceptable.
  4. Finish Coat: Tnemec Series 1074, 3-5 mils DFT, Color; Dark Bronze (86BR). Sherwin-Williams equivalent also acceptable.
13. Lifting Chain & Cable: Each pump shall have a stainless steel lifting chain and cable system for retrieving the pump without entering the wet well. This system shall be a "Grip-Eye" style system.

## 2.2 CONTROLS:

- A. Controls shall be provided with the pumps and shall be coordinated with the pump manufacturer to meet the requirements herein. Service requirements for control shall be as stated in paragraph 2 below. The pump control panel shall include breakers for auxiliary equipment, a radar level monitoring/control system, a pump station management system, a soft-start/soft-stop starter or variable frequency drive (as directed by ReWa) for each pump motor, an emergency backup full voltage starter (for one pump motor) and all items required for a complete system to operate on 480 volts, 60 Hz, three phase power. The system shall be complete, requiring only connection of power, motor and control wiring.
- B. Normal Operation: Liquid level will be monitored with an radar level transmitter to control operation of the submersible pumps according to level variation. The system shall automatically alternate starting between the two pumps. At the end of a pump cycle, the pump controls shall rotate lead and lag pump selection. If for any reason one pump is temporarily out of service, the controls shall automatically rotate lead status to the remaining pump. The following tasks shall be performed, with all normally operated controls, reset buttons, indicator lights and timers located on the face of the control panel, as described.
1. Start and stop the lead pump at the selected wet well levels, which can be adjusted by the level controller.
  2. Provide a "Hand-Off-Automatic" switch for each pump on the face of the control panel. "Hand" position shall override all controls except high motor temperature shut down.
  3. Two amber indicator lights for each pump (4 required) shall be provided on the face of the pump control panel to indicate when a pump is locked out due to moisture detection in the motor or high motor temperature.
  4. When a pump fails to start or becomes lock-out due to high motor temperature or moisture detection in the motor, the control system shall automatically rotate to the net pump selection when the "pump start" liquid level is reached. These alarm circuits shall signal the autodialer so operations personnel will be notified of the alarm condition.
  5. If a high water condition is detected by the liquid level monitoring/control system, it shall activate the autodialer. The autodialer shall also be activated during a total power failure.
  6. One mercury float switch (backup high level alarm) shall be installed in the pump station wet well to activate an audible alarm, an alarm light and shall be directly wired to and signal the autodialer. An alarm silence button shall be provided on the face of the pump

panel door to acknowledge alarm and silence the horn. The alarm light and horn shall be mounted on the side of the Control Building in a convenient location (coordinate with Engineer/Owner). A second float switch shall be provided for low level (pump off) control during backup operation (see Paragraph C). The float switches shall be Model 9G Direct Acting float switch by Consolidated Electric or equal, and shall be mounted on a stainless steel cable/weight mounting kit (Model LS) by Consolidated Electric, or equal.

7. The level control system shall utilize a radar level transmitter housed in waterproof and explosion proof housing with a sensor designed to mount at the top of the wet well. Transmitter full scale operating range shall be 1-31 ft., and shall provide a 4 20mA output signal. The transmitter shall be a microprocessor based unit capable of easy calibration. Radar level system shall be VEGAPULS C21 Sensor with VEGAMET 341 Panel Mount Controller by VEGA. The unit shall function with the station management system (see below) while also maintaining backup capability to operate both the primary starters and the emergency backup full voltage starter.
  8. The alarm horn and light (see 6 above) shall be Adapta-Beacon Model 51R-N5-40W with flashing red light. Unit shall operate on 120 volt power. Unit is available from Edwards Signaling Products, (203) 699-3300.
  9. As described in paragraph 3 (h) above, the control panel shall have circuitry to lock out a pump due to high temperature. The autodialer shall be signaled during a high temperature condition. This alarm condition shall not activate the local audible and visible alarm.
  10. In automatic operation, the liquid level controller shall start the lead pump when the “lead pump on” water level is reached. If the liquid level drops to the “pump off” water level, the lead pump shall stop. If the water level continues to rise after the lead pump is started, the standby pump shall be started when the “lag pump on” level is reached. If the level continues to rise, the autodialer shall be signaled when the “high level alarm” level is reached.
- C. Backup Operation: In the event that normal operations are not functional, the system shall have the capability of maintaining pumping operations by backup systems. These systems shall be provided with all necessary components for functions intended.
1. An automatic transfer switch and standby generator unit shall be provided to power the station in the vent of commercial power loss. The components are described on the drawings and specified in the electrical specifications.
  2. The liquid level/control unit shall have backup capability to control the emergency full-voltage starter (see below).
  3. One full-voltage emergency starter shall be provided of proper size and type to allow operation of one of the pumps should the primary starters be off line. This starter shall be housed in its own cabinet section, and shall have all required power switching and operational devices necessary for the complete system. This starter system shall be capable of manual operation and control by either the Pulsar unit or by the two backup float switches.

- D. Alarms shall include devices necessary to signal high water in the wet well, high motor temperature, loss of one phase of power, and other conditions normally monitored by the equipment supplier. The backup float switch shall activate the local audible/visible alarm and signal the autodialer. The moisture detection and high motor temperature alarms shall be indicated with amber pilot lights on the face of the pump panel door. Auxiliary alarm circuits for high water in wet well, loss of liquid flow, high motor temperature and loss of one phase of power shall be wired to the autodialer. The autodialer shall also monitor for power failure.
- E. Components of the control panel shall include the starters for both pumps and strip of 120/240 volt branch circuit breakers for distribution of 120/240 volt power as shown on the construction drawings.
1. Control panel components shall be designed to be compatible with the starters for each pump.
  2. Control panel shall include necessary components to allow functions described in (b) above backup operation.
  3. Suitable transformers shall be provided in the pump control panel to provide single phase power, including any power required by the liquid level radar transmitter and/or related controller, transmitter, etc. Single phase 120 volt power distribution shall be by a strip of single phase breakers. All control wiring shall be 120 volt single phase power.
  4. Elapsed time meters (six digit non-reset type) shall be connected to each motor to record total running time for each pump in hours and tenths of an hour. Meters shall be mounted on the face of the pump control panel.
  5. Pump controls shall include continuous power phase monitoring that will stop the pumps and signal the autodialer in the case of losing one phase of power.
- F. Wiring, design, workmanship and wiring diagrams of the control panel shall be in compliance with standards and specifications of the Joint Industrial Council (JIC), National Machine Tool Builders Association (NMTBA), and National Electric Code (NEC). All wiring shall be color coded, minimum 14 gauge in the panel. Control wires in the panel shall be bundled and tied with bundles flexible at the hinged side of the enclosure to allow the door(s) to open fully. All wires, connections and terminal strips shall be numbered and identified on the wiring shop drawings and service manuals. Internal components shall be identified by nameplates. Exterior controls, switches, indicators and components shall be permanently identified with engraved plastic nameplates. This panel shall be constructed and labeled as having been constructed in accordance with Underwriters Laboratories standards. The control panel design shall consist of electro mechanical devices and not a solid state card type design.
- G. The Control Panel Enclosure shall be NEMA 3R. Control compartments shall be removable from panels on which components are mounted. Back panels shall be secured to the enclosure with collar studs. All control units and wiring shall be accessible from the operator side (front) of the panel. No rear or side access shall be required for component access or maintenance. Steel panels shall be phosphatized before painting and finished with a rust inhibiting primer and two coats of exterior grade baked enamel. The control panel enclosure door shall be latched with a single handle.
1. Autodialer system: The autodialer shall be Mission Communications MyDro 850 Series.

- H. Lightning Protection: The control panel shall be provided with a lightning arrester with surge protector. This equipment shall be Phoenix Contact, Inc. of Middleton, PA, (800) 888-7388, or approved equal.
- I. Controls shall be provided by the pump station supplier.

2.3 ELECTROMAGNETIC FLOWMETER:

- A. All pump stations shall be equipped with a discharge flow meter on the discharge force main.
- B. Flanged type electromagnetic flowmeter to be furnished pump station manufacturer and installed by contractor. The flowmeter materials shall be suitable for raw wastewater service. The magnetic flowmeter will maintain an accuracy of  $\pm 0.5\%$  of flow rate or better when mounted as close as one pipe diameter from the flange of the magmeter when located next to elbows in the line sizes up to 18". It will also have no downstream piping requirements for maintaining its published accuracy specification. The output signal shall be integrated with mission control. The magnetic flowmeter shall be the LF654 series flow tube and the LF620 series converter as manufactured by Toshiba. Alternative magmeters by Rosemount or Krohne may also be submitted for ReWa review provided they meet the operational and space requirements of the pump station.

2.4 ABOVE GROUND VALVE PACKAGE

- A. System Description:
  - 1. The contractor shall furnish and install one factory built automatically controlled above ground submersible pump valve package capable of handling raw unscreened sewage or similar liquids.
- B. Manufacturer
  - 1. The pump station system integrator must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.
  - 2. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.
  - 3. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.
  - 4. In event the contractor obtains engineer's (or owner's) approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the



proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer (or owner) prior to acceptance.

5. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the saving

C. Station Enclosure

1. The station enclosure shall contain and enclose all valves, and associated controls and shall be constructed to enhance serviceability by incorporating the following design characteristics:
  - a. Two access panels per side of station shall be provided. Panels shall be sized and placed to permit routine maintenance operations through the panel openings of the enclosure. For these purposes, routine maintenance shall include frequently performed adjustments and inspections of the electrical components, controls and valves.
  - b. The access panels shall be provided with a hinge and latch. Hinge shall be the continuous type. Latch shall engage the enclosure at not less than three places, and shall be protected by a keyed lock.
  - c. One enclosure side shall contain a screened vent to maximize air flow for enclosure ventilation.
  - d. Station enclosure, less base, must be removable or able to be disassembled following the removal of reusable hardware.
  - e. Removal or disassembly of the enclosure shall be accomplished by not more than two maintenance personnel without the use of lifting equipment.
2. The station enclosure shall be manufactured of molded reinforced orthophthalic polyester resins with a minimum of 30% fiberglass, and a maximum of 70% resin. Resin fillers or extenders shall not be used.
3. Glass fibers shall have a minimum average length of 1 1/4 inches. Major design considerations shall be given to structural stability, corrosion resistance, and watertight properties. The polyester laminates shall provide a balance of mechanical, chemical, and electrical properties to insure long life. They must be impervious to micro-organisms, mildew, mold, fungus, corrosive liquids, and gases which can reasonably be expected to be present in the environment surrounding the wet well.
4. All interior surfaces of the housing shall be coated with a polyester resin-rich finish. It shall provide:
  - a. Maintenance-free service
  - b. Abrasion resistance
  - c. Protection from sewage, greases, oils, gasoline, and other common chemicals
  - d. The outside of the enclosure shall be coated with a suitable pigmented resin, compounded to insure long maintenance-free life.
5. An exhaust blower shall be mounted on the side of the enclosure. Blower capacity shall be sufficient to change station air a minimum of once every two minutes. Blower motor shall be operated automatically and shall be turned on at approximately 70 degrees F and shall be turned off at 55 degrees F. Blower motor and control circuit shall be protected by a thermal-magnetic air circuit breaker to provide overcurrent and overload protection. Blower exhaust outlet shall be designed to prevent the entrance of rain, snow, rocks, and foreign material.

D. Station Base

1. Station base shall be constructed of pre-cast, reinforced concrete bonded inside a fiberglass form covering top and sides, and shall be designed to insure adequate strength

to resist deformation of the structure during shipping, lifting, or handling. The enclosure base shall function at the wet well top and incorporate a duplex access lid, sized for the installation and removal of the specified pumps, and shall be of sufficient size to permit access to the wet well. Color used shall de-emphasize the presence of dirt, grease, etc., and shall be provided with a non-skid surface.

2. A static wet well vent shall be mounted in the station base, and be housed in the station enclosure. The station enclosure shall provide a transition area between the wet well and the vent outlet. The vent shall terminate through the station wall with a screened opening which shall be designed to prevent the entrance of rain, snow, rocks and foreign material.
3. The station base shall incorporate a cable transition adapter for the pump cables, level controls, and associated wiring. The adapter shall provide for a vapor tight transition between the wet well and the lift station enclosure. The adapter shall incorporate cable grips for each cable and be provided with a gasket between the adapter and the station for a positive seal. Junction boxes shall not be considered for cable transition.
4. The station base shall be furnished with elastomeric compression sealing devices for all piping penetrations to provide for a vapor tight transition between the wet well and lift station enclosure.

E. Station Heater

1. Pump station shall be provided with a 1300/1500 watt, 115 volt electric heater with cord, thermostat and grounding plug. Ungrounded heaters shall not be acceptable.

F. Discharge Gauge Kit

1. The pump station shall be equipped with a glycerin-filled pressure gauge to monitor discharge pressures. Gauge shall be a minimum of 4 inches in diameter, and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full scale reading. Pressure gauge shall be graduated 0 to 140 feet water column minimum. Gauge kit shall be mounted and complete with all hoses and stainless steel fittings and shall include a shutoff valve installed in each connection to discharge piping and a three way valve to monitor either pump.

G. Compression Couplings

1. Compression couplings shall be provided for each suction and discharge connection to join plain end ductile iron pipe to wet well piping

H. Valves and Piping

1. Check Valve: Each pump shall be equipped with a full flow type check valve capable of passing a 3" spherical solid. Valve shall be constructed with flanged ends and fitted with an external lever and torsional spring. Valve seat shall be constructed of stainless steel, secured to the body to ensure concentricity, sealed by an O-ring, and shall be replaceable. The valve body shall be cast iron incorporating a clean-out port large enough to allow removal and/or replacement of the valve clapper without removing valve or piping from the line. Valve clapper shall have a molded neoprene seating surface incorporating low pressure sealing rings. Valve hinge pin and internal hinge arm shall be stainless steel supported on each end in brass bushings. Shaft nut shall have double O-rings which shall be easily replaceable without requiring access to interior of valve body. All internal hardware shall be stainless steel. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable. Acceptable manufacturers are Dezurik, GA Industries or Mueller. An alternate manufacturer must be submitted to and approved by ReWa prior to installation.



2. Each discharge line shall be equipped with a 2-way plug valve to permit isolation of the pumps from the common discharge header. The plug valve shall be non-lubricated type. Valve body shall be cast iron with flanged end connections drilled to 125 pound standard. Valve shall be furnished with a drip-tight shutoff plug mounted in stainless steel or teflon over phenolic bearings, and shall have a resilient facing bonded to the sealing surface. Valves shall have ports designed to pass 3" spherical solids. Acceptable manufacturers are Milliken, DeZurik or Mueller. An alternate manufacturer must be submitted to and approved by ReWa prior to installation.
  
3. Piping
  - a. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.
  - b. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.
  - c. Pipe and flanges shall be threaded and suitable thread sealant applied before assembling flange to pipe.
  - d. Bolt holes shall be in angular alignment within 1/2° between flanges. Flanges shall be faced and a gasket finish applied.
  - e. All pipes connected to the pump station shall be supported according to good commercial practice.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION:

- A. The contractor shall install pumps and controls as shown on the plans and as recommended by the equipment manufacturer, for a complete operating facility including all wiring and piping.

#### 3.2 SERVICE:

- A. The Contractor shall provide for the services of a qualified service representative to include start-up services and operation-maintenance instruction. The manufacturer shall provide detailed instructions for the proper installation of equipment and the contractor shall furnish two complete copies of the installation and start-up manual to the Engineer prior to installation of the pumps, controls, and accessories. The manufacturer's representative shall provide the necessary time required to insure proper installation, start-up and instruction. Service shall be no less than two (2) 8-hour days, exclusive of travel time to and from the project site, and divided into two (2) trips to the site. The first trip shall be for the final inspection, minor adjustments, initial operation services and initial instruction. The second trip about 30 days later, shall be for final adjustments and follow-up operating instruction. The Owner and Engineer shall be notified 48 hours in advance of each trip. Service and start-up shall be coordinated so that pump and controls service personnel are on the job together.
  
- B. Service Manual shall be furnished for each type of equipment specified in this section. Manual shall contain a description of equipment, complete accessory and parts list, and complete installation, operation and maintenance instructions. Four copies of manual shall be submitted for review. After review of manual, three additional copies shall be furnished.

- C. Changes in structures and other features which are necessary to accommodate equipment supplied by the Contractor shall be made at no additional cost to Owner. No equipment structure shall be constructed until certified equipment dimensions and requirements are available to the Contractor.
- D. Testing shall be performed by the pump manufacturer prior to shipping. Each pump shall be tested at the manufacturer's testing facility in accordance with the latest code of the Hydraulic Institute to determine actual head vs. capacity and kilowatt draw required. Certified pump curves shall be submitted to the Engineer in triplicate. Results of the tests shall be approved by the Engineer prior to shipment.

3.3 **WARRANTY:** The authorized pump / package shall warrant the pumps to be supplied to the owner for a period of five (5) years under normal use. The warranty period shall start from the date of initial operation by the equipment representative, as described under Service above. The warranty must include 100% coverage of the manufacturer's shop labor and parts including seals for the first year, and then pro-rated coverage through the fifth year.

3.4 **SPARE PARTS:**  
1. One (1) set of pump seals

END OF SECTION 333210

## PART 1 – GENERAL

### 1.1 SECTION INCLUDES

- A. Work under this section includes, but is not limited to, furnishing and installing a factory built duplex or triplex pump station as indicated on the project drawings, herein specified, as necessary for proper and complete performance.

### 1.2 REFERENCES

- A. Publications listed below form part of this specification to extent referenced in the text by basic designation only. Consult latest edition of publication unless otherwise noted.

1. American National Std. Institute (ANSI) / American Water Works Assoc. (AWWA)
  - a. ANSI B16.1 Cast iron pipe flanges and flanged fittings.
  - b. ANSI/AWWA C115/A21.51 Cast/ductile iron pipe with threaded flanges.
  - c. ANSI 253.1 Safety Color Code for Marking Physical Hazards.
  - d. ANSI B40.1 Gages, Pressure and Vacuum.
  - e. AWWA C508 Single Swing Check Valves.
2. American Society for Testing and Materials (ASTM)
  - a. ASTM A48 Gray Iron Castings.
  - b. ASTM A126 Valves, Flanges, and Pipe Fittings.
  - c. ASTM A307 Carbon Steel Bolts and Studs.
  - d. ASTM A36 Structural Steel.
3. Institute of Electrical and Electronics Engineers (IEEE)
  - a. ANSI/IEEE Std 100 Standard Dictionary of Electrical Terms.
  - b. ANSI/IEEE Std 112 Test Procedure for Polyphase Induction Motors.
  - c. IEEE Std 242 Protection of Industrial and Control Power Systems.
4. National Electric Code (NEC) / National Electrical Manufacturers Assoc. (NEMA)
  - a. NEC National Electric Code.
  - b. NEC 701 National Electric Code article 701.
  - c. NEMA Std MG1 Motors and Generators.
5. Miscellaneous References
  - a. Ten-State Standards Recommended Standards for Sewage Works.
  - b. Hydraulic Institute Std for Centrifugal, Rotary and Reciprocating Pumps.
  - c. NMTBA and JIC Std. National Machine Tool Builders Association and Joint Industrial Council Standards
  - d. ISO 9001 International Organization for Standardization.

1.3 SYSTEM DESCRIPTION

- A. Contractor shall furnish and install one factory built, automatic pump station with integral. The station shall be complete with all equipment specified herein, factory assembled on a common steel baseplate.
- B. The principal items of equipment shall include two self priming, horizontal, centrifugal, v belt motor driven sewage pumps, valves, piping, modular fiberglass enclosure and integral station base. A pump motor control panel with thermal magnetic circuit breakers, motor starters, automatic liquid level control systems for normal and standby operation, and internal wiring.
- C. Factory built pump station design, including materials of construction, pump features, valves and piping, and motor controls shall be in accordance with requirements listed under PART 2 - PRODUCTS of this section.

1.4 PERFORMANCE CRITERIA

- A. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Each pump shall be selected to perform under following operating conditions:

1. Type of Pump	Self-Priming Centrifugal
2. Pump Configuration (Duplex or Triplex)	
3. Suction Size	
4. Discharge Size	
5. Pumps Required	
6. Liquid Temperature	
7. Solid Size, Maximum	
8. Design Capacity (GPM)	
9. Design Total Dynamic Head (FT)	
10. Total Dynamic Suction Lift (FT)	
11. Maximum Repriming Lift (FT)	
12. Maximum Static Suction Lift (FT)	
13. Total Static Discharge Head (FT)	
14. Minimum Submergence Depth (FT)	
15. Minimum Pump Efficiency	
16. Maximum Motor Horsepower	
17. Nominal Motor Speed	

- B. Primary design operating point to fall within the Preferred Operating Range (POR). Refer to ReWa Development Manual for further detail.
- C. Station Power Requirements
  - 1. Site power furnished to pump station shall be phase, hertz, volts, wire, maintained within industry standards. The available fault current provided at the pump station control panel is kA rms symmetrical. Voltage tolerance shall be plus or minus 10 percent. Phase-to-phase unbalance shall not exceed 1% average voltage as set forth in NEMA Standard MG-1. Control voltage shall not exceed 132 volts.

## 1.5 SUBMITTALS

### A. Product Data

1. Prior to fabrication, pump station manufacturer shall submit submittal data in portable document format (.pdf) form for review and approval.
2. Prior to fabrication, pump station manufacturer shall submit paper copies of submittal data for review and approval.

### B. Shop drawings shall provide layout of mechanical equipment and anchor bolt locations for equipment baseplate. The electrical ladder logic drawings shall illustrate motor branch and liquid level control circuits to extent necessary to validate function and integration of circuits to form a complete working system.

### C. Operations Maintenance Manuals

1. Installation shall be in accordance with written instructions provided by the pump station manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, piping and valves, but lack experience on exact equipment supplied.
2. Documentation shall be specific to the pump station supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the station manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:
  - a. Functional description of each major component, complete with operating instructions.
  - b. Instructions for operating pumps, pump controls in all modes of operation.
  - c. Calibration and adjustment of equipment for initial start-up, replacement of level control components, or as required for routine maintenance.
  - d. Support data for commercially available components not produced by the station manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacturer and incorporated as appendices.
  - e. Electrical schematic diagram of the pump station circuits shall be in accordance with NFPA70. Schematics shall illustrate, to the extent of authorized repair, pump motor branch, control and alarm system circuits including interconnections. Wire numbers and legend symbols shall be shown. Schematic diagrams for individual components, not normally repairable by the station operator, need not be included. Details for such parts shall not be substituted for an overall system schematic. Partial schematics, block diagrams, and simplified schematics shall not be provided in lieu of an overall system diagram.
  - f. Mechanical layout drawing of the pump station and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of all pumps, motors, valves and piping.
3. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

## 1.6 QUALITY ASSURANCE

- A. The pumps and pump station manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- B. The pumps and pump station manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability by the use of best management practices, technological advances, promoting environmental awareness and continual improvement.
- C. Upon request from the engineer, the pump station manufacturer shall prove financial stability and ability to produce the station within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long term customer service and product support.
- D. Manufacturer must show proof of original product design and testing. Products violating intellectual property regulations shall not be allowed, as they may violate international law and expose the user or engineer to unintended liabilities. "Reverse-engineered" products fabricated to substantially duplicate the design of original product shall not be allowed, as they may contain substantial differences in tolerances and material applications addressed in the original design, which may contribute to product failure.
- E. The term "pump manufacturer" or "pump station manufacturer" shall be defined as the entity which designs, machines, assembles, hydraulically tests and warranties the final product. Any entity that does not meet this definition will not be considered a "pump manufacturer" or "pump station manufacturer" and is not an acceptable supplier. For quality control reasons and future pump and parts availability, all major castings of the pump shall be sourced and machined in North America.
- F. Pump Performance Certifications
  - 1. All internal passages, impeller vanes, and recirculation ports shall pass a \_\_\_" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.
    - a. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.
    - b. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.
    - c. Pump must reprime vertical feet at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:
      - 1) A check valve to be installed downstream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.
      - 2) A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.

- 3) The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90o elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.
  - 4) Impeller clearances shall be set as recommended in the pump service manual.
  - 5) Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
  - 6) Liquid to be used for reprime test shall be water.
- d. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

G. Certified Pump Performance Test

1. Tests shall be conducted using a dynamometer in accordance with Hydraulic Institute Standards (ANSI/HI) 14.6.3.4 acceptance grade 2B. A minimum of five test points shall be measured. Test point data shall include flow, head, pump shaft input speed and torque. Efficiency and horsepower shall be calculated using the measured test point data. Performance test data evaluation shall be in accordance with ANSI/HI 14.6.3.4.2.
2. For pumps utilizing up to (13 HP) motors; but larger than (1.3 HP), tests shall be conducted in accordance with Hydraulic Institute Standards (ANSI/HI) 14.6.3.4.1, as the specified head, capacity, rated speed and horsepower.

H. Factory System Test

1. All components including the pumps, motors, valves, piping and controls will be tested as a complete working system at the manufacturer's facility. Tests shall be conducted in accordance with Hydraulic Institute Standards at the specified head and capacity per acceptance grade 2B. Factory operational test shall duplicate actual performance anticipated for the complete station.
2. Upon request from the engineer, the operational test may be witnessed by the engineer, and/or representatives of his choice, at the manufacturer's facility.

- I. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.7 MANUFACTURER'S WARRANTY

- A. The pump station manufacturer shall warrant all equipment to be of quality construction, free of defects in material and workmanship. A written warranty shall include specific details described below.
1. In addition to defects in material and workmanship, fiberglass reinforced polyester station enclosures (where applicable) are warranted for sixty (60) months to be resistant to rust, corrosion, corrosive soils, effects of airborne contamination or physical failures occurring in normal service for the period of the pump station warranty.
  2. All other equipment, apparatus, and parts furnished shall be warranted for sixty (60) months, excepting only those items that are normally consumed in service, such as light bulbs, oils, grease, packing, gaskets, O rings, etc. The pump station manufacturer shall be solely responsible for warranty of the station and all components.



- B. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.
- C. It is not intended that the station manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.
- D. Equipment supplied by others and incorporated into a pump station or enclosure is not covered by this limited warranty. Any warranty applicable to equipment selected or supplied by others will be limited solely to the warranty, if any, provided by the manufacturer of the equipment.
- E. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. A start-up report completed by an authorized manufacturer's representative must be received by manufacturer within thirty (30) days of the initial date the unit is placed into service. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

## PART 2 – PRODUCT

### 2.1 UNITARY RESPONSIBILITY

- A. The pump station system integrator must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- B. In order to unify responsibility for proper operation of the complete pumping station, it is the intent of these Specifications that all system components be furnished by a single supplier (unitary source). The pumping station must be of standard catalog design, totally warranted by the manufacturer. Under no circumstances will a system consisting of parts compiled and assembled by a manufacturer's representative or distributor be accepted.

### 2.2 MANUFACTURER

- A. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company which are deemed most suitable for the service anticipated. It is not intended, however, to eliminate other products of equal quality and performance. The contractor shall prepare his bid based on the specified equipment for purposes of determining low bid. Award of a contract shall constitute an obligation to furnish the specified equipment and materials.
- B. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.
- C. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.
- D. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.



### 2.3 UNIT BASE

- A. The unit base shall be comprised of structural steel with a perimeter flange and reinforcements. Perimeter flange and reinforcements shall be designed to prevent flexing or warping under operating conditions. Perimeter flange shall be drilled for hardware used to secure unit base to concrete pad as shown on the contract drawings. Unit base shall contain provisions for lifting the complete pump station unit during shipping and installation.

### 2.06 PUMP DESIGN:

- A. Each pump station shall be individually designed for the specific application. The specifications below generally apply to a broad range of pump configurations and capacities.
- B. Pump shall be horizontal, self-priming centrifugal type, designed specifically for handling raw unscreened domestic sanitary sewage or industrial waste. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section.
- C. The pump manufacturer must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- D. Materials and Construction Features
  - 1. Pump casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:
    - a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
    - b. Fill port cover plate, 3 1/2" diameter, shall be opened after loosening a positive lock clamp bar assembly. In consideration for safety, cap screw threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A non-metallic gasket shall prevent adhesion of the fill port cover to the casing while assuring a reliable seal.
    - c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
    - d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.
  - 2. Cover plate shall be cast iron Class 30. Design must incorporate the following maintenance features
    - a. Retained by acorn nuts for complete access to pump interior. Cover plate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wear plate or check valve without removing suction or discharge piping.
    - b. A replaceable wear plate secured to the cover plate by weld studs and nuts shall be AISI 1015 HRS. Wear plate shall be self-cleaning design ensuring that debris is cleared away and does not collect on the impeller vanes.
    - c. In consideration for safety, a pressure relief valve shall be supplied in the cover plate. Relief valve shall open at 75-200 PSI.
    - d. Two O-rings of Buna-N material shall seal cover plate to pump casing.
    - e. Pusher bolt capability to assist in removal of cover plate. Pusher bolt threaded holes shall be sized to accept same retaining cap screws as used in rotating assembly.
    - f. Easy-grip handle shall be mounted to face of cover plate.

## PACKAGED WASTEWATER PUMPING STATIONS

3. Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, seal plate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate the following features:
  - a. Seal plate and bearing housing shall be cast iron Class 30. Anti-rotation ribs shall be cast into the seal plate to reduce internal wear and maximize component life. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.
    - 1) The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
    - 2) The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.
    - 3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.
  - b. Impeller shall be ductile iron, two vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall be statically or dynamically balanced. Impeller shall thread onto the pump shaft and be secured with a lock screw and conical washer.
  - c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel shall be supplied.
  - d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.
  - e. Shaft seal shall be oil lubricated mechanical type. The stationary and rotating seal faces shall be silicon carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design. An external O-ring secures the stationary seat to the seal plate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be Viton; cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.
  - f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same cap screws as used for retaining rotating assembly.
4. Adjustment of the impeller face clearance (distance between impeller and wear plate) shall be accomplished by external means.
  - a. Clearances shall be maintained by a four point external shimless cover plate adjustment system, utilizing a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or accidental operator contact. The four point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts,

couplings, etc., shall not be acceptable. Cover plate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.

- b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the cover plate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above
  - c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.
5. An externally removable suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished from the top of pump without disturbing the suction piping or completely draining the casing. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.
  6. Pump shall include flange kit consisting of two ASA spool flanges that shall be one piece cast iron class 30 suitable for attachment to suction and discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

E. Serviceability

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs by incorporating the following features.
2. No special tools shall be required for replacement of any components within the pump.

A. Pump Drain Kit

2. The pump drain kit shall consist of a 10' length of plastic hose with a quick connect female Kamlock fitting on one end of hose and two sets of fittings for pump drains. Each set of fittings for pump drain includes a stainless steel pipe nipple, stainless steel bushing, stainless steel ball valve and an aluminum quick connect male Kamlock fitting.

B. Spare Parts Kit

2. There shall be furnished with each pump station the following minimum spare parts:
  - a. One spare pump mechanical seal (complete), and with it all gaskets, seals, sleeves, O rings, and packing required to be replaced during replacement of the seal.
  - b. One set of impeller clearance adjustment shims.
  - c. One set cover plate O ring.
  - d. One rotating assembly O ring.
  - e. One rotating assembly

## 2.09 VALVES AND PIPING

A. Check Valve

1. Each pump shall be equipped with a full flow type check valve, capable of passing a 3" spherical solid, with flanged ends and be fitted with an external lever and spring. 316 stainless steel body ring shall be threaded into the valve port. Valve clapper shall be cast iron, rubber

face, and shall swing completely clear of waterway when valve is full open. The seating shall be by a resilient field replaceable ring on the valve disc contacting a bronze or stainless seat ring in the valve body. Hinge pin shall be of 18-8 stainless steel construction and shall be utilized with bronze bushings and packing type seal. Valves shall be equipped with removable cover plate to permit entry or for complete removal of internal components without removing the valve from the line. Valve shall be rated at 175 PSI water working pressure, 350 PSI hydrostatic test pressure. Valves other than full flow type or valves mounted in such a manner that prevents the passage of a 3" spherical solid shall not be acceptable. Acceptable manufacturers are Dezurik, GA Industries or Mueller. An alternate manufacturer must be submitted to and approved by ReWa prior to installation.

**B. Plug Valve (Duplex Configuration)**

1. The discharge header shall include a 3 way plug valve to permit either or both pumps to be isolated from the common discharge header. Valves shall have ports designed to pass spherical solids equal to the pumps capability. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi steel with flanged end connections drilled to 125 pound standard. Valve shall be furnished with a drip tight shutoff plug mounted in stainless steel bearings, and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a single lever actuator providing lift, turn, and reseal action. The lever shall be equipped with a locking device to hold the plug in the desired position. Acceptable manufacturers are Milliken, DeZurik or Mueller. An alternate manufacturer must be submitted to and approved by ReWa prior to installation.

**C. Plug Valve (Triplex Configuration)**

1. A plug valve shall be provided for each pump to isolate pump from the force main. Valve shall pass 3" spherical solids. The plug valve shall be non-lubricated, tapered type. Valve body shall be semi-steel with flanged end connections drilled to 125 pound standard. The drip-tight shutoff plug shall be mounted in stainless steel bearings, and shall have a resilient facing bonded to the sealing surface. Valve shall be operated with a hand wheel actuator. Acceptable manufacturers shall be Milliken, DeZurik or Mueller. An alternate manufacturer must be submitted to and approved by ReWa prior to installation.

**D. Automatic Air Release Valves**

1. An automatic air release valve shall be furnished for each pump designed to permit the escape of air to the atmosphere during initial priming or unattended repriming cycles. Upon completion of the priming cycle or repriming cycle, the valve shall close to prevent recirculation. Valves shall provide visual indication of valve closure, and shall operate solely on discharge pressure. Valves which require connection to the suction line shall not be acceptable.
2. All valve parts exposed to sewage shall be constructed of cast iron, stainless steel, or similar corrosion resistant materials. Diaphragms, if used, shall be of fabric reinforced neoprene or similar inert material.
3. A cleanout port, three inches in diameter, shall be provided for ease of inspection, cleanout, and service.
4. Valves shall be field adjustable for varying discharge heads.
5. Connection of the air release valves to the station piping shall include stainless steel fittings.

E. Gauge Kit

1. Each pump shall be equipped with a glycerin filled compound gauge to monitor suction pressures, and a glycerin filled pressure gauge to monitor discharge pressures. Gauges shall be a minimum of 4 inches in diameter and shall be graduated in feet water column. Rated accuracy shall be 1 percent of full-scale reading. Compound gauges shall be graduated 34 feet to +34 feet water column minimum. Pressure gauges shall be graduated \_\_\_ to \_\_\_ feet water column minimum.
2. Gauges shall be mounted on a resilient panel and frame assembly which shall be firmly secured to pumps or piping. Gauge installations shall be complete with all hoses and stainless steel fittings and shall include a shutoff valve installed in each gauge inlet at the point of connection to suction and discharge pipes.

F. Station Low Enclosure Temperature Alarm

1. Pump station shall be supplied with a thermostat which shall monitor interior station temperature. The control shall incorporate an unpowered dry contact wired to terminal blocks for field connection to a remote alarm device. The contact will close in the event that the temperature within the enclosure falls below approximately 35 degrees F.

G. Piping

1. Flanged header pipe shall be centrifugally cast, ductile iron, complying with ANSI/AWWA A21.51/C115 and class 53 thickness.
2. Flanges shall be cast iron class 125 and Comply with ANSI B16.1.
3. Pipe and flanges shall be threaded, and suitable thread sealant applied before assembling flange to pipe.
4. Bolt holes shall be in angular alignment within 1/20 between flanges. Flanges shall be faced with a gasket finish.

- H. Contractor must ensure all pipes connected to the pump station are supported to prevent piping loads from being transmitted to pumps or station piping. Pump station discharge force main piping shall be anchored with thrust blocks where shown on the contract drawings.

2.10 DRIVE UNIT

A. Motors

1. Pump motors shall be \_\_\_ HP, \_\_\_ phase, \_\_\_ hertz, \_\_\_ VAC, horizontal ODP, 1800 RPM, NEMA design B with cast iron frame with copper windings, induction type, with class F insulation and 1.15 SF for normal starting torque and low starting current characteristics, suitable for continuous service. The motors shall not overload at the design condition or at any head in the operating range as specified.
2. Motors shall be tested in accordance with provisions of ANSI/IEEE Std 112.

2.11 FINISH

- A. Factory Finished Components: Pumps, piping, and exposed steel framework shall be cleaned prior to coating using an approved solvent wipe or phosphatizing cleaner. The part must thoroughly dry before paint application. Open joints shall be caulked with an approved polyurethane sealant. Exposed surfaces shall be applied with one coat of Tnemec Series 69 Polyimide Epoxy Primer and

one finish coat of Series 73 Aliphatic Acrylic Polyurethane for a total dry film thickness of 4-6 mils. Finish coat shall be semi-gloss white for optimum illumination and enhancement. The coating shall be corrosion, moisture, oil, and solvent resistant when completely dry. The factory finish shall allow for over-coating and touch-up for 6 months after coating. Thereafter, it will generally require sanding to accept a topcoat or touch-up coating. Color for components within the manufactured package shall be the manufacturer's standard colors.

- B. Field installed components: Piping, valves, and exposed steel components shall be coated in accordance with the following schedule:
  - 1. Surface Prep: SSPC-1
  - 2. Prime Coat: Red Epoxy Primer, Dry Film Thickness (DFT), as recommended by paint mfr
  - 3. Intermediate Coat: Tnemec Series 66, 3-6 mils DFT, Color; Gray (33GR). Sherwin-Williams equivalent also acceptable.
  - 4. Finish Coat: Tnemec Series 1074, 3-5 mils DFT, Color; Dark Bronze (86BR). Sherwin-Williams equivalent also acceptable.

## 2.12 ELECTRICAL COMPONENTS

- B. The pump station control panel will be tested as an integral unit by the pump station manufacturer. The control panel shall also be tested with the pump station as a complete working system at the pump station manufacturer's facility.
- C. The electrical control components shall be provided by the pump station supplier and shall be provided with the following features.
- D. Panel enclosure
  - 1. Enclosure shall be constructed in conformance with applicable section of National Electrical Manufacturers Association (NEMA) standards for type 1 electrical enclosures. Enclosure shall be fabricated of steel having a minimum thickness of not less than 0.075 Inch (14 gauge). All seams shall be continuously welded, and shall be free of burrs and voids. Interior and exterior surfaces shall be coated with a paint finish suitable for the NEMA classification of the enclosure. There shall be no holes through the external walls of the enclosure for mounting the enclosure or any components contained within the enclosure. Panel enclosure up to 60" x 36" x 12" shall be mounted on floor stands and secured to pump base.
  - 2. Enclosure shall be equipped with a door mounted on a continuous steel hinge, and sealed around its perimeter. Door shall be held closed with clamps that are quick and easy to operate. The door shall accommodate the mounting of switches and indicators.
  - 3. Enclosure shall be furnished with a removable back panel, fabricated of steel having a thickness of not less than 0.106 Inch (12 gauge), which shall be secured to the enclosure with collar studs. Such panel shall be of adequate size to accommodate all basic components.
  - 4. All control components shall be securely fastened to a removable back panel with screws and lock washers. Switches, indicators and instruments shall be mounted through the control panel door. All control devices and instruments shall be secured to the sub-plate with machine screws and lock washers. Mounting holes shall be drilled and tapped; Self tapping screws shall not be used to mount any components. All connections from the back panel to door mounted or remote devices shall be made through terminal blocks. All control devices shall be clearly labeled to indicate function.



E. UL Label Requirement

1. Pump station controls shall conform to third party safety certification. The panel shall bear a serialized UL label listed for "Enclosed Industrial Control Panels". The enclosure, and all components mounted on the sub-panel or control cover shall conform to UL descriptions and procedures.

F. 750 VA Control Power Transformer

1. The lift station shall be equipped with a 750 VA step-down transformer to supply 115 volt, AC, single phase for the control equipment.

G. 5 kVA Auxiliary Power Transformer

1. The lift station shall be equipped with a 5 KVA step-down transformer to supply 115 volt, AC, single phase for the control and auxiliary equipment. The primary and secondary side of the transformer to be protected by a thermal magnetic circuit breaker, sized to meet the power requirements of the transformer. An operating mechanism shall penetrate the control panel door and a padlockable operator handle shall be secured on the exterior surface. Interlocks must prevent opening the door until circuit breakers are in "OFF" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

H. Motor Branch Circuit Components

1. Main Connections

- a. A main terminal block and ground lug shall be furnished for field connection of the electrical supply. The connections shall be designed to accept copper conductors of sufficient size to serve the pump station loads. The main terminal block shall be mounted to allow incoming wire bending space in accordance with article 373 of the National Electric Code (NEC). A separate terminal strip shall be provided for 115 volt, single phase control power and shall be segregated from the main terminal block. Ten percent of the control terminals shall be furnished as spares.
- b. All motor branch and power circuit components shall be of highest industrial quality. The short circuit current rating of all power circuit devices shall be a tested combination or evaluated per the National Electrical Code Article 409. The lowest rated power circuit component shall be the overall control panel short circuit rating and shall not be less than the fault current available. The minimum control panel rating shall not be less than 10 kA, rms symmetrical. Control assemblies operating at 120 volts nominal or less may be provided with transformers which limit the fault current and may be rated less than the minimum required short circuit rating.

2. Circuit Breakers and Operating Mechanisms

- a. A properly sized heavy duty air circuit breaker shall be furnished for each pump motor. All circuit breakers shall be sealed by the manufacturer after calibration to prevent tampering.
- b. A padlocking operating mechanism shall be installed on each motor circuit breaker. Operator handles for the mechanisms shall be located on the exterior of the control compartment door, with interlocks which permit the door to be opened only when circuit breakers are in the "off" position. An additional mechanism(s) shall be provided on the circuit breaker permitting the breaker to be operated and/or locked with the control panel door in the open position.

I. Motor Starters: Reduced Voltage Soft Starter, standard installations

1. A reduced voltage, solid state motor starter shall be furnished for each pump motor. The starter construction shall be modular with separately replaceable power and control sections. The power section shall consist of six back-to-back SCR's rated 208 to 480 volts, 50/60 hertz. The SCR's shall have a minimum repetitive peak inverse voltage rating of 1400 volts at 480 volts. The enclosed operating temperature range shall be 0 to 40 degrees C at altitudes up to 2000 meters without derating.
  - a. Starting Modes: Starting modes shall be selectable soft start, current limit, or full voltage. Soft starting the pump shall include an adjustable initial torque value of 0 to 90 %. The acceleration ramp shall be adjustable from 0 to 30 seconds. The starter shall include a selectable kick start providing a current pulse at start. Kick start level shall be adjustable from 0 to 90% of locked rotor torque. Kick start time shall be adjustable from 0 to 2 seconds. Current limit mode shall provide means for limiting the starting current to a programmable value between 50 and 600% of full load current. Full voltage start shall provide across the line starting with a ramp time of less than 0.25 seconds.
  - b. Pump Control Mode: Ramp time will be dependent on pump torque requirements. The starter shall provide smooth acceleration and deceleration, which approximates the flow rate of a centrifugal pump. The starter's microcomputer shall analyze motor variables and generate control commands, which will minimize surges in the system. Pump stop time shall be adjustable from 0 to 120 seconds. Pump control provides reduced hydraulic shock.
  - c. Bypass: When the start ramp time is complete, the starter shall energize an integral bypass contactor. When in the bypass mode, the bypass contactor shall carry the motor load to minimize internal heating in the electrical enclosure.
  - d. Protection: The starter shall include protective features: Communication fault, control temperature, excess starts/hour, stall, jam, line fault, open gate, overload, overvoltage, phase reversal, power loss, underload, under voltage, shorted SCR, open bypass and voltage unbalance.
    - 1) An integral electronic overload relay equipped with thermal memory shall be included and shall utilize three phase current sensing. Adjustments shall include trip current, service factor and 10, 15, 20 or 30 trip class.
    - 2) Jam trip shall be adjustable 0-1,000% of the nominal motor current with a delay time adjustment of 0-99 seconds.
    - 3) Stall protection senses that the motor is not up-to-speed at end of ramp and will shut down after a user-selected delay time has elapsed. Stall delay shall be adjustable from 0-10 seconds.
    - 4) Fault diagnostics shall be displayed on the starter and shall include temperature fault, line fault, open gate and power loss.
  - e. Display: The starter shall include a keypad and display on the front of the control module. The display is equipped with a built-in four line, 16 character backlit LCD. The LCD displays metering, faults and parameter settings in English. Faults will display in English and fault code. A fault buffer will store the last five faults. Metering capabilities shall include: Three phase current, three phase voltage, power factor, motor thermal usage, wattmeter, kilowatt hours, and elapsed time meter. Digital parameter adjustments shall be made using the keypad.
  - f. Door Mounted Display: Each starter shall be furnished with a display and keypad mounted to the door of the control panel. The door mounted display will duplicate the functions of the starter display and allow the operator to monitor or change parameters without opening the control panel door.



- J. Motor Starters: Variable Frequency Drives (VFD's), when specified by designer
1. When variable frequency drives are specified, RVSS starters described in section 2.12.F above shall also be installed with a transfer switch for backup in case of VFD failure.
  2. The variable frequency drive shall be capable of operation under any combination of the following conditions without mechanical or electrical damage. Ambient Temperature: 0 to + 40 degrees C
    - a. Relative Humidity: Less than 95% non-condensing
    - b. Altitude: Less than 1,000M (3300 ft) above sea level
    - c. Vibration: .006 inches displacement, 1G peak
    - d. Shock: 15G peak for 11mS (+/- 1.0mS)
    - e. Control Specification
    - f. Control System: Sinusoidal pulse width modulated voltage waveform
    - g. Frequency Accuracy: +/- 0.4% of max. frequency
    - h. Volts/Hertz Ratio: V/Hz user programmable
    - i. Operation Frequency: 0 to 400 Hz
    - j. Overload Capacity: 110% Overload capability for up to 1 minute, 150% Overload capability for up to 3 seconds
  3. Digital Readout and Monitor
    - a. Interface to the drive is provided via a module with integral LCD display. Unit is a 7 line by 21 character backlit LCD display with graphics capability. It is used to display drive operating conditions, fault / alarm indications and programming information with full text support in multiple languages, including but not limited to English, German, French, Italian, Spanish, Portuguese and Dutch. The unit will display standby status (power on, not running), output frequency (drive run), set-up parameters and fault. With keypad, user can monitor current, voltage, frequency, acceleration and deceleration time, minimum frequency and maximum frequency. Readout also provides inverter status and protective circuit status.
  4. Protection
    - a. The variable speed drive system shall include a diode or fully gated bridge rectifier, capacitor filter, and transistorized inverter section. Base driver signals to control firing of the power transistors will be designed with optically coupled isolators for maximum protection of the control circuits from high voltage and noise. The output will be a sinusoidal, pulse width modulated, voltage waveform for reduced harmonic heating in the motor.
  5. The system protection will provide the following:
    - a. Intermittent overload - 50 to 150%
    - b. Current limit - 50 to 115%
    - c. Overcurrent - 220-300% of rated output current
    - d. Inverse time overload - 50 to 100%
    - e. Short circuit - Phase to phase or phase to ground
    - f. Overvoltage - 10% above input line or DC bus voltage

- g. Undervoltage - 10% below line voltage
  - h. Power loss ride-through - 500mS
6. When the inverter trips out on a fault, the fault relay shall activate and the display shall indicate the reason for the trip as follows:
- a. Overcurrent
  - b. Short circuit
  - c. Overload
  - d. Overvoltage
  - e. Undervoltage
  - f. Overheat
  - g. Ground fault
  - h. Motor stalled
  - i. Power supply fault
7. Auto restart shall occur when the inverter faults. Auto restart shall be adjustable up to 9 attempts with a 0.5 to 30 second interval. Auto restart will not be attempted for ground fault, output shorted, transistor shorted or internal microprocessor fault but will trip out immediately, activate the fault relay and make the appropriate indication on the display.
8. In the event of a fault trip, the microprocessor shall save the status of the inverter at the time of the fault and make that information available on the digital display. Information regarding the last 4 faults is maintained in event of a power loss.
9. Operational Functions:
- a. Acceleration and deceleration time independently adjustable from 0.1 to 3600.0 seconds (selectable ranges).
  - b. Volts/Hertz patterns user selectable.
  - c. Maximum and minimum frequency limit adjustments.

K. Three Phase Voltage Monitor

1. The control panel shall be equipped to monitor the incoming power and shut down the pump motors when required to protect the motor(s) from damage caused by phase reversal, phase loss, high voltage, low voltage, and voltage unbalance. An adjustable time delay shall be provided to minimize nuisance trips. The motor(s) shall automatically restart, following an adjustable time delay, when power conditions return to normal.

L. Transient Voltage Surge Suppressor

1. All Control Panels shall have Surge Protective Devices installed immediately after the main overcurrent device or immediately after the supply conductors to the panel have been terminated. The Surge Protective Device(s) shall follow IEEE C62.41 recommendation for cascading to protect all voltage levels to and including 24 volts AC/DC and shall be as follows:
2. Be UL 1449 3rd Edition Recognized for UL Type 2 applications except at 48 volts AC/DC and below may be UL 1449 3rd Edition for Type 3 applications.
3. Provide suppression for both normal mode (L-N [Wye]) and common mode (L+N-G [Wye] or L-G [Delta]).
4. Have a Surge Current Capacity ( $I_{max}$ ) of at least 40kA.

5. Have a Nominal Surge Current Rating ( $I_n$ ) of 20kA.
6. Have SCCRs of 200kA, except that 347Y/600V, 240/480V High leg Delta and 347V single-phase SPDs shall have a minimum SCCR of 125kA.
7. Use MOV technology with thermal disconnect.
8. Be RoHS compliant.
9. SPD status monitoring shall be provided by local visual indication and, if needed, by remote contact signaling using an optional Form C contact relay.
10. Hardwired Listed Type 1 or Type 2 Surge Protective Devices Shall:
  - a. All Type 1 or Type 2 surge protective devices shall be manufactured by a single ISO-9001 registered company normally engaged in the design, development and manufacture of such devices for electrical distribution system/ equipment protection. Surge protective devices shall be UL Listed with a Short-Circuit Current Rating of 200kA, Nominal Discharge Current ( $I_n$ ) of 20kA, and Surge Current Capacity ( $I_{max}$ ) of 120kA, 200kA, 300kA or 400kA. These SPDs shall be installed in accordance with the NEC® and/or local code requirements. The said manufacturer shall offer a minimum five (5) year warranty for its Type 1 and Type 2 surge protective devices.
  - b. The hardwired surge protective device shall have specifications as shown below:
    - 1) The Maximum Continuous Operating Voltage (MCOV) shall not exceed 25% on Wye and 40% on Delta systems of the nominal voltage (system voltage) in the configuration being used
    - 2) Prewired NEMA 1 or NEMA 4X factory sealed enclosure suitable for the intended installation location
    - 3) Shall have a two color LED status indicator per phase
    - 4) Have an operating temperature range of at least  $-40^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$
    - 5) Only use thermally protected MOV technology, such as Bussmann SurgePOD™.
  - c. Surge Protective Device Agency Information: SPDs shall be "Listed" by Underwriters Laboratories, Inc. to UL 1449 3rd Edition as a Type 1 or Type 2 device and shall exhibit the UL Listing mark for the UL category VZCA for USA and/or VZCA2 for Canada; and must have CSA certification.
  - d. Manufacturers must provide verification of performance data for UL and CSA standards.
  - e. All SPDs must be RoHS compliant.
  - f. Surge protective devices shall be installed and located in accordance with the all applicable agency, NEC® and local code requirements. The SPDs must be suitable for the particular installation, be it on the upstream side (Type 1) or downstream side (Type 1 or Type 2) of service entrance Overcurrent Protective Device (OCPD).
  - g. All SPDs shall match voltage and system specific requirements as provided by the manufacturer.
  - h. All SPDs shall provide surge protection for both normal mode (L-N [Wye], L-L [Delta]) and common mode (L+N-G [Wye] or L-G [Delta]).
  - i. Surge protective device shall be clearly marked with specifications as required by UL 1449 3rd Edition along with UL holographic label on the SPD.
  - j. Each surge protective device should be serial numbered along with barcode for easy identification and traceability.

M. Voltage Alert Indication

1. The control panel shall include a voltage alert indicator to reduce the risk of electrical arc flash by pre-verifying the electrical isolation from outside of the control panel. Hardwired to the main incoming point of termination, the indicator shall be powered by the same voltage that it indicates utilizing redundant circuitry, thereby flashing whenever voltage is present. An eight detector display shall visually alert the presence of dangerous AC or DC potentials occurring between any combination of the monitored input lines.

N. Other Equipment

1. The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
2. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein.
3. The level control system shall be capable of operating as either an air bubbler type level control system, submersible transducer type system, or radar transmitter type system.
4. The level control system shall utilize alternation to select first one pump, then the second pump, then the third pump (if required), to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle, or in the event of excessive run time.
5. The level control system shall utilize an electronic pressure switch which shall continuously monitor the wet well level, permitting the operator to read wet well level at any time. Upon operator selection of automatic operation, the electronic pressure switch shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the electronic pressure switch shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the electronic pressure switch shall start the second and/or third pump (if required) when the liquid reaches the "lag pump start level", or "standby pump start level" so that all pumps are operating. These levels shall be adjustable as described below.
  - a. The electronic pressure switch shall include integral components to perform all pressure sensing, signal conditioning, EMI and RFI suppression, DC power supply and 120 volt outputs. Comparators shall be solid state, and shall be integrated with other components to perform as described below.
  - b. The electronic pressure switch shall be capable of operating on a supply voltage of 12-24Vdc in an ambient temperature range of 10 degrees C (14 degrees F) through 55 degrees C (131 degrees F). Ingress Protection of IP56 for indoor use with closed cell neoprene blend gasket material. Evaluated by Underwriters Laboratories for Pollution Degree 2 device for U.L. and cU.L. Control range shall be 0 to 33.3 feet of water with an overall repeat accuracy of (plus/minus) 0.1 feet of water. Memory shall be non-volatile. A Battery backed real time clock shall be standard.
  - c. Eleven optically isolated, user defined digital inputs for pump and alarm status. Rated at 10mA at 24Vdc. Eight digital output relays (mechanical contacts), configurable for pump start/stop or alarms. Three relays rated at 12 Amp @ 28Vdc and 120Vac, five relays rated at 3 Amp @ 30Vdc and 120Vac. The electronic pressure switch shall consist of the following integral components: pressure sensor, display, electronic comparators, digital inputs and digital output relays.
    - 1) The internal pressure sensor shall be a strain gauge transducer and shall receive an input pressure from the air bubbler system. The transducer shall convert the input to a proportional electrical signal for distribution to the display and electronic comparators. The transducer output shall be filtered to prevent control response to level pulsations

- or surges. The transducer range shall be 0 to 14.5 PSI, temperature compensated from 40 degrees C ( 40 degrees F) through 85 degrees C (185 degrees F), with a repeat accuracy of (plus/minus) 2.5% full scale about a fixed temperature. Transducer overpressure rating shall be 3 times full scale.
- 2) The electronic pressure switch shall incorporate a digital back lighted LCD panel display which, upon operator selection, shall indicate liquid level in the wet well, and pump status indication for up to 3 pumps. The display shall include a 128 x 64 bit resolution LCD to read out directly in feet of water, accurate to within one tenth foot (0.1 foot), with a full scale indication of not less than 12 feet. The display shall be easily convertible to indicate English or metric units.
  - 3) Level adjustments shall be electronic comparator set points to control the levels at which the lead, lag and standby pumps start and stop. Each of the level settings shall be easily adjustable with the use of membrane type switches, and accessible to the operator without opening any cover panel on the electronic pressure switch. Controls shall be provided to permit the operator to read the selected levels on the display. Such adjustments shall not require hard wiring, the use of electronic test equipment, artificial level simulation or introduction of pressure to the electronic pressure switch.
  - 4) Each digital input can be programmed as pump run, pump HOA, pump high temp, pump moisture/thermal, starter failure (FVNR, RVSS, VFD), and phase failure. Inputs are used for status and alarm indication.
  - 5) Each output relay in the electronic pressure switch shall be hard contact mechanical style. Each relay input shall be optically isolated from its output and shall incorporate zero crossover switching to provide high immunity to electrical noise. Each output relay shall have an inductive load rating equivalent to one NEMA size 3 contactor. A pilot relay shall be incorporated for loads greater than a size 3 contactor.
6. The electronic pressure switch shall be equipped with alarm banners with time and date history for displaying alarm input notification. Alarm history will retain a 16 of the most recent alarm events.
  7. The electronic pressure switch shall be equipped with pump start/stop and alarm input delay(s) that have an adjustable delay set points.
  8. An Antiseptic function with a built in timer shall be incorporated in the electronic pressure switch to prevent the well from becoming septic.
  9. The electronic pressure switch shall be capable of jumping to next available pump if current pump is out of service due to pump failure or manual selection. Circuit design in which application of power to the lag pump motor starter is contingent upon completion of the lead pump circuit shall not be acceptable.
  10. The electronic pressure switch shall be equipped with a simulator system capable of performing system cycle testing functions.
  11. The electronic pressure switch shall be capable of calculating and displaying pump elapse run time. The elapse run time is resettable and adjustable.
  12. The electronic pressure switch shall have internal capability of providing automatic simplex, duplex, and triplex alternation, manual selection of pump sequence operation, and alternation in the event of 1-24 hours of excessive run time.
  13. The electronic pressure switch shall be equipped with a security access code to prevent accidental set up changes and provide liquid level set point lock out. The supervisor access code is adjustable.

14. The electronic pressure switch shall be equipped with one (1) 0-33 ft. W.C. input, one (1) scalable analog input of either 0-5Vdc, or 4-20mA, and one (1) scalable analog output of either 0-5Vdc, 0-10Vdc or 4-20mA. Output is powered by 10-24Vdc supply. Load resistance for 4-20mA output shall be 100-1000 ohms.
15. The electronic pressure switch shall include a DC power supply to convert 120Vac control power to 12 or 24Vdc power. The power supply shall be 500 mA (6W) minimum and be UL listed Class II power limited power supply.
16. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a high liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a high wet well level exists. The alarm signal shall be maintained until the wet well level has been lowered and the circuit has been manually reset. High water alarm shall be furnished with a dry contact wired to terminal blocks.
17. The electronic pressure switch shall be equipped with an electronic comparator and mechanical output relay to alert maintenance personnel to a low liquid level in the wet well. An alarm banner, visible on the front of the controller, shall indicate that a low wet well level exists. The alarm signal shall be maintained until the cause for the low wet well level has been corrected and the circuit has been manually reset. A low liquid level condition shall disable all pump motors. When the wet well rises above the low level point, all pump motors shall be automatically enabled. Low water alarm shall be furnished with a dry contact wired to terminal blocks.
18. Integrinex Standard Analog Output circuit will be furnished with transient voltage surge suppression to protect related equipment from induced voltage spike from lighting.
19. An alarm silence pushbutton and relay shall be provided to permit maintenance personnel to de-energize the audible alarm device while corrective actions are under way. After silencing the alarm device, manual reset of the alarm condition shall clear the alarm silence relay automatically. The pushbutton shall be a membrane style button integral to the Integrinex Standard level controller.
20. A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected to the Integrinex™ Standard. If casing temperature rises to a level sufficient to cause damage, the thermostat causes the Integrinex™ Standard to interrupt power to the motor. The Integrinex™ Standard will display an alarm banner indicating the motor stopped due to high pump temperature. The motor shall remain locked out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.
21. The PLC shall be an Allen-Bradley CompactLogix 5370 L2 Control System. The PLC shall be equipped with a CPU with 750KB [1769-L16ER] or 1MB [1769-L18ERM] of user memory, and two EtherNet/IP communication ports supporting ring topologies and 1 USB port for firmware download and programming. The Controller shall utilize the small applications 1769 I/O modules. The Controller shall be designed to implement consumed tag, event instruction, embedded inputs, remote I/O, axis, and motion event triggers. The controller shall be equipped to handle up to 32 Controller Tasks and 100 programs/task.
22. The PLC shall operate on 24VDC power and be equipped with a 24VDC embedded power supply. A 1784-SD1 (1GB) Memory Module shall be shipped with the controller. The controller will contain, at least but not limited to, embedded digital I/O [16DC Inputs, 16DC



- Outputs]. The controller shall accept all digital and analog I/O necessary to accomplish the specified operation. A minimum of 10% spare of the I/O used shall be supplied.
23. The program logic shall be stored on the processor as well as on a programmable, read only 1 GB SD card [shipped with controller]. The memory module shall auto load and run when installed in the programmable control processor and is included to facilitate field repair or replacement of the programmable control hardware without the use of programming terminals or personal computers.
  24. The PLC shall communicate with the drive using an EtherNet/IP, but can also support other communication protocols such as ControlNet, or DeviceNet networks. The PLC shall issue drive start/stop and speed commands. Drive status shall also be communicated to the PLC using EtherNet/IP. The drive shall be configured to operate manually without the use of the PLC.
  25. An Allen-Bradley PanelView Plus 6 1000 electronic operator interface shall be provided for data entry and display. The Operator Interface Display size will be at least 10 inches with Color active matrix, thin film transistor (TFT), liquid crystal display (LCD). The operator interface shall have an 18-Bit color graphic resolution with backlight CCFL of 50,000 hours minimum. The operator interface shall be mounted on the front of the control panel with other operator controls and shall be compatible with the PLC communication protocol. The operator interface shall be a backlit, touch-screen terminal. The operator interface program shall be stored externally on a Secure Digital (SD) card .
  26. Electromechanical relays and timers, when used shall be equipped with 120vac coils and contacts rated NEMA A-300 minimum. Timers shall be pneumatic or synchronous motor driven.
  27. The control circuit shall be fused, and shall be provided with a disconnect switch connected in such a manner as to allow control power to be disconnected from all control circuits.
  28. Pump mode selector switches shall be connected to permit manual start and manual stop of each pump motor individually. Manual operation shall override shutdown systems supplied with the level control system except motor overload.
  29. Pump alternation shall be integral to the PLC. Provisions for automatic alternation or manual selection shall also be integral to the PLC.
  30. A selector switch shall provide manual alternation of the air pumps in the bubbler system. The switch shall be connected in such a manner that either pump may be selected to operate continuously.
  31. A pushbutton switch shall be provided to silence one of the 115 volt AC alarm circuits while corrective actions are underway. Depressing the alarm silence pushbutton shall also cause the high water alarm circuit (low water alarm optional) to reset when the liquid level has been lowered.
  32. High Pump Temperature Shutdown Circuit
    - a. A high pump temperature protection circuit shall override the level control and shut down the pump motor(s) when required to protect the pump from excessive temperature. A thermostat shall be mounted on each pump casing and connected to the PLC. If casing temperature rises to a level sufficient to cause damage, the thermostat N.O. contact shall close indicating a high pump temperature condition to the PLC. The PLC will then interrupt power to the pump motor. The operator interface terminal will display an alarm banner indicating the motor stopped due to high pump temperature. The motor shall remain locked

## PACKAGED WASTEWATER PUMPING STATIONS

out until the pump has cooled and circuit has been manually reset. Automatic reset of this circuit is not acceptable.

## 33. Elapsed Time Meter

- a. Six digit elapsed time meter shall be displayed on the operator interface terminal to indicate total running time of each pump in "hours" and "tenths of hours". Pump runtime shall be adjustable and password protected.

## 34. Indicating Lights

- a. Indicating lights shall be provided on the operator Interface terminal to alert the user of the following conditions:
  - 1) Pump Run
  - 2) Pump Fault
  - 3) Wet Well Level Alarm Conditions
- b. Physical indicating lights shall be oil tight type and equipped with integral step down transformers for long lamp life. Lamps shall be incandescent type rated 14 volts or less. Lamps shall be replaceable from the front without opening the control panel door and without the use of tools. Physical indicating lights will be provided for the following functions:
  - 1) General Alarm

## 35. Wiring

- a. The pump station components, as furnished by the manufacturer, shall be completely pre-wired. (Note: If control panel is opted to be shipped loose, the pump station as furnished by the manufacturer shall be completely pre-wired except for the power feeder lines and final connections to pump motors, and remote alarm devices. The interconnecting wire, conduit, and other materials required shall be furnished and installed by the electrical contractor.)
- b. All wiring, workmanship, and schematic wiring diagrams shall be in compliance with applicable standards and specifications for industrial controls set forth by the Joint Industrial Council (JIC), National Machine Tool Builders Association (NMTBA), and the National Electric Code (NEC).
- c. All user serviceable wiring shall be type MTW or THW, 600 volts, and shall be color coded as follows:
  - 1) Line and load circuits, AC or DC power .....black
  - 2) AC control circuit less than line voltage ..... red
  - 3) Interlock control circuit, from external source ..... yellow
  - 4) Equipment grounding conductor ..... green
  - 5) Current carrying ground ..... white
  - 6) Hot with circuit breaker open ..... orange

## 36. Wire Identification and Sizing

- a. Control circuit wiring inside the panel, with the exception of internal wiring of individual components, shall be 16 gauge minimum, type MTW or THW, 600 volts. Wiring in conduit shall be 14 gauge minimum. Motor branch wiring shall be 10 gauge minimum.
- b. Motor branch conductors and other power conductors shall not be loaded above the temperature rating of the connected termination. Wires shall be clearly numbered at each end in conformance with applicable standards. All wire connectors in the control panel



shall be of the ring tongue type with nylon insulated shanks. All wires on the sub plate shall be bundled and tied. All wires extending from components mounted on door shall be terminated on a terminal block mounted on the back panel. All wiring outside the panel shall be installed in conduit

37. Control conductors connecting components mounted on the enclosure door shall be bundled and tied in accordance with good commercial practice. Bundles shall be made flexible at the hinged side of the enclosure. Adequate length and flex shall be allowed so that the door can swing to its full open position without undue mechanical stress or abrasion on the conductors or insulation. Bundles shall be clamped and held in place with mechanical fastening devices on each side of the hinge.

O. Conduit requirements are as follows:

1. All conduit and fittings shall be UL listed.
2. Liquid tight flexible metal conduit shall be constructed of a smooth, flexible galvanized steel core with smooth abrasion resistant, liquid tight, polyvinyl chloride cover.
3. Conduit shall be supported in accordance with articles 346, 347, and 350 of the National Electric Code.
4. Conduit shall be sized according to the National Electric Code.

P. Grounding

1. The pump station manufacturer shall ground all electrical equipment to the enclosure back panel. The mounting surface of all ground connections shall have any paint removed before making final connections.
2. The contractor shall provide an earth driven ground connection to the control panel at the main ground lug in accordance with the National Electric Code (NEC).

Q. Equipment Marking

1. Permanent corrosion resistant name plate(s) shall be attached to the control and include following information:
  - a. Equipment serial number
  - b. Control panel short circuit rating
  - c. Supply voltage, phase and frequency
  - d. Current rating of the minimum main conductor
  - e. Electrical wiring diagram number
  - f. Motor horsepower and full load current
  - g. Motor overload heater element (if applicable)
  - h. Motor circuit breaker trip current rating
  - i. Name and location of equipment manufacturer
2. Control components shall be permanently marked using the same identification keys shown on the electrical diagram. Labels shall be mounted adjacent to device being identified.
3. Switches, indicators, and instruments mounted through the control panel door shall be labeled to indicate function, position, etc. Labels shall be mounted adjacent to, or above the device.

- R. Control logic shall be accomplished using programmable controllers. Electromechanical relays may be used when necessary. However, the primary control logic shall be performed by the PLC.

1. The O&M manual shall be provided with complete ladder logic program documentation including English names, rung comments, and coil/contact cross-references.
  2. The control shall be pre-programmed or wired to provide the following routines:
  3. Pump alternation at lead stop
  4. Excessive pump run time alternation
  5. Jump to next pump on lead failure
  6. Start/stop pumps at normal level settings
  7. Pump start delays when called simultaneously
  8. General alarm pilot light activation: Quick flashing alarm/slow flashing acknowledge/ steady on reset/off when clear
  9. Station trouble alarm(115vac and normally open dry contact)
  10. High and low level alarms
  11. Pump start/stop level control
  12. Drive speed/level control (If supplied with VFDs)
  13. Pump high temperature shutdown
- Drive fault alarm

S. The operator interface shall be equipped with the following displays and functions:

1. Main Menu
2. Wet Well Level
3. Wet Well Level Simulation
4. Low Water Alarm Status
5. High Water Alarm Status
6. Pump High Temperature Status #1, #2
7. Drive Fault Status #1, #2 (If VFDs are supplied)
8. Pump Fault Statue #1, #2 (If FVNR or RVSS starters are supplied)
9. Pump Sequence Selection
10. Alarm Silence
11. Alarm Reset
12. General Alarm Lamp Test
13. Lead Level Start/Stop Setpoints
14. Lag Level Start/Stop Setpoints
15. Low Water Alarm Setpoints
16. High Water Alarm Setpoints
17. Speed/Level Setpoints 1 pump running (Speed settings if VFDs are supplied)

18. Speed/Level Setpoints 2 pumps running (Speed settings if VFDs are supplied)
19. Power-up Delay Setpoint
20. Alarm Delay Setpoint
21. Pump Start Delay Setpoint
22. Alternation Time Interval Setpoint
23. Level Transmitter Calibration

### 2.13 LIQUID LEVEL CONTROL SYSTEM

- B. The manufacturer of the liquid level control system must be ISO 9001:2000 revision certified, with scope of registration including design control and service after sales activities.
- C. Sequence of Operation with Utility Power
  1. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein. The level control system shall utilize the PLC sequencer to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle or if one pump runs as the lead pump for an excessive time.
  2. Upon operator selection of automatic operation, the PLC shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the PLC shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the PLC shall start the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating.
  3. The level control system shall start and stop the pump motors in response to changes in wet well level, as set forth herein. The level control system shall utilize the PLC sequencer to select first one pump, then the second pump, to run as lead pump for a pumping cycle. Alternation shall occur at the end of a pumping cycle or if one pump runs as the lead pump for an excessive time.
  4. Level and speed controls shall include logical comparator setpoints. Settings shall be provided to control the levels at which the pumps start and stop as well as level endpoints for minimum and maximum speed. Two sets of speed setpoints shall be provided. The first set will be enabled when a single pump is running. The second set shall be enabled when two pumps are running. Each of the settings shall be adjustable and accessible to the operator without opening the control panel. Controls shall be provided to permit the operator to read and adjust the selected levels and speeds on the operator interface. Setpoint adjustments which require hard wiring, the use of electronic test equipment or artificial level simulation are not acceptable.
  5. Upon operator selection of automatic operation, the PLC shall start the motor for one pump when the liquid level in the wet well rises to the "lead pump start level". When the liquid is lowered to the "lead pump stop level", the PLC shall stop this pump. These actions shall constitute one pumping cycle. Should the wet well level continue to rise, the PLC shall start the second pump when the liquid reaches the "lag pump start level" so that both pumps are operating.
  6. When a single pump is running and the wet well is equal to the "1 pump minimum level", the drive will run at the "1 pump minimum speed". As the level rises, drive speed will increase to

the “1 pump maximum speed” when the wet well level is equal to the “1 pump minimum level”. Likewise, when two pumps are running, the “1 pump” settings will be disabled and the control will use the “2 pump” level and speed settings.

7. Level control range shall be 0 to 12.0 feet of water. Speed control range shall be 20.0 to 60.0 hertz. Overall repeat accuracy shall be (plus/minus) 0.1 feet of water or hertz.

C. Alarms and shutdown routines shall operate as follows:

1. Condition abnormal: The general alarm pilot light will quick flash until acknowledged, then slow flash until reset, then glow steady until condition returns to normal, then off. The operator interface will display the alarm when acknowledged. The external alarms will be active until silenced, and then off.
2. Condition abnormal then returns to normal: The general alarm pilot light will quick flash until silenced, then slow flash until reset, then off. The operator interface will display the alarm when acknowledged. The external alarms will be active until silenced, and then off.
3. Subsequent alarms will re-alarm when silenced or reset.

E. Radar Level Sensor

1. The level control system shall utilize a radar level transmitter housed in waterproof and explosion proof housing with a sensor designed to mount at the top of the wet well. Transmitter full scale operating range shall be 1-31 ft., and shall provide a 4 20mA output signal. The transmitter shall be a microprocessor based unit capable of easy calibration. Radar level system shall be VEGAPULS C21 Sensor with VEGAMET 341 Panel Mount Controller by VEGA.

## 2.17 AUTOMATIC TELEPHONE DIALER

- A. The contractor shall provide a Mission Communications auto-dialer, Model MyDro 850 series, for remote monitoring and control by the owner personnel. Contractor shall provide wiring from pump control panel.
- B. One mercury float switch (backup high level alarm) shall be installed in the pump station wet well to activate an audible alarm, an alarm light and shall be directly wired to and signal the autodialer. An alarm silence button shall be provided on the face of the pump panel door to acknowledge alarm and silence the horn. The alarm light and horn shall be mounted on the side of the Control Building in a convenient location (coordinate with Engineer/Owner). A second float switch shall be provided for low level (pump off) control during backup operation (see Paragraph C). The float switches shall be Model 9G Direct Acting float switch by Consolidated Electric or equal, and shall be mounted on a stainless steel cable/weight mounting kit (Model LS) by Consolidated Electric, or equal.

## 2.18 ELECTROMAGNETIC FLOWMETER

- A. All pump stations shall be equipped with a discharge flow meter on the discharge force main.
- B. Flanged type electromagnetic flowmeter to be furnished pump station manufacturer and installed by contractor. The flowmeter materials shall be suitable for raw wastewater service. The magnetic flowmeter will maintain an accuracy of  $\pm 0.5\%$  of flow rate or better when mounted as close as one pipe diameter from the flange of the magmeter when located next to elbows in the line sizes up to 18”. It will also have no downstream piping requirements for maintaining its published accuracy specification. The output signal shall be integrated with mission control. The magnetic flowmeter

shall be the LF654 series flow tube and the LF620 series converter as manufactured by Toshiba. Alternative magmeters by Rosemount or approved equal may also be submitted for ReWa review provided they meet the operational and space requirements of the pump station.

## 2.19 STATION FIBERGLASS ENCLOSURE AND BASE

### A. Station Construction and Design:

1. The station shall incorporate a fiberglass enclosure and steel base. The station shall be supplied as a complete, weathertight unit with all pump, piping and controls installed and wired by the pump manufacturer.
2. The enclosure and base is to be rectangular with outside dimensions of \_\_\_' long by \_\_\_' wide and having a maximum outside height of 9'-6" at the roof peak. The internal height of the enclosure shall be 8'-6".
3. A minimum of (4) four lifting eyes provided on the station base shall be provided to ease handling and installation onto a concrete pad furnished by the contractor.
4. Enclosure walls and roof shall be seamless, one-piece sprayed fiberglass panels laminated to form a structural composite as follows: 1/8" thick fiberglass outside surface, minimum 2" thick urea foam polyurethane core, 7/16" oriented strand board (OSB), and 3/32" thick fiberglass inside surface. OSB shall replace foam at all cut-out openings and penetration points.
5. Each wall panel shall overlap at the corner and form an internal connection joint using stainless steel hardware. All panel joints shall be thoroughly sealed with silicone caulk. The enclosure shall have a minimum R10 insulation factor and shall be capable of withstanding 150 mph wind loads.
6. The pump station enclosure shall incorporate an optional insulation package which increases the standard R10 insulation rating to R20 by doubling the thickness of the urea foam polyurethane core in the wall and roof panels.
7. The exterior of the enclosure shall be covered with an aesthetically pleasing simulated brick façade, consisting of polyurethane panels affixed to the exterior fiberglass enclosure with industrial grade urethane adhesive and mechanical fasteners. The polyurethane panels shall be manufactured from highly durable weather proof material with near zero UV degradation. The insulation factor (R-value) of the polyurethane panels shall achieve a minimum of an R-2 factor. The polyurethane material used in the manufacturing of the panels shall be tested in accordance with ASTM test methods.
8. All interior surfaces shall be sprayed white isophthalic gel coat finish offering the same characteristics as the exterior surfaces.
9. The roof panel shall be an arched, one-piece design incorporating the same materials of construction as the side walls. The roof shall be removable as a unit, allowing for complete access to the pumping equipment with a crane. The pitch of the roof shall be sufficient for good moisture drainage, and withstand a minimum snow load of 40 pounds per square foot.
10. The station shall be furnished with one (1) 3'0" wide x 6'8" high entrance door(s) shall be constructed of the same laminated fiberglass and foam core materials as the remainder of the station. OSB will replace the insulation in areas where auxiliary equipment will be mounted. Each door shall be hung with (3) three stainless steel ball bearing type hinges incorporating a three point closure system with a lockable door handle. An adjustable door positioner and holder shall be mounted at the top of the door. A gasket consisting of solid rubber and sponge

shall seal the door while closed. The door and all hardware shall be mounted to withstand 150 MPH winds. A wall mounted drip molding will be installed above each door.

11. The station enclosure shall be furnished with one (1) extra wide doors. A double hung door design with 3-point locking hardware, door closer, and hinges on each section shall allow complete access to the 6'-0" x 6'-8" full door opening without the need for a center sill.
  12. The station enclosure shall be furnished with an overhead rolling hurricane style service door measuring 8'x7' or 10'x7'. The door shall be sealed and gasketed for weather protection, and shall be capable of being internally padlocked. Door shall include overhead receiver and track hardware installed and shall be constructed with locking provisions. Door shall be capable of being electrically operated by one or more optional devices including a pushbutton and/or key pad. It will also include manual override in the event of a power outage.
  13. The design shall resist deformation of the structure during shipping, lifting, or handling. Base shall incorporate drainage provisions, and an opening sized to permit installation of piping and service connections to the wet well. After installation, the opening shall serve as a grout dam to be utilized by the contractor. The base shall incorporate anchor points for securing the complete station to a concrete pad (supplied by the contractor) in accordance with the project plans.
  14. Pumps and motor stands shall bolt directly to the station base eliminating the need for a pump skid.
  15. Holes through the base shall be provided for suction and discharge lines, air release lines, and level control cabling or air lines. Holes for the suction and discharge lines shall be provided with a grout dam incorporated in a grout retention cavity which the contractor shall fill at installation with suitable grout to seal each pipe to base joint against the entrance of hazardous gases from the wet well.
  16. The station base shall be coated with a non-slip surface.
  17. The walls of the fiberglass enclosure shall be mounted to the steel base with mechanical fasteners in two foot intervals. The connection between the enclosure walls and the steel base shall be sealed with a neoprene gasket.
  18. The station shall be positioned on the concrete mounting pad supplied by others.
- B. Enclosure Functional Equipment:
1. The interior of the station shall be illuminated by factory installed 120 volt LED light fixtures. All lights will be prewired and run to a load center through PVC conduit and a weatherproof switch shall be installed adjacent to each station entrance. The lighting circuit shall be protected by a thermal-magnetic circuit breaker.
  2. The exterior of the station shall be illuminated by factory installed 120 volt LED exterior rated wall pack light fixtures. All lights will be prewired and run to a load center through PVC conduit and a weatherproof switch shall be installed adjacent to each station entrance. The lighting circuit shall be protected by a thermal-magnetic circuit breaker.
  3. A thermostatically controlled 120 VAC exhaust fan with screen and weatherproof shutters shall be installed in the wall approximately opposite the fresh air intake vent. The fan shall have a minimum capacity of 1600 CFM at free air and be capable of changing the air in the enclosure a minimum of six times per hour. The exhaust fan shall be protected by a thermal-magnetic circuit breaker.



4. The enclosure will be complete with one (1) set of exhaust louvers. The exhaust louvers will be completely self-contained and shall not require the use of motors, solenoids, or other electrically operated devices. Exhaust louver will consist of four (2) 15" wide and 18-7/8" high shutters that open automatically at 75° F, and close at 60° F. Shutter operation will be the result of the expansion and contraction of wax in an enclosed plunger which shall drive the louver vanes through a mechanical linkage. The exhaust shutter will have the actuator mounted in the flow of the exhaust air and shall maintain the shutter vanes in the open position. Exhaust shutter frame will be constructed of anodized aluminum with zinc plated steel actuator mounting and linkage. The shutter vanes will pivot on plastic bearings. The four (4) intake shutters will be mounted in two aluminum fixed vane louver assemblies to prevent the entrance of rain or snow.
5. A battery back-up 12 volt DC emergency lighting system shall provide 50 watts of illumination for 1-1/2 hours in the event of power outage. The system shall be fully self-contained for automatic operation of (2) two sealed beam lamps powered by a maintenance free pure-lead 12 volt battery. An automatic solid state battery charger with integral transfer circuit shall maintain the battery in a constant state of readiness. A charge rate pilot light and test switch shall be provided. The charging circuit shall be protected by a thermal-magnetic circuit breaker.
6. A high capacity electric blower type station heater shall be provided for the protection of the pumping equipment. The heater shall maintain an inside/outside differential temperature of 60 degrees F while operating on the primary voltage supplied to the station. The heater shall be provided with an adjustable thermostat, circuit breaker, and contactor.
7. One wall mounted duplex GFI utility receptacle providing 120 volt AC power shall be installed and prewired through PVC conduit with the station lighting. The receptacle shall be protected by thermal magnetic circuit breaker.
8. Consists of a three piece assembly including duck bill check valve, SST strainer top, and PVC spacer to provide a gas and water tight drain receptacle for use in concrete pad within Modular Enclosure. (Note: A 4" PVC drain pipe and PVC coupling shall be required to be provided and installed by others.)
9. The station enclosure shall include limit switches with defeater switch alarm circuit and time delay, mounted and wired in the station enclosure to indicate that there has been a door left open or unauthorized entry to the station. There shall be an adjustable time period for the operator to disable alarm with an unmarked pushbutton located inside the station. The notification shall be activated when a station door is opened. Includes dry contacts pre-wired to a terminal strip for remote monitoring.

END OF SECTION 33 32 13

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## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes: Air release/vacuum breaker valves for wastewater treatment facilities.
- B. Related Requirements:
  - 1. Section 33 01 32 – Sewer and Manhole Testing.

### 1.2 REFERENCE STANDARDS

- A. American Water Works Association:
  - 1. AWWA C512 - Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
- B. ASME International:
  - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
- C. ASTM International:
  - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - 2. ASTM A240 – Heat-Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels.
  - 3. ASTM A351/A351M - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
  - 4. ASTM A536 - Standard Specification for Ductile Iron Castings.
  - 5. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
- D. International Organization for Standardization:
  - 1. ISO 9001 - Quality Management Systems.

### 1.3 COORDINATION

- A. Coordinate Work of this Section with installation of process piping.

### 1.4 SUBMITTALS

- A. Provide submittals in accordance with requirements set forth in the project manual.
- B. Product Data: Submit manufacturer catalog information.

- C. Shop Drawings: Indicate materials, dimensions, weights, and end connections on assembly drawings.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit special procedures and setting dimensions.
- F. Operation & Maintenance Manual.
- G. Source Quality-Control Submittals: Indicate results of shop/factory tests and inspections.
- H. Manufacturer Reports: Certify that equipment has been installed according to manufacturer instructions, verifying the results of the following:
  - 1. Certified performance information produced by an independent testing laboratory acceptable to the Construction Manager, current to within five years from the date of the submittal, specific to the construction details for the model proposed, confirming performance not less than that required by this specification. The test methodology may use mathematical modeling techniques to affirm specific model size performance so long as the test performance for specific size valve(s) has been spot-checked by bench tests of the valve size in question and the results show modeling performance within  $\pm 5$  percent of bench test results. The performance confirmation shall be dated, signed by the author of responsible for the test information, notarized as true and correct.
- I. Qualifications Statements:
  - 1. Submit qualifications for manufacturer.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of air release/vacuum breaker valves.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Quality Management System: Certified to ISO 9001.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. Furnish five-year manufacturer's warranty for air release/vacuum breaker valves.

PART 2 - PRODUCTS

2.1 AIR/VACUUM VALVES FOR WASTEWATER SERVICE

A. Manufacturers:

1. ARI Model D-025 - "SAAR" Short Version, or ARI D-020 – Stainless Steel Version.
2. Vent Tech Model SDG, Series C – Sewage Short Valve.
3. Vent Tech Model SXG, Series C.
4. Ventomatic
5. Or Approved Equal.

B. Description:

1. Type: Fully automatic, float operated.
2. Comply with AWWA C512 (if cast iron or ductile iron bodies are used).
3. Connection Size: As indicated on Drawings.
4. Orifice Size: Designed to provide adequate Air/Vacuum release rates anticipated under operating conditions. Provide supporting calculation information to Engineer and ReWa approval.
5. Suitable for sewage service.
6. Valve Body Connections: Furnish 2-inch NPT cleanout and 1-inch NPT drain.
7. Pressure Rating:
  - a. 150 psig max working pressure.
  - b. If higher pressures are required, calculations supporting valve sizing/design shall be submitted to Engineer and ReWa for review

- C. Materials: As specified by individual manufacturer.

D. End Connections:

1. Size 3 Inches and Smaller:
  - a. Threaded, NPT.
  - b. 1-Inch Valves: Furnish 2-inch inlet.
2. Size 4 Inches and Larger: Flanged, ASME B16.1.
3. Backwash Accessories: Furnish three additional NPT connections.

E. Valve Body Connections:

1. Threaded, NPT.
2. Cleanout: 2 inches.
3. Drain: 1 inch.

F. Accessories:

1. Backwash accessories, including inlet shutoff valve, blowoff valve, rubber supply hose, and quick-disconnect couplings.
2. Epoxy lining.

2.2 INSULATION

- A. As indicated on Drawings.

2.3 FINISHES

- A. Prepare piping appurtenances for field finishes as specified in Section 099635 - Chemical-Resistant Coatings.

2.4 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of completed assembly.
- B. Certificate of Compliance:
1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
  2. Specified shop tests are not required for Work performed by approved fabricator.

2.5 SPARE PARTS

- A. One spare valve shall be provided for each type and size of valve specified.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that field dimensions are as indicated on Shop Drawings.
- B. Inspect existing flanges for nonstandard bolt hole configurations or design and verify that new pipe and flanges mate properly.

#### 3.2 PREPARATION

- A. Thoroughly clean end connections before installation.
- B. Close pipe and equipment openings with caps or plugs during installation.
- C. Cleaning: Clean surfaces to remove foreign substances.

#### 3.3 INSTALLATION

- A. According to manufacturer instructions.
- B. Provide access for operation, removal, and maintenance, and to avoid discharge to occupied areas or other equipment.

#### 3.4 FIELD QUALITY CONTROL

- A. Inspect for interferences and proper supports.
- B. Testing:
  - 1. As specified in Section 33 01 32 – Sewer and Manhole Testing.
  - 2. Demonstrate operation without undue noise or vibration.
- C. Equipment Acceptance:
  - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
  - 2. Make final adjustments to equipment under direction of manufacturer's representative.
  - 3. Repair damaged coatings with material equal to original coating.
- D. Furnish installation certificate from equipment manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 CLEANING

- A. Keep interior of air release valves clean as installation progresses.

3.6 DEMONSTRATION

- A. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION 40 05 78.23

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Non-freeze yard hydrants.
- B. Related Requirements:
  - 1. Not Used

1.2 COORDINATION

- A. Coordinate Work of this Section with installation of water mains.

1.3 SUBMITTALS

- A. Provide submittals in accordance with requirements set forth in the project manual.
- B. Product Data: Submit manufacturer information regarding component materials, fittings, assembly and parts diagram, and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- F. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of non-freeze yard hydrants.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Tools: Furnish one tee wrench of required length, for each hydrant, to Owner.

1.6 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified according to NSF 61 and NSF 372.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
  - 1. Seal hydrant ends to prevent entry of foreign matter.
  - 2. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location.
  - 2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 NON-FREEZE YARD HYDRANTS

- A. Manufacturers:
  - 1. Woodford Model Y-1, or approved equal
- B. Description:
  - 1. Type: Non-freeze.
  - 2. Closure Valve: Free-floating, compression type.
  - 3. Barrel: Automatic drain after use.
  - 4. Stem: Nourishing.
  - 5. Main Valve: 1-1/2 inches.
  - 6. Lubrication: Furnish access hole in operating nut.
- C. Materials:
  - 1. Body: Cast Iron.
  - 2. Head: Cast iron.
  - 3. Outlets: Brass.
  - 4. Main Valve: Bronze.
  - 5. Drain Valve: Bronze.
  - 6. Operating Rod: Brass.
- D. Operation:
  - 1. Cast-iron lever control



2. Drain Valve: Actuated when main valve is in CLOSED position.

E. Connections:

1. Hose Connection: One each, 3/4-inch hose connections, with threaded quick-disconnect adapters.
2. Drain Port: 1/8 inch.
3. Inlet:
  - a. Size: 1 inch.
  - b. Type: Threaded.

F. Accessories:

1. Operating handle lock.
2. Casing Guard: Cast Iron

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Verify that elevations of existing facilities prior to excavation and installation of non-freeze yard hydrants are as indicated on Drawings.

#### 3.2 PREPARATION

- A. Locate, identify, and protect from damage utilities to remain.
- B. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.
  1. Notify Engineer not less than 3 days in advance of proposed utility interruption.
  2. Do not proceed without written permission from Engineer.

#### 3.3 INSTALLATION

- A. Perform trench excavation, backfilling, and compaction as specified in Section 31 23 16.13 - Trenching.
- B. Install non-freeze yard hydrants in conjunction with pipe laying.
- C. Provide support blocking and drainage gravel while installing non-freeze yard hydrants; do not block drain hole.

- D. Orientation:
1. Set valves and hydrants plumb.
  2. Set non-freeze yard hydrants with outlets as indicated on Drawings.
  3. Set non-freeze yard hydrants with centerline of outlets 24 inches above finished grade or as indicated on Drawings.
- E. After main-line pressure testing, flush non-freeze yard hydrants and check for proper drainage.
- F. Disinfection of Water Piping System: Flush and disinfect non-freeze yard hydrants with water mains in accordance with local water provider and/or SCDHEC requirements.

### 3.4 FIELD QUALITY CONTROL

- A. Testing: Pressure test non-freeze yard hydrants with water mains in accordance with local water provider and/or SCDHEC requirements.

END OF SECTION 40 05 81.26

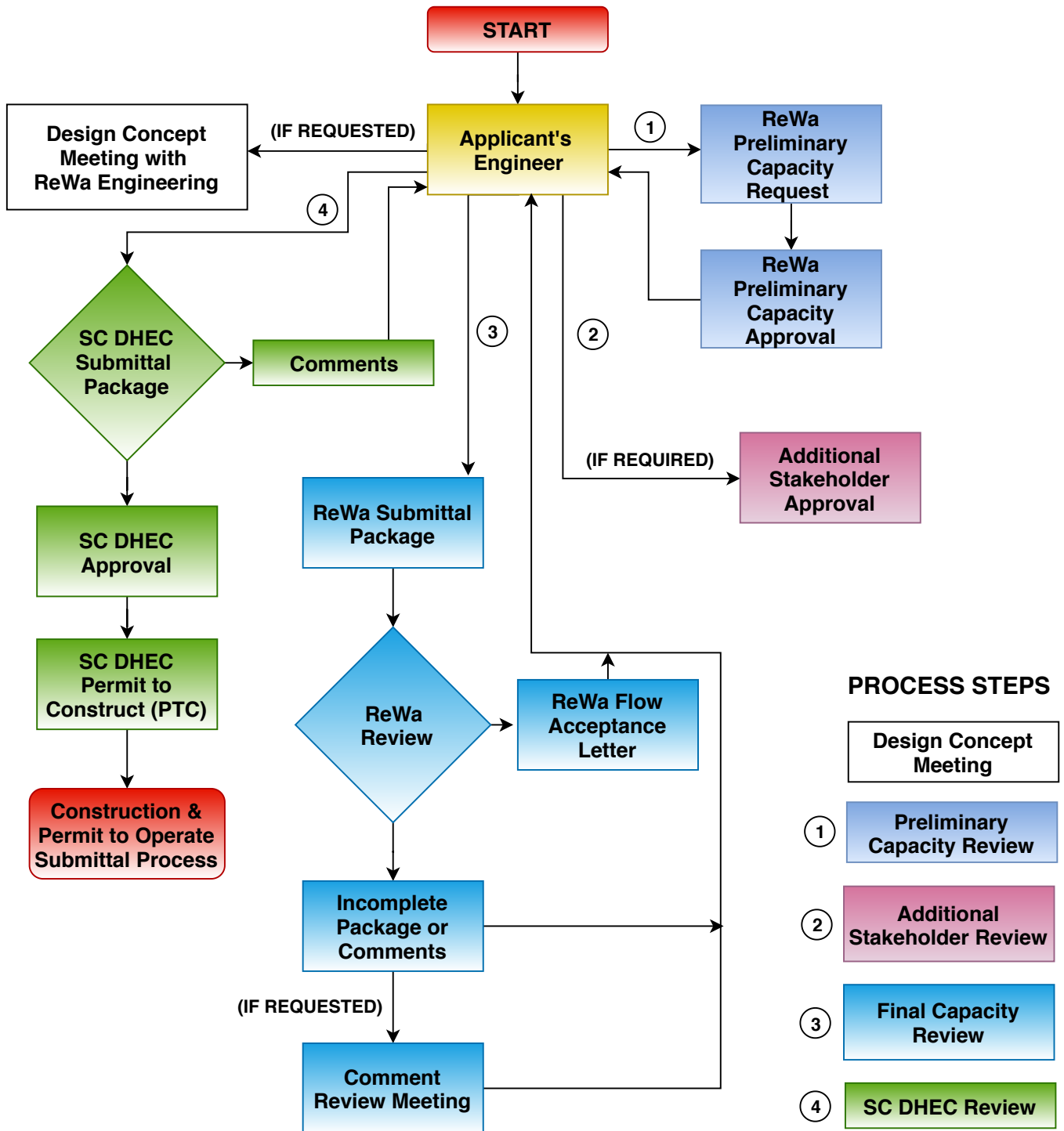
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APPENDIX III

PROCESS FLOWCHARTS

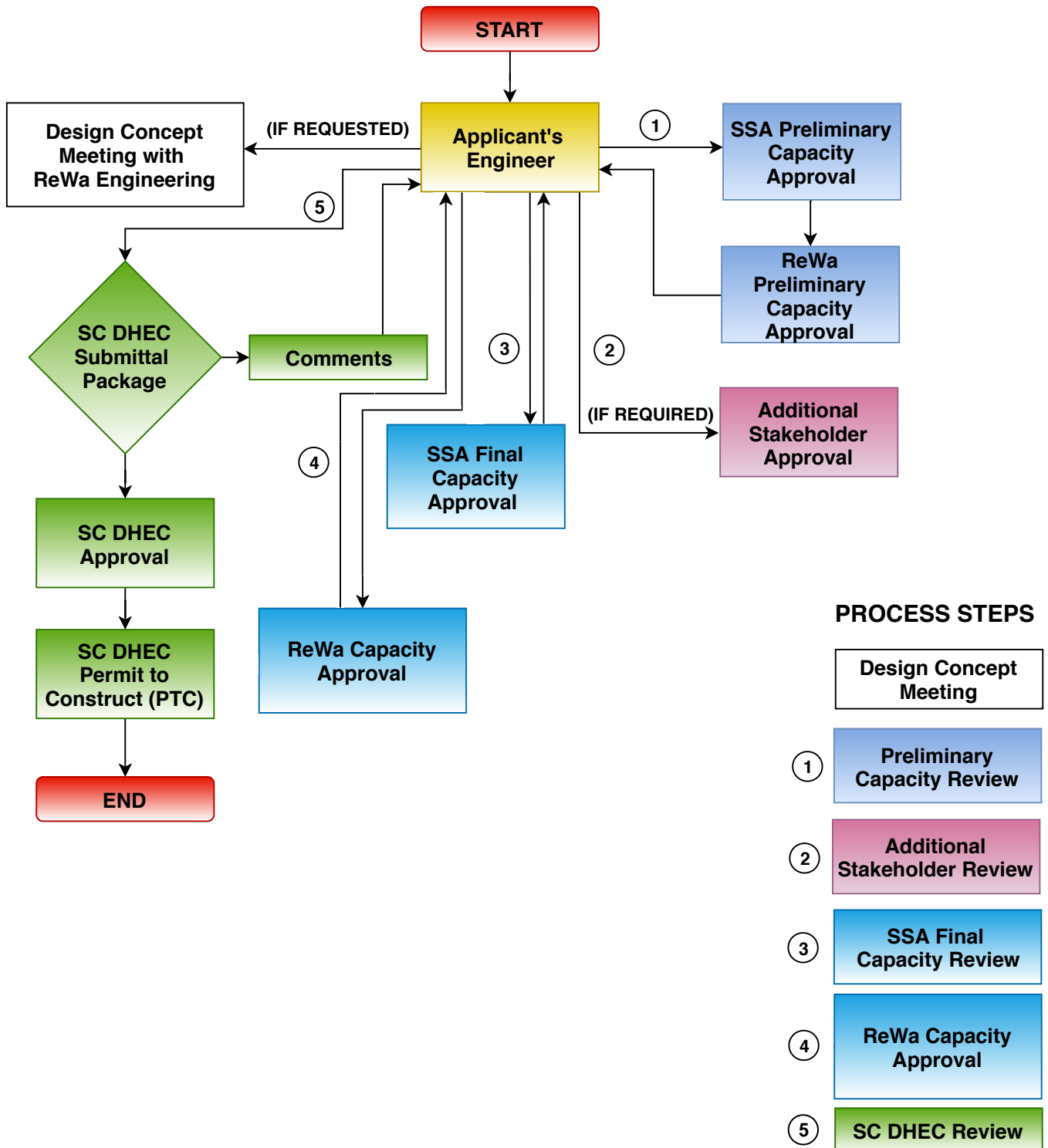


## ReWa PUBLIC MAIN EXTENSION CAPACITY APPROVAL & PERMIT TO CONSTRUCT SUBMITTAL PROCESS



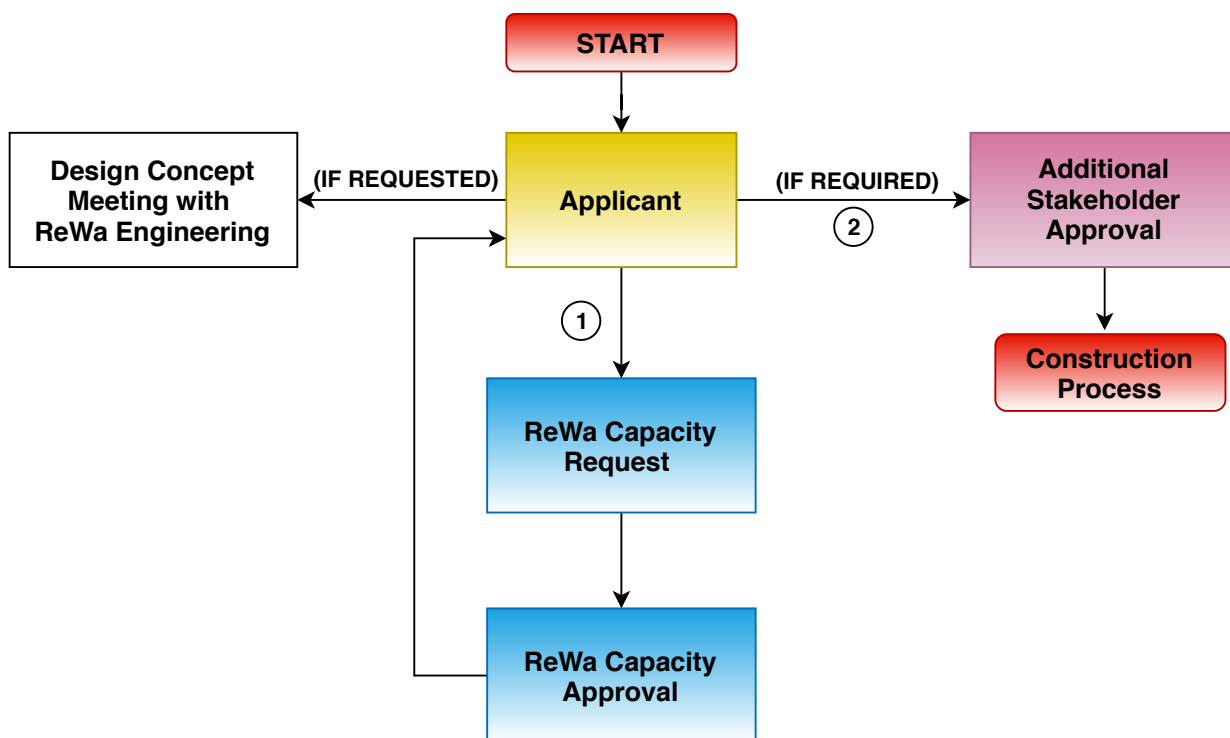


**SATELLITE SEWER AGENCY (SSA) MAIN EXTENSION  
CAPACITY APPROVAL & PERMIT TO CONSTRUCT  
SUBMITTAL PROCESS**

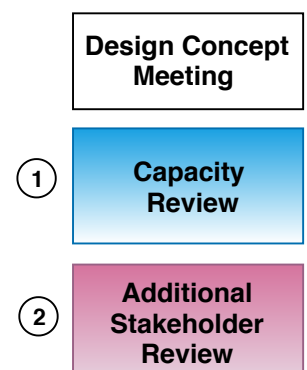




## ReWa SERVICE LATERAL CONNECTION CAPACITY APPROVAL SUBMITTAL PROCESS

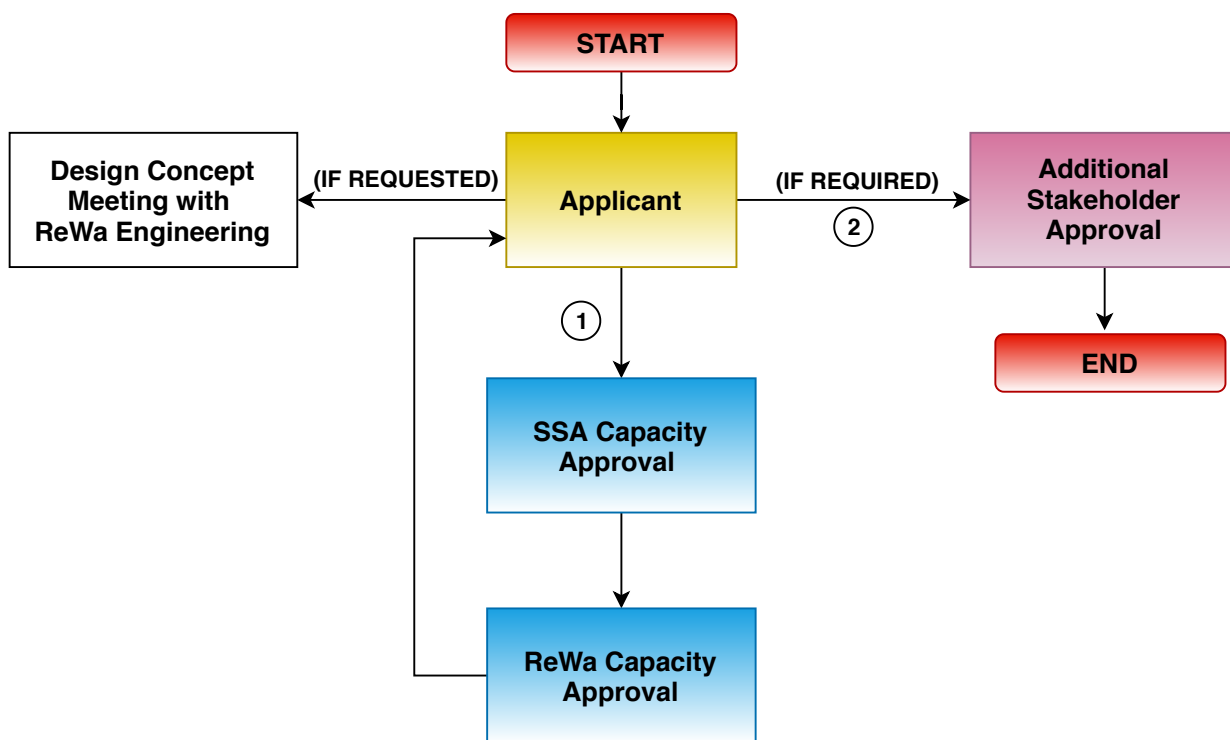


### PROCESS STEPS

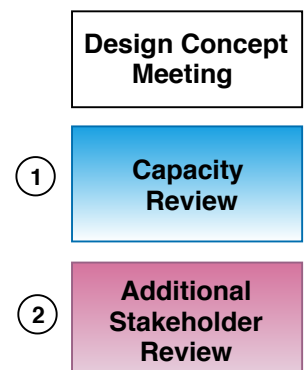




**SATELLITE SEWER AGENCY (SSA)  
SERVICE LATERAL CONNECTION  
CAPACITY APPROVAL SUBMITTAL PROCESS**



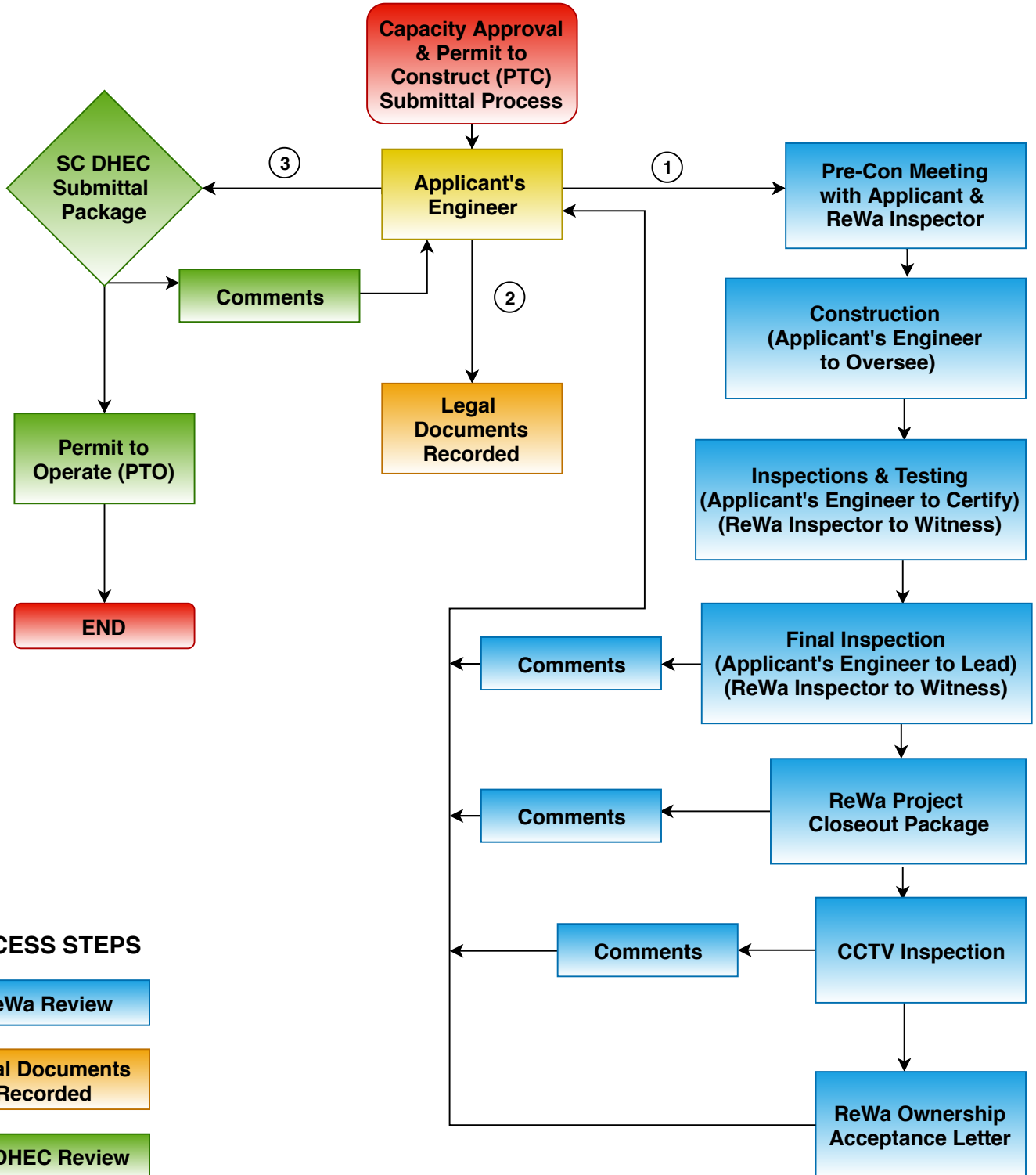
**PROCESS STEPS**





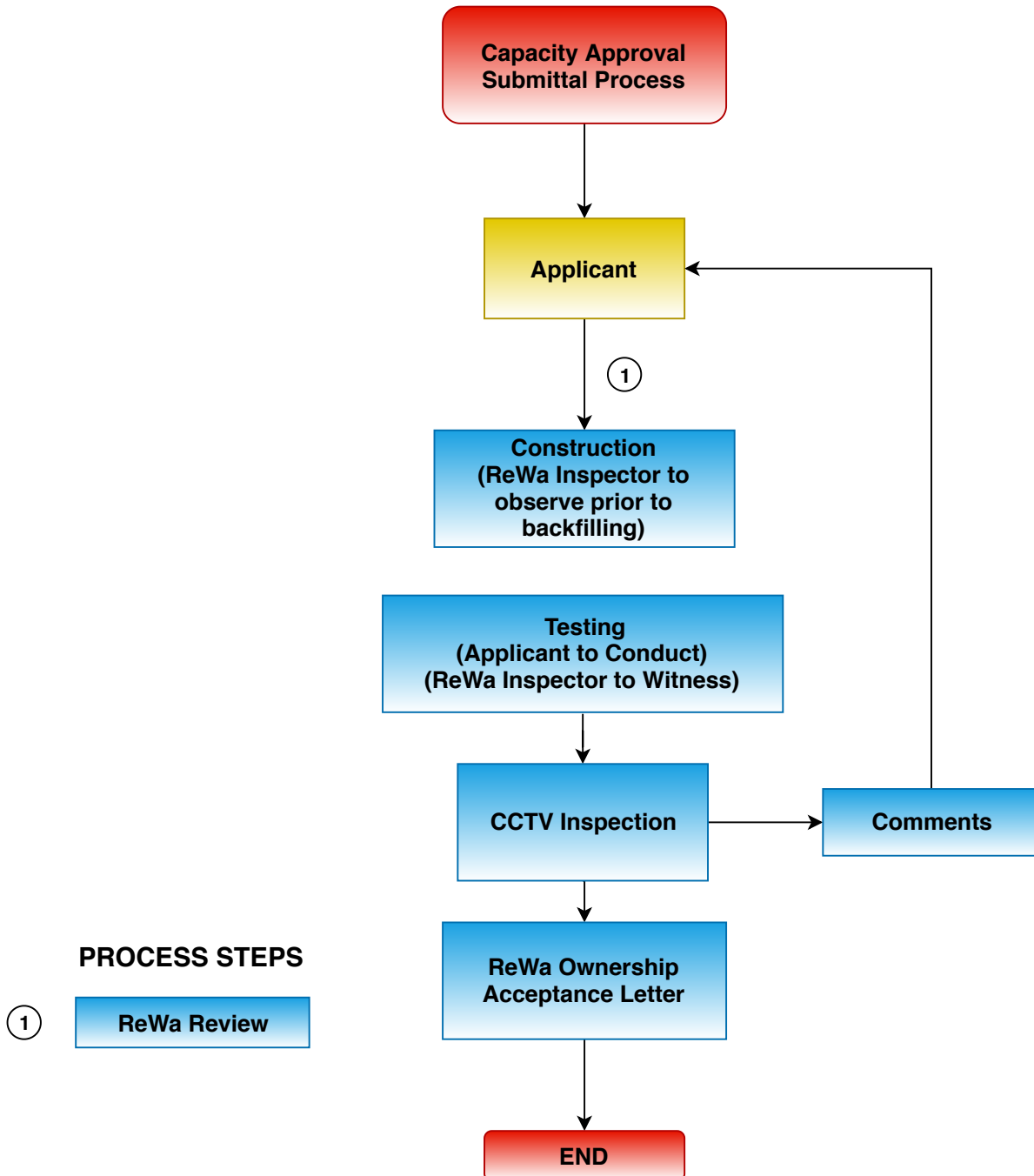


**ReWa PUBLIC MAIN EXTENSION  
CONSTRUCTION & PERMIT TO OPERATE  
SUBMITTAL PROCESS**

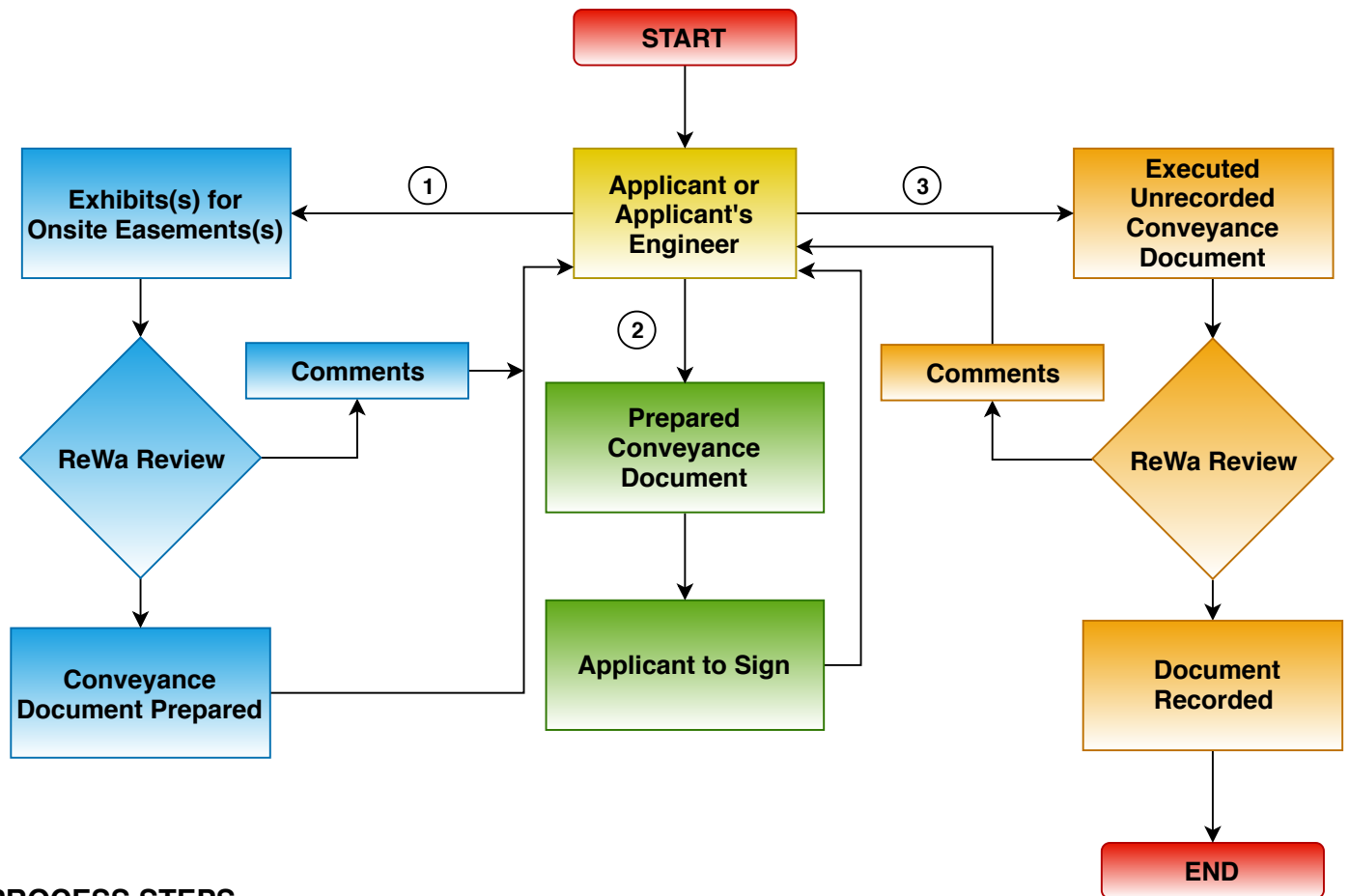




## ReWa SERVICE LATERAL CONNECTION CONSTRUCTION PROCESS



**ON SITE DEDICATION AND CONVEYANCE PROCESS**

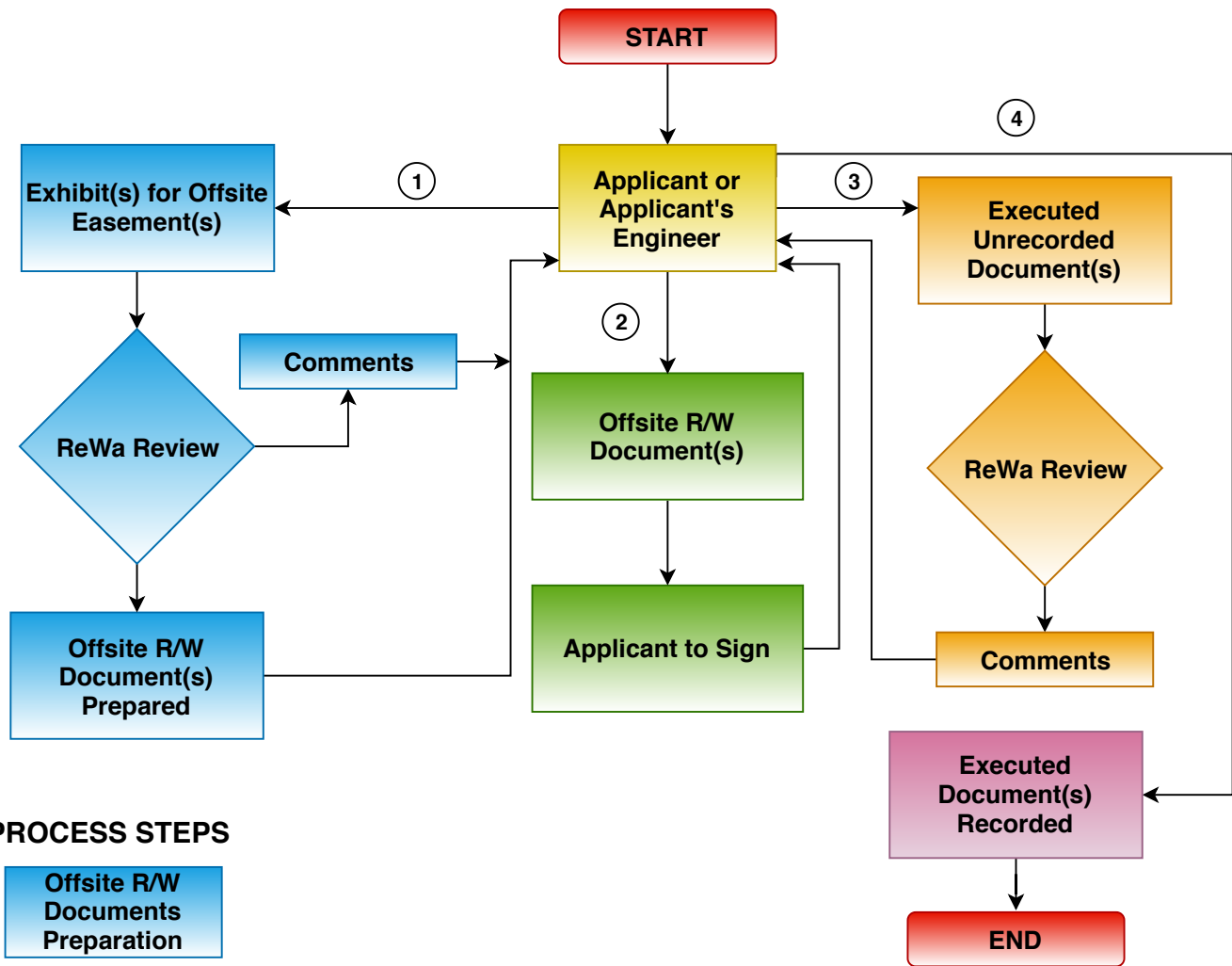


**PROCESS STEPS**

- ① **Conveyance Document Preparation**
- ② **Applicant Signature**
- ③ **Dedication & Conveyance Documents Recorded**

\* On-Site Easement: The right to use the real property within the defined limits of Applicant's property.

**OFFSITE DEDICATION AND CONVEYANCE PROCESS**



**PROCESS STEPS**

- ① Offsite R/W Documents Preparation
- ② Applicant Signature
- ③ Before Recording
- ④ Executed and Recorded

\* Off-Site Easement: The right to use the real property outside the defined limits of Applicant's property.

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## APPENDIX IV

# CAPACITY APPROVAL PROCESS & PROJECT CLOSEOUT CHECKLISTS

## Renewable Water Resources Capacity Approval Process Checklist Design Calculations – Gravity Sewer

PROJECT NAME:	
APPLICANT'S ENGINEER:	
ENGINEERING CONTACT:	DATE:

The Applicant's Engineer shall complete and submit this checklist along with the other items listed in the ReWa Capacity Approval Process Checklist. **All documents shall be delivered to ReWa in one submittal.** All electronic copies shall be provided in PDF format, unless otherwise noted. If any required items deemed incomplete by ReWa, it will be noted in the form below and returned to the Applicant's Engineer. ReWa will not issue a flow acceptance letter until all required items have been received and deemed complete.

Check boxes to denote completion or write "N/A" if not applicable to project.

### DESIGN CHECKLIST

<u>Required Items</u>	<u>Engineer</u>	<u>ReWa</u>	
	Complete	Complete	Complete
Initial Design Flow Calculations (Peak Hour Flow)			
Future Contribution Calculation			
Pipe Material: PVC preferred, provide justification for DIP or FRP			
Pipe Bedding per ReWa Standard Details (refer to Appendix I – Standard Drawings)			
Pipe Layout / Sizing Calculations:			
Minimum 8" Diameter			
Minimum slope (per Table 6-1 of Manual)			
Maximum allowable flow depths (per Table 6-2 of Manual)			
Minimum velocity $\geq 2.0$ ft/s			
Aerial Crossing Design Calculations (if applicable):			
Pipe Support Structural Design Calculations			
Pipe Thickness Design Calculations			
Connections to Manholes per ReWa Standard Details (refer to Appendix I – Standard Drawings)			
Grease Control Devices – Inground Grease Interceptor			
Volume = 20 gallons per seat (for FSEs) or 20 gallons per bed (for healthcare facilities)			
Minimum Single Grease Interceptor $\geq 1,500$ gallons			
Maximum Single Grease Interceptor $\leq 2,000$ gallons			
Potable water supply near Grease Interceptor			
Grease Control Devices – Under-the-Sink Grease Trap			
Constructed with non-metallic, non-corrosive material			
Located above grade of floor			
Minimum size of 20 # (pound) (10 gpm)			

**Renewable Water Resources  
Capacity Approval Process Checklist  
Design Calculations – Gravity Sewer**

**SIGNATURES (SIGN AND DATE)**

APPLICANT'S ENGINEER:	DATE:
ReWa DEVELOPMENT PROJECT ENGINEER:	DATE:



**Renewable Water Resources  
Capacity Approval Process Checklist  
Design Calculations – Pump Station & Force Main**

PROJECT NAME:	
APPLICANT'S ENGINEER:	
ENGINEERING CONTACT:	DATE:

The Applicant's Engineer shall complete and submit this checklist along with the other items listed in the ReWa Capacity Approval Process Checklist. **All documents shall be delivered to ReWa in one submittal.** All electronic copies shall be provided in PDF format, unless otherwise noted. If any required items deemed incomplete by ReWa, it will be noted in the form below and returned to the Applicant's Engineer. ReWa will not issue a flow acceptance letter until all required items have been received and deemed complete.

Check boxes to denote completion or write "N/A" if not applicable to project.

**DESIGN CALCULATIONS – DESIGN FLOW & OPERATING POINT**

<u>Required Items</u>	<u>Engineer</u>	<u>ReWa</u>	
	Complete	Complete	Complete
Initial Design Flow Calculations			
Future Contribution Calculations			
Total Dynamic Head (TDH) Calculation:			
Static Head Calculations (Highest Pt. along FM – Pump Off Elev.)			
Dynamic Head Calculation (Friction Head, Minor Head Losses, etc.)			
Operating Point – plot TDH vs. flow rate onto pump curve; include pump impellor size and operating point			
Pump Station Piping Design Compliance with ANSI/HI 9.6.6 (latest edition)			
NPSH margin and NPSH margin ratio across entire operating range equal to or greater than values listed in Table 9.6.1.5.5 of Hydraulics Institute standard ANSI/HI 9.6.1 (latest edition)			

**DESIGN CALCULATIONS – WET WELL DESIGN**

<u>Required Items</u>	<u>Engineer</u>	<u>ReWa</u>	
	Complete	Complete	Complete
Cycle Time:			
$Volume = (T * q) / 4$ where Volume = active between Low Water Level and High Water Level, in gallons. T = 10, allowable minimum cycle time between starts (time to fill + time to empty), in minutes Q = pumping rate of single pump, in gpm			

**Renewable Water Resources  
Capacity Approval Process Checklist  
Design Calculations – Pump Station & Force Main**

Fill time = Volume / ADF			
Run time – Volume / (q – ADF) where q = pumping rate of single pump, in gpm			
Dynamic Head Calculation (Friction Head, Minor Head Losses, etc.)			
Uplift Check (Buoyancy), Factor of Safety (FS) ≥ 2.0			
FS = (wet well weight + soil overburden + soil resistance) / (uplift force)			
Operating Point – plot TDH vs. flow rate onto pump curve; include pump impellor size and operating point			
Wet Well and Intakes Design Compliance with ANSI/HI 9.8 (latest edition)			

**DESIGN CALCULATIONS – SURGE RELIEF CHECK**

<u>Required Items</u>	<u>Engineer</u>	<u>ReWa</u>	
	Complete	Complete	Complete
Condition – all pumps running			
Wave Velocity Calculations			
Water Hammer Pressure Calculations			
Total Pressure – equal to water hammer pressure plus static head (check total pressure against pressure ratings for valves & piping; i.e. provide class & thickness)			

**DESIGN CALCULATIONS – EMERGENCY STORAGE (only if requested by ReWa)**

<u>Required Items</u>	<u>Engineer</u>	<u>ReWa</u>	
	Complete	Complete	Complete
Storage between overflow elevation (lowest pipe RIM elev.) and lead pump on elevation			
Storage Calculations:			
Storage Time = Total Storage / ADF			
Total Storage = (Wet Well Storage) + (Pipe Storage) + (Manhole Storage)			
Verify Storage Time ≥ Maximum Power outage time over last 5 years			
Total Storage > Volume in force main to 1st downstream			

**Renewable Water Resources  
Capacity Approval Process Checklist  
Design Calculations – Pump Station & Force Main**

**DESIGN CALCULATIONS – SUPPORTING DOCUMENTATION**

<u>Required Items</u>	<u>Engineer</u>		<u>ReWa</u>	
	Complete	Complete	Complete	Complete
Basin Map Delineating Service Area				
100-year flood map (FEMA) or high ground water elevation (SCS)				
Provide cut sheets or product literature for the following:				
Pumps – include pump curves, motor data, electrical data, arrangement dimensions				
Valves – include max. operating pressure info				
Power Source (utility provider)				
Hydraulic Calculations prepared by a Professional Engineer licensed in the State of South Carolina				

**SIGNATURES (SIGN AND DATE)**

APPLICANT’S ENGINEER:	DATE:
ReWa DEVELOPMENT PROJECT ENGINEER:	DATE:

**Renewable Water Resources  
Project Closeout Checklist – Part 1  
General**

PROJECT NAME:	
APPLICANT'S ENGINEER:	
ENGINEERING CONTACT:	DATE:

The Applicant's Engineer shall complete this checklist and include it in Part 1 of Project Closeout Submittal Package to the ReWa Development Project Engineer. **All documents shall be delivered to ReWa in one submittal.** All electronic copies shall be provided in PDF format, unless otherwise noted. If any required items are deemed incomplete by ReWa, it will be noted in the form below and returned to the Applicant's Engineer. ReWa will not proceed with CCTV Inspection until all required items in Part 1 have been received and deemed complete.

Check boxes to denote completion or write "N/A" if not applicable to project.

**PART 1**

<u>Required Items</u>	<u>Engineer</u>		<u>ReWa</u>	
	Complete	Complete	Complete	Incomplete
Engineer's Letter of Certification				
Gravity sewer main installations shall include the following:				
One (1) copy of Low-Pressure Air test results				
Infiltration test results – if applicable				
Exfiltration test results – if applicable				
Mandrel test results				
Manhole vacuum test results				
Force main installations shall include the following:				
Pressure test results				
Pump Station installations shall include the following:				
Pump station drawdown test results				
Factory & Field Hydraulic Acceptance Testing and Grade 1U Tolerance Conformance in accordance with Hydraulic Institute Standard ANSI/HI 14.6 (latest edition)				
Factory & Field Vibration Testing in accordance with Hydraulic Institute Standard ANSI/HI 9.6.4 (latest edition)				
Record drawings – include & complete appropriate checklist				

**SIGNATURES (SIGN AND DATE)**

APPLICANT'S ENGINEER:	DATE:
ReWa DEVELOPMENT PROJECT ENGINEER:	DATE:
ReWa INSPECTOR:	DATE:

**Renewable Water Resources  
Project Closeout Checklist – Part 1  
Record Drawing – Gravity Sewer**

PROJECT NAME:	
APPLICANT'S ENGINEER:	
ENGINEERING CONTACT:	DATE:

The Applicant's Engineer shall complete this checklist and include it in Part 1 of Project Closeout Submittal Package to the ReWa Development Project Engineer. All documents shall be delivered to ReWa in one submittal. All electronic copies shall be provided in PDF format, unless otherwise noted. If any required items are deemed incomplete by ReWa, it will be noted in the form below and returned to the Applicant's Engineer. ReWa will not proceed with CCTV Inspection until all required items have been received and deemed complete.

Check boxes to denote completion or write "N/A" if not applicable to project.

<u>Required Items</u>	<u>Engineer</u>	<u>ReWa</u>	
	Complete	Complete	Incomplete
ReWa Project Name (on all sheets)			
ReWa Project # (on all sheets)			
ReWa Extension # (on all sheets)			
SC DHEC Permit # (on title sheet)			
Block Designation			
Lot, Unit, Tax Map Numbers			
Street Names			
Site Map – minimum size 3"x 3"			
Text Height – 0.08-inch or larger			
Proposed force mains must be shown as a bold linetype and lineweight. Include labels detailing length, diameter, material (Ex. 150 LF of 8" PVC)			
Graphic and Relative Scales - Maximum 1" = 40'			
North Arrow			
Legend			
Utility Contractor's Name, Address, Phone Number, Email Address (on title sheet)			
Engineering Firm Name, Address, Phone Number (on title sheet)			
Construction Completion Date (month, year)			
Horizontal (NAD 83) and Vertical Datum (NGVD 29) (on all sheets)			
Professional Land Surveyor (PLS) Signature and Stamp (on title sheet)			
Registered Professional Engineer (PE) Signature and Stamp			
Sewer Easements – Label as "xx-FT ReWa Force Main Easement"			

**Renewable Water Resources  
Project Closeout Checklist – Part 1  
Record Drawing – Gravity Sewer**

<u>Required Items</u>	<u>Engineer</u>	<u>ReWa</u>	
	Complete	Complete	Incomplete
Installed Material Listing – Record Drawing must reflect same information:			
Pipe – length, diameter, material			
Manholes – diameter, quantity			
Service Lateral Connections – diameter, quantity			
Cleanouts – quantity			
Installed Material Listing – Record Drawing must reflect same information			
Coordinate Table for all installed sewer appurtenances in a tabular format, State Plane Coordinates (NAD 83) to include:			
Point Number			
Northing			
Easting			
Elevation			
Station Number			
Indicate how new main will tie into existing main (show existing in dashed, faded linetype and label size), show point of tie-in in State Plane Coordinates.			
Manhole Invert and Top Elevations, including pipe inverts (show on both Plan and Profile sheets)			
Manhole Station Numbers – must be tied to State Plane Coordinates			
Manhole Numbers			
Gravity Sewer Mains (show on both Plan and Profile):			
Length – manhole to manhole			
Percent of grade (slope) – manhole to manhole			
Separation from other utilities			
Pipe Cover Label (maintain a minimum of 3 feet of cover at all times)			
DIP Sewer Sections – manhole to manhole length or other sections			
Service Laterals – indicate distance from main to first cleanout within the easement or right-of-way			
End of Main – label and show in State Plane Coordinates			

**SIGNATURES (SIGN AND DATE)**

APPLICANT’S ENGINEER:	DATE:
ReWa DEVELOPMENT PROJECT ENGINEER:	DATE:
ReWa INSPECTOR:	DATE:

**Renewable Water Resources  
Project Closeout Checklist – Part 1  
Record Drawing – Pump Station & Force Main**

PROJECT NAME:	
APPLICANT'S ENGINEER:	
ENGINEERING CONTACT:	DATE:

The Applicant's Engineer shall complete this checklist and include it in Part 1 of Project Closeout Submittal Package to the ReWa Development Project Engineer. All documents shall be delivered to ReWa in one submittal. All electronic copies shall be provided in PDF format, unless otherwise noted. If any required items are deemed incomplete by ReWa, it will be noted in the form below and returned to the Applicant's Engineer. ReWa will not proceed with CCTV Inspection until all required items have been received and deemed complete.

Check boxes to denote completion or write "N/A" if not applicable to project.

**DRAWINGS – GENERAL**

<u>Required Items</u>	<u>Engineer</u>		<u>ReWa</u>	
	Complete		Complete	Incomplete
ReWa Project Name (on all sheets)				
ReWa Project # (on all sheets)				
ReWa Extension # (on all sheets)				
SC DHEC Permit # (on title sheet)				
Block Designation				
Lot, Unit, Tax Map Numbers				
Street Names				
Site Map – minimum size 3"x 3"				
Text Height – 0.08-inch or larger				
Proposed force mains must be shown as a bold linetype and lineweight. Include labels detailing length, diameter, material (Ex. 150 LF of 8" PVC)				
Graphic and Relative Scales - Maximum 1" = 40'				
North Arrow				
Legend				
Utility Contractor's Name, Address, Phone Number, Email Address (on title sheet)				
Engineering Firm Name, Address, Phone Number (on title sheet)				
Construction Completion Date (month, year)				
Horizontal (NAD 83) and Vertical Datum (NGVD 29) (on all sheets)				
Professional Land Surveyor (PLS) Signature and Stamp (on title sheet)				
Registered Professional Engineer (PE) Signature and Stamp				
Sewer Easements – Label as "xx-FT ReWa Force Main Easement"				
Installed Material Listing – Record Drawing must reflect same information:				
Pipe – length, diameter, material				
Manholes – diameter, quantity				

**Renewable Water Resources  
Project Closeout Checklist – Part 1  
Record Drawing – Pump Station & Force Main**

**DRAWINGS – GENERAL**

<u>Required Items</u>	<u>Engineer</u>	<u>ReWa</u>	
	Complete	Complete	Incomplete
Service Lateral Connections – diameter, quantity			
Cleanouts – quantity			
Installed Material Listing – Record Drawing must reflect same information:			
Coordinate Table for all installed sewer appurtenances in a tabular format, State Plane Coordinates (NAD 83) to include:			
Point Number			
Northing			
Easting			
Elevation			
Station Number			

**DRAWINGS – FORCE MAIN**

<u>Required Items</u>	<u>Engineer</u>	<u>ReWa</u>	
	Complete	Complete	Incomplete
Indicate how the new force main ties into the existing force main or manhole (show as dashed and label size), show point of tie-in in State Plane Coordinates			
Sewer Force Mains (show on both Plan and Profile):			
Length (pump station to discharge point)			
Pipe size & type			
Bore & Jack locations – if applicable			
Valves			
Separation from other utilities			
PVC Piping for all piping within 2 feet of top of pipe at all high points – if applicable			
PVC piping			
Plug isolation valves located upstream and downstream of ARVs			
PVC Piping for all downstream “flow-way” condition piping			
Air Release Valve (ARVs) Station Numbers – must be tied to State Plane Coordinates			
Surveyed Elevation of Discharge			
Top of Pipe Elevation at ARVs			
Force Main Valves – must be in State Plane Coordinates with Stations Numbers (include elevation to top of operating nut)			



**Renewable Water Resources  
Project Closeout Checklist – Part 1  
Record Drawing – Pump Station & Force Main**

**DRAWINGS – PUMP STATION**

<u>Required Items</u>	<u>Engineer</u>	<u>ReWa</u>	
	Complete	Complete	Incomplete
Address and TMS# of Pump Station property (if known)			
Pump Station Plan View (show, label & include dimensions for the following:)			
Wet well and valve vault size			
Spacing between wet well and valve vault			
Access hatches (size and type)			
3" Vent pipe location			
Pumps and FM piping			
Influent line			
Valve vault drain line			
Surge relief line			
Pipe supports			
Pumps and FM piping			
Influent line			
Pump Station Profile View (show, label & include dimensions for the following:)			
Wet well and valve vault top elevations			
Wet well and valve vault invert elevations			
Influent line invert elevation			
3" Vent pipe location w/ bird screen			
Pumps and FM piping			
Type of wall penetration			
Float elevations (High Level alarm, Lag Pump On, Lead Pump On, Pumps Off)			
Wet well and Valve Vault Construction Joints			
Pump Station Electrical Schematics & Drawings:			
Single Line Diagram			
Lighting Fixture Schedule			
Power Pole & Equipment Rack Details			
Electrical Site Plan			

**Renewable Water Resources  
Project Closeout Checklist – Part 1  
Record Drawing – Pump Station & Force Main**

**SIGNATURES (SIGN AND DATE)**

APPLICANT'S ENGINEER:	DATE:
ReWa DEVELOPMENT PROJECT ENGINEER:	DATE:
ReWa INSPECTOR:	DATE:

**Renewable Water Resources  
Project Closeout Checklist – Part 2  
General**

PROJECT NAME:	
APPLICANT'S ENGINEER:	
ENGINEERING CONTACT:	DATE:

The Applicant's Engineer shall complete this checklist and include it in Part 2 of Project Closeout Submittal Package to the ReWa Development Project Engineer. **All documents shall be delivered to ReWa in one submittal.** All electronic copies shall be provided in PDF format, unless otherwise noted. If any required items are deemed incomplete by ReWa, it will be noted in the form below and returned to the Applicant's Engineer. ReWa will not proceed with issuing an ownership acceptance letter until all required items have been received and deemed complete.

Check boxes to denote completion or write "N/A" if not applicable to project.

**PART 2**

<u>Required Items</u>	<u>Engineer</u>		<u>ReWa</u>	
	Complete	Complete	Complete	Incomplete
Pump Station installations shall include the following:				
Affidavit for Transfer of Real Property (1 electronic copy)				
Affidavit for Exempt Transfer of Real Property (1 electronic copy)				
One (1) copy of Title to Real Estate (1 electronic copy)				
Pump Station Operation & Maintenance Manual (1 hard copy & 1 electronic copy)				
Pump Station electric bill for account transfer (1 electronic copy)				
Pump Station gas bill for account transfer – if applicable (1 electronic copy)				
Pump Station water bill for account transfer – if applicable (1 electronic copy)				
Maintenance Agreement				
Easements – include & complete separate checklist and provide the following:				
Sanitary Sewer Exhibit (6 hard copies with original signature and seal)				
Copy of Rights-of-Way for Offsite Sewer Dedicated to ReWa – if applicable				
Dedication Document & Exhibit				

**SIGNATURES (SIGN AND DATE)**

APPLICANT'S ENGINEER:	DATE:
ReWa DEVELOPMENT PROJECT ENGINEER:	DATE:
ReWa INSPECTOR:	DATE:

## Renewable Water Resources Project Closeout Checklist – Part 2 Easement

PROJECT NAME:	
APPLICANT'S ENGINEER:	
ENGINEERING CONTACT:	DATE:

The Applicant's Engineer shall complete this checklist and include it in Part 2 of Project Closeout Submittal Package to the ReWa Development Project Engineer. **All documents shall be delivered to ReWa in one submittal.** All electronic copies shall be provided in PDF format, unless otherwise noted. If any required items are deemed incomplete by ReWa, it will be noted in the form below and returned to the Applicant's Engineer. ReWa will not proceed with issuing an ownership acceptance letter until all required items have been received and deemed complete.

Check boxes to denote completion or write "N/A" if not applicable to project.

<u>Required Items</u>	<u>Engineer</u>		<u>ReWa</u>	
	Complete	Complete	Complete	Incomplete
Easement shall include the following:				
24" x 36" On-site or Off-site Easement Exhibit				
Tax Map Numbers				
Site address				
Lot numbers				
North arrow				
Graphical scale bar				
Existing sanitary lines and manholes				
Existing sanitary sewer easements (label owner, i.e. ReWa, Satellite Sewer Agency, etc.)				
Hatch and label proposed easement				
Road rights-of-way with road name – if applicable				
Associated water bodies – if applicable				
Sanitary sewer easement detail and note				
No vertical data (rim or invert elevation)				
Number of manholes				
Total Length of easement				
Professional Land Surveyor (PLS) Signature and Stamp (on title sheet)				

### SIGNATURES (SIGN AND DATE)

APPLICANT'S ENGINEER:	DATE:
ReWa DEVELOPMENT PROJECT ENGINEER:	DATE:
ReWa INSPECTOR:	DATE:

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## APPENDIX V

# PRE-CONSTRUCTION MEETING AGENDA AND INSPECTION & TESTING FORMS

# Renewable Water Resources CCTV Inspection Report

Sent To - Applicant's Engineer: \_\_\_\_\_ Attention: \_\_\_\_\_

Renewable Water Resources (ReWa) has completed a CCTV inspection for \_\_\_\_\_  
(project name) to verify that the installed sanitary sewer system has been constructed to meet ReWa specifications and standards. The results of the CCTV inspection are:

- Deficiencies were not identified or observed during the CCTV inspection.  
or
- Deficiencies have been identified and shall be repaired prior to ReWa's acceptance of the sewer system.
- Copies of the CCTV video and deficiencies list are available to the Applicant's Engineer and may be picked up at ReWa.*
- Copies of the deficiencies list are included with this form.*

The Applicant's Engineer shall notify the Applicant of these deficiencies and verify that repairs have been made. Any sewer lines that are repaired shall be re-tested in accordance with ReWa testing procedures. The Applicant's Engineer shall confirm that all repairs and testing are complete by filling out the information below, signing and returning this document to ReWa.

By: \_\_\_\_\_ (ReWa) Date: \_\_\_\_\_

-----

I \_\_\_\_\_ (Applicant's Engineer), certify to the best of my knowledge and belief, that all repairs required to correct the deficiencies identified by the CCTV inspection have been completed and that the project is ready for a follow-up inspection. (attach completed testing forms)

\_\_\_\_\_ (signature) Date: \_\_\_\_\_

- A follow-up CCTV inspection indicates that deficiencies remain, and additional work is required. The Applicant's Engineer shall follow the procedure as outlined above.

Follow-Up #1 By: \_\_\_\_\_ (ReWa) Date: \_\_\_\_\_

Follow-Up #2 By: \_\_\_\_\_ (ReWa) Date: \_\_\_\_\_

Follow-Up #3 By: \_\_\_\_\_ (ReWa) Date: \_\_\_\_\_

-----

I \_\_\_\_\_ (Applicant's Engineer), certify to the best of my knowledge and belief, that all repairs required to correct the deficiencies identified by the follow-up CCTV inspection have been completed and that the project is ready for a follow-up inspection. (attach completed testing forms)

Follow-Up #1 \_\_\_\_\_ (signature) Date: \_\_\_\_\_

Follow-Up #2 \_\_\_\_\_ (signature) Date: \_\_\_\_\_

Follow-Up #3 \_\_\_\_\_ (signature) Date: \_\_\_\_\_

- The sanitary sewer system meets all ReWa requirements and specifications. ReWa's ownership acceptance letter shall be mailed to the Applicant's Engineer's office and transmitted via email within several working days.

By: \_\_\_\_\_ (ReWa) Date: \_\_\_\_\_



561 Mauldin Road · Greenville, SC 29607  
864.299.4000

## Daily Construction Report

---

<b>Project:</b>	<b>Contractor:</b>	<b>ReWa PN:</b>
<b>Date:</b>	<b>Day:</b>	<b>Time In:</b>
<b>Location/Station #:</b>		<b>Time Out:</b>

---

<b>Weather:</b>			<b>Site Condition:</b>		
	AM	PM		AM	PM
Clear	<input type="checkbox"/>	<input type="checkbox"/>	Dry	<input type="checkbox"/>	<input type="checkbox"/>
Overcast	<input type="checkbox"/>	<input type="checkbox"/>	Muddy	<input type="checkbox"/>	<input type="checkbox"/>
Rain	<input type="checkbox"/>	<input type="checkbox"/>	Snow	<input type="checkbox"/>	<input type="checkbox"/>
Snow	<input type="checkbox"/>	<input type="checkbox"/>	Other	<input type="checkbox"/>	<input type="checkbox"/>

**Temperature:** AM PM

Click or tap here to enter text.

---

**Contractor on Site:**

**Number of Contractor Personnel:**

**Visitors:**

**Equipment on Site:**

---

<b>Work Observed:</b>	<b>Items Discussed:</b>
<b>Nonconforming Work:</b>	<b>Field Orders:</b>
<b>Quantified Items:</b>	<b>Comments:</b>
<b>Material Delivered:</b>	<b>Testing:</b>
<b>Subcontractor:</b>	<b>Subcontractor:</b>
<b>Manpower:</b>	<b>Manpower:</b>
<b>Work Performed:</b>	<b>Work Performed:</b>

---

**Attachments:**

---

**ReWa Project Manager:**

**ReWa Inspector:**









**RENEWABLE WATER RESOURCES  
(INSERT PROJECT NAME HERE)**

ReWa NO. \_\_\_\_\_ (Insert ReWa Project No. here)

\_\_\_\_\_ (Inset meeting date here)

\_\_\_\_\_ (Insert meeting time here)

**PRE-CONSTRUCTION MEETING AGENDA**

1.0 PERSONNEL

OWNER:

Renewable Water Resources  
561 Mauldin Road  
Greenville, SC 29607

\_\_\_\_\_ - Project Manager  
Office No: 864-299-4000 ext. XXX  
Mobile No: \_\_\_\_\_  
[XXXXXX@re-wa.org](mailto:XXXXXX@re-wa.org)

\_\_\_\_\_ - Project Inspector  
Mobile No: \_\_\_\_\_  
[XXXXXX@re-wa.org](mailto:XXXXXX@re-wa.org)

APPLICANT:

\_\_\_\_\_ (Insert Applicant's engineering firm's name here)  
\_\_\_\_\_ (Insert consulting engineering firm's address here)

\_\_\_\_\_

\_\_\_\_\_ (Insert primary point of contact for Applicant)  
Office No: (\_\_\_\_) \_\_\_\_ - \_\_\_\_\_  
Mobile No: (\_\_\_\_) \_\_\_\_ - \_\_\_\_\_  
Email:

APPLICANT'S ENGINEER:

\_\_\_\_\_ (Insert Applicant's Engineer's firm's name here)  
\_\_\_\_\_ (Insert Applicant's Engineer's firm's address here)

\_\_\_\_\_

Phone No: (\_\_\_\_) \_\_\_\_ - \_\_\_\_\_

\_\_\_\_\_ (Insert primary point of contact for Applicant's Engineer)

Office No: (\_\_\_\_) \_\_\_\_ - \_\_\_\_\_

Mobile No: (\_\_\_\_) \_\_\_\_ - \_\_\_\_\_

Email:

*GENERAL CONTRACTOR: (if different from the Applicant)*

\_\_\_\_\_ (Insert General Contractor's office here)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (Insert primary point of contact for General Contractor)

Office No: (\_\_\_\_) \_\_\_\_ - \_\_\_\_\_

Mobile No: (\_\_\_\_) \_\_\_\_ - \_\_\_\_\_

Email:

Project Manager: \_\_\_\_\_ Mobile: \_\_\_\_\_

Construction Superintendent: \_\_\_\_\_ Mobile: \_\_\_\_\_

*SUB-CONTRACTORS:*

\_\_\_\_\_ (Insert Sub-Contractor's office here)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ (Insert primary point of contact for Sub-Contractor)

Office No: (\_\_\_\_) \_\_\_\_ - \_\_\_\_\_

Mobile No: (\_\_\_\_) \_\_\_\_ - \_\_\_\_\_

Email:

Project Manager: \_\_\_\_\_ Mobile: \_\_\_\_\_

**2.0 ACTION ITEMS**

- A.
- B.
- C.
- D.
- E.

**Renewable Water Resources  
Pressure Test Form  
Record of Field Test**

**Location/Structure:**

<b>Test Start</b>	<i>Date</i>	<i>Time</i>	<b>Rainfall During Test Period (in)</b>
<b>Test End</b>	<i>Date</i>	<i>Time</i>	

**Test Basin**

<i>Start Reading (in)</i>	<i>End Reading (in)</i>
$\Delta H_{\text{basin}} =$ _____	

**Control**

<i>Start Reading (in)</i>	<i>End Reading (in)</i>
$\Delta H_{\text{control}} =$ _____	

Adjusted Net Elevation Drop ( $H_{\text{control}} - H_{\text{basin}}$ )      \_\_\_\_\_

Allowable Elevation Drop (in)      \_\_\_\_\_

\_\_\_\_\_ Pass      \_\_\_\_\_ Fail

**Comments**

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Witness/Participants**

Inspector	_____	Date _____
Contractor	_____	Date _____
Other	_____	Date _____

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APPENDIX VI  
PUMP STATION POLICY



# RENEWABLE WATER RESOURCES

## RESOLUTION

### To Establish a Policy on the Acceptance of Wastewater Pump Stations for Ownership Operation and Maintenance

WHEREAS, Renewable Water Resources (ReWa) has historically owned and maintained sanitary sewer pump stations of various sizes as part of its conveyance system;

WHEREAS, Some Municipalities and Sewer Subdistricts have historically owned and maintained sanitary sewer pump stations of moderate to smaller sizes as part of their conveyance systems;

WHEREAS, Private Utility Providers and Home Owner Associations or similar groups have historically owned and maintained sanitary sewer pump stations of smaller sizes separately from publicly-owned gravity sewer systems, or part of their conveyance systems;

WHEREAS, Reference to a Pump Station represents the Pump Station system which includes the Pump Station facilities including wet well structure, dry pit structure, generator, electrical control panel, valve vault structure, screening structure, and all structures and appurtenances typically located within a fenced area; access drive to the Pump Station system; the Force Main including valves, various control structures and appurtenances; and all other structures, devices, and appurtenances that are required for the proper operation and maintenance of a Pump Station.

WHEREAS, ReWa recognizes that sanitary sewer Pump Stations are necessary in certain circumstances to provide short term or long term solutions to sanitary sewer expansion which supports growth;

WHEREAS, in an effort to adapt to the increased challenges of providing sanitary sewer service within ReWa's service area, ReWa has determined that a Pump Station Policy is necessary.

NOW, THEREFORE, BE IT RESOLVED that the following Pump Station Policy will be used to define the requirements and conditions in which ReWa will accept ownership of sanitary sewer pump stations:

#### 1) Definitions

- a) Regional Pump Station – A pump station that serves a significant service area. Typically, the influent gravity line size is equal to or greater than 18". Regional pump stations are owned and operated by ReWa.

- b) Local Pump Station – A pump station that serves a moderate service area. Typically, the influent gravity line size ranges from 10” to 16”. Local pump stations are usually owned by the local sewer subdistrict, municipality, or county.
- c) Temporary Pump Station – A pump station that serves a limited area and is considered a short-term solution for the current master planning documents. Typically, these pump stations have an 8” influent gravity line size. Temporary pump stations are usually owned by the local sewer district or municipality.

## 2) Planning


- a) All proposed pump stations shall be reviewed by ReWa with respect to determining the location, size, ownership, and justification. Factors that will be considered in the reviews are:
  - i) How the pump station fits into ReWa's current masterplan, Upstate Roundtable Plan, 208 plan, and county/municipal/subdistrict planning.
  - ii) Gravity sewer options that have been evaluated and reviewed by the local sewer district or municipality, and ReWa.
  - iii) Impact to ReWa's facilities with respect to capacity.
  - iv) Rate of return on ReWa's investment for pump station projects that include ReWa funding.
  - v) Limiting the use of temporary pump stations for long term (greater than 5 years) service solutions.
- b) Ultimately, gravity sanitary sewer systems are the preferred method of providing service due to the low maintenance cost and longevity of the infrastructure.

## 3) ReWa Ownership of Local and Temporary Pump Stations

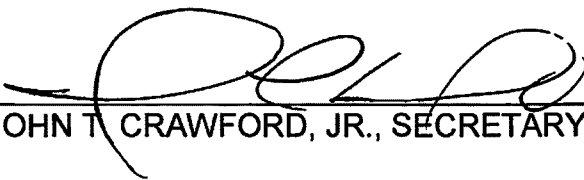
- a) The first option for ownership of a new local or temporary pump station shall be the local public sanitary sewer provider (municipality, subdistrict, or county). If the local public sanitary sewer provider chooses not to accept the pump station for ownership, then ReWa shall consider taking ownership of the pump station under the following conditions:

- i) All proposed and future public sanitary sewer infrastructure within the service area of the pump station shall be owned and operated by ReWa.
  - ii) Any public sanitary sewer provider that has territory within the service area of the proposed pump station must acknowledge their acceptance through an agreement between ReWa, public sewer provider(s), and the developer, if applicable.
- b) ReWa may seek additional funding to support the operation and maintenance of the pump station, fund a portion of an upgrade project necessary to serve the proposed service area, or to fund a portion of a future project that would allow for the abandonment or removal of the Pump Station. A summary of these options are as follows:
- i) A lump sum payment for the first five years of projected operation and maintenance costs determined at the time of ReWa's approval of the project. Payment of these costs would be required prior to issuing the Flow Acceptance Letter for the project.
  - ii) A prorated lump sum payment to help fund downstream upgrades of the existing conveyance system or future project. Payment of these costs would be required prior to issuing the Flow Acceptance Letter for the project.
  - iii) A special tap fee paid along with the New Account Fee.
  - iv) The establishment of a pump station sewer fee applied to a customer's water bill.
  - v) The establishment of an improvement district (MID, RID, or CID).
  - vi) The establishment of a special tax district.
- c) ReWa's decision to take ownership of a local or temporary pump station will be based on consideration of the above factors and options, including customer costs and fees. ReWa reserves the right to determine what is in the best interests of its operations and facilities, and its customers.
- d) The Chief Executive Officer and/or his designee is authorized to determine if ReWa takes ownership of local or temporary pump stations.

The above Resolution, upon motion duly made, was passed and approved by the Board of Commissioners of Renewable Water Resources at a regular meeting held on the 17<sup>th</sup> day of December, 2018

  
\_\_\_\_\_  
DANIEL K. HOLLIDAY, CHAIRMAN

ATTEST:

  
\_\_\_\_\_  
JOHN T. CRAWFORD, JR., SECRETARY/TREASURER

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APPENDIX VII

LEGAL DOCUMENTS

STATE OF SOUTH CAROLINA )  
 )  
COUNTY OF \_\_\_\_\_)

AFFIDAVIT FOR  
EXEMPT TRANSFER

PERSONALLY appeared before me the undersigned, who being duly sworn, deposes and says:

1. I have read the information on this affidavit and I understand such information.
2. The property being transferred is located at \_\_\_\_\_ bearing County Tax Map Number \_\_\_\_\_, was transferred by easement document to The Board of Commissioners of Renewable Water Resources (ReWa) on the \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.
3. The deed is exempt from the deed recording fee because it is a transfer to a political subdivision of the State.

If exempt under exemption #14 as described in the Information section of this affidavit, did the agent and principal relationship exist at the time of the original sale and was the purpose of this relationship to purchase the realty? Check Yes \_\_\_\_\_ or No

4. As required by Code Section 12-24-70, I state that I am a responsible person who was connected with the transaction as: Officer of The Board of Commissioners of Renewable Water Resources (Grantee).
5. I understand that a person required to furnish this affidavit who willfully furnishes a false or fraudulent affidavit is guilty of a misdemeanor and, upon conviction, must be fined not more than one thousand dollars or imprisoned not more than one year, or both.

\_\_\_\_\_  
*Responsible Person Connected with the Transaction*

\_\_\_\_\_  
*Type or Print Name Here*

Sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

\_\_\_\_\_  
*(Notary Affix Seal)*

Notary Public for the State of \_\_\_\_\_  
My Commission Expires: \_\_\_\_\_

STATE OF SOUTH CAROLINA )  
 )  
COUNTY OF \_\_\_\_\_ )

AFFIDAVIT FOR  
TRANSFER OF REAL PROPERTY

PERSONALLY appeared before me the undersigned, who being duly sworn, deposes and says:

1. I have read the information on this Affidavit and I understand such information.
2. The property is being transferred by Title to Real Estate to The Commissioners of Renewable Water Resources on this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_.
3. Check one of the following: **The DEED is**
  - a. \_\_\_\_\_ subject to the deed recording fee as a transfer for consideration paid or to be paid in money or money's worth.
  - b. \_\_\_\_\_ subject to the deed recording fee as a transfer between a corporation, a partnership, or other entity and a stockholder partner or owner of the entity or is a transfer to a trust or as distribution to a trust beneficiary.
  - c.  EXEMPT from the deed recording fee because of exemption #2.  
  
(If exempt, please skip items 4-6, and go to item 8 on this affidavit.)
4. Check one of the following if either item 3(a) or item 3(b) above has been checked.
  - a. \_\_\_\_\_ The fee computed on the consideration paid or to be paid in money or money's worth in the amount of \$ \_\_\_\_\_.
  - b. \_\_\_\_\_ The fee is computed on the fair market value of therealty.
  - c. \_\_\_\_\_ The fee is computed on the fair market value of the realty as established for property tax purposes which is \$ \_\_\_\_\_.
5. Check YES or NO to the following: A lien of encumbrance existed on the land, tenement, or realty before the transfer and remained on the land, tenement, or realty after the transfer. If "YES", the amount of the outstanding balance of this lien or encumbrance is \$ \_\_\_\_\_.
6. The DEED Recording Fee is computed as follows:
  - a. \$ \_\_\_\_\_ The amount listed in item 4 above.
  - b. \$ \_\_\_\_\_ The amount listed in item 5 above (no amount place zero).
  - c. \$ \_\_\_\_\_ Subtract Line 6(b) from Line 6(a) and place the result.
7. As required by Code Section 12-24-70, I state that I am the responsible person who was connected with the transaction as Grantor, Grantee or Legal Representative.
8. I understand that a person required to furnish this affidavit who willfully furnishes a false or fraudulent affidavit is guilty of a misdemeanor and, upon conviction, must be fined not more than one thousand dollars or imprisoned not more than one year, or both.

Sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_

\_\_\_\_\_  
*Grantor, Grantee or Legal Representative*  
*Connected with this transaction (sign above)*

\_\_\_\_\_  
*(Type or Print Name Here)*

\_\_\_\_\_  
*(Notary Affix Seal)*  
Notary Public for the State of \_\_\_\_\_  
My Commission Expires: \_\_\_\_\_



STATE OF SOUTH CAROLINA     )           DEDICATION AND CONVEYANCE OF  
  )           SANITARY SEWER LINE AND RIGHT OF WAY  
COUNTY OF \_\_\_\_\_         )

**[GRANTEE IS A POLITICAL SUBDIVISION OF THE STATE OF SOUTH CAROLINA EXEMPT FROM RECORDING FEES UNDER S.C. CODE ANN., SECTION 12-24-40(2)]**

KNOW ALL MEN BY THESE PRESENTS, that \_\_\_\_\_ ("Grantor"), in consideration of One (\$1.00) Dollar to the Grantor paid in hand at and before the sealing of these presents by the Grantee, the receipt of which is hereby acknowledged, has granted, bargained, sold, released, dedicated and conveyed, and by these presents does grant, bargain, sell, release, dedicate and convey to the Renewable Water Resources, a body politic under the laws of South Carolina, its successors and assigns ("Grantee"):

Those certain sanitary sewer lines, manholes, valves, adjuncts and appurtenances (but excluding any service line or lines, or any part thereof, outside of the easement herein dedicated and conveyed) installed and located in, under or along the property of Grantor as shown on a plat entitled \_\_\_\_\_, prepared by \_\_\_\_\_, dated \_\_\_\_\_, recorded in Plat Book\_\_\_\_, Page\_\_\_\_, and also being more particularly shown and described on an As-Built drawing of said lines entitled " \_\_\_\_\_" prepared by \_\_\_\_\_, dated \_\_\_\_\_, on file with Grantee, which are by reference made a part of this description;

Together with and including a permanent right of way and easement extending twelve and one-half (12.5) feet on each side of the centerline of the sanitary sewer line(s) for purposes of the operation, maintenance, repair, replacement or relocation of such lines and appurtenances (the "Right(s) of Way").

The above described property is all or a portion of that conveyed to Grantor herein by Deed of \_\_\_\_\_, recorded \_\_\_\_\_ in the Office of the Register of Deeds for Greenville County, South Carolina in Deed Book \_\_\_\_\_, Page \_\_\_\_\_.

**[Complete the following paragraph if off-site easements are to be conveyed.]**

ALSO, certain off-site easements acquired by Grantor as more particularly described on **Exhibit "A"** attached hereto and incorporated herein.

TOGETHER WITH all and singular the rights, members, hereditaments and appurtenances to said premises belonging or in any ways incident or appertaining, including, without limitation, the right of ingress and egress to the above Right(s) of Way over and through lands of Grantor and Grantor's heirs or successors and assigns; to have and to hold all and singular the premises before mentioned unto the Grantee, and the Grantee's successors and assigns, forever, subject to the terms and provisions hereof. The Right(s) of Way herein dedicated and granted include the right, privilege and easement of the Grantee to install, repair, and/or add to and extend existing lines and appurtenances now or hereafter constructed, within the boundaries of the Right(s) of Way herein described and conveyed for the purpose of serving other properties or otherwise, without any further approval, consent or authorization of the Grantor, or the Grantor's heirs, successors or assigns, and to operate, maintain, repair and replace such lines as installed or extended. No

building, improvement or other structure may be constructed or installed within the boundaries of the Right(s) of Way nor so close thereto as to impose any load on the existing lines and appurtenances; and the Grantee shall have the right to cut away and keep clear of the sanitary sewer lines and appurtenances any and all vegetation, including but not limited to branches, limbs, or other outgrowth that projects onto the Right(s) of Way, that might, in the opinion of Grantee, endanger or injure the sewer lines or their appurtenances, or interfere with their proper operation and maintenance.

Without limiting the right of ingress and egress to and from the Right(s) of Way and sanitary sewer system herein dedicated and conveyed for the purpose of exercising the rights, privileges and easements hereby granted, in the event that said Right(s) of Way and sanitary sewer system are within the boundaries of a gated subdivision, community or development, or in any location where access is otherwise controlled or restricted, the Grantee shall at all times be afforded access and shall be given an access code for any coded entrance gate by the Grantor or its heirs, successors and assigns. Said access code shall not be changed, altered or deleted without the prior consent and approval of the Grantee or its successors and assigns.

The Grantor hereby acknowledges and agrees that in the event a building or other structures should be erected contiguous to the Right(s) of Way, no claim for damages may be made by the Grantor, his heirs or assigns, on account of any damage that might occur to such structure, building or contents thereof due to the operation or maintenance, or negligent operation or maintenance of the lines and appurtenances within said Right(s) of Way, or any accident or mishap that might occur therein or thereto.

GRANTOR WARRANTS AND REPRESENTS that except as provided below, the property and the rights and easements herein conveyed are not subject to any mortgage, judgment or lien other than for property taxes which are not yet past due, nor to any encumbrance which would interfere with Grantee's ability to operate, maintain, repair, replace, relocate or otherwise own and utilize the lines and system described above. In the event of a mortgage on the property herein conveyed, Grantor has obtained the consent and joinder of the Lender/Mortgagee as provided in the attached Joinder and Consent of Lender/Mortgagee attached hereto.

GRANTOR DOES HEREBY bind itself and its heirs or successors to warrant and forever defend all and singular said premises unto the Grantee and the Grantee's heirs or successors and against the Grantor and the Grantor's heirs or successors and against every person whomsoever lawfully claiming or to claim the same or any part thereof.

[SIGNATURE PAGE TO FOLLOW]

[INDIVIDUAL GRANTOR SIGNATURE PAGE]

IN WITNESS WHEREOF, the Grantor has executed this Dedication and Conveyance of Sanitary Sewer Line and Right of Way this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

SIGNED, sealed and delivered  
in the presence of:

GRANTOR:

\_\_\_\_\_  
Witness 1

Print Name: \_\_\_\_\_

\_\_\_\_\_  
Print Name: \_\_\_\_\_

\_\_\_\_\_  
Witness 2

Print Name: \_\_\_\_\_

STATE OF \_\_\_\_\_ )

COUNTY OF \_\_\_\_\_ )

ACKNOWLEDGMENT  
(Individual)

I, the undersigned Notary Public for the State of South Carolina, do hereby certify that \_\_\_\_\_, [Grantor(s)], personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and seal this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
(SEAL)

Notary Public for State of \_\_\_\_\_

Print Name: \_\_\_\_\_

My commission expires: \_\_\_\_\_

[ENTITY GRANTOR SIGNATURE PAGE]

IN WITNESS WHEREOF, the Grantor has executed this Dedication and Conveyance of Sanitary Sewer Line and Right of Way this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

SIGNED, sealed and delivered  
in the presence of:

GRANTOR:

\_\_\_\_\_  
Name of Entity

By: \_\_\_\_\_

Its: \_\_\_\_\_

Print Name: \_\_\_\_\_

\_\_\_\_\_  
Witness 1

Print Name: \_\_\_\_\_

\_\_\_\_\_  
Witness 2

Print Name: \_\_\_\_\_

STATE OF \_\_\_\_\_ )

COUNTY OF \_\_\_\_\_ )

ACKNOWLEDGMENT  
(Entity)

I, the undersigned Notary Public, do hereby certify that \_\_\_\_\_ **[name of individual]**, the \_\_\_\_\_ **[title of individual]** of the above named Grantor personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and seal this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

\_\_\_\_\_  
(SEAL)

Notary Public for State of \_\_\_\_\_

Print Name: \_\_\_\_\_

My commission expires: \_\_\_\_\_

**CONSENT AND JOINDER OF LENDER/MORTGAGEE**

\_\_\_\_\_ ("Lender/Mortgage"), the owner and holder of a certain encumbrance, to wit: that certain mortgage encumbering the property described in the foregoing Dedication and Conveyance, which mortgage is recorded in Mortgage Book\_\_ at page\_\_ of the Office of the Register of Deeds of Greenville County, South Carolina, does hereby join in the grant of the dedication and conveyance for the purpose of consenting to the same, hereby agreeing to honor and recognize the same hereafter, in accordance with its terms.

In Witness Whereof, the undersigned has executed this Consent and Joinder this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

WITNESS

\_\_\_\_\_  
Name of Lender/Mortgagee

By: \_\_\_\_\_

Its: \_\_\_\_\_

Print Name: \_\_\_\_\_

\_\_\_\_\_  
Witness 1

Print Name: \_\_\_\_\_

\_\_\_\_\_  
Witness 2

Print Name: \_\_\_\_\_

STATE OF \_\_\_\_\_ )

COUNTY OF \_\_\_\_\_ )

**ACKNOWLEDGMENT**  
(Lender/Mortgagee)

I, the undersigned Notary Public, do hereby certify that \_\_\_\_\_, the \_\_\_\_\_ of the above named Lender/Mortgagee personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and seal this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

\_\_\_\_\_  
(SEAL)

Notary Public for State of \_\_\_\_\_

Print Name: \_\_\_\_\_

My commission expires: \_\_\_\_\_

**EXHIBIT "A"**

**Offsite Easements**

A certain off-site easement acquired by Grantor from \_\_\_\_\_, by instrument dated \_\_\_\_\_ and recorded in the Office of the Register of Deeds for Greenville County in Deed Book \_\_\_\_\_, Page \_\_\_\_\_, together with the lines, manholes, valves, adjuncts and appurtenances constructed and installed thereon.

A certain off-site easement acquired by Grantor from \_\_\_\_\_, by instrument dated \_\_\_\_\_ and recorded in the Office of the Register of Deeds for Greenville County in Deed Book \_\_\_\_\_, Page \_\_\_\_\_, together with the lines, manholes, valves, adjuncts and appurtenances constructed and installed thereon.

A certain off-site easement acquired by Grantor from \_\_\_\_\_, by instrument dated \_\_\_\_\_ and recorded in the Office of the Register of Deeds for Greenville County in Deed Book \_\_\_\_\_, Page \_\_\_\_\_, together with the lines, manholes, valves, adjuncts and appurtenances constructed and installed thereon.

A certain off-site easement acquired by Grantor from \_\_\_\_\_, by instrument dated \_\_\_\_\_ and recorded in the Office of the Register of Deeds for Greenville County in Deed Book \_\_\_\_\_, Page \_\_\_\_\_, together with the lines, manholes, valves, adjuncts and appurtenances constructed and installed thereon.

A certain off-site easement acquired by Grantor from \_\_\_\_\_, by instrument dated \_\_\_\_\_ and recorded in the Office of the Register of Deeds for Greenville County in Deed Book \_\_\_\_\_, Page \_\_\_\_\_, together with the lines, manholes, valves, adjuncts and appurtenances constructed and installed thereon.



(p) 864.299.4000 • (f) 864.299.8958

561 Mauldin Rd. • Greenville, SC 29607  
[www.ReWaonline.org](http://www.ReWaonline.org)

(Insert date here)

(Insert Applicant's Engineer's primary point of contact)  
(Insert Applicant's Engineer's firm)  
(Insert Applicant's Engineer's firm address)

RE: Flow Acceptance – (Insert project name & number here)

Dear Mr. / Ms. \_\_\_\_\_:

Renewable Water Resources (ReWa) has sufficient capacity to treat (insert estimated total sewer flow here) per day of wastewater flow from the proposed project at our (insert wastewater treatment facility receiving flow here) (NPDES No. \_\_\_\_\_), and hereby approves and accepts this requested flow. This approval is based on the review and approval of plans submitted by (insert Applicant's Engineer's firm & submission date here); and (insert Satellite Sewer Agency or ReWa)'s willingness to accept the completed sanitary sewer system for ownership, operation, and maintenance.

This approval may be rescinded if either of the following occurs:

- A SCDHEC Permit to Construct for the proposed sanitary sewer system has not been issued within 120 days of the date of this letter.
- A SCDHEC Permit to Operate for the proposed sanitary sewer system has not been issued within 3 years of the SCDHEC Permit to Construct.

Notify us of any project revisions that will impact sewer flow, sanitary sewer design, or scheduling issues that could impact the time restrictions above. Please note that the Applicant must pay a "New Account Fee" for all sanitary sewer connections.

Sincerely,

Nina Hallissy, PE  
Engineering Project Manager

CC: (insert Satellite Sewer Agency & primary point of contact)





(Insert date here)

(Insert Applicant's Engineer's primary point of contact)  
(Insert Applicant's Engineer's firm)  
(Insert Applicant's Engineer's firm address)

(Insert SC DHEC permit number here)

RE: Ownership Acceptance – (insert project name & number here)

Dear Mr. / Ms. \_\_\_\_\_:

Based on ReWa's acceptance of the CCTV inspection and completion of the Final Inspection submitted, the sanitary sewer system for this project has been accepted for ownership, operation and maintenance by Renewable Water Resources. This letter of ownership acceptance is for the entire sanitary sewer system and easements only and does not grant permission to discharge flow into the system. A "Permit to Operate" must be issued by the South Carolina Department of Health and Environmental Control (SC DHEC) prior to any flow being discharged into the system.

Neither this letter nor the dedication and acceptance of the system shall be deemed to waive any rights that ReWa may have for defects in the line not caused by ReWa.

Sincerely,

Nina Hallissy, PE  
Engineering Project Manager

CC: SC DHEC





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APPENDIX VIII

DOCUMENT REVISION TRACKING

## Development Manual - Revision Tracking

Paragraph and Title	Description of Update	Rev Date
General Document Update	Added section titles to footer	7/1/2022
1.1.1 Definitions	<p>Added the following definitions:</p> <p>Capital Contribution Agreement – An agreement designed for developers to bear a portion of the cost of these capacity improvements rather than existing customers through current sewer rates.</p> <p>EDU - “Equivalent Dwelling Unit” is equal to 1 single family home, or 300 gallons per day of allocated wastewater flow</p>	7/1/2022
1.5 ReWa Online Resources	<b>Updated link for New Account Fees</b>	<b>6/20/2023</b>
	<b>Updated link for sewer use regulation</b>	<b>6/20/2023</b>
2.1 ReWa	7. Review Closed-Circuit Television (CCTV) documentation provided by Applicant’s Engineer of newly installed sanitary sewer system before it is placed into operation.	7/1/2022
	<b>6. Added reference to specifications for record documents in Appendix II - Standard Specifications</b>	<b>6/20/2023</b>
2.1.1.2	Added new Capital Contribution Agreement paragraph	7/1/2022
<b>2.2 Applicant</b>	<b>2. Updated to reference the Sewer Use Regulation</b>	<b>6/20/2023</b>
2.3 Applicant's Engineer	12. Prepare requests for Final Inspection and submit CCTV inspection records to ReWa.	7/1/2022
3.3 Service Lateral Connections	Updated examples to include FSE's	11/12/2021
	Updated Figures SL-1 & 2 to include FSE's	
3.5.3 Easement Width	Updated to add reference to the Standard Specifications for Record drawings	6/20/2023
4.4.1.3 Final Pay Application	Updated 4.4.1.3; Applicant's Engineer responsible for CCTV Inspection	7/1/2022
4.4.2 CCTV Inspection & GPS Documentation	Updated 4.4.2; Applicant's Engineer responsible for CCTV Inspection	7/1/2022

## Development Manual - Revision Tracking

Paragraph and Title	Description of Update	Rev Date
	<b>Updated to reference the surveying specifications in Appendix II</b>	<b>6/20/2023</b>
5.2.3.1 Food Service Establishments	Added "Additional Requests to include FSE's	11/12/2021
5.4.1 CCTV Inspection	Changed detail reference to 'Detail No. SS-18, Service Lateral Cleanout'  Updated 5.4.1; Applicant's Engineer responsible for CCTV Inspection	7/1/2022
	<b>Updated to reference the surveying specifications in Appendix II</b>	<b>6/20/2023</b>
6.1.1 General Minimum Design Standards	Updated additional pump design requirements	11/12/2021
<b>6.1.5 Surveying Standards</b>	<b>Updated to reference the surveying specifications in Appendix II and removed detail in items 1-7</b>	<b>6/20/2023</b>
6.1.6 Bypass Pumping	<b>Added section on bypass pumping</b>	<b>6/20/2023</b>
6.2.2.5 Design Criteria	5. Manhole spacing shall adhere to the maximum spacing requirements set forth below or the latest SC DHEC standards, whichever spacing is shorter. a. Pipe diameters up to 15": 400 ft. b. Pipe diameters from 18" – 30": 500 ft.	7/1/2022
6.2.4.7 Service Laterals	7. Cleanouts for service laterals shall be installed prior to CCTV inspection. Refer to Detail No. SS-18, Service Lateral Cleanout in Appendix I – Standard Drawings.	11/12/2021
<b>6.2.5.3 Brick Manholes</b>	<b>Added section about replacing existing brick manholes with new precast manholes.</b>	<b>6/20/2023</b>
6.2.7.2 Tracer Wire	Added section	11/12/2021

## Development Manual - Revision Tracking

Paragraph and Title	Description of Update	Rev Date
6.3 Wastewater Pumping Stations	Updated with references to HI Standards	11/12/2021
	Added requirements for AOR and POR	
	Updated polymer concrete references	
	Updated Figure 6-1	
	Added Figure 6-2	
<b>6.4 Receiving Manholes</b>	<b>Added Section 33 01 30 reference to 6.4.5.2</b>	<b>6/20/2023</b>
	<b>Added Section 33 05 75 reference to 6.4.5.4</b>	
	<b>Added section 6.4.7 Surge Analysis and Pressure Surges</b>	<b>6/20/2023</b>
III - PROCESS FLOWCHARTS		
Flowchart: SSA Main Extension Capacity Approval & Permit to Construct Submittal Process	Added process step #4 and renumbered DHEC review steps to #5	7/1/2022
IV - CAPACITY APPROVAL PROCESS & PROJECT CLOSEOUT CHECKLISTS		
Checklist: Design Calculations - Gravity Sewer	Added checklists for Grease Control Devices	11/12/2021
Checklist: Design Calculations for PS & FM	Added checklist items for HI Standards, Wetwell Design, Emergency Storage & Supporting Documentation	11/12/2021
Project Closeout Submittal Checklist - Part 1	Added checklist reference to HI Standards Testing	11/12/2021



## Standard Drawings - Revision Tracking

Drawing #	Drawing Title	Description of Update	Rev Date
SS-0	Sewer Standard Details Table of Contents	Added new details	11/12/2021
SS-1.1	Standard Pipe Embedment	Revised detail for DIP and PVC pipe embedment	7/1/2022
SS-1.2	Trench Check Dam	Detail content unchanged, renumbered from 1.3 to 1.2	7/1/2022
SS-2	Standard Manhole Schedules and General Requirements	Changed all MH cover diameters to 24". Deleted Note 2.	11/12/2021
SS-3	Standard Precast Manholes with Cone Sections (4' and 5' Only)	Original version, no updates	11/18/2019
		<b>Updated bench height</b>	<b>6/20/2023</b>
SS-4	Standard Precast Manholes with Flat Top Sections	Original version, no updates	11/19/2021
		<b>Updated bench height</b>	<b>6/20/2023</b>
SS-5	T-Series Manhole	Original version, no updates	11/18/2019
SS-6	Precast Doghouse Manhole Installed Over Existing Sewer	Updated base design and notes	11/12/2021
SS-7.1	External DIP Drop Connection at Manhole	Modified to 12" maximum pipe diameter and changed detail number to SS-7.1	11/12/2021
		<b>Updated bench height</b>	<b>6/20/2023</b>
SS-7.2	Service Lateral Inside Drop Connection	New Detail	11/12/2021
SS-8	Bench and Invert Plan	Original version, no updates	11/18/2019
		<b>Updated bench height</b>	<b>6/20/2023</b>
SS-9.1	Standard Manhole Ring and Cover	Corrected dimensions	11/12/2021
SS-9.2	Standard Manhole Ring and Watertight Cover	Corrected dimensions	11/12/2021
SS-9.3	Slab-Type Cast-In Ring and Cover	Corrected dimensions	11/12/2021
SS-9.4	Slab-Type Cast-In Ring and Watertight Cover	Corrected dimensions	11/12/2021
SS-9.5	Hinged Manhole Ring and Cover	Original version, no updates	11/18/2019
SS-9.6	Hinged Manhole Ring and Watertight Cover	Original version, no updates	11/18/2019
SS-9.7	Composite Manhole Ring and Watertight Cover	Original version, no updates	11/18/2019
SS-9.8	Ventilated Hinged Manhole Ring and Cover	New Detail	11/12/2021
SS-10.1	Restraint System for Frames and Covers	Added reference to detail SS-10.2 and changed detail number to SS-10.1	11/12/2021
SS-10.2	Manhole Ring Seal	New Detail	11/12/2021
SS-11	Plastic Manhole Step – Cored Hole/Driven in Place	Original version, no updates	11/18/2019
SS-12	Standard Manhole Vent Pipe	Original version, no updates	11/18/2019
SS-13	Remote Manhole Vent Pipe	Original version, no updates	11/18/2019
SS-14	Manhole Vent Pipe	Original version, no updates	11/18/2019
		<b>Updated bench height</b>	<b>6/20/2023</b>
SS-15	Service Lateral Tee-Wye Connection to New Sewer	Original version, no updates	11/18/2019
SS-16	New Service Lateral Installation to New Manhole	Original version, no updates	11/18/2019
		<b>Updated bench height</b>	<b>6/20/2023</b>
SS-17	New Service Lateral Installation to Existing Manhole	Original version, no updates	11/18/2019
		<b>Updated bench height</b>	<b>6/20/2023</b>
SS-18	Service Lateral Cleanout	Changed from Two-Way to Single Cleanout	7/1/2022

## Standard Drawings - Revision Tracking

Drawing #	Drawing Title	Description of Update	Rev Date
SS-18	Service Lateral Cleanout	<p>Changed detail to allow 4" or 6" cleanouts and piping.</p> <p>Changed depth of cast iron frame and cover to 8" min.</p> <p>Added to Note 1: " Laterals shall be 4" unless additional capacity is required (multi-family, commercial, etc.) in which case a 6" lateral shall be used. Size/Capacity to be determined by Design Engineer or as directed by ReWa."</p> <p>Added Note 3:</p> <p>"3. Cast iron meter box shall be 16"x8" traffic tated cleanout box and lid. Provide Capitol Foundry of Va., Inc. Model VB9S, or approved equal with "S" Lettered Cover."</p>	7/1/2022
SS-19.1	Rehabilitation and Height Adjustment of Existing Manhole Frame and Cover	Original version, no updates	11/18/2019
SS-19.2	Precast Manhole Abandonment	New Detail	11/12/2021
SS-19.3	Pipe Cap Detail	New Detail	11/12/2021
SS-20	New Pipe Connection at Existing Manhole	<b>See note 2</b>	<b>6/20/2023</b>
SS-21	Connection of Existing Sewer to New Manhole	Removed concrete encasement	11/12/2021
SS-22	Service Lateral Saddle Connection to Existing Sewer Main	Add minimum 2' distance	11/12/2021
SS-22	Service Lateral Saddle Connection to Existing Sewer Main	<p>Changed detail to allow 4" or 6" piping and appurtenances.</p> <p>Removed the following from Note 2: "For 4" laterals, provide 4"x6" reducer before pipe saddle connection.</p>	7/1/2022
SS-23	Service Lateral Tee-Wye Connection to Existing Sewer (Rehab Proj only)	Original version, no updates	11/18/2019
SS-24	Abandoning Existing Service Laterals Connecting to Main Sewer	Original version, no updates	11/18/2019
SS-25	Abandoning Existing Service Laterals Connecting to Manholes	Original version, no updates	11/18/2019
SS-26	Service Lateral Connecting to Cured-in-Place Pipe Lining (CIPP)	Original version, no updates	11/18/2019
SS-27	Typical Repair to Existing Sewer	Removed concrete encasement	11/12/2021
SS-28	Typical Repair to New Sewer	Removed concrete encasement	11/12/2021
SS-29	Typical Right-of-Way Detail	Original version, no updates	11/18/2019
		<b>Tie-back slope</b>	<b>6/20/2023</b>
SS-30	Aerial Creek Crossing with Concrete Piers	Original version, no updates	11/18/2019
SS-31	Concrete Encasement For Stream Crossings	Original version, no updates	11/18/2019
SS-32	Pipe Installation Under Highways	Original version, no updates	11/18/2019
SS-33	Pipe Installation Under Railroads	Original version, no updates	11/18/2019

## Standard Drawings - Revision Tracking

Drawing #	Drawing Title	Description of Update	Rev Date
SS-34	Sewer Installation Within Casing Pipe	Added reference to Spec Section 33 05 07.23	11/12/2021
SS-35	Concrete Collar	Original version, no updates	11/18/2019
SS-36	Steel Gate – Single Gate Installation	Original version, no updates	11/18/2019
SS-37	Steel Gate – Double Gate Installation	Original version, no updates	11/18/2019
SS-38	Asphalt Pavement Patch In A Primary SCDOT City/County Road	Original version, no updates	11/18/2019
SS-39	Asphalt Pavement Patch In A Secondary SCDOT City/County Road	Original version, no updates	11/18/2019
SS-40	Asphalt Overlay	Original version, no updates	11/18/2019
SS-41	Asphalt Pavement Patch In Parking Lots and Private Roads	Original version, no updates	11/18/2019
SS-42	Asphalt Pavement for Walk Paths and Driveways	Original version, no updates	11/18/2019
SS-43	Asphalt Restoration for Parking Lots and Private Roads	Original version, no updates	11/18/2019
SS-44	Concrete Driveways, Parking Lots and Sidewalks	Original version, no updates	11/18/2019
SS-45	Tracer Wire Box	New Detail	11/12/2021
SS-46.1	Grease Interceptor - Baffled	New Detail	11/12/2021
SS-46.2	Grease Interceptor - Two Tank Layout	New Detail	11/12/2021
SS-46.3	Grease Interceptor - Unbaffled	New Detail	11/12/2021

## Standard Drawings - Revision Tracking

Drawing #	Drawing Title	Description of Update	Rev Date
PS-0	Pump Station Standard Details Table of Contents	Added new details	11/12/2021
PS-1.1	Typical Small Above Ground Pump Station - Site Plan	Moved generator to bottom right corner of site and electrical rack and bollards to front right corner of site.  'NOTE: Drawing Intended to show ReWa-Preferred General Arrangement. Actual pump station layout to be designed by Project Engineer.'	11/12/2021
PS-1.2	Standard Small Above Ground Pump Station - Plan View	Added influent pipe  'NOTE: Drawing Intended to show ReWa-Preferred General Arrangement. Actual pump station layout to be designed by Project Engineer.'	11/12/2021
PS-1.3	Standard Small Above Ground Pump Station - Section View	Moved influent pipe to opposite side of wet well and turn pipe into a drop connection, added electronic level sensor and backup floats, changed ARV discharge line to SST.  'NOTE: Drawing Intended to show ReWa-Preferred General Arrangement. Actual pump station layout to be designed by Project Engineer.'	11/12/2021
PS-2.1	Large Above Ground Pump Station - Site Plan	Moved generator to bottom right corner of site and electrical rack and bollards to front right corner of site; rotated wet well and pump station 90 degrees clockwise direction and moved location of gravity sewer influent manhole.  Changed Wetwell to rectangular or circular option.  Add the following notes: 'NOTE: Drawing Intended to show ReWa-Preferred General Arrangement. Actual pump station layout to be designed by Project Engineer.'	11/12/2021
PS-2.2	Large Pump Station Plan	Moved Future Pump assembly from the middle pump to the right pump.  Changed Wetwell to rectangular or circular option.  Moved RTU unit to inside of enclosure	11/12/2021

## Standard Drawings - Revision Tracking

Drawing #	Drawing Title	Description of Update	Rev Date
PS-2.3	Large Pump Station Section	<p>Add drop pipe into wet well; shift pump station enclosure from over top of the wet well, moved to Electronic Level sensor close to middle</p> <p>Changed Wetwell to rectangular or circular option.</p> <p>Add the following to General Notes:</p> <p>6. Valves shall be oriented to facilitate removal of equipment and/or valves.</p> <p>11. Provide influent drop pipe. PVC, DIP or FRP piping may be utilized. Drop bowl system by "Reliner" also acceptable. Engineer to design on a case by case basis.</p> <p>Add the following notes: 'NOTE: 1. Drawing Intended to show ReWa-Preferred General Arrangement. Actual pump station layout to be designed by Project Engineer. 2. Circular or Rectangular Wet wells may be used.'</p>	11/12/2021
PS-3.1	Typical Duplex Submersible Pump Station	<p>Add FM and Suction Bypass Connections; Moved generator to bottom right corner of site and electrical rack and bollards to front right corner of site; rotated wet well and pump station 90 degrees clockwise direction and moved location of gravity sewer influent manhole</p> <p>Add the following notes: 'NOTE: Drawing Intended to show ReWa-Preferred General Arrangement. Actual pump station layout to be designed by Project Engineer.'</p>	11/12/2021
PS-3.2	Typical Duplex Submersible Pump Station - Plan View	<p>Add the following notes: 'NOTE: 1. Drawing Intended to show ReWa-Preferred General Arrangement. Actual pump station layout to be designed by Project Engineer. 2. Circular or Rectangular Wet wells may be used.'</p>	11/12/2021

## Standard Drawings - Revision Tracking

Drawing #	Drawing Title	Description of Update	Rev Date
PS-3.3	Typical Duplex Submersible Pump Station - Section View	Made influent pipe a drop connection  Add the following notes: 'NOTE: Drawing Intended to show ReWa-Preferred General Arrangement. Actual pump station layout to be designed by Project Engineer.'	11/12/2021
PS-4.1	Typical Triplex Submersible Pump Station	Modified wet well from circular to rectangular Moved generator to bottom right corner of site and electrical rack and bollards to front right corner of site; rotated wet well and pump station 90 degrees clockwise direction and moved location of gravity sewer influent manhole  Add the following notes: 'NOTE: Drawing Intended to show ReWa-Preferred General Arrangement. Actual pump station layout to be designed by Project Engineer.'	11/12/2021
PS-4.2	Typical Triplex Submersible Pump Station - Plan View	Modified wet well from circular to rectangular; relocated entry to wall to south  Add the following notes: 'NOTE: Drawing Intended to show ReWa-Preferred General Arrangement. Actual pump station layout to be designed by Project Engineer.'	11/12/2021
PS-4.3	Typical Triplex Submersible Pump Station - Section View	Moved RTU unit to inside of enclosure  Extended length of drop pipe in wet well. Revised pump and piping layouts in the wet well and pump station enclosure.  Add the following notes: 'NOTE: Drawing Intended to show ReWa-Preferred General Arrangement. Actual pump station layout to be designed by Project Engineer.'	11/12/2021
PS-5	Typical By-Pass Pumping Piping Configuration 8' 0 Wetwells and Larger	Added 2nd Plug Valve & Box to By-pass Configuration	11/12/2021
PS-6.1	Typical Air/Vacuum Release Valve in Paved Areas	Updated valve to ARI body style; Opened bottom to drain	11/12/2021
PS-6.2	Typical Air/Vacuum Release Valve in Unpaved Areas	Updated valve to ARI body style; Opened bottom to drain	11/12/2021

## Standard Drawings - Revision Tracking

Drawing #	Drawing Title	Description of Update	Rev Date
PS-7	Typical Force Main Discharge to Receiving Manhole	Original version, no updates	11/18/2019
PS-8	Typical Mechanical Joint Restraint for Horizontal and Vertical Bends	Original version, no updates	11/18/2019
PS-9	Typical Pipe Penetration Seal	Original version, no updates	11/18/2019
PS-10	Typical Chain Link Fence with Double Swing Gate	Original version, no updates	11/18/2019
PS-11	Typical Yard Hydrant Detail	Original version, no updates	11/18/2019
PS-12	Typical Backflow Preventer for Water Service	Updated enclosure to "Hotbox" and pipe matl. to Sch 80 PVC.	11/12/2021
PS-13	Standard Pump Station Sign	Original version, no updates	11/18/2019
PS-14	Pump Station Asphalt Paving Detail	Original version, no updates	11/18/2019
EL-1.0	One-Line Diagram Packaged Wastewater Pumping Station	Original version, no updates	11/18/2019
EL-1.1	Typical Equipment Rack Packaged Wastewater Pumping Station	Original version, no updates	11/18/2019
EL-1.2	Typical Junction Box Detail Packaged Wastewater Pumping Station	Original version, no updates	11/18/2019
EL-2.0	One-Line Diagram Submersible Wastewater Pumping Station	Original version, no updates	11/18/2019
EL-2.1	Typical Equipment Rack Submersible Wastewater Pumping Station	Original version, no updates	11/18/2019
EL-2.2	Typical Junction Box Detail Submersible Wastewater Pumping Station	Original version, no updates	11/18/2019
EL-3.0	CT Cabinet Rack Packaged & Submersible Wastewater Pumping Stations	Original version, no updates	11/18/2019
EL-3.1	Surge Protective Device Packaged & Submersible Wastewater Pumping Stations	Revised note 1 to include alternate manufacturers	7/1/2022
S-1	Electrical Panel Canopy Foundation Plan	Original version, no updates	11/18/2019
S-2	Electrical Panel Canopy Roof Framing Plan	Original version, no updates	11/18/2019
S-3	Electrical Panel Canopy Bollard Detail	Original version, no updates	11/18/2019
S-4	Electrical Panel Canopy Typical End Elevation	Original version, no updates	11/18/2019
S-5	Electrical Panel Canopy Typical Side Elevation	Original version, no updates	11/18/2019
S-6	Electrical Panel Canopy Slab Sections	Original version, no updates	11/18/2019
S-7	Electrical Panel Canopy Column Detail	Original version, no updates	11/18/2019
S-8	Electrical Panel Canopy Notes, Schedules & Angle Connection Detail	Added paint color reference for roof, trim & wall panels. Revised '2015 SC Building Code...' to '2018 SC Building Code...' Added Note 5	11/12/2021

## Standard Specifications - Revision Tracking

Specification Section #	Drawing Title	Description of Update	Rev Date
<b>DIVISION 1 – GENERAL REQUIREMENTS</b>			
01 05 00	Field Engineering/Surveying	New Section	6/20/2023
01 41 10	Regulatory Requirements	New Section	11/12/2021
01 57 13	Temporary Erosion and Sediment Control	New Section	11/12/2021
01 66 00	Materials Storage, Handling and Protection	New Section	11/12/2021
01 72 00	Record Documents	New Section	6/20/2023
<b>DIVISION 2 - EXISTING CONDITIONS</b>			
02 22 26	Utility Removal and Abandonment	3.1.A updated	11/12/2021
<b>DIVISION 3 – CONCRETE</b>		3.4.A updated	11/12/2021
03 30 00	Cast-in-Place Concrete	New Section	11/12/2021
03 60 00	Grouting	New Section	11/12/2021
<b>DIVISION 26 – ELECTRICAL</b>			
26 00 00	Electrical	Original version, no updates	11/18/2019
26 32 13	Standby Electrical Power System	Original version, no updates	11/18/2019



## Standard Specifications - Revision Tracking

DIVISION 31 – EARTHWORK			
31 10 00	Site Clearing	New Section	11/12/2021
31 22 00	Site Grading	New Section	11/12/2021
31 23 16.13	Trenching	<p>1.3 Definitions:</p> <p>G. Excavation: Excavation is defined as unclassified excavation of every description regardless of materials encountered.</p> <p>H. Bedding: Select Material placed to bring trench bottom up to grade (bottom of pipe).</p> <p>I. Haunching: Granular Material placed from the top of bedding to the pipe springline. Where coarse material with voids (i.e. washed stone or pea gravel) is used for bedding, the same material shall be used for haunching.</p> <p>J. Initial Backfill: Suitable, Select, or Granular Material placed from the springline to a specified distance at or above the crown of the pipe. See standard details for specific requirements.</p> <p>K. Final Backfill: Suitable or Select Materials placed from the top of Initial Backfill to the top of finished grade or pavement/structure subgrade. Final Backfill beneath roadways or structures may require use of Granular Materials or Flowable Fill, as directed by ReWa or other agency (i.e. SCDOT, County, City, etc.).</p> <p>3.5 Dewatering:</p> <p>B. Where groundwater or wet/unsuitable soil is encountered, trench bottom shall be over excavated until stable in-situ soil is encountered. Depth to be determined in field by engineer and/or ReWa inspector. Unsuitable soil shall be removed from trench and replaced with granular material to provide acceptable pipe foundation.</p>	7/1/2022

## Standard Specifications - Revision Tracking

31 23 16.13	Trenching	<p>3.6. Backfilling</p> <p>D. Revsied entire Paragraph</p> <p>E. Maximum placement depths of various backfill materials for final backfill are as follows:</p> <p>1.Suitable (Common) Fill: Maximum 8 inches compacted depth.</p> <p>2.Select Fill: Maximum 8 inches compacted depth.</p> <p>3.Washed Stone: Maximum 12 inches consolidated depth.</p> <p>3.8 Field Quality Control</p> <p>1.a. Deleted sentence. Renumbered b. and c. to a. and b.</p>	7/1/2022
<b>31 23 16.13</b>	<b>Trenching</b>	<b>3.5.A. Detailed /designed dewatering plan may be required depending on site specific conditions.</b>	<b>6/20/2023</b>
31 23 16.16	Excavation and Backfill for Structures	<p>3.3. replaced with reference to 33 23 19</p> <p>3.2.A.2. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the excavation or trench.</p>	11/12/2021
<b>31 23 16.16</b>	<b>Excavation and Backfill for Structures</b>	<b>3.2.A.3 Added additional blasting plan requirements.</b>	<b>6/20/2023</b>
31 23 19	Dewatering	New Section	11/12/2021
31 37 16.13	Riprap	Original version, no updates	11/18/2019
<b>DIVISION 32 – EXTERIOR IMPROVEMENTS</b>			
32 12 16	Asphalt Paving	Original version, no updates	11/18/2019
32 31 13	Chain Link Fences and Gates	Original version, no updates	11/18/2019

## Standard Specifications - Revision Tracking

DIVISION 33 – UTILITIES			
33 01 30	Corrosion Protection for Concrete Wastewater Structures	<p>2.2 Repair Products:</p> <p>A.Approved coating product manufacturers:            1.Raven Lining Systems,            2.Sherwin Williams,            3.or Approved Equal</p> <p>D: 1. Manufacturer:            a. Raven Lining Systems,            b. AW Cook,            c. Or approved equal.</p> <p>E: 1. Manufacturer:            a. Raven Lining Systems,            b. AW Cook,            c. Or approved equal.</p> <p>F: 1. Manufacturer:            a. Raven Lining Systems            b. AW Cook            c. or approved equal.</p>	7/1/2022

## Standard Specifications - Revision Tracking

33 01 30	Corrosion Protection for Concrete Wastewater Structures	<p>2.2.G: 1. Manufacturer: As recommended by coating product manufacturer.</p> <p>2.3 Coating Products:</p> <p>C: 1. Manufacturer:</p> <p>a. Raven Lining Systems, b. Sherwin Williams, c. Or approved equal.</p> <p>2. Product: Raven Added 'Sherwin Williams Duraplate 6100 Epoxy' to the list.</p> <p>D: 1. Manufacturer:</p> <p>a. Raven Lining Systems, b. Sherwin Williams, c. Or approved equal.</p> <p>E: 1. Manufacturer:</p> <p>a. Raven Lining Systems, b. Sherwin Williams, c. Or approved equal.</p>	7/1/2022
33 01 30.11	Television Inspection of Sewers	<p>1.3.</p> <p>A. CCTV work to be performed after cleanout is installed, prior to placing into operation.</p> <p>B. Schedule Work of this Section to coincide with relining sewers and/or joint sealing.</p>	7/1/2022

## Standard Specifications - Revision Tracking

33 01 30.45	Temporary Bypass Pumping	New Section	6/20/2023
33 01 32	Sewer and Manhole Testing	Original version, no updates	11/18/2019
33 05 07.23	Utility Boring and Jacking	New Section	11/12/2021
33 05 07.23	Utility Boring and Jacking	<p><b>1.2.A If work is sub-contracted, then sub-contractor personnel shall also be properly trained and experienced in performing utility boring and jacking. Documentation of experience and/or training may be requested by ReWa.</b></p> <p><b>2.1.C Engineer shall be responsible for verifying casing thickness design based on specific site conditions, geotechnical conditions, and/or specific permitting requirements (i.e. SCDOT).</b></p> <p><b>3.2.C.Maintain in dry condition by use dewatering in accordance with Section 33 23 19. De-tailed /designed dewatering plan may be required depending on site specific conditions.</b></p>	6/20/2023
33 05 61	Concrete Manholes	<p>2.4: Added Ductile Iron Hinged Covers section</p> <p>2.5.A: added language that steps are only where shown on drawings or directed by ReWa</p> <p>2.6.A: Updated language on where protective coating is required</p>	11/12/2021
33 05 63	Concrete Vaults and Chambers	Original version, no updates	11/18/2019
33 05 75	Polymer Concrete Manholes and Wetwells	New Section	11/12/2021
33 05 75	Polymer Concrete Manholes and Wetwells	<b>2.4.A 8.Manufacturer shall provide specifications for appropriate sealant to be used to seal joints from infiltration/exfiltration.</b>	6/20/2023
33 05 97	Identification and Signage for Utilities	Updated Tracer Wire References	11/12/2021
33 31 11	Public Sanitary Sewerage Gravity Piping	1.1.B Revised domestic manufacturing requirements	11/12/2021
33 31 11	Public Sanitary Sewerage Gravity Piping	3.3.F.4 Revised minimum separation distance between laterals to 10 ft.	11/12/2021
33 31 11	Public Sanitary Sewerage Gravity Piping	2.1.B.2 Change SDR 35 to SDR 26	11/12/2021
33 31 23	Sanitary Sewer Force Main Piping	<p>1.1.B Revised domestic manufacturing requirements</p> <p>2.1 formatting edits</p> <p>2.2 Corrected DR18 pressure class to 235</p> <p>3.4.B Edited to reference Section 31 23.16.13 - Trenching</p>	11/12/2021
33 32 10	Submersible Sewage Pumping Station	2.1.A.1 Added 'Flygt' to pump manufacturers list	7/1/2022
33 32 10	Submersible Sewage Pumping Station	2.1.A.12, Added finish section with ReWa colors	11/12/2021
33 32 10	Submersible Sewage Pumping Station	Removed all references to the use of ultrasonic level control systems	11/12/2021

## Standard Specifications - Revision Tracking

33 32 10	Submersible Sewage Pumping Station	<p>2.4.H.Valves and Piping, 1.:</p> <p>Added to end of section: 'Acceptable manufacturers are Dezurik, GA Industries or Mueller. An alternate manufacturer must be submitted to and approved by ReWa prior to installation.</p> <p>2. Deleted Paragraph            3. Deleted Paragraph            4. Renumbered to paragraph 2. Revised Acceptable Manufacturer's list to include Milliken, Dezurik or Mueller.            5. Renumbered to paragraph 3.</p>	7/1/2022
33 32 13	Packaged Wastewater Pumping Stations	Added painting specification	11/12/2021
33 32 13	Packaged Wastewater Pumping Stations	Revised and added following language to 2.09.C.1: 'Acceptable manufacturers shall be Milliken or Dezurik. An alternate manufacturer must be submitted to and approved by ReWa prior to installation.'	11/12/2021
33 32 13	Packaged Wastewater Pumping Stations	1.4.B. Primary design operating point to fall within the Preferred Operating Range (POR). Refer to ReWa Development Manual for further detail.	11/12/2021

## Standard Specifications - Revision Tracking

33 32 13	Packaged Wastewater Pumping Stations	<p>2.09, Valves and Piping:</p> <p>A. Check Valve:</p> <p>1.: Added to end of section: ' Acceptable manufacturers are DeZurik, GA or Mueller. An alternate manufacturer must be submitted to and approved by ReWa prior to installation.</p> <p>B. Plug Valve (Duplex Configuration):</p> <p>1.: Added to end of section: ' Acceptable manufacturers are Milliken, DeZurik or Mueller. An alternate manufacturer must be submitted to and approved by ReWa prior to installation.</p> <p>C. Plug Valve (Triplex Configuration):</p> <p>1.: Added to end of section: ' Acceptable manufacturers are Milliken, DeZurik or Mueller. An alternate manufacturer must be submitted to and approved by ReWa prior to installation.</p> <p>2.10 Deleted Paragraph Heading. Renumbered subsequent paragraphs</p>	7/1/2022
<b>DIVISION 40 – PROCESS INTERCONNECTIONS</b>			
40 05 78.23	Air/Vacuum Valves for Wastewater Service	<p>1.2.C. Added ASTM requirement</p> <p>1.4.F. Added O&amp;M Manual submittal</p> <p>1.4.H. Updated manufacturer report requirements</p> <p>2.1.A. Updated manufacturer list</p> <p>2.1.B. Updated product descriptions</p> <p>2.5 Added spare parts requirements</p>	7/1/2022
40 05 81.26	Freeze-Proof Yard Hydrants	Removed NSF certification references.	11/12/2021

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