STANDARD SPECIFICATIONS FOR

PLURIS HAMPSTEAD, LLC

WASTEWATER COLLECTION SYSTEM

(*Revised November 1, 2024*)

Contents

Part I DEFINITIONS, ABBREVIATIONS, AND GENERAL REQUIREMENTS

When standards are referred to in this design criteria document, the most recent revision shall be applicable. This document addresses the collection and transmission of wastewater, not the treatment of wastewater.

Pump stations, force mains, and all related appurtenances shall be manufactured, designed, constructed, and tested in accordance with accepted standards, good engineering practice, and in complete compliance with the most current state regulations, as well as the North Carolina Department of Environmental Quality ("NCDEQ") Minimum Design Criteria.

These standards apply to gravity collection sewers, pump stations, force mains, and appurtenances.

1. STANDARD DEFINITIONS

a. DEFINITIONS

Wherever used in this Manual, the following terms shall have the meanings indicated, which shall be applicable to both the singular and plural thereof. There are other terms used in this document, which are defined in the sections to which they apply.

Applicant - Entity who is financially responsible for the proposed sewer collection system construction or modification, and who shall maintain operational responsibility of said system unless fee simple title is granted to PLURIS, Hampstead, LLC (PLURIS).

Application - Form or forms provided by NCDEQ and completed by the Engineer of Record and Applicant providing pertinent information regarding the design and the proposed construction or modification of sewer collection facilities. It includes all required associated documents.

Approved Plans - Sewer system improvement plans that have been reviewed by and received the approval of PLURIS and/or the appropriate state and local agencies.

Approving Authority - Authorized agent of PLURIS, who shall be responsible for approving plans and granting service.

Contract Documents - Refer to the project plans and specifications for sewer system improvements.

Contractor - The person, business, or corporation responsible for the performance of sewer system construction work.

Design Population - The population figure is obtained by multiplying the effective population figure by the proper factors for determining the design flow.

Developer - The person(s) or corporation(s) financially responsible for the design and construction of a development for which wastewater service by PLURIS will be requested.

Documents - All drawings, graphs, charts, calculations, compilations of data, writings, photographs, audio or video recordings, or other such records from which project pertinent information can be obtained, extracted, or translated in a usable form.

Engineer of Record – A professional engineer licensed to practice in the state of North Carolina and responsible for performing the design and preparing the drawings and specifications for the proposed sewer collection system construction or modification(s) and construction administration. They certify the completion of such construction or modification(s) in accordance with the approved plans, specifications, and permits. The Engineer of Record shall have experience and knowledge regarding the design and operation of sewer improvements.

Manual - Refers to all applicable standards, specifications, standard details, and policies contained in or referenced by this document.

Permit (NCDEQ Permit) - Written document issued by NCDEQ authorizing the construction or modification of sewer infrastructure.

Permit Period - Duration during which an NCDEQ permit is valid, commencing on the date of permit issuance by the Approving Authority and, unless suspended, modified, or revoked for cause, shall be valid for the succeeding twelve (12) months or until work is complete, accepted, and certified by the Engineer of Record, whichever occurs first.

Person - Individuals, sole proprietorships, partnerships, limited liability corporations, corporations, professional associations, firms, joint ventures, businesses, institutions, municipal or other local government subdivisions, governmental agencies, or any other corporate or political body, for profit or nonprofit.

Pipe Trench - The following terms are used in reference to excavation and backfill for pipes:

Bedding - The portion of the pipe support structure bounded by the foundation or undisturbed trench bottom, the trench walls, and the bottom of the pipe.

Final Backfill - The portion of the backfill lying above the initial backfill.

Foundation - The portion of the pipe support structure bounded by the undisturbed trench bottom, the trench walls, and the pipe bedding.

Haunching - The portion of the pipe support structure bounded by the bedding, the trench walls, the outside of the pipe, and a horizontal plane having an elevation equal to that of the spring line of the pipe.

Initial Backfill - The portion of the backfill lying above the spring line (midline) of the pipe and below a horizontal plane having an elevation that is one (1) foot above the top of the pipe.

PLURIS Sewer Collection System - Part or portion of the facilities owned by PLURIS, which are used to collect and carry wastewater to the treatment works and end at the sewer service lateral cleanout or other designated connection.

PLURIS - PLURIS Hampstead, LLC

Record Drawing - A complete set of drawings, consisting of one (1) hard copy on bond paper and one (1) electronic copy in PDF format that can be printed out but not modified and that shows actual installed or constructed conditions. Controlled location shall be based upon North American Datum of 1983. Vertical control shall be based upon North American Vertical datum of 1988 unless no such control is available within 2,000 feet of the property, in which case the datum used in setting the control monument will be used.

Required Fee - Fees levied by PLURIS as established in adoption of PLURIS User Rates and Application Fee for construction observation, permit application, modification, or renewal, as well as administrative review.

Service Lines - Small pipelines (sewer lines six [6] inches or less) connecting homes and buildings to the collection system.

Sewer Collection System - The meaning as stated in North Carolina General Statute 143-213 (15) in its most current amended form.

Standards - Where this Manual makes a reference to published standards, including but not limited to ASTM, ANSI, and AWWA, the latest revisions of such standards shall apply.

Sewer Service Area - Area designated as the franchise area by the North Carolina Public Utilities Commission (the land area within which sewer service is or will soon be available).

2. STANDARD ABBREVIATIONS

Several specific standards and practices are referenced in these minimum design criteria. The following acronyms and abbreviations shall be used when referring to these standards and practices for purpose of enhancing the clarity of this document:

A

AASHTO - American Association of State Highway Transportation Officials
ABC - Aggregate Base Course
ACI - American Concrete Institute
ANSI - American National Standards Institute

API - American Petroleum Institute
ASTM - American Society for Testing and Materials
AWWA - American Water Works Association

D

DIP - Ductile Iron Pipe

E

EA - Environmental Assessment
EEP - Environment Enhancement Program
EIS - Environmental Impact Statement

F

FEMA - Federal Emergency Management Agency
FIRM - Flood Insurance Rate Map
FONSI - Finding of No Significant Impact

G

Gal/Person - Gallons Per Person
Gal/Unit - Gallons Per Unit
Gal/Acre - Gallons Per Acre
GPD - Gallons Per Day
GPM - Gallons Per Minute

H

HDPE - High Density Polyethylene
HI - Hydraulic Institute

I

I/I - Inflow and Infiltration

M

MGD - Million Gallons Per Day

N

NC - North Carolina
NCAC - North Carolina Administrative Code
NCDA - North Carolina Department of Administration
NCDEH - North Carolina Division of Environmental Health
NCDOT - North Carolina Department of Transportation

NCDWQ - North Carolina Division of Water Quality
NEC - National Electric Code
NEMA - National Electric Manufacturer's Association
NFPA - National Fire Protection Association
NPDES - National Pollutant Discharge Elimination System
NPSHA - Net Positive Suction Head Available
NPSHR - Net Positive Suction Head Required

O

OSHA - Occupational Safety and Health Administration

P

PPI - Plastic Pipe Institute
psi - Pounds per square inch
psig - Pounds per square inch gauge
PVC - Polyvinylchloride

S

SF - Safety Factor

T

TDH - Total Dynamic Head

U

UL - Underwriters Laboratories
USCE - United States Corps of Engineers

3. GENERAL REQUIREMENTS

a. Sewer Permits – Prior to submitting the application to NCDEQ, PLURIS will need to issue a flow acceptance letter for the additional flow to systems owned, operated, and maintained by an entity other than PLURIS. PLURIS will review and approve all plans for the proposed sewer improvements prior to submission to NCDEQ for permitting. In the case of extensions that will be dedicated to PLURIS, the Applicant will provide a completed application in the name of PLURIS for the proposed work.

The following situations require approval and are permitted by the state of North Carolina (NCDEQ - DWQ), regardless of ownership (in addition to PLURIS approval):

i. Outfalls into a basin where sewer service has not yet been provided.
ii. Low pressure sewer systems or STEP systems.
iii. Projects involving environmental assessments.
iv. Any collection system where a variance from state regulations is required.

b. All PLURIS Design Standards shall be incorporated and become an integral part of the Plans, Specifications, and Contract Documents submitted for review and approval. Deviations must be noted in writing and receive written approval from PLURIS prior to final Contract Document approval.

c. The Contract Documents shall ensure that all structures, pavements, utilities, and other facilities that could be damaged because of project work are replaced or repaired in a manner that meets the approval of PLURIS or any governing bodies having jurisdiction.

d. No connection to or alteration of any existing facilities owned or maintained by PLURIS shall be permitted without the express permission of PLURIS and, where required, the presence of PLURIS's representative, except as directed by PLURIS.

Where a connection or alteration of any existing facilities is approved, the connection or alteration shall conform to the standards of this Design Manual for new installations.

e. All sewer extensions to be operated and maintained by PLURIS, in addition to any extensions not owned by PLURIS, shall be designed and built in accordance with this Design Manual and all applicable state and local regulations.

4. SUBMITTALS AND GUIDELINES

a. REQUIRED COPIES OF CONTRACT DOCUMENTS FOR PLURIS APPROVAL

The Engineer of Record should submit to PLURIS one (1) set of Contract Documents, including pertinent calculations, plans sheets, specifications, and all required supporting documentation such as (but not limited to) Watershed Classification Statements and Certificates of Public Convenience. The Engineer of Record shall have applied for applicable permits to NCDEQ and have paid associated fees for a preliminary review prior to submission of all Contract Documents necessary. These documents shall be presented in duplicate to PLURIS as an entire submission package for review.

PLURIS shall review such plans, make appropriate notes, and return the "redlined drawings" to the developer's Engineer of Record marked so that the necessary revisions can be made, and the Contract Documents can be revised. Upon review by PLURIS of the "red lines," PLURIS may request to meet with Applicant to discuss comments. All comments shall be addressed to comply or an explanation of reasons for not complying must be provided and approved by PLURIS.

The submitted plans must meet PLURIS design requirements. If plans or specifications do not meet PLURIS design requirements, PLURIS may elect to return the submittal package until such time the plans and specifications meet PLURIS design requirements (unless a variance has been given and a copy of such variance included with submission). Any applicable review fees paid to PLURIS are nonrefundable, and applicable fees are required for each review submittal.

The revised plans, permit applications, fees, and other supporting documentation shall be submitted for the approval by PLURIS and the appropriate state agencies, as appropriate.

b. ENGINEERING DESIGN CALCULATIONS & REPORTS

All Contract Documents submitted to PLURIS for approval shall be accompanied with the necessary design calculations as specified herein or requested by PLURIS. The calculations and any reports shall be prepared by the Engineer of Record.

All design calculations based on data not contained therein shall be referenced to the source. The calculations shall be submitted in duplicate, clearly referencing the project and presented in a neat, orderly, and logical procedure. All reports prepared by subconsultants shall list the assumptions made in the report preparation.

c. SEWER DESIGN CALCULATIONS

Sanitary sewer, force main, and pump station improvement calculations shall demonstrate adequate capacity to serve the entire contributing area. The calculations for the gravity mains shall be based on Manning's Formula, using a roughness ("n" factor) appropriate for the material in question. This n factor must be supported by published data from the manufacturer or other industry publication.

5. CONCEPTUAL PHASE

a. GENERAL

The developer's Engineer of Record and/or Developer shall become familiar with the sewer improvement policies of PLURIS prior to making conceptual plans for developments that require sewer service.

b. INITIAL CONFERENCE

Prior to finalizing any plans for sewer collection system improvements, the Developer and/or the developer's Engineer of Record shall consult with PLURIS' Authorized Agent to determine whether an initial conference will be necessary prior to the submission of plans for approval. If the scope of the proposed development is such that an initial conference will be beneficial prior to the development of final plans and specifications, considered and labeled as "Final Plans - Not Released for Construction" on the plans, the Developer will request scheduling of an initial conference. The Developer shall present the following:

i. Conceptual Plans: Submit two (2) copies of conceptual subdivision plans or site plans at a scale of 1-inch equals 200 feet (or larger scale) showing the proposed layout of the sewer extensions. The conceptual plans should show all proposed pipelines and sizes, manholes, valves, clean outs and pump stations, and the nearest existing sewer facilities to which the proposed new improvements will be located or connected. All proposed easements shall be shown. Provide a sketch of improvements and projected inverts within service area for the sanitary sewer. All Conceptual Plans are to include at least one (1) page with only the water and wastewater utilities, manholes, mains, and services, etc... They should be in color to reflect their content: green for identifying wastewater and blue for identifying water.

ii. Design: Provide copies of preliminary engineering design calculations used to determine estimated wastewater demands used to size line and pump station requirements, including expected initial and future populations to be served. The probable character of the wastewater generated should be provided.

iii. Estimated Time Schedules: Submit an estimated time schedule identifying the expected dates of completion of the final plans and specifications and expected beginning and completion dates of construction.

Part II GENERAL SPECIFICATIONS

1. CLEARING

a. All clearing will follow the guidelines for erosion control per an NCDEQ approved and permitted erosion control plan if one is required. Projects that do not require an approved plan will follow all industry standards for erosion control. All disturbed areas will be stabilized within 15 days of the end of work in that area. Stabilization of disturbed areas should follow the seeding guidelines set forth in Specification 3.

2. EXCAVATING, GRADING, TRENCHING, & BACKFILLING

a. General

The contractor shall furnish all labor, equipment, supplies, and materials and perform all operations in connection with the excavations, grading, and backfilling, including borrow for drainage structures, curb and gutter, sidewalks, driveways, pavements, slopes, storm drains, water and sanitary sewer lines. This also includes all hauling, wetting, rolling, and other operations pertaining thereto within the clearing limits - complete, in strict accordance with this section of the specifications and all applicable NCDEQ approved drawings, plans and permits.

b. Existing Conditions

Every reasonable effort should be made to provide accurate information on existing site conditions. The Contractor should become familiar with the site and satisfy himself as to the scope of the work involved and the materials to be encountered.

c. References

i. ASTM C33 - Standard specification for concrete aggregates

ii. ANSI/ASTM C136 - Sieve analysis of fine and coarse aggregates.

iii. ANSI/ASTM D698 - Tests for moisture-density relations of soils and soil-aggregate mixture using 5.5 lb. (2.49 kg) rammer and 12-inch (305 mm) drop.

iv. ANSI/ASTM D1556 - Density of soil in place by sand-cone method.

v. ASTM D2487 - Classification of soils for engineering purposes.

d. Products - Soils

i. General: Use soils free of organic matter, refuse, rocks, and lumps greater than 2 inches in diameter and other deleterious matter.

1. Backfilling Materials: Suitable material, when used as backfill in paved areas, shall be capable of being compacted as specified in paragraph "Compaction and Testing" of this section of these specifications.

a. Type 1 Material: Excavated material from the trench or materials from other sources that are free from large clods, roots, or stones larger than 1 inch may be used as initial backfill in trenches.

b. Type 2 Material: Excavated material from the trench or materials from other sources that are free from large clods, roots, or stones larger than 2 inches may be used as final backfill in trenches.

ii. Classification: For this specification, soils to be used as fill material are grouped into five classes according to soil properties and characteristics.

1. Class I - Angular, 6 - 40 mm (1/4 to 1 ½ in.), graded stone, including several fill materials that have regional significance such as coral, slag, cinders, crushed stone, crushed gravel, and crushed shells.

2. Class II - Coarse sands and gravels with maximum practical size of 44 mm (1 ½ in.), including variously graded sands and gravels containing small percentages of fines, granular, and non-cohesive, either wet or dry. Soil types of GW, GP, SW, and SP are included in this class.

3. Class III - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types of GM, GC, SM, and SC are included in this class.

4. Class IV - Silt, silty clays, and clays, including inorganic clays and silts of low to high plasticity, and liquid limits. Soil types of MH, ML, CH, and CL are included in this class. These materials are not recommended for bedding, pipe haunching, or initial backfill.

5. Class V - This class includes the organic soil, OL, OH, PT, as well as soils containing frozen earth, debris, rocks larger than 40 mm (1 ½ in.) in diameter, and other foreign materials. These materials are not recommended for bedding, pipe haunching, or initial backfill.

iii. Topsoil: Natural, friable soil free of subsoil, stumps, rocks larger than 2 inches in diameter, weeds, and other material detrimental to plant growth.

iv. Granular Fill: Granular fill under floor slabs shall be Class I material.

v. Structural Fill: Fill material placed inside the line of the building foundation or slab shall be Class I or II.

vi. Fill Beneath Pavement: Fill material used beneath pavement and for road shoulders shall be Class II or III.

vii. General Fill: General fill material not otherwise specified shall be Class II or III.

viii. Trench Backfill: Material used for bedding, pipe haunching, and initial backfill shall be as specified hereinafter.

a. Crushed Stone: Crushed stone shall be size no. 57, washed stone. If fines are insufficient, stone screenings shall be added to the extent required to stabilize it in the trench.

b. Concrete: Concrete placed thrust blocks shall be 3,000 psi or greater, 28-day concrete and shall not encase the fittings or bolts.

3. EXECUTION

a. General

i. Familiarization: Prior to commencement of the earthwork, become thoroughly familiar with the site, the site conditions, and all portions of the work specified in this Section.

b. Surface Preparation

i. Clearing: Areas designated for clearing and required for construction operations shall be cleared of trees, brush, structures, and other materials. Trees that are to remain shall be protected during clearing operations and subsequent work.

ii. Grubbing: Roots, stumps, and other materials shall be grubbed from the cleared areas to a depth of at least 18 inches. Tree stumps shall be grubbed in their entirety, including tap roots where applicable.

iii. Topsoil: Strip existing topsoil to a depth of 4 inches from areas to be excavated or graded. Stockpile the topsoil in a suitable area for use during final grading operations. Protect the topsoil from excessive erosion.

iv. Unsuitable Material: Remove sod, muck, or other unsuitable material to firm subsoil in areas designated for filling or grading operations.

v. Disposal: Trees, stumps, roots, rubbish, unsuitable soil, or other material resulting from surface preparation shall be removed from the site by the Contractor and disposed of.

c. Excess Water Control

i. General: Grade and maintain all areas of the site to preclude surface runoff into excavations and prevent ponding of water.

ii. Dewatering: Excavations should be kept free of surface water and/or groundwater. Provide and always maintain the necessary means and devices to prevent water from entering the excavations and to remove all water entering the excavations at no additional cost to the owner.

iii. Softened Subgrade: Remove all soil softened or eroded by the presence of water and replace with suitable backfill material.

d. Excavation

i. Excavation shall be accomplished in accordance with the grades and lines as established by the applicable plans and as required by the work to be performed. Excavation shall include the removal and replacement of all asphalt, concrete, curb, rock, earth, fences, trees (as directed by the Engineer of Record), shrubs, and other materials as applicable. The contractor will exercise care to prevent undercutting lower than the required subgrades. All materials from excavation, considered as suitable by the Engineer of Record, shall be used as fill wherever required, and the Contractor shall arrange work so that this usage of excavated materials will be possible. Unsuitable and surplus materials from excavation, if any, shall be disposed of by the Contractor at their expense. All areas of the site shall be graded and always maintained to prevent surface runoff from draining into the excavations and to prevent ponding of water therein.

ii. Excavated materials not required for topsoil, fill, or backfill shall be removed from the site of the work by the Contractor, but none shall be deposited on private property without written consent of the private property owner.

iii. Unsuitable Materials: Unsuitable materials encountered in an excavation shall be removed as directed by the Owner's representative, backfilled with suitable material, and compacted. Unsuitable materials include organic soils, muck, soft and compressible silts, and clays and running sands.

iv. Undercutting: Undercutting, unless authorized by the Engineer of Record, shall be replaced and compacted, as specified in section f (Fill and Compaction), at the Contractor's expense. If the material, after excavation to subgrade, is found to be soft, spongy, or pumping and thus unfit for use as subgrade, such unsuitable material shall be removed to a depth as directed by the Engineer of Record, and the subgrade shall be brought to proper elevation by filling with suitable material from excavation or from an approved borrow site.

v. Borrow: The Contractor will supply all borrow necessary and will provide all labor and equipment necessary to dig and haul such borrow. The placing of borrow shall be as provided for section f (Fill and Compaction).

e. Preparation of Subgrade

General: Upon completion of site preparation and excavation, scarify to a depth of 12 inches and compact as specified. For areas to receive fill, the compacted subgrade shall be scarified to a depth of 4 inches prior to placing the fill.

f. Fill and Compaction

i. General: When and where existing plans and grades require the use of fill to reach the required elevation, the Contractor shall deposit suitable material from previously excavated areas. Such material shall be free from debris, roots, trash, stones, or other harmful substances and shall be spread in successive layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly by motor grader or other approved device and rolled with an approved tamping or three-wheeled power roller until thoroughly compacted to 90% of maximum density obtained at optimum moisture content, as determined by the AASHTO Standard Method T-180. When any portion of the fill is constructed on an old roadbed, the existing surfaces shall be scarified and manipulated as directed by the Engineer of Record so that, when compacted, it shall have a uniform density, as specified in this section. Fills shall be shaped and always maintained during their construction to prevent an accumulation of standing water in the event of rain.

ii. Moisture Conditioning: Moisten or aerate the subgrade and fill material as required to obtain proper compaction.

iii. Structural Fill: Compact the subgrade and fill to a minimum of 98%, ASTM D698 (Standard Proctor) maximum density at optimum moisture content.

iv. Granular Fill: Place granular fill on compacted, scarified fill or subgrade and compact to a minimum of 100%, ASTM D698, maximum density at optimum moisture content.

v. Pavement Areas: Compact the subgrade and fill material beneath paved areas and shoulders to a minimum 100% ASTM D698 maximum density at optimum moisture content.

vi. Landscaped Areas: Compact the subgrade and fill to a minimum 98% ASTM D698 maximum density at optimum moisture content. Compact topsoil to 85% ASTM D698 maximum density at optimum moisture content.

g. Finish Grading

i. General: Perform finish grading to the lines and grades shown on the drawings. Finished grades should be smooth and uniform and provide positive drainage.

ii. Tolerances:

a. Rough Grade Plus or minus 0.1 foot
b. Finish Grade Plus or minus 0.1 foot

iii. Topsoil: The top 4 inches of soil in landscaped areas shall be topsoil.

iv. Protection: Protect areas that have been graded from equipment traffic.

h. Trenching, Backfilling, and Compaction for Utility Systems

i. General: Refer to specific utility sections in these specifications for installation requirements. Trench, backfill, and compact as specified except as modified herein.

ii. Trenching: Trench widths at and below the top of the pipe shall be the minimum necessary for proper installation. Trench banks above the top of the pipe shall be as vertical as practicable. Over depth excavation shall be backfilled with Class I material and compacted. The Contractor shall provide, at the contractor’s expense and as directed by the Owner's representative, special bedding material or concrete encasement as may be necessary due to over-width excavation.

iii. Depth: Trench to the lines and grades shown on the drawings. Where elevations are not shown, trench to a depth sufficient to provide at least 36 inches of cover above the top of the pipe, unless otherwise specified. Grade trenches to provide a constant slope free of sags and high spots.

iv. Dewatering: Keep trenches free of water. Include cost of dewatering in unit price bid for pipe. No additional payment for this item is permitted.

v. Trench Bracing: Properly brace, sheet, and support trench walls as soil conditions indicate and in strict conformance with all laws and OSHA regulations. Provide adequate bracing and shoring to protect adjacent improvements. Contractor shall provide certifications for all premanufactured trench bracing devices prior to any excavation activities.

vi. Bedding, Pipe Haunching, and Initial Backfill: Tamp to provide firm, even bedding. Excavate bedding material to match the shape of the bottom of the pipe and bell, as detailed in the drawings. Place haunching material to provide full bearing around the bottom of the pipe. Place bedding haunching and initial backfill as specified below.

vii. Pipe Bedding:

1. PVC C-900 Gravity Main - Provide six (6) inches of Class I bedding material compacted to 98% ASTM D698 density. Haunching material shall be Class I material compacted to 98% ASTM D698 density. Haunching of pipe from invert to spring line shall be by hand placement to ensure material is worked under haunch. Initial backfill shall be Class I to top of pipe (washed #57 stone preferred).

2. DIP and C-900 PVC Gravity Main - Provide six (6) inches of Class I bedding material compacted to 98% ASTM D698 density. Haunching material shall be Class I material compacted to 98% ASTM D698 density. Haunching of pipe from invert to spring line shall be by hand placement to ensure material is worked under haunch. Initial backfill shall be Class I to spring line of pipe Class I, II, or III material to top of pipe.

3. Pressure Main PVC C-900 or DIP - Provide six (6) inches of Class I or II bedding material compacted to 98% ASTM D698 density. Haunching material shall be Class I or II material compacted to 98% ASTM D698 density. Haunching of pipe from invert to spring line shall be by hand placement to ensure material is worked under haunch. Initial backfill shall be Class I or Class II to top of pipe Class I, II, or III material from top of pipe to 6 inches above pipe.

4. Service Pipe (C-900) - Provide six (6) inches of Class I or II bedding material compacted to 98% ASTM D698 density. Haunching material shall be Class I or II material compacted to 98% ASTM D698 density. Haunching of pipe from invert to spring line shall be by hand placement to ensure material is worked under haunch. Initial backfill shall be Class I or II to top of pipe.

viii. Backfill: Backfill the remainder of the trench in accordance with paragraphs 2d (Products-Soils) and f. (Fill and Compaction) of this section. Backfill from embedment zone to surface grade may be by hand of mechanical placement. Trench backfills shall be compacted in 8-inch lifts.

ix. Foundation: Firm foundation support materials shall be required in wet, yielding, and mucky locations and shall be constructed by removal of wet, yielding, or mucky material and its replacement with sufficient Class I material to correct the instability. In areas where foundation is required, bedding shall be class I only.

x. Backfilling in Traffic Areas (highways, paved streets, paved parking lots, alleys, driveways, highway, and street shoulders)

1. Initial Backfilling of Pipe (Ordinary Bedding for DIP Pipe)

a. After preparing the trench for ordinary bedding as described under h. (Trenching, Backfilling and Compaction for Utility Systems) of this section, this portion of the pipe trench shall be backfilled with suitable materials (Type 1) under and around the pipe, carefully deposited in uniform layers on both sides of pipe, and compacted by hand or pneumatic tampers until backfill reaches one (1) foot above top of pipe. The depth of backfill layers shall be six (6) inches maximum. Each layer of material shall be compacted to a dry density 95% of the maximum determined by the Standard Proctor Compaction Test.

b. When crushed stone is used, the initial backfill of suitable materials will not be required.

c. The tampers shall be proper sized to operate between trench wall and pipe without damaging the pipe.

2. Initial Backfilling of Pipe (Crushed Stone Encasement for PVC pipe, DIP in unstable or wet conditions)

This portion of the pipe trench shall be backfilled with crushed stone to provide crushed stone encasement.

3. Backfilling Trench to Subgrade After Initial Backfilling (Suitable Materials)

a. After initial backfilling has been compacted as specified above, backfill the remainder of the trench in compacted layers not to exceed twelve (12) inches using a mechanical tamper up to the bottom elevation of the pavement structure with suitable materials (Type 2) to be a dry density 95% of the maximum determined by the Modified Proctor Compaction Test.

i. Field Quality Control

i. Field inspection, sampling, and testing will be performed per owner's instructions.

ii. For areas where paving is disturbed and must be reinstalled, an independent geotechnical engineer and testing laboratory shall perform sufficient tests and inspection procedures, to the satisfaction of the Engineer of Record, both in the field and lab to ensure that the provisions of this specification are met. The Contractor shall pay for all testing. The Engineer of Record shall approve the testing lab. After testing is completed and reports are provided, all subgrades below the paving will be examined by the Engineer of Record before any paving is authorized. The responsibility of the geotechnical engineer and testing laboratory is to promptly, and accurately report the results of their tests and inspections to the Engineer of Record. In addition, the geotechnical engineer must work in coordination with the Contractor, in performing all tests required. The geotyechnical engineer’s reports must state whether the results comply with contract requirements. The testing and control firm shall deliver all its reports to the Engineer of Record with a copy to the Contractor.

2. SEEDING AND STABILIZATION OF DISTURBED AREAS

a. The seeding and stabilization of all disturbed areas shall conform to the NCDEQ approved soil erosion plan and permit. If an approved plan is not required, all disturbed areas shall be seeded and stabilized per the latest edition of the *Erosion and Sediment Control Planning and Design Manual*.

Part III SUBMITTALS

1. GENERAL: Before any work is started at the job site, the Contractor shall make submittals to the Engineer of Record and PLURIS in accordance with the requirements of this section. The Contractor shall be responsible for preparing a progress or work schedule for the project. The Contractor shall process the shop drawings for all materials required to the Engineer of Record and PLURIS, and the Contractor shall be responsible for timely submission in accordance with the shop drawing schedule, which is included in the overall progress or work schedule as described in this section.

2. SUBMITTALS

a. Submittals are defined as shop drawings, diagrams, illustrations, schedules, performance charts, brochures and other data prepared by each contractor that illustrate how specific portions of the work shall be fabricated and/or installed.

b. Shop drawings are not part of the Contract Documents but are a supplementary means of communication to assist in understanding what each Contractor proposes to provide and to establish whether what is intended to be installed conforms to the drawing and specifications.

c. In the instance of a substituted item, the Contractor shall verify that it will fit into the space allocated to the originally required item, giving due regard to all other trades' requirements. Where modifications to the Plans and Specifications are proposed, the Contractor must indicate such deviation in writing in the submittal.

3. SUBMITTAL PROCEDURES: All shop drawings shall be delivered to the Engineer of Record and PLURIS. The Engineer of Record and PLURIS will screen shop drawing submittals to ensure that the shop drawings have been properly certified and identified. If they are submitted properly, the Engineer of Record will review the items.

4. CATALOG SHEETS: For standard manufactured items considered by the Engineer of Record and PLURIS as not requiring special shop drawings, each Contractor shall submit three (3) copies of the manufacturer's catalog sheets showing illustrated cuts of the items to be furnished, scale details, sizes, dimensions, performance characteristics, capacities, wiring and control diagrams, and all other pertinent information.

5. SHOP DRAWINGS

a. Each contractor will submit for review three (3) white prints of shop and working drawings of materials fabricated for a specific contract and of equipment and materials for which such drawings are specifically requested.

b. Prior to submitting drawings to the Engineer of Record and PLURIS, the Contractor shall check thoroughly all such drawings are satisfactory that the subject matter conforms to the Plans and Specifications in all respects. Drawings that are correct shall be marked with the date, checker's name, and certification of the Contractor's approval and then shall be submitted to the Engineer of Record and PLURIS. Any shop drawings submitted without the Contractor's certification will be returned without review.

c. Shop drawings shall show the principal dimensions, including but not limited to weight, structural, and operating features; performance characteristics and wiring diagrams; space required; clearances; type and/or brand of finish or shop coat; and grease fittings, depending on the drawing. When it is customary to do so, when the dimensions are of particular importance, or when so specified, the drawings shall be certified by the manufacturer or fabricator as correct.

d. When so specified or if considered by the Engineer of Record and PLURIS to be acceptable, the manufacturer's specifications, catalog data, descriptive matter, and illustrations may be submitted for review in place of shop and working drawings. In such a case, the requirements shall be as specified for shop and working drawings, to the extent possible.

e. The Contractor shall be responsible for the prompt submission of all shop and working drawings in accordance with the shop drawing schedule so that there shall be no delay to the work due to the absence of such drawings.

f. No material shall be purchased or fabricated until the required construction shop and working drawings have been submitted and reviewed. All materials and work involved in the construction shall then be as represented by said drawings.

g. Only drawings that have been checked or corrected by the fabricator should be submitted to the Contractor by subcontractors and vendors. Prior to submitting drawings to the Engineer of Record and PLURIS, the Contractor shall check thoroughly all such drawings to ensure that the subject matter thereof conforms to the drawings and specifications in all respects. Correct drawings shall be marked with the date, checker's name, and indication of the Contractor's approval, and then shall be submitted to the Engineer of Record and PLURIS; other drawings shall be returned for correction.

h. The Engineer of Record’s and PLURIS's review of shop and working drawings will follow a general check made to ascertain conformance with the design concept and functional result of the project and compliance with the information given in the Plans and Specifications.

   The Contractor is responsible for details and accuracy, for conforming and correlating all quantities and dimensions at the job site, for information that pertains to the fabrication processes or to techniques of construction, for coordination of the work of all trades, and for timely delivery of all materials so that the project will not be delayed.

Part IV Record Drawings

1. RECORD DRAWINGS

Certified, surveyed record drawings ("as-built" plans), sealed by a North Carolina Licensed Professional Land Surveyor or Professional Engineer (engineer seal required for profiles), shall be furnished to PLURIS by the Engineer of Record (or Developer where applicable) upon completion and acceptance of the infrastructure by PLURIS. Record drawings should, at a minimum, reflect all information found on the approved plans with all pertinent revisions and field changes.

For gravity sewer and force main projects, the as-built plans shall include accurate information regarding pipe size, pipe material, pipe length, manhole construction (size of manhole, invert, rim, alignment, location), services, cleanouts, and pump stations along with any relevant rights-of-way, property boundaries, and easements. Plans shall also include sewer profiles showing any utility crossings along with the aforementioned information. Recorded drawings shall also include at least one-color page with only the water and wastewater utilities, manholes, mains, and service, etc.… They should be in color to reflect their content: green for identifying wastewater and blue for identifying water.

For pump station projects, the as-built plans shall include accurate information regarding interior and exterior pipe sizes, material, and length, as well as all structural dimensions of the pump station, all electrical equipment (make and model), pump information (make, model, and impeller size), and site layout information. Both plan view and section view drawings are required on the as-built plans.

2. DIGITAL INFORMATION

Digital as-built information shall be provided by the Engineer of Record in AutoCAD and PDF format and shall include all information required on the as-built drawings. Digital pictures of all items of interest such as utility crossings and separations should be included.

Part V Gravity Sewer

1. Material

Suitable couplings complying with ASTM specifications shall be used for joining dissimilar materials that consider the leakage limitations on these joints.

a. Ductile Iron Pipe

i. Pipe shall be manufactured as per AWWA C141 in 18-foot lengths. Pipe shall be Class 50, as manufactured by Griffin, U.S. Pipe, American, Tyler, or Clow.

ii. Pipe joints shall be of the push-on type as per AWWA C111. Pipe lining shall be cementing mortar with a seal coat of bituminous material, all in accordance with AWWA C104.

iii. DIP shall be designed and manufactured in accordance with AWWA C150 and C151 for a laying condition Type 2 and pressure class rating as follows:

Minimum Pressure Class for DIP Sewer Mains

Diameter	Cover	Class
8-Inch	3 to 20 Feet	350 psi
10 to 12-Inch	3 to 14 Feet	350 psi
14 to 20-Inch	3 to 10 Feet	250 psi
24 to 64-Inch	3 to 8 Feet	200 psi

Note: For cases not specified, consult with PLURIS for further guidance.

iv. All buried DIP and fittings shall have bituminous coating on the exterior surface in accordance with AWWA C151.

b. Polyvinyl Chloride (PVC) Pipe

i. PVC C-900 pipe shall be made of PVC plastic having a classification of 12454-B, 12454-C, or 13364-B (with minimum tensile modulus of 500,000 psi) as defined in ASTM Specification D1784.

ii. PVC C-900 pipe shall have integral wall bell and spigot joints for the conveyance of domestic sewage and shall be supplied in minimum 12.5-foot lengths. Fittings *(*private sewer service fittings*)* shall be made of PVC plastic having a cell classification of 12454-B 12454-C or 13343-C as defined in *ASTM* Specification D1784.

iii. All PVC C-900 gravity sewer pipe and PVC C-900 fittings shall be manufactured in accordance with the latest version of ASTM D3034. Fittings shall be manufactured by pipe supplier or approved as equal and have bell and/or spigot configurations compatible with that of the pipe. Fittings shall be ductile iron fittings for six (6) inch diameter and larger pipes.

iv. All PVC pipe up to and including 15 inches in diameter shall be C-900.

v. PVC C-900 pipe of any make, brand, or type shall not be used for installations larger than 15 inches in diameter without first receiving written approval of PLURIS.

vi. PVC C-900 pipe shall not be used for installations deeper than twenty (20) feet.

c. Material Identification

i. Each length of pipe shall have plainly and permanently marked thereon the following information, as well as any additional information specifically noted in the sections below:

1. Pipe class or strength designation
2. Manufacturer's name or trademark

3. Nominal pipe size

d. Bedding Materials

For PVC sewer mains, see Section L, in the Construction Requirements "Additional Requirements for "PVC C-900" and the Standard Details for bedding requirements.

e. Sewer Manholes

i. Concrete Manholes

a. Manholes shall be precast concrete.
b. All manholes shall have eccentric cone sections.
c. Precast manholes shall meet ASTM C478 as to design and manufacturing requirements.
d. The standard joint shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant.
e. All lift holes must be plugged with non-shrinking grout after installation.
f. All grade adjustment rings shall be sealed with non-shrink grout.
g. All grade adjustment rings will be of precast concrete. No block or brick risers will be accepted.
h. All manholes shall have 6-inch, 3,000 psi or greater concrete bottoms resting on a minimum of 12 inches of #57 stone.
i. Sewer main flow shall enter and exit radially through the manhole.
j. Inverts shall be constructed with a width equivalent and a height equal to ½ that of the effluent pipe and shall be so finished that a minimum energy loss occurs in the manhole.
k. At each inlet and outlet, compression connectors (flexible sleeves) shall be cast into the manhole section.
l. Flexible connectors are to be manufactured of high-quality rubber or synthetic rubber, and all strap clamps or draw bolts shall be stainless steel.
m. Boots are to meet standards of ASTM C923.
n. Rings and clamps are to meet standards ASTM A167 and/or ASTM C923.
o. All manholes shall have inflow protectors. Locking manhole covers may be desirable in isolated easement locations or where vandalism may be a problem. Locking manhole covers may be required in wetland areas.
p. Precast polymer concrete manholes may be utilized.

ii. Manhole Frame and Cover Materials

a. Manhole frames and covers shall be Class 35 gray iron with "Sanitary Sewer" forged into the cover as indicated in the details.
b. Rings and cover shall be stamped with the make and model.
c. For installation in roadways, use a Type 1 ring and cover, and place sufficient depth concrete below the pavement around the ring to ensure contact with manhole.
d. For installation in unpaved areas, use Type 2 ring and cover.
e. Use Type 3 ring and cover for installations necessitating watertight requirements.
f. Locking covers shall be required in all outfall locations.
g. Castings shall be machined to give even and continuous bearing on the full length of the frame.

h. Castings shall be free of porosity and blow holes.
i. Manhole frames shall be bolted to the manhole, except in paved streets.
j. All manhole rings in roadways shall be encased in a concrete collar of 3,000 psi or greater concrete beneath the asphalt, with the cover flush with the top of pavement.
k. Watertight manhole frames and covers shall have neoprene gasket and machined bearing surfaces.
l. Bolts shall be standard hexagonal head, countersunk such that when fully tightened the bolt head is flush with the top of locking bolts.
m. Only stainless steel locking bolts shall be used.
n. Use of more than one (1) paving ring to achieve paving grade requires PLURIS approval.

iii. Manhole Steps
a. Manhole steps shall be permitted with precast manhole sections.
b. Steps shall be of polypropylene material reinforced with a ½ inch diameter reinforcing rod.
c. Manhole steps shall be designed for a vertical load of 400 pounds and a horizontal pull-out load of 1,000 pounds.
d. Steps shall be set twelve (12) inches on center.
e. Holes for the installation of manhole steps shall not project through the manhole wall but shall stop a minimum of one (1) inch from the outside wall.
f. Steps shall be at least twelve (12) inches clear width and shall project at least 5 inches from the wall into which they are embedded.
g. Steps shall be located along the effluent side of the manhole.
h. The eccentric cone shall be oriented so that the steps are vertical.
over the downstream. The minimum diameter of manholes shall be 4 feet (48 inches). Larger diameters are preferable for large diameter sewers. A minimum access diameter of 24 inches shall be provided.
i. Manholes for sewers less than 16 inches in diameter shall be a minimum of 4 feet in diameter. Manholes for sewers 16 inches in diameter or greater shall be a minimum of 5 feet in diameter.
j. Any manholes without rubber boots will not be accepted. Boots shall be accompanied by stainless steel banded #316 connection.
k. Manholes shall be waterproofed by wrapping all joints with a minimum eight (8) inches width a band of inorganic fabric felt saturated in waterproofing asphalt.
l. Waterproofing shall be installed by mopping asphalt over the joint area, then wrapping the felt around the joints, and finally mopping the felt with another coat of asphalt.

f. For Service Connections

i. Pipe Materials

a. PVC pipe shall be C-900 or greater supplied in minimum of 18-feet individual lengths. The pipe requires gasket joints.

b. PVC pipe shall meet the requirements of ASTM D3033 (C-900) as furnished by Johns-Manville, Gifford Hill, David, Olin, or approved equal. The pipe may be joined by elastomeric gaskets.

c. DIP shall be used for sanitary sewer for services with less than three (3) feet of cover or more than twenty (20) feet of cover. Pressure class and thickness class of all ductile iron lines with less than three (3) feet of cover will be indicated on all plan and profile sheets. Ductile iron services shall also be used in all cases where a water supply well is located within 100 feet of the sewer service line.

ii. Service Materials

a. PVC service wyes shall be of the same material as the main and shall be factory gasket X gasket X gasket wyes, compounded for sewer service.

b. Ductile Iron Service Wye's shall be of the same material as the main and shall be factory gasket X gasket X gasket wyes, compounded for sewer service.

c. Service Wye's for PVC services shall be PVC with a PVC cap at the right-of-way.

d. Sewer service saddles are not prohibited.

2. Design

a. Location

i. All public sanitary sewer mains shall be installed in dedicated street right-of-way or in dedicated utility easements. Mains located within NCDOT right-of-way shall be placed in accordance with NCDOT standards and the applicable encroachment permit.

ii. Minimum widths sanitary easements shall be as follows:

50 feet	Construction Easement
30 feet	Permanent Easement

iii. The size of easements for sanitary sewer mains greater than 24 inches shall be determined by PLURIS.

iv. Sewer mains shall be centered within their easements unless otherwise determined by PLURIS.

a. Proposed sewers paralleling a creek shall be designed to a proper depth to allow lateral connections such that all creek crossings will be below stream bed elevation. The top of the sewer main shall have at least one (1) foot of cover between it and the stream bed. Concrete encasement shall be required when the cover between the top of the pipe and the stream bed is less than three (3) feet. Sewers entering or crossing streams shall be constructed of ferrous metal pipe with mechanical joints; otherwise, they shall be constructed so they will remain watertight and free from changes in alignment or grade and pressure tested to 150 psi. PVC pipe may be used where a minimum of three (3) feet of cover can be maintained. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials that will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe.

v. Sanitary sewer mains shall not be installed under any part of water impoundments.

vi. All private sewer collection mains inside PLURIS service area that will connect or will discharge into a PLURIS sewer system shall comply with all PLURIS design, siting, and installation criteria outlined herein. The owner of the private sewer collection system shall meet all state design requirements and obtain a state permit to construct and operate the private system.

vii. No developer, contractor, or property owner shall place any part of a structure, permanent equipment, permanent retaining wall, fence, or impoundment within sanitary sewer easements or utility easements dedicated to PLURIS.

viii. Fill or cut slopes are not allowed to extend into easements except by specific approval of PLURIS.

ix. Sewer line easements shall be graded smooth; free from rocks, boulders, roots, stumps, and other debris; and seeded and mulched upon completion of construction. Easements across sloped areas shall be graded uniformly across the slope to no steeper than a 5:1 ratio.

x. Mains shall be deep enough to serve the adjoining property and allow for sufficient slope in lateral lines and shall have the following minimum covers. These requirements may be waived at the discretion of PLURIS, in which case DIP shall be installed.

   a. Four (4) feet from the top of the pipe to finished subgrade in roadways
   b. Three (3) feet from the top of pipe to finished grade outside roadways

xi. Mains over twenty (20) feet deep require ductile iron for the entire run between manholes and shall be approved by PLURIS.

xii. Mains shall have a minimum vertical separation of twenty-four (24) inches between storm pipe when the horizontal separation is three (3) feet or less unless structural bridging is provided.

xiii. There shall be a minimum of five (5) feet horizontal separation between parallel gravity and/or force mains.

xiv. Sewer mains shall have a minimum horizontal separation distance of ten (10) feet from water lines unless the top of the sewer main is at least eighteen (18) inches below the bottom of the water main, and there is a horizontal separation of at least three (3) feet from the closest edge of pipes.

xv. Where sewer mains cross beneath water mains with a vertical separation of eighteen (18) inches or less, or where water mains cross under sewer mains, the entire leg of sewer main shall be DIP, and the void space between the pipe crossing shall be backfilled with suitable fill that meets or exceeds NCDOT specifications. The water main shall be centered at the point of crossing, which shall be at an approximate 90-degree angle.

xvi. Structures - The sewer outfalls, headwalls, manholes, gate valve boxes, or other structures shall be located so they do not interfere with the free discharge of flood flows of the stream.

xvii. Alignment - Sewers crossing streams shall be designed to cross the stream as nearly perpendicular to the stream flow as possible and shall be free from change in grade. Sewer systems shall be designed to minimize the number of stream crossings.

xviii. Aerial crossings shall be prohibited unless specifically allowed by PLURIS and only under extreme circumstances.

a. Proper joint technology (e.g., flanged or restrained), adequate supports to prevent excessive flexion, or a combination of both shall be provided for all aerial pipe crossings. Supports shall be designed to prevent frost heave, overturning, and settlement.

b. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above ground and below ground sewers. Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize heaving.

c. For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe should be placed no lower than the elevation of the 25-year flood. DIP with mechanical joints shall be required.

d. In the event that the 25-year flood elevation cannot be determined, or the proposed gravity sewer must be placed below the 25-year flood elevation, a letter shall be provided by the applicant upon certification stating, “Regular and proper inspection and maintenance of the aerial crossing shall be provided to ensure that the creek/stream flow is not impeded and that no damage will be caused to upstream or adjacent properties.”

xix. Anti-Seepage Collars - In areas where the sewer trench has the potential to drain wetlands, anti-seepage collars shall be installed. Please be informed, in these areas, a 401/404 permit may be required. All areas directional bored under wetlands require anti-seep collars.

b. Protection of Potable Water Supplies and Storm Sewers

i. Cross Connections Prohibited - There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which would allow the passage of any wastewater or polluted water into the potable supply. No water pipe shall pass through or meet any part of a sewer manhole.

c. Size

i. The minimum diameter size for gravity sewer mains conveying wastewater shall be eight (8) inches for public sewers and six (6) for private sewers.

ii. New sewer systems shall be designed based on NC Regulation Design Criteria and NCDEQ requirements for flow as found in 15A NCAC 02T .0114.

iii. The ratio of peak to average daily flow shall be as follows:

Q /Q max /avg.	*Q* average flow (GPD)
4.0	3,000 or less
3.5	3,000 – 6,000
3.0	6,000 – 10,000
2.5	Greater than 10,000

iv. Sewers shall be designed to flow half full at the average daily flow.

v. Sanitary sewers shall be designed to carry the projected peak flow at no more than 3/4 full.

vi. All sewers shall be designed and constructed to give mean velocities, when flowing full, of not less than 2.0 feet per second, based on Manning's formula using an "n" value of 0.013. The following are the minimum slopes to provide; however, slopes greater than these are recommended.

The minimum grades for public sanitary sewers shall be as follows:

Main Size (in.)	Minimum Slope (ft/100 ft)
6	0.60
8	0.40
10	0.28
12	0.22
Main Size (in.)	Minimum Slope **(ft/100**
14	0.17
15	0.15
16	0.14
18	0.12
21	0.10
24	0.08
27	0.07
30	0.06

vii. The minimum slope for the uppermost reach of a sanitary sewer line shall be 1.00% regardless of sewer line size.

viii. The maximum grade for sanitary sewers is 10%. The maximum velocity in sanitary sewers is 15 ft./sec.

ix. Sewer extensions should be designed for projected flows even when the diameter of the receiving sewer is less than the diameter of the proposed extension at a manhole, with special consideration of an appropriate flow channel to minimize turbulence when there is a change in sewer size.

x. A downstream analysis of the receiving sewer is required prior to submitting applicable permits associated with the proposed project.

xi. Pipe diameter changes shall occur in a manhole with the invert of the larger pipe lowered sufficiently to maintain the same energy gradient. An approximate method of securing these results is to place the 0.8 depth point of both sewers at the same elevation.

xii. Manning's Equation for Gravity Flow $V = [1.486/n] \times R^{.66} \times S^{.5}$

Where:

V = Velocity in feet per second
n = Coefficient of Roughness (0.013)
S = Slope in foot per foot
R = Hydraulic Radius in feet (cross sectional area divided by the wetted perimeter)

xiii. The pipe diameter and slope shall be selected to obtain the greatest practical velocities to minimize settling problems. Designs must include a minimum scouring velocity of 2 feet per second. Sewers shall not be oversized to justify using flatter slopes. If the minimum scouring velocity cannot be maintained during initial operation prior to the design flow capacities being reached, the ability to periodically flush the system shall be required.

d. Manholes

i. Manholes shall be spaced at a maximum distance of 425 feet apart for all sewer lines.

ii. Manholes for sewers less than sixteen (16) inches in diameter shall be a minimum of four (4) feet in diameter. Manholes for sewers sixteen (16) inches in diameter or greater shall be five (5) feet in diameter. A minimum access diameter of twenty-four (24) inches shall be provided.

iii. Manholes shall be installed at each change of direction of line and/or grade. The flow channel through manholes should be made to conform in shape and slope to that of the entering sewer line. Therefore, no elevation drop shall occur at the manhole and centerline inverts shall be used.

iv. Inside drop manholes shall be used when necessary. Moor base or outside drop manholes shall not be permitted.

v. Where the difference in elevation between the incoming sewer and the manhole invert is less than two (2) feet, the pipe must extend over the invert so that material is deposited directly into the stream of flow. Where the incoming sewer is elevated greater than two (2) feet, the influent line must have a fixed drop to convey the flow to the invert.

vi. A bench shall be provided on each side of any manhole channel when the pipe diameter(s) are less than the manhole diameter. The bench shall be sloped no less than 1/2 inch per foot (4%). The invert elevation of any lateral sewer, service connection, or drop manhole pipe shall be above the bench surface elevation. No invert shall be located directly on the surface of the bench.

vii. Inlet and outlet pipes shall be joined to the manhole with a gasketed flexible watertight connection or any watertight connection arrangement that allows minor differential settlement of the pipe and manhole wall to take place.

viii. Flow Channel

a. The flow channel straight through a manhole shall be made to conform as closely as possible in shape and slope to that of the connecting sewers. The channel walls shall be formed or shaped to three quarters (3/4) of the height of the crown of the outlet sewer in such a manner that it does not obstruct maintenance, inspection, or flow in the sewers.
b. When curved flow channels are specified in manholes, including branch inlets, minimum slopes should be increased to maintain acceptable velocities.

ix. Sewers shall be laid with uniform slope between manholes.

x. All sewers shall have straight alignment between manholes. Straight alignment shall be checked by using either a laser or lamping.

xi. Location

a. Manholes shall be installed at the end of each line, at all changes in grade, size, or alignment, at all intersections, and at distances not greater than 425 feet for all sewers.

b. Cleanouts may not be used in lieu of manholes for 6-inch private sewer lines.

xii. Watertightness

Manholes shall be designed for protection from the 100-year flood using any of these options that follow:

i. Manhole rims shall be two (2) feet above the 100-year flood elevation.
ii. Manholes shall be watertight and vented two (2) feet above the 100-year flood elevation.
iii. Manholes shall be vented every 1,000 feet or every other manhole, whichever is greater.
iv. In some situations, recast polymer concrete manholes may be utilized.

xiii. Buoyancy - Buoyancy shall be considered, and flotation of the manholes shall be prevented with appropriate construction in every design where high groundwater conditions are anticipated. All manholes shall have a minimum six (6) inches extended base.

xiv. Inspection and Testing - The specifications shall include a requirement for inspection and testing for watertightness or damage prior to placing into service.

xv. Corrosion Protection for Manholes

a. Where corrosive conditions exist due to septicity or other causes are anticipated, consideration shall be given to providing corrosion protection on the interior of the manholes by applying an epoxy coating.
b. Where high flow velocities are anticipated, the manholes shall be protected against displacement by erosion and impact.

e. Pipes

i. The pipe material selected shall be adapted to local conditions, such as character of industrial wastes, possibility of septicity, soil characteristics, exceptionally heavy external loadings, abrasion, corrosion, and similar problems. Consideration shall also be given to pipes and compression joint materials subjected to corrosive or solvent wastes.

ii. The specifications shall stipulate: (a) the pipe interior, (b) sealing surfaces, (c) fittings and other accessories shall be kept clean; (d) pipe bundles be stored on flat surfaces with uniform support; (e) stored pipe shall be protected from prolonged exposure (6 months or more) to sunlight with a suitable covering (canvas or other opaque material); (f) air circulation shall be provided under any covering; (g) gaskets shall not be exposed to oil, grease, ozone (produced by electric motors), excessive heat and direct sunlight; and (h) consultation with the manufacturers for specific storage and handling recommendations.

iii. All sewers shall be designed to prevent damage from superimposed live, dead, and frost induced loads. Proper allowance for loads on the sewer shall be made because of soil and potential groundwater conditions, as well as the width and depth of trench. Where necessary, special bedding, haunching and initial backfill, concrete cradle, or other special construction shall be used to withstand anticipated potential superimposed loading or loss of trench wall stability. See ASTM D 2321 OR ASTM C 12 when appropriate.

iv. For new pipe materials for which ASTM standards have not been established, the Engineer of Record shall provide complete pipe specifications and installation specifications developed based on criteria adequately documented and certified in writing by the pipe manufacturer to be satisfactory for the specific detailed plans.

v. The use of header and/or manifold piping will not be permitted in any application.

f. Joints

i. The installation of joints and the materials used shall be included in the specifications. Sewer joints shall be designed to minimize infiltration and to inhibit the entrance of roots throughout the life of the system.

ii. Relation to Water Supply Sources

a. 100 feet distance shall be maintained between any private or public water supply source, including any WS-I waters or Class I or Class II impounded reservoirs used as a source of drinking water. If this minimum separation cannot be maintained, ferrous metal pipe with joints equivalent to public water supply design standards and pressure tested to 150 psi to assure watertightness shall be used. The minimum separation shall, however, not be less than twenty-five (25) feet from a private well or fifty (50) feet from a public water supply well.

b. All existing waterworks units, such as basins, wells, or other treatment units, within 200 feet of the proposed sewer shall be shown on the engineering plans.

iii. Relation to Water Mains and Storm Sewers

a. Horizontal and Vertical Separation

i. Sewers shall be laid at least ten (10) feet horizontally from any existing or proposed water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot separation, the appropriate reviewing agency (e.g., NCDEQ) may allow deviation on a case-by-case basis, if supported by data from the Engineer of Record. Such deviation may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation, so the bottom of the water main is at least eighteen (18) inches above the top of the sewer.

ii. If it is impossible to obtain proper horizontal and vertical separation as described in this section or anytime the sewer is over the water main, both the water main and sewer must be constructed of ferrous metal pipe complying with public water supply design standards and be pressure tested to 150 psi to ensure watertightness before backfilling.

iii. A 24-inch vertical separation shall be provided between storm sewer and sanitary sewer lines, or ferrous metal pipe specified.

b. Crossings

i. Sewers crossing water mains shall be laid to provide a minimum vertical distance of eighteen (18) inches between the outside of the water main and the outside of the sewer. The crossing shall be arranged so that the sewer joints will be of equal distance and as far as possible from the water main joints.

ii. When it is impossible to obtain proper horizontal and vertical separation as stipulated in this section, one of the following methods must be specified:

1. The sewer shall be designed and constructed of ferrous metal pipe and shall be pressure tested at 150 psi to ensure water tightness prior to backfilling, or
2. Either the water main or the sewer line may be encased in a watertight carrier pipe that extends ten (10) feet on both sides of the crossing, measured perpendicular to the water main. The carrier pipe shall be of materials approved by the regulatory agency for use in water main construction.

g. Buoyancy - Buoyancy of sewers shall be considered, and flotation of the pipe shall be prevented with appropriate construction where high groundwater conditions are anticipated.

h. Depth - Three (3) feet minimum cover shall be provided for all sewers unless ferrous metal pipe is specified. Ferrous metal pipe, or other pipe with proper bedding to develop design supporting strength, shall be provided where sewers are subject to traffic bearing loads. Additional protection shall be provided for sewers that cannot be placed at a depth sufficient to prevent damage.

i. Design Capacity and Design Flow - Sewer capabilities shall be designed for the estimated ultimate tributary population including consideration not limited to the maximum anticipated capacity of institutions and industrial parks. The capability of downstream sewers to accept future flow made tributary to the collection system shall be evaluated by the engineer representing the Applicant. Where future relief sewers are planned, analysis of alternatives should accompany initial permit applications.

j. Standards - Installation specifications shall contain appropriate requirements based on the criteria, standards, and requirements established by the construction industry in its technical publications. Requirements shall be set forth in the construction specifications for the pipe and methods of bedding and backfilling thereof so as not to damage the pipe or its joints, impede cleaning operations and future tapping, create excessive side fill pressures and ovality of the pipe, or seriously impair flow capacity.

k. Service Connections

General Requirements

All residential subdivision lots shall be served by gravity unless otherwise approved by PLURIS. If a pump is approved, it shall be privately maintained, must pump into a service connection placed on the lot, and must have a note on the recorded Plat indicating that a private pump is required to serve the lot.

a. Service connections to the main lines shall be perpendicular to the main line and shall extend to the edge of the right of way or easement line.
b. Cleanouts are required on all services with a maximum spacing of 75 feet on 4-inch services and 100 feet on 6-inch services, and at the right of way line or edge of easement. All cleanouts shall extend a minimum of six (6) inches above finished grade with screw-in cap and concrete donut or cleanout method requirements in accordance with other PLURIS Standard Details.

d. Sewer cleanouts located in paved areas that bear vehicle loading must have ductile iron risers, ductile iron fittings, and brass caps, or meet optional cleanout method requirements in accordance with Standard Details.

3. Construction

a. Siltation and Erosion

Construction methods that will minimize siltation and erosion shall be employed. The Engineer of Record shall include in the project specifications the method(s) to be employed in the construction of sewers. Such methods shall provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting trees and vegetation, dumping soil or debris, or pumping silt-laden water into streams. Specifications shall require that cleanup, grading, seeding, and planting or restoration of all work areas shall begin immediately. Exposed areas shall not remain unprotected for more than seven (7) days unless a sedimentation and erosion control plan is submitted to and approved by the NCDEQ Division of Land Resources.

b. Bedding, Haunching, and Initial Backfill

i. Bedding Classes, A, B, C, or crushed stone as described in ASTM C 12 shall be used and carefully compacted for all rigid pipe, provided the proper strength pipe is used with the specified bedding to support the anticipated load, based on the soil type encountered and potential ground water conditions.

ii. Embedment materials, Classes I, II, or III, as described in ASTM D 2321, for bedding, haunching and initial backfill, shall be used and carefully compacted for all flexible pipe provided the proper strength pipe is used with the specified bedding to support the anticipated load based on the type of soil encountered and potential groundwater conditions. (See Class definitions in section L.2.f.)

iii. All water entering the excavations or other parts of the work shall be removed until all the work has been completed. No sanitary sewer shall be used for the disposal of trench water.

c. Sanitary sewer mains shall be deep enough to serve the adjoining property and allow for sufficient slope in lateral lines. All sanitary sewer mains shall have the following minimum covers:

1. Four (4) feet from the top of pipe to finished subgrade when under a roadway or parking lot.
2. Three (3) feet from the top of pipe to finished grade when outside a roadway.

The above requirements may be waived at the direction of PLURIS, in which case DIP of appropriate thickness and pressure class shall be installed.

d. Sewer mains from fourteen (14) to twenty (20) feet deep shall require special bedding in accordance with the Standard Details.

e. Sewers over twenty (20) feet deep shall require ductile iron or reinforced concrete pipe for the entire run between manholes.

f. Pipe trench excavation and backfilling shall be performed in accordance with Part II of these specifications.

   i. The width of the trench shall be ample enough to allow the pipe to be laid and jointed properly and to allow the bedding and haunching to be placed and compacted to adequately support the pipe. The trench sides shall be kept as nearly vertical as possible. When wider trenches are specified, appropriate bedding class and pipe strength shall be used.

   ii. In unsupported, unstable soil, the size and stiffness of the pipe, stiffness of the embedment, and in-situ soil and depth of cover shall be considered in determining the minimum trench width necessary to adequately support the pipe.

   iii. Ledge rock, boulders, and large stones shall be removed to provide a minimum clearance of six (6) inches below and on each side of all pipes.

g. Where sanitary sewers cross beneath water mains with a vertical separation of eighteen (18) inches or less or where water mains cross under sewer mains, both lines shall be DIP for ten (10) feet on either side of the point of crossing. The waterline pipe shall be centered at the point of crossing.

h. Sanitary sewers shall have the top of pipe at least two (2) feet below the bottom of storm sewer pipe when the horizontal separation between the closest edges of the two pipes is three (3) feet or less. Where sanitary and storm sewers cross with a vertical separation of less than two (2) feet, the sanitary sewer shall be of water main standard DIP for ten (10) feet on either side of the point of crossing with the sanitary sewer pipe section centered at the crossing.

i. There shall be a 5-foot horizontal separation between parallel gravity and/or force mains.

j. Additional Requirements for (PVC)

   i. For PVC C-900 pipe, the pipe shall be produced with bell and spigot end construction. Joining will be accomplished by rubber gasket in accordance with manufacturer's recommendation, unless otherwise directed or approved by PLURIS. Each pipe length shall be clearly marked with information including pipe size, profile number, and class number.

   ii. The installation shall satisfy the requirements of the manufacturer and/or the following, whichever is more stringent:

      a. Installation of PVC C-900 pipe shall follow the recommendations of ASTM D-2321 "Underground Installation of PVC C-900 Sewer Pipe".

         Pipe bedding and embedment material shall be either Class I or Class II. For PVC C-900 pipe, Class III materials may also be used. In any area where the pipe will be installed below existing or future ground water levels or where the trench could be subject to inundation, only Class I material shall be used for bedding and embedment.

b. The manufacturer's specifications or otherwise approved method shall be used in determining the stiffness class of the pipe to be installed to attain the required deflection control. The class of the pipe must be approved by PLURIS prior to installation.

c. The bedding (4 inches minimum) and embedment materials shall be per ASTM D2321. The embedment materials shall be installed from trench wall to trench wall and from the invert to a minimum of six (6) inches above the crown of the pipe.

d. The bedding and embedment material shall be compacted to a minimum of 90% Standard Proctor density for Class I and II materials and a minimum of 95 % Standard Proctor density for Class III materials.

e. If hydraulic jack shoring is utilized for trench walls, where shoring is used, it shall be kept to the area just above the top of the pipe. This will ensure the embedment materials and pipe will not be disturbed when removal is made.

f. Bedding and embedment material classifications shall be defined as follows:

CLASS I - Angular, (1/4 to 1 ½ inch) graded stone, including several fill materials that have regional significance such as coral, slag, cinders, crushed stone, crushed gravel, and crushed shells.

CLASS II - Coarse sands and gravels with maximum particle size of 1 ½ inch, including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types of GW, GP, SW and SP are included in this class.

CLASS III - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types of GM, GC, SM, and SC are included in this class.

CLASS IV - Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types of MH, ML, CH, and CL are included in this class. These materials are not recommended for embedment.

iii. Pipe shall be laid going uphill.

For Service Connections

I. General Requirements

a. See design criteria contained herein for additional installation requirements.

b. Sewer laterals shall not be in easements when gravity service can be provided to the property frontage at the street.

c. Direct sewer service taps shall not be allowed on sewer interceptor or outfall mains 18 inches in diameter or larger, except by manhole connection.

d. All services entering a manhole shall be placed a minimum of six (6) inches below any manhole seam and must be sealed watertight on the inside and outside of the manhole. The service must extend to the receiving invert for deposition of solids to prevent accumulation of solids on the invert bench.

e. Each separately owned structure requires a separate tap to the sewer main.

f. All service connections to existing sanitary sewer mains shall be made by PLURIS. Service connections to new mains may be made by the Contractor but must include the use of wye (not tee) connections. Taps onto new lines may be approved only by PLURIS. All service lines with less than three (3) feet of cover or deeper than twenty (20) feet shall be made of DIP.

g. Service lines between three (3) and eight (8) feet in depth do not require special bedding. PVC service lines between eight (8) and twenty (20) feet in depth shall require Class I bedding from four (4) inches below the service line to four (4) inches above the service line.

h. Final Backfill

i. Final backfill shall be of a suitable material removed from excavation except where other material is specified. Debris, frozen material, large clods or stones, organic matter, or other unstable materials shall not be used for final backfill within 2 feet of the top of the pipe. Stones used in backfills shall not be greater than 1 inch along any axis.

ii. Final backfill shall be placed in such a manner as not to disturb the alignment of the pipe.

II. Individually owned structures shall require at least one (1) sewer tap.

III. Service taps into mains shall be made with factory service gasket X gasket X gasket wyes and made of the same material as the main.

IV. Service connections to the main lines shall be perpendicular to the main line and shall extend to the edge of the right-of-way or easement line. Four-inch lines shall have a minimum slope of 0.60 ft./100 feet. Cleanouts shall be required on all sewer services with a maximum spacing of 50 feet on 4-inch services and 100 feet on 6-inch services. A cleanout shall be placed on all service lines at the right-of-way line or at the edge of the easement. All cleanouts shall be protected with a concrete donut and extend a minimum of six (6) inches above finished grade as in accordance with the Standard Details.

4. Testing

The Contractor/Applicant shall furnish all materials, labor, and equipment to perform all testing.

a. The maximum allowable deflection after installation shall BE LESS THAN 5% of the pipe diameter. PLURIS may require a mandrel to be pulled through a segment or segments of lines if CCTV footage suggests needs to further be verified. For PVC C-900 Pipe the following shall apply:

Nominal Diameter (inches)	(Proving Ring) Diameter Mandrel (inches)
6”	5.65”
8”	7.76”
10”	9.08”
12”	10.79”
15”	14.09”
18”	16.53”
21”	19.30”
24”	22.08”
27”	24.84”
30”	27.62”
33”	30.38”
36”	33.15”
42”	38.68”
48”	44.21”
54”	49.74”
60”	55.27”

b. Deflection Test

i. Deflection tests shall be performed on all pipe installations. The tests shall be conducted after the final backfill has been in place at least thirty (30) days to permit stabilization of the soil-pipe system. As an alternative to waiting thirty (30) days to permit stabilization of the soil-pipe system, PLURIS will accept certification from a soil testing firm verifying that the backfill of the trench has been compacted to at least 95% maximum density.

ii. No pipe shall exceed a deflection of 5%. If deflection exceeds 5%, replacement or correction shall be accomplished in accordance with requirements in the approved specifications.

iii. The rigid ball or mandrel used for the deflection test shall have a diameter not less than 95% of the base inside diameter or average inside diameter of the pipe depending on which is specified in the ASTM Specification, to which the pipe is manufactured. The pipe shall be measured in compliance with ASTM D2122 Standard Test Method of Determining Dimensions of Thermoplastic Pipe and Fittings. The test shall be performed without mechanical pulling devices.

c. Visual Testing and Observation

i. All materials used must be approved by PLURIS prior to installation. Rejected materials shall be immediately removed from the job.

ii. Gravity sanitary sewer lines shall be clean and free from obstructions and shall be visually inspected from every manhole. Lines that do not exhibit a true line and grade or that have structural defects shall be corrected. Sanitary sewer service connections shall be visually inspected prior to backfilling.

d. Video Assessment and Cleaning

i. As a final measure required for acceptance, the Contractor shall clean and televise all newly installed sewer mains prior to acceptance by PLURIS. The Contractor shall televise the sewer main, and all lateral connections installed from the upstream to downstream manhole with no reverse setups or cutaways. Throughout shooting, the camera shall be panned and tilted for a complete view of the main. Lighting shall be adequate to view the entire sewer main and service connections from beginning to end. The video inspection shall be submitted to PLURIS on DVD and formatted with software compatible and readable by PLURIS. PLURIS shall not be responsible for purchasing additional software necessary to view the videos.

ii. The camera shall be advanced at a uniform rate that allows a full and thorough inspection of the new sewer main. The camera shall be a color, pan, and tilt camera. The picture quality and resolution shall be acceptable and sufficient to allow a complete inspection with no lapses in coverage. The length of the sewer main shall be measured and recorded on the video screen. The distance counter shall be calibrated before shooting the inspection video.

iii. The Contractor shall clean the sewer mains ahead of video inspection with a high-velocity water jet. The video inspection shall take place within two (2) hours of cleaning operations as witnessed by PLURIS. All construction debris shall be collected and removed in the downstream manhole and shall not be released into the sewer system.

iv. A PLURIS representative shall be present throughout the cleaning and televising of the sewer mains to verify that the video work complies with the specifications.

v. Video inspection of services shall show a 5-gallon water-drop and the lot number clearly written on the service stack.

vi. A CCTV contractor must supply video footage of each individual property from the service to the sewer main. Each service on each property shall be clearly numbered to correlate within the development.

vii. Prior to submitting the DVD to PLURIS, the Contractor shall label the DVD with the following information:

- Name of the Project/Development.

- Name and contact information of responsible party.
- Date of televising.
- Manhole identification as shown on the design plans.

e. Manholes

i. Vacuum Testing

a. All newly installed manholes shall pass a vacuum test in accordance with ASTM C 1244-93. The Contractor shall supply all equipment and materials necessary to vacuum test the manholes.

b. Vacuum Testing shall not be initiated until the manholes and all specified coatings and lining materials have been cured in accordance with manufacturer recommendations.

c. A PLURIS representative shall be present and witness all vacuum testing.

d. The following vacuum testing criteria shall apply for compliance with the testing procedure.

i. A vacuum of ten (10) inches of mercury shall be drawn with an approved vacuum testing unit.

ii. The testing time shall not be measured until after the vacuum and pump have been shut off.

iii. The time required for the vacuum to drop from ten (10) inches to nine (9) inches of mercury shall meet or exceed the values listed in the following table:
Manhole Vacuum Testing Time

Depth (feet)	Manhole Diameter (inches)		
	48	60	72
	Time (seconds)		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	48	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97
26	64	85	105
28	69	91	113
30	74	98	121

Note: If depth falls below 8 feet or between two depths, the next deepest increment of depth shall be used.

5. Repairs

a. Sewer Main Repairs

i. PVC C-900 Pipe – replace damaged section with PVC C-900 pipe and install a mechanical coupling.
ii. DIP – replace damaged section with DIP pipe and install a mechanical coupling.
iii. HDPE Pipe – replace damaged section with new HDPE pipeline section and install electrofusion couplings at both ends; minor breaches may be repaired with an electrofusion repair coupling as considered by a manufacturer's representative.

iv. No FERNCO style couplings will be permitted.

v. Encasement of fittings and bolts in concrete will not be permitted.

b. Installation

i. All repairs to damaged sanitary sewer lines in paved areas shall be backfilled with ABC stone (crushed stone) to a density of 95% Standard Proctor.

ii. All repairs to damaged sanitary sewer lines shall be bedded with six (6) inches of washed stone and compacted to a minimum of 95% Standard Proctor density before installing the new joint of ductile iron.

Part VI Sewer Force Main

1. Material

a. General

i. Force mains smaller than four (4) inches in diameter shall be PVC or HDPE, while force mains four (4) inches or larger shall be DIP, PVC, or HDPE.

ii. Force mains shall be of a size greater than the diameter of solid capable of being passed by the sewage pumps.

PVC and HDPE pipe requires the installation of 3-inch-wide detector tape a maximum of two (2) feet below the finished grade and green plastic coated #10 copper tracer wire affixed directly on top of the sewer main and made accessible at all valve boxes.

iii. All fittings shall be as manufactured by Rusco, Clow, Tyler, American, Union, or Griffin.

iv. All taps into an existing Force Main shall utilize a Tapping Sleeve of an appropriate size.

v. Force main shall be installed with a minimum cover of three (3) feet measured from the top of the pipe to the finished subgrade.

b. Ductile Iron Pipe

i. DIP shall be manufactured as per AWWA C141 in minimum 18-foot lengths. Pipe shall be Class 51, as manufactured by Griffin, U. S. Pipe, American, or Clow.

ii. DIP shall be designed and manufactured in accordance with AWWA C150 and C151 for a laying condition Type 2. Pipe joints shall be of the push-on type per AWWA C111. Pipe lining shall be cementing mortar with a seal coat of bituminous material, all in accordance with AWWA C104. DIP joints shall be mechanical or gasketed joint as per AWWA C151.

Working pressure shall be as follows:

Diameter	Pressure
4" – 12"	350 psi
14" – 20"	250 psi
24"	200 psi
30" – 54"	150 psi

iii. DIP shall conform to ANSI/AWWA C151/A21.51 "Ductile Iron Pipe, Centrifugally Cast in Metal Molds for Water or Other Liquids."

iv. The thickness and pressure class of DIP required for the installation and operating conditions during the expected service life of the force main shall be determined in accordance with ANSI/AWWA C150/A21.50 "Thickness Design of Ductile Iron Pipe."

v. Fittings for DIP shall conform to ANSI/AWWA C110/A21.10 "Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. for Water and Other Liquids" or ANSI/AWWA C153/A21.53 "Ductile Iron Compact Fittings, 3 In. through 24 In. and 54 In. through 66 In., for Water Service."

vi. Force mains of DIP shall have mechanical or gasketed push-on type joints. If exposed, force mains of DIP shall have flanged joints. Restrained joint DIP may be used for anchoring purposes as described in Section 4.03C.

a. Gaskets shall be manufactured of vulcanized natural or synthetic rubber in accordance with ANSI/AWWA C111/A21.11 "Rubber Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings."

b. Flanged DIP shall conform to ANSI/AWWA C115/A21.15 "Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges."

vii. Consideration shall be given to the existence of or the potential for development of corrosive environments within and outside the force main, and mitigation measures shall be taken to ensure corrosivity has been addressed Sources of corrosion may include acidic soils, septic wastewater, and air entrainment within the force main. Where corrosion is deemed to be a serious problem, DIP shall be provided with cathodic protection or an internal/external encasement, lining, or coating appropriate for the pipe material and situation. Such encasements, linings, and coatings shall be manufactured or applied in accordance with the appropriate ANSI and AWWA standards.

c. PVC Pipe

i. PVC pipe shall meet the requirements of AWWA C-900.

ii. Pipe shall be pressure rated to 250 psi, AWWA C-900, integral bell with strength equal to the pipe wall, cast iron O.C., 18-foot lengths, with a solid elastomeric ring as furnished by Johns-Manville, Clow, North Star, or Robin-Tech.

iii. PVC pipe will require the installation of a detector tape placed a maximum of two (2) feet below the finished grade. The tracer wire shall be green plastic coated #10 copper wire affixed to the top of the force main and made accessible at all valve boxes.

iv. All fittings shall be as manufactured by Rusco, Clow, Tyler, American, Union, or Griffin, or approved by PLURIS.

v. PVC pipe may be cored when necessary, using an appropriately sized tapping sleeve.

vi. PVC Pipe shall be AWWA C-900 PVC pipe with push joints. Pipe and joints shall meet all applicable requirements of ASTM D-2241 and D-1785. PVC pipe requires the installation of detector tape a maximum of two (2) feet below the finished grade and a green plastic coated #10 copper wire affixed to the top of the force main and made accessible at all valve boxes.

vii. PVC material used in the manufacture of PVC pipe shall conform to ASTM D1784 “Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.”

viii. The thickness and pressure class of PVC pipe required for the installation and operating conditions during the expected service life of the force main shall be determined in accordance with AWWA C-900 “Poly (Vinyl Chloride) (PVC) Pressure Pipe, 4 In. through 12 In., for Water” or AWWA C-905 “Poly (Vinyl Chloride) (PVC) Water Transmission Pipe, Nominal Diameters 14 In. through 36 In.”

ix. Force mains of PVC pipe shall have gasketed push-on type joints. Gaskets shall be manufactured of elastomeric material in accordance with ASTM F477 “Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.”

x. Mechanical joint DIP fittings conforming to ANSI/AWWA C110/A21.10 or gasketed PVC fittings shall be used for force mains four (4) inches in diameter and larger. Solvent-welded or gasketed fittings may be used for smaller diameter force mains.

d. High-Density Polyethylene Pipe (HDPE)

i. HDPE pipe shall be produced from a high molecular weight, high density, polyethylene resin, meeting the requirements of ASTM D3350 “Standard Specification for Polyethylene (PE) Plastic Pipe and Fitting Materials.” Resin material shall be listed by PPI in the name of the manufacturer and shall be based on testing in accordance with ASTM D2837 “Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe.”

ii. HDPE pipe shall conform to ASTM D3035 “Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter” or ASTM F714 “D3035 “Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.”

iii. The thickness and pressure class of HDPE pipe required for the installation and operating conditions during the expected service life of the force main shall be determined in accordance with AWWA C906 “Polyethylene (PE) Pressure Pipe and Fittings, 4 In. through 63 In., for Water Distribution.”
Fittings for HDPE pipe shall conform to ASTM D3261 “Standard Specification for Butt Fusion of Polyethylene (PE) Plastic Fittings for PE Plastic Pipe and Tubing” and shall be manufactured by injection molding, a combination of extrusion and machining, or fabrication from HDPE pipe material.

iv. Force mains of HDPE pipe shall be joined by the thermal butt fusion process and shall be performed in accordance with ASTM A2657 “Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings” and the manufacturer’s recommendations during installation.

e. Pipe Fitting Materials

i. Pipe fittings shall be cast, or ductile iron designed and manufactured per AWWA C110. Fittings up to and including twelve (12) inches shall be designed for an internal pressure of 250 psi. Fittings larger than twelve (12) inches shall be designed for an internal pressure of 150 psi. Joints for fittings shall be mechanical joints and shall be cement mortar lined with a seal coat of bituminous material, in accordance with AWWA C104.

ii. All buried DIP and fittings shall have bituminous coating on the exterior surface in accordance with AWWA C151.

iii. Except for HDPE, pipe shall be supplied in minimum of 18-foot lengths unless approved otherwise by PLURIS.

f. Material Identification

i. Force mains shall be appropriately identified upon installation so they will not be confused with potable water lines. Green detector tape clearly labeled sanitary sewer shall be laid a maximum of two (2) feet below finished grade and green plastic coated #10 copper tracer wire shall be affixed to the top of the force main and be made accessible at all valve boxes.

ii. Force main valves shall have valve box covers marked “Sewer.”

g. Manhole Materials - All manholes installed along a force main, and the discharge manhole shall be installed according to Section 7.2.1(F) of PLURIS Standard Specifications and coated with an approved epoxy coating.

2. Design

a. General

i. Sizes of fittings up to and including sixteen (16) inches shall be designed for an internal pressure of 250 psi.

ii. Reaction blocking for all fittings or components subject to hydrostatic thrust shall be securely anchored using concrete thrust blocks poured in place. The reaction areas are shown in Standard Detail 6.11. No concrete shall interfere with the removal of fittings. Materials for reaction blocking shall be 3,000 psi or greater concrete.

iii. Air release valves shall be designed at the high points of all force mains and in the valve vault of all lift stations. The air release valves shall be constructed from stainless steel and utilize a ball valve.

iv. Force sewer mains shall be installed in dedicated public right-of-way or in dedicated utility easements having the following dimensions:

50 feet	Construction Easement
20 feet	Permanent Easement

b. Material

i. Pipe material and specifications shall be selected based on the installation and operating conditions of the force main following installation. Such factors shall include but not be limited to:

a. Installation depth and overburden pressure.
b. Soil conditions and groundwater presence
c. Corrosion resistance from both external and internal sources.
d. Strength required to withstand internal pressures expected during normal operation as well as those resulting from hydraulic surges and water hammer.

ii. Force mains shall be constructed of one of the following types of pipes:

a. DIP
b. PVC C-900
c. HDPE

All pipe used for force main construction shall be labeled or otherwise identified as conveying wastewater. Green detector tape clearly labeled “sanitary sewer” shall be laid a maximum of two (2) feet below finished grade and green plastic coated #10 copper wire shall be affixed to the top of the sewer main and made accessible at all valve boxes.

c. Diameter

i. The pipe diameter of the force main shall be larger than the diameter of the maximum solid size that is passed by pumps present in the pump station.

A minimum 4-inch force main shall be used unless the force main is served by pumps capable of grinding, chopping, or cutting solids or a mechanical means of reducing the size of a 3-inch solid and any trash or stringy material that can pass through a 4-inch stainless steel pipe installed in the pump station. Acceptable mechanical means of solids reduction shall be as defined in 15A NCAC 02T regulations.

d. Velocity

i. Wastewater velocity occurring in a force main shall be calculated using the continuity equation:

$V = 0.409Q/D^2$

V = velocity (feet per second)
Q = pumping rate of a single pump (gpm)
D = diameter of the pipe segment (inches)

ii. A self-cleansing velocity of at least two (2) feet per second shall be provided throughout the length of the force main in accordance with 15A NCAC 2H .0219(i)(2)(B).

a. Consideration shall be given to preventing or alleviating the accumulation of solids in the force main by providing one or more of the following:

i. The ability to provide velocities of between two (2) and five (5) feet per second during a cleaning event that are suitable to resuspend any solids that may have settled out.

ii. Drain or blow-off valves provided at all low points in the force main. Such valves shall be connected to an available entry point into the wastewater collection system, provided with a connection for a vacuum pumper truck, and designed with some other method to prevent an intentional discharge of wastewater during their operation.

iii. Flushing ports along the length of the force main as well as a water supply of sufficient quantity and pressure. Such ports shall either be connected to an available entry point into the wastewater collection system, provided with a connection for a vacuum pumper truck, and designed with some other method to prevent an intentional discharge of wastewater during their operation.

iv. Pigging device launching and retrieval stations of a size sufficient to clean the inside diameter of the force main.

b. Compliance with NCDEQ's Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains Section4.03 B.1 shall also be required when engineering calculations determine that depressed sections of the force main will not be completely flushed in a single pumping cycle.

iii. Anchorage

a. Force mains shall be adequately anchored to resist thrusts that may develop at bends, tees, valves, fittings, plugs, and any other location where a change in flow direction occurs.

i. Such anchoring shall be provided by using concrete thrust blocking and/or restrained joint pipe.

1. Concrete thrust blocks shall be located between the fitting to be anchored and undisturbed soil material. Appropriate thrust reaction block bearing areas shall be calculated based not only on the maximum expected force but also on the soil material. Concrete thrust blocks shall have a minimum compressive strength of 3,000 pounds or greater per square inch.

2. Concrete thrust blocking, anchoring, or pour in -place concrete shall not encase any fitting or bolts.

3. Self-restrained joints or joints restrained with tie rods and clamps shall both be acceptable. In both cases, component parts shall either be manufactured with corrosion-resistant materials or coated liberally with a corrosion-retarding product.

ii. Anchoring devices shall be designed to withstand force main pressures of at least 25% greater than the maximum pump shut-off head, plus an allowance for water hammer and an appropriate factor of safety.

e. Surge and Water Hammer

i. Consideration shall be given to analyzing force mains in conjunction with their associated pump stations with respect to the development of hydraulic transients.

ii. Force main design shall be such that active devices for control of transient hydraulic conditions are minimized to the greatest extent possible; however, if this is not feasible, the following shall be acceptable control strategies:

a. Providing air scouring velocities in the force main.
b. Construction of the force main using a higher-strength pipe.

c. Vacuum relief valves in accordance with NCDEQ's Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains Section 4.05.
d. Specialized control and/or release valves and other devices designed to prevent transient pressures from reaching levels that could damage the pump station and force main systems.

f. Appurtenances

Air Release Valves

a. The route of the force main shall be such that the number of air release valves are minimized to the greatest extent possible.

b. In accordance with 15A NCAC 02T .0305(h)(5), an air release valve shall be provided at all high points to prevent air locking of the force main. NCDEQ has interpreted this regulation as requiring an air release valve at locations where the distance between the low point and high point in the force main exceeds ten (10) vertical feet.

i. Automatic air release valves shall be acceptable.
ii. Automatic air release valves with flood protection in areas within the 100-year floodplain or anywhere flooding is anticipated to occur.
iii. Automatic air valves shall be of the quick-opening, slow-closing type to prevent the development of hydraulic surge conditions.

g. Force mains shall be installed with a minimum cover of three (3) feet measured from the top of the pipe to the finished subgrade.

h. Dedicated easements for force mains and appurtenances shall be recorded as "PLURIS Utility and Pipeline Easement" or "PLURIS Sanitary Sewer Easement." PLURIS sewer easements shall not contain any other utilities.

i. Force mains shall discharge at the invert of the receiving manhole and shall be as close as possible to 180 degrees from the outlet pipe.

j. Sewage air release valves shall be installed at all the high points or runs exceeding 3,000 feet on all force mains in accordance with the Standard Details.

k. A gate valve shall be installed every 1,000 feet of force main length with full accessibility unless otherwise directed by PLURIS. At least two (2) gate valves shall be installed at every tee junction.

l. A hammerless cast iron check valve shall be installed at each tap. It shall be connected directly to the gate valve after the tap has been made on the receiving force main. Hammerless check valves may be direct burial.

m. All air release valves, plug valves, or other fittings or appurtenances that have moving or operating parts and require maintenance and routine access shall have a manhole placed over them or over the operating portion of the device. Manholes shall be designed and installed as described in Section 7.0 of PLURIS Standard Specifications.

n. Refer to Part I and Part II of PLURIS Standard Specifications for more details on easements, separation distances, bedding requirements, and any other installation requirements.

3. Construction

a. DIP force main may be cored if necessary, using an appropriately sized tapping sleeve.

b. PVC C9-00 pipe will require the installation of a detector tape placed a maximum of two (2) feet below the surface. #10 gauge copper tracer wire with green plastic coating will be laid with all force mains and made accessible at all valve boxes.

c. Force mains shall be appropriately identified upon installation so they will not be confused with potable waterlines or other utilities.

d. Reaction blocking for all fittings or components subject to hydrostatic thrust shall be securely anchored using concrete thrust blocks poured in place and shall not encase the fittings.

e. Force mains shall be installed with a minimum cover of three (3) feet measured from the top of the pipe to the finished subgrade.

f. Force main valves shall be spaced at appropriate intervals as determined by PLURIS and shall have valve box caps marked “Sewer.” All valves shall be clearly indicated on as-built drawings.

g. The receiving manhole for a force main shall receive an interior coating of a suitable cold tar epoxy approved by Pluris with a total dry film thickness of ten (10) mils. The force main shall discharge at the invert of the receiving manhole and shall be as close as possible to 180° from the outlet pipe.

h. Installation

    i. Joints and Bedding

        a. Force mains shall be installed such that pipe and joint deflection is minimized.

            i. Force mains of DIP shall be installed in accordance with AWWA C600 “Installation of Ductile Iron Water Mains and Their Appurtenances.”
            ii. Force mains of PVC C-900 pipe shall be installed in accordance with AWWA C605 “Installation of Underground Installation of PVC C-900 Pipe and Fittings for Water.”
            iii. Force mains of HDPE pipe shall be installed as described in NC DENR’s “Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains” Section 4.01B.3.e. Contractors shall be fully trained and qualified by the manufacturer to install HDPE pipe.

        b. Continuous and uniform bedding, haunching, and backfill that is appropriate for the soil type and pipe material shall be provided in the force main trench.

ii. Burial

a. A minimum burial depth of three (3) feet as measured from the crown of the pipe to the ground surface shall be provided throughout the length of the force main in accordance with 15A NCAC 02T .0305(g)(4). Consideration shall be given to utilizing a greater burial depth in locations where the frost depth exceeds three (3) feet.

b. If the appropriate installation depth cannot be met by the design, the force main shall be constructed of ferrous metal pipe or provided with a ferrous pipe encasement in accordance with state requirements.

iii. Separations

a. Minimum separations between pump stations/force mains and natural features, or any utilities, shall be maintained in accordance with 15A NCAC 02T. .0305(f).

b. Stream Crossings

i. Force mains shall be routed such that the number of stream crossings is minimized. When a stream crossing is required by the design, the crossing shall be as nearly perpendicular to the stream flow as possible.
ii. DIP with joints equivalent to water main standards or a watertight ferrous metal pipe for encasement shall be used to construct force mains that cross streams. The DI or encasement pipe shall be extended horizontally for a length equal to that required by 15A NCAC 02T .0305 on either side of the stream.
iii. Force main bedding, haunching, and backfill shall be appropriate for the installation location and pipe material. However, the ability of the bedding and backfill material to readily erode, cause siltation, damage the force main during installation, and corrode the force main after installation shall also be considered.
iv. No aerial stream crossing of force mains will be permitted. All stream crossings will be by directional bore.

c. If the appropriate separation cannot be met by the design, the force main shall be constructed of ferrous metal pipe with joints equivalent to water main standards or provided with a watertight, ferrous metal pipe encasement. However, force mains shall not be closer than twenty-five (25) feet from a private water supply well or fifty (50) feet from a public water supply well, even if ferrous metal pipe with joints equivalent to water main standards is used.

4. Testing

a. Force Main Testing

i. General

a. Prior to testing any segment of force main, care shall be taken to prevent the pipe from moving while under pressure.

b. Temporary taps and air releases shall be permissible to facilitate testing.

c. Discharge or disposal of any water used for testing force main installation into the system is not permitted by PLURIS and shall be the responsibility of the Applicant to dispose of in accordance with state and federal laws and regulations.

d. All testing shall be performed in the presence of the applicant, the Engineer of Record or their representative, and an authorized representative from PLURIS.

e. The results of all testing shall be maintained by the applicant as part of the construction record documentation as stipulated in NC DENR's "Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains" Section 1.03B.

ii. Force mains shall be installed in a manner such that pipe deflection is minimized.

iii. Pressure Testing

a. The pressure test shall be performed after the force main has been backfilled and at least seven (7) days following the pouring of the last thrust block.

b. The pressure test may be performed concurrently or separately with the leakage test as required in NC DENR's "Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains" Section 6.04D.

iv. Each layer of fill or backfill over the force main shall be compacted to a density needed to accommodate the use of the force main installation area or otherwise may be required by governmental agencies having jurisdiction, including, but not limited to, the NCDEQ, the DOT, and County.

b. Inspections

i. All materials and equipment used in the construction of the wastewater pumping system must be verified for compliance with the specifications (or other approval granted by PLURIS) by the developer's Engineer of Record prior to installation. Nonconforming materials or equipment shall be immediately removed from the job site.

ii. Compliance with plans and specifications shall be verified on a regular basis by the Engineer of Record.

c. General

i. The Contractor shall furnish all materials, labor, and equipment to perform all testing.

ii. All water or wastewater used during testing of the pump station, force main, or any of the systems described in this section must be disposed in a way that complies with all NCDEQ regulations.

iii. Before the operational tests are conducted, the required copies of the operation. and maintenance manuals shall be delivered to PLURIS.

iv. PLURIS reserves the right to require further testing, as necessary, to ensure that all components and infrastructure are performing in accordance with the manufacturer's recommendations and PLURIS's specifications. All testing, repairs and/or readjustments, and necessary re-testing, shall be at no additional cost to PLURIS.

v. All on-site testing and/or installation verification shall be performed in the presence of the Inspector or other representative authorized by PLURIS.

vi. All testing, installation verification, and training shall be performed in the presence of, or by, an experienced, competent, and authorized manufacturer's representative.

vii. Factory testing shall consist of evaluating all operating functions of the equipment under varying operating conditions to ensure that it will perform as specified. Any specific testing that may be required is discussed under the individual equipment items below. Results of factory testing shall be presented to PLURIS prior to delivery of the equipment.

viii. Installation verification shall consist of a visit to the site by a manufacturer's representative to inspect, check, adjust (if necessary), and approve the equipment installation. The manufacturer's representative shall certify that the equipment has been professionally installed and lubricated, is in accurate alignment, and is free from any undue stress imposed by connecting piping or anchor bolts. Any specific verification requirements are discussed under the individual equipment items provided in subparagraphs 1x., x., xi., of this section, and Part 5, below. Results of the installation verification shall be presented to PLURIS prior to start-up of the equipment.

ix. On-site testing shall consist of all manual and automatic operating functions under various operating conditions, including full load conditions. The equipment shall also be tested under adverse or emergency conditions. All alarms and remote signals shall also be tested. Any specific testing that may be required for each individual equipment item. Results of the on-site testing shall be presented to PLURIS prior to final acceptance of the project.

x. All functions and systems of the pump station, even those not specifically listed, shall be tested to ensure proper operation under normal and emergency situations.

xi. All defective equipment or malfunctioning systems shall be replaced or corrected, and the full system placed in a fully operational condition to the satisfaction of PLURIS, at no cost to PLURIS.

Results of all factory testing, installation certifications, and on-site operational testing shall be provided to PLURIS in the final construction documents as described in the Submittals portion of this specification section.

5. Valves and Appurtenances

a. Check Valve: All check valves shall be iron bodied and check valves within the valve vault shall have a weighted hammer lever arm capable of being mounted on either side of the valve.

b. Check valves being used at the tap shall have an internally weighted clapper and capable of direct burial.

c. All piping, valves, elbows, tee, and other like fittings shall be flanged-to-flanged fittings within the valve vault.

d. Smaller diameter taps may require a Myers CV-200 Check Valve and will require Pluris approval.

e. All taps into a receiving force main shall utilize a stainless-steel tapping sleeve.

f. Ball check style valves shall not be permitted.

g. Plug Valve: Plug valves shall be eccentric action and resilient plug facing with heavy-duty stainless-steel bearings and welded in corrosion resistant nickel seal. Force main plug valves shall provide clean passage for a solid sphere of at least 67% of the adjoining pipe diameter to facilitate pigging of the force main. Force main plug valves shall be a "full port" cross-sectional area perpendicular to the flow of at least 100% of the adjoining pipe.

h. Air Release Valve:

i. The valve shall be sized by a North Carolina licensed Engineer and approved by PLURIS. Information on the manufacturer's recommended sizing, along with the Project Engineer's recommendation, shall be submitted to PLURIS for review when applying for approval of the sizing.

ii. ARV air valves shall be of the single housing style. The valve shall have a minimum two (2) inch NPT inlet and two (2) inch ball valve and 150-psig working pressure. The valve must meet the requirements of AWWA C512.

iii. All ARV's inside the valve vault shall be placed atop a blind flange of a tee downstream of the valve assembly.

iv. All ARV associated parts for tapping and installation shall be stainless steel.

Part VII Sewer Pump Stations

1. Material

a. Site Work - A LED light of 600-watt (min) capacity to illuminate the pump station area shall be provided. The light shall be mounted on a Class V utility pole at a height of fifteen (15) feet and controlled by means of a photocell and manual switch to bypass photocell.

b. Piping and Valves – Suction and discharge piping shall be stainless steel flanged pipe as manufactured under AWWA Specification C 141. A weighted arm swing check valve and a gate valve shall be provided in a valve vault outside the station for the discharge pipe of each pump. A tee shall be installed in the valve vault to join each discharge pipe into the common force main line. An ARV combination air valve shall be in the valve vault downstream of the gate and check valves. In addition, a six (6) inch minimum stainless steel suction pipe and a four (4) inch minimum DIP discharge pipe will be supplied to provide connection of a bypass pump in an emergency.

c. Electrical - The electrical power entrance shall be through a meter base, followed by a NEMA 4X heavy duty, single throw, fusible safety switch with a solid neutral, followed by a NEMA 4X heavy duty, double throw, three pole safety switch, which feeds the control panel from one side and heavy duty, circuit breaking 4 wire, 4 pole receptacle assembly as manufactured by Crouse-Hinds or other approved equal from the other side.

d. Control Equipment Enclosure - Liquid Level Controls – The cord connection for the control shall be numbered 16-2, rated for 13 amps, and shall be type SJTO. To ensure optimum longevity, contacts shall be rated for 20 amps at 115 V AC and shall be sealed in a heavy-duty glass enclosure.

e. Pump Station – Submersible Pump Type

i. Sewage Pumps and Motors

a. Pumps shall be three (3) phase Myers or Flyght or another approved manufacturer submersible non-clog sewage pumps where applicable.

b. Grinder pump application will be subject to PLURIS approval.

c. The pump shaft shall be 416 stainless steel.

d. Power cables to pumps shall be AWG (min) Hypalon jacketed type SPC cable of thirty (30) feet in length as a minimum.

ii. Discharge Piping and Valves

a. Discharge piping inside the wet well shall be flanged stainless steel pipe and DIP inside the valve vault, sized to produce a minimum head loss while maintaining a minimum velocity of 2.5 feet per second, as herein before specified.

b. All hardware used inside the wet well shall be 316 stainless steel.

iii. Lift Out Rail System - Guide rails shall be stainless steel pipe.

iv. Telemetry – Mission Control Model MYDRO 150 Series wireless monitoring and alarm with manufacturers enclosure shall be required.

2. Design

a. General Requirements

i. Sewage pumping stations shall meet the requirements as stated in this section and as described in each section for the type of station selected. Pump stations may be submersible pumps only.

ii. All stations shall have a minimum of two (2) pumps of equal capacity. The pumps shall be 3 phase solid handling, non-clog pumps where applicable, and capable of handling flows more than the expected peak flow. Where three or more pumps are required, they should be of such capacity that with any one unit out of service, the remaining units will have capacity to handle peak sewage flows. Pumps and the sewage force main shall be sized to provide a minimum velocity in the force main of 2.5 fps.

iii. Grinder pump application will be subject to PLURIS approval.

iv. Sewage pumping stations, all related structures and controls, shall be protected from physical damage by the 100-year flood. Stations shall be designed to remain fully operational and accessible during the 25-year flood. The 100-year flood elevation shall be shown on all site plans. All lift stations with a tributary flow of 15,000 gallons per day must be equipped with an emergency self-priming Godwin bypass pump with a diesel engine and controlled by independent floats. All pump stations with less than 15,000 gallons per day tributary flow must be plumbed with ports for a mobile bypass pump. Plumbing connections shall be specified by PLURIS.

b. Site Work

i. The site shall be graded generally to drain away from the pump station and to remove stormwater runoff from site in a non-erosive manner.

ii. The site shall be stabilized by a minimum of six (6) inches of compacted crushed stone, low maintenance vegetative ground cover, or other suitable materials. A shrubbery screen shall be provided on three sides of all pump stations, outside the security fence, no closer than four (4) feet away from any side, corner, or utility structure when applicable.

iii. The site area shall be secured by a six (6) foot high chain link fence. Fence products shall be only new materials using hot dipped galvanized iron or steel components and aluminum coated fabric. Line posts, top and bottom rails, gate, and fabric shall be as specified on the Standard Detail Drawings. Gates shall permit 180 degree opening and shall be located to provide vehicle accessibility for lifting the pumping units. There shall be a minimum gate opening of fourteen (14) feet to facilitate Vac truck access.

iv. Privacy slats are to be installed in all chain link fencing.

v. The site shall feature an adequate turnaround area for service vehicles and provide a twelve (12) foot (minimum) wide all-weather access road to the site with grades not to exceed ten (10) feet in one hundred feet (10%). The road must consist of six (6)-inch compacted stone or concrete.

vi. There shall be provided a LED of 600-watt (min) capacity to illuminate the pump station area. The light shall be mounted on a Class V utility pole at a height of fifteen (15) feet and controlled by means of a photocell and manual switch.

c. Piping Valves - Check valves shall be iron bodied and if within the valve vault, shall have a weighted hammer lever arm capable of being mounted on either side of the valve and rated for 175 psi working pressure.

d. Ball check style valves will not be permitted.

e. Wet well.

   i. The wet well shall be precast concrete manhole sections conforming to ASTM C-478, latest revision, with a six (6) foot minimum diameter. The base of the wet well shall be pre-cast, steel-reinforced concrete and have a minimum extended base of six (6) inches greater than the outside diameter of the wet well. The concrete shall have a minimum 28-day compressive strength of 3,000 psi or greater.

   ii. The manhole sections shall have joints of a durable mastic sealing material, and the joints shall be further waterproofed on the outside of the wet well by the application of asphalt, overlapped by a 12-inch-wide band of inorganic fabric felt and a finish mopping of asphalt. The interior side of the joints shall be plastered smooth with three (3) coats of Portland cement grout. The interior and the exterior of the wet well shall then receive two successive coats of a suitable coal tar epoxy, approved by PLURIS, with a total dry film thickness of ten (10) mils. The access hatch to the wet well shall be a square hatch of ¼ inch aluminum, 6063 alloy, diamond pattern plate with steel hinges on an aluminum frame cast in place in the cover slab.

   iii. The wet well shall have a vent made from ductile iron, flanged joint, and pipe fittings as shown on the plans. An insect screen shall be included at the exposed end of the vent pipe. The insect screen shall be stainless steel or aluminum insect screening.

f. Electrical

g. All electrical panels shall be mounted on a grounded frame backboard constructed of aluminum or stainless steel.

   i. Electrical service to all pump stations shall be three (3) phase, 240 or 480 V AC, unless approved by PLURIS. The electrical power entrance shall be through a meter base, followed by a NEMA 4X heavy duty, single throw, fusible safety switch that feeds the control panel from one side and heavy duty, circuit breaking four (4) wires, four (4) pole receptacle assembly as manufactured by the Crouse-Hinds or other approved equal.

   ii. All electrical components shall be suitably sized to be capable of service with all sewage pumps running.

   iii. All electrical components, including panels shall be sealed off with sealing compound in accordance with the NC electrical code requirements for electrical service to gas pumps.

h. Pump Motor Controls - Pump motor controls equipment shall be located within a NEMA 4X stainless steel above ground housing.

i. Control Equipment Enclosure

i. NEMA4X Enclosure - Enclosure shall be a NEMA type 4X and be of suitable size to house all components. A locking hasp shall be provided in addition to screw clamp type latches. Enclosure shall be fabricated from 14-gauge stainless steel. The top of the enclosure shall serve as a drip shield and the seam-free sides shall prevent rain and sleet from entering. The inner panel shall be made of 12-gauge steel and shall be painted white. The enclosure and interior panel shall be painted with heat fused modified polyester powder, electrostatically applied over a phosphatized base. Enclosure shall be ANSI/ASI 61 grey.

ii. All control panels shall be Ohio Electric control panels unless approved by PLURIS. No panels will be configured with an uninterrupted power source (UPS). Panels must have independently operating relays.

iii. Hinged Inner Door – An inner door shall be furnished. Overload reset push buttons, circuit breakers, switches, and pilot lights shall be the only components accessible with door closed. The door shall be hinged and may be opened when service is required.

iv. Line Terminal Block – A terminal block shall be furnished with properly sized line lugs to accept the main power source entering the control panel. Load lugs shall be adequate to accept all required load side wiring requirements. All live parts shall be fully shielded.

v. Motor Circuit Breakers (240 or 460 V AC) - A properly sized, molded case, thermal magnetic circuit breaker shall be provided for each pump motor. Line and load sides shall be equipped with lugs properly sized for the horsepower and current rating of the motor(s). They shall be attached to mounting brackets which are specifically manufactured for use with the circuit breaker. The interrupting rating shall be 10,000 RMS symmetrical amps.

vi. Transformer Primary Circuit Breaker (when transformer is required) – A properly sized, two (2) pole, molded case circuit breaker shall be furnished ahead of the control power 120 V AC power transformer for short circuit protection and disconnecting power to the transformer. The circuit breaker shall conform to the specifications for the motor circuit breaker(s).

vii. Control Power Transformer (When Neutral Is Not Available at Jobsite – Std. on 460 V AC) - An industrial quality control transformer shall be furnished to provide control voltage. The transformer shall be sized with an adequate KVA rating to provide 120 V AC power for all items required in the control and alarm circuits. - Transformer shall be protected in its secondary by properly sized fuses and/or circuit breaker(s).

viii. Magnetic Contactors and Overload Relays- A magnetic contactor shall be furnished for each motor. A separate, panel-mounted, three leg (three phase) overload relay shall be supplied for each motor. Each leg of the overload relay shall be equipped with a properly sized overload heater. Contactor and overload relay shall be properly sized for the required horsepower, voltage, and phase.

ix. Elapsed Time Meters – Six-digit, non-resettable elapsed time meters shall be mounted in the control panel enclosure to record the running time of each pump.

x. Phase and Voltage Monitor- A phase failure, reversal and under voltage monitor shall be supplied to prevent the motors from running under low voltage, phase loss, or phase reversal conditions. The monitor will lock out the control circuit until the problem is corrected and automatically reset.

xi. Lightning Arrestor- Suitable lightning arrestors shall be provided to protect motors and control equipment from lightning induced line surges.

xii. Thru-Flash panel Door Overload Reset Push Buttons - Overload reset push buttons shall be provided for each overload relay. Push buttons shall be mounted so that with the inner door closed, overload relays may be reset without entering high-voltage compartment.

xiii. Switches - Heavy duty industrial grade oiltight switches shall be provided for each pump for "Hands-Off-Automatic' operation selection. All switch components shall be made of corrosion resistant metals and polyesters. Contact blocks shall be made of see-through polycarbonate for simplified inspection of contacts. Cams and strokes shall be Teflon impregnated for abrasion free service without lubrication. The switches required shall be as follows:

Switch Function (Name Plate)	Voltage
Manual-off-Automatic	120 V AC

xiv. Pilot Lights – Full voltage heavy duty, industrial grade, oiltight pilot lights shall be provided. All pilot light components shall be made of corrosion resistant metals and polyesters. An insulated socket shall be furnished to eliminate the possibility of shock during bulb change. Lens shall be made of Lexan. The pilot lights required shall be as follows:

Pilot Light Function (Name Plate)	Voltage	Lens Color
PUMP 1	120 V AC	GREEN
PUMP 2	120 V AC	GREEN

xv. Seal Failure Circuit Test Push Button (illuminated) - Heavy duty, industrial grade, oiltight push buttons shall be provided for each submersible pump motor. All push button components shall be made of corrosion resistant metals and polyesters. Contact blocks shall be made of see-through polycarbonate for simplified inspection of contacts. An insulated socket shall be furnished to eliminate the possibility of shock during bulb change. Lens shall be made of Lexan.

The push buttons required shall be as follows:

Pilot Light Function (Name Plate)	Voltage	Lens Color
P1 SEAL FAIL	120 V AC	AMBER
P2 SEAL FAIL	120 V AC	AMBER

xvi. Pump Alternator Circuit (for duplex pump operation) - The electromechanical alternator relay shall be of industrial design specifically for use in pump applications. It shall have single pole, double throw heavy duty, 10-amp, silver cadmium oxide contacts enclosed in a transparent cover. The contacts shall transfer when the unit is deenergized. The circuit shall never be closed or opened while current is being conducted. The alternator circuit shall alternate the lead pump position between the pumps and shall allow the lag pump to start in response to a rising water level in the wet well. Needs to be switchable I.E. Pl or P2 lead. (P1 alt. P2).

xvii. Power Failure - Once power is restored after a failure and the pump has pumped the water from alarm level down to pump off, the alarm should automatically reset itself.

xviii. Control Relay(s) - Plug-in control relays with 120 V AC coils shall be provided as required. Contact rating shall be five amps (minimum). Sockets shall be from the same manufacturer, and the relays and hold-down clips shall be furnished to prevent relay from sliding out of the socket.

xix. High Wet Well Level Alarm - The control panel shall be provided with a suitable alarm circuit, activated by a separate level control. This alarm shall signal a high-water condition in the sump. Terminals shall be furnished in the control panel for connection of an externally mounted alarm device.

A red flashing light shall be provided as a visual alarm and a horn provided as an audible alarm of the high-water condition in the wet well. The pump station shall also be equipped with buttons to both test and silence the horn and light.

xx. Liquid Level Controls - Mercury level control switches shall be provided for pumps on, lead pump on, lag pump on, and high-level alarm functions. The mercury switch shall be encapsulated in polyurethane foam for corrosion and shock resistance. Level switches shall be weighted to hold desired position in the sump. The cord connection for the control shall be numbered 16-2, rated for thirteen (13) amps, and shall be type SJTO. To ensure optimum longevity, contacts shall be rated for twenty (20) amps at 115 V AC and shall be sealed in a heavy-duty glass enclosure. No junction boxes or cable splices of any kind will be allowed in the wet well. Float leads shall not be in the same conduit as the motor leads.

xxi. High Temperature Shutdown Circuit(s) - The high pump motor temperature circuit shall provide terminals for connection of the leads from the temperature sensor provided in the pump motor windings. Upon a high temperature condition in the pump windings, the control power to the pump motor contactor shall be disconnected, thus stopping the pump motor. An overheating light shall come on, and the pump shall automatically restart when the pump motor temperature returns to an acceptable level.

xxii. Ground Lug(s) - Equipment ground lug(s) shall be provided for grounding the enclosure. The ground lug(s) shall be suitable for the service provided to the enclosure and shall be sized per table 250-95 of the N.E.C. In all cases the enclosure must be adequately grounded per article 250 of the N.E.C.

xxiii. Terminals - Terminals shall be provided for connecting mercury float switch leads, temperature sensor leads, and seal fail sensor leads. Terminal blocks shall be rated for 600 volts use and accept a wide range of #22-8. All live parts shall be fully shielded. Block shall be constructed of nylon and have insulating walls on all sides of the lug. Blocks must be U. L. recognized.

xxiv. Construction Standards - Subpanel shall be drilled and tapped to accept machine thread bolts (self-tapping screws are not acceptable). All control wiring shall be 16 AWG machine tool wire, Carol type 76512 or equal. All control wire shall be color coded or numbered in accordance with JIC standards. Power (motor) wiring shall be in accordance with the 1984 National Electrical Code. Major groups of wires shall be contained in a plastic wiring trough such as Panduit Type E or other approved equal.

xxv. Guarantee- The manufacturer of the control panel shall furnish a warranty for one year from the date of start-up stipulating that all equipment shall be free from defects in design, materials, and workmanship. The control panel manufacturer shall furnish replacement parts for any component proven defective, whether of the control panel manufacturer or other manufacturer during the guarantee period, excepting only those items that are normally consumed in service, such as light bulbs.

xxvi. Panels must be equipped with dry contact terminal boxes for telemetry.

j. Pump Station – Submersible Pump Type

i. General - The submersible pump station structure shall consist of the wet well, duplex pumps and rails, pump controls and related appurtenances, discharge piping, valves, valve vault, cover slabs, and access hatches.

The wet well shall have a minimum diameter of six (6) feet and shall be large enough to easily accommodate the location and removal of each pump so that no pump will have more than five (5) starts per hour when the other pump is out.

ii. Sewage Pumps and Motors - Pumps shall be Myers, Flyght, or other PLURIS-approved manufacturer, submersible, large grinder or non-clog sewage pumps, or a pump approved by PLURIS's engineer. Submersible pumps shall be provided with each capable of handling raw, unscreened sewage at peak design flow. Major pump components shall be of gray cast iron devoid of burr, pits, or other irregularities. The pump motors shall be sealed, submersible type and shall be three (3) phase, 60 Hertz, 240- or 460-volt motors with a wye connection. The motors shall meet the U. S. requirements of Class I, Division I, and Group D for hazardous locations and shall be sized to non-overloading throughout the entire operating range of the pump.

Stator winding shall be of the open type with insulation good for 1,800 centigrade maximum temperature. Winding housing shall be filled with a clean high dielectric oil that lubricates bearings and seals and transfers heat from windings and rotor to outer shell.

Motor shall have two (2) heavy duty ball bearings to support the pump shaft and be capable of handling radial and thrust loads and a sleeve guide bushing directly above the lower seal to manage the radial load and function as flame path for seal chamber. Ball bearings shall be designed for 30,000 hours B-10 life. Stator shall be heat shrunk into motor housing.

A heating sensor thermostat shall be attached to and embedded in the winding and be connected in series with the motor starter contactor coil to stop motor if temperature of winding is more than 220° F. Thermostat shall reset automatically when motor cools to safe operating temperature. The common pump shaft shall be of 416 stainless steel.

The pump motor shall be protected by two (2) mechanical seals mounted in tandem with a seal chamber between the seals. Seal chamber shall be oil filled to lubricate seal face and to transmit heat from shaft to outer shell. Seal face shall be carbon and ceramic and lapped to a flatness of one light band. Lower seal faces shall be tungsten carbide.

A double electrode shall be mounted in the seal chamber to detect any water entering the chamber through the lower seal. Water in the chamber shall cause a red light to turn on at the control panel. This signal shall not stop the motor but shall function as a warning only.

Power cables to pumps shall be AWS (mm) Hypalon jacketed type SPC cable of thirty (30) feet in length as a minimum.

iii. Discharge Piping and Valves - Discharge piping shall be flanged stainless steel pipe inside the wet well and DIP on the inside of the valve vault and sized to produce a minimum head loss while maintaining a minimum velocity of 2.5 feet per second, as herein before specified. All exposed piping shall have adequately sized stainless steel thrust rods.

The discharge connection elbow shall be a straight through fitting with no flap valve and shall be permanently installed in the wet well along with the discharge piping. The pumps shall be automatically connected to the discharge connection elbow when lowered into place. A sliding guide bracket shall be guided no less than two (2) guide bars. The entire weight of the pump shall bear upon the guides and base support with no part of the pump bearing directly on the floor of the sump. A stainless steel chain shall be provided for lifting each pump from the wet well and shall be in a single length and extend a minimum of fifteen (15) feet past the hatch. All hardware used shall be 316 stainless steel.

Gate valves and check valves on the discharge side of each pump shall be in a valve vault separate from and adjacent to the wet well. A mechanical joint coupling shall be installed on each discharge main between the wet well and the valve vault. The valve vault shall consist of a precast rectangular structure at least six (6) feet square, all complete with a drain that goes to the wet well and that has a flapper style valve on the drain line, access ladder or rungs, and access cover cast in the top slab.

The access cover for the valve vault shall be a square hatch of 1/4 inch aluminum diamond pattern plate with stainless steel hinges on an aluminum frame cast in place in the cover slab.

iv. Lift Out Rail System - The lift out systems shall consist of a straight elbow that bolts to bottom of basin, a combination disconnect assembly with a seal flange that mounts to pump, rail support guides that fasten to wall of basin and guide and support brackets that mount to pump.

Guide rails shall be Stainless steel pipe.

The discharge quick disconnect shall be tapered and have a holding groove machined into the face to hold a-sealing--O-ring. The tapered seat shall allow the pump to be nearly sealed to the discharge elbow before the sealing faces make contact. A guide plate and adjustable guide bar shall be fastened to the top of the pump to ensure good alignment and for support of the pump.

The rail support and mounting bushing shall be securely mounted to the basin wall and shall not be attached to the basin cover or cover frame.

The guide rail support shall be adjustable so that a perfect vertical alignment of the rails can be obtained.

k. Warranties and Documentation

i. Warranties - The pump manufacturer shall warrant to the Developer and subsequently PLURIS, that the pumps, motors, and controls supplied are free of defects in workmanship and material for a period of one (1) year. The warranty shall be in printed form and made applicable to PLURIS (as Warrantee) at the time of acceptance for maintenance by PLURIS. Digital and hardcopy drawings of the as-builts shall be provided to PLURIS. The drawings shall contain all adjacent utility information including, but not be limited to, force mains, valves, and gravity sewer manholes.

ii. Documentation – Documentation to be supplied to PLURIS shall be three copies of the complete Operation and Maintenance manuals, which include the following:

a. Cover Sheet Listing: Pump manufacturer; source of repair parts, complete with address and phone number; operating conditions – rated capacity and TDH of each pump; model number, serial number, impeller diameter of each pump; all data plate information from each pump motor; and data on other equipment included as components in the pump station.

b. Pump performance curve with operating conditions indicated on it.

c. Detailed dimensional drawings of the pump and pump base elbow.

d. Detailed dimensional drawings of the pump motor.

e. A control panel wiring diagram.

f. Pump and motor installation and service manual.

g. Detailed information related to other components of the pump station.

l. Pump Design

i. General Requirements

a. Only pumps designed and manufactured for use in conveying raw, unscreened wastewater shall be acceptable.

b. Pump selection shall consider the duty requirements as well as the physical and chemical characteristics of the wastewater being conveyed. Materials used in pump construction shall also be suitable for the physical and chemical characteristics of the wastewater being conveyed.

c. Pump stations conveying residential, commercial, institutional, or industrial domestic wastewater shall be provided with pumps that are suitable for continuous duty in conveying raw, unscreened wastewater.

i. Pumps shall be three (3) Phase and capable of handling a three-inch solid and any trash or stringy material that can pass through a four-inch pipe unless a mechanical means of solids reduction is installed at the pump station.

1. Pumps shall be approved by PLURIS. Impellers shall have blades that are generally forward rounded or otherwise configured to avoid catching solids, trash, and stringy material.

2. Mechanical bar screens, communicators, dominators, or other similar devices may be required at regional pump stations.

ii. Pump suction and discharge openings shall be no less than four (4) inches in diameter (unless approved by PLURIS), the pump is capable of grinding, chopping, or cutting solids or a mechanical means of reducing the size of a three-inch solid and any trash or stringy material that can pass through a four-inch pipe in the pump station.

iii. Pumps shall be designed for continuous duty pumping of raw, unscreened wastewater. Pumps shall be adequately protected from damage due to failure conditions specific to the selected pump type and pump station configuration.

ii. Number and Capacity

a. Pump stations shall be provided with the number and capacity of pumps that are stipulated in 15A NCAC 02T .0305(h)(1).

i. Multiple pumps shall be used such that the pump station can convey the peak hourly wastewater flow to its desired outfall location with the largest single pump out of service.

1. In duplex pump stations, the pumps shall be of the same capacity.
2. If pumps in series are required to meet capacity or total dynamic head requirement, each set of pumps in series shall be viewed as a single pumping unit.
3. Priming pumps as well as any other auxiliary system that is required for pump functionality shall also be provided in multiple numbers.

ii. Determination of pump capacity shall be based on wastewater flows expected to become tributary to the pump station for the entire project/development at build out. For regional pump stations, pump capacity shall be based on wastewater flows expected to become tributary from the entire service area over the life of the pump station.

1. Interim sizing of pumps and associated pump stations shall be allowable providing Pluris accepts this. At a minimum however, it shall only be used to meet requirements as set forth in 15A NCAC 02T .0305 or the minimum design criteria contained in this document and not for economic purposes.

2. A conspicuous statement that specifies the initial service capacity shall be provided on the drawings for projects that are approved for an interim condition. Additional wastewater flows (i.e., those more than that approved for the interim condition) shall not be made tributary to the pump station until a request for permit modification is submitted to and approved by NCDEQ, the pumps and associated pump station are upgraded, and the required certificate of completion and other supporting documentation are received by NCDEQ.

iii. The minimum allowable design daily wastewater flow to the pump station shall be determined in accordance with 15A NCAC 02T .0305.

1. Where a pump station is designed to serve a developed service area, historical potable water use, or wastewater flow generation data may be used to determine design daily wastewater flows.

2. Where a pump station is designed to serve a broad service area for which specific development is not known, design daily wastewater flows may be established based on historical data for the broad service area or established long-range wastewater planning criteria.

iv. The selected peak hourly wastewater flow to the pump station shall be appropriate for the service area as well as the associated wastewater generation patterns and population being served by the pump station. The minimum peak hourly wastewater flow to the pump station shall be calculated using the design daily wastewater flow in conjunction with a peaking factor determined from the following equation:

$$PF = Q_{phf} / Q_{ddf} = [(18 + sqrt(P) / (4 + sqrt(P)]$$

Where:

PF = Peaking Factor
Q_{phf} = Peak hourly flow (gpd)
Q_{ddf} = Design daily flow(gpd)
P = service population(thousands)

1. The above equation yields a peaking factor that is intended to cover normal infiltration and inflow for well-maintained sewer systems and/or those built with modern materials and construction methods. Consideration shall be given to applying higher peaking factors for special conditions including but not limited to such conditions as pump stations serving older collection systems, those serving collection systems located in areas with high actual groundwater tables, and those serving areas and that may have combined sewer systems. Infiltration and inflow allowances shall be incorporated using actual flow data whenever possible.

2. Peaking factors for pump stations conveying industrial or other process wastewater shall be determined based on actual operating conditions of the facility; however, in no case shall the peaking factor be less than the minimum set forth in NC DENR's Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains Section 2.02A.4.c.

3. In no case shall a peaking factor less than 2.5 be used to calculate peak hourly wastewater flows for any pump station.

iii. Selection Methodology

a. Pump selection shall be based on a hydraulic analysis of the system through which the wastewater is to be conveyed.

i. The design operating point(s) of the pump(s) shall be determined using a pump curve-system curve analysis. Pumps shall be capable of pumping the required capacity, as described in NC DENR's "Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains" Section 2.02, for all total dynamic head requirements developed by the system for the lifetime of the pump station.

ii. A system curve, plotting total dynamic head versus capacity, shall be developed for all operating conditions that may be imposed on the system. Total dynamic head requirements for the system shall be calculated as the total of the following individual components:

1. Static head requirements of the system, including those associated with both the suction and discharge sides of the pumps, shall be evaluated. In addition to calculating static head with the discharge evaluation of the force main, any intermediate high points in the force main that would influence the total dynamic head requirements of the pump shall be analyzed.

2. Friction head requirements of the system, including those associated with both the suction and discharge sides of the pumps, shall be evaluated. The friction head shall be calculated using the Hazen-Williams formula:

$$h_f = L\,[\,4.73Q^{1.85}/\,C^{1.85}D^{4.87}]$$

Where:
h_f = Friction head in feet
L = Length of the pipe segment in feet
Q = Flow rate in gpm.
C = Hazen Williams coefficient
D = Inside pipe diameter in inches

All operating conditions shall be evaluated including, but not limited to, multiple pump operation within the subject force main, simultaneous pump station operation for common force main situations, and the possibility for gravity flow conditions in force main segments with extreme negative slopes that may not flow full.

3. Hydraulic head derived from any minor losses of the system, including that associated with both the suction side and discharge side of the pump, shall be evaluated. Such minor losses shall include hydraulic head derived from valves and other fittings including but limited to tees and bends.

iii. If applicable, the pressure head at the junction of the existing force main shall also

be evaluated for its effect on the total dynamic head requirements of the system. The evaluation shall consider the effects of simultaneous pump station operation, as well as multiple pump operations in other pump stations.

iv. System curves shall be generated and evaluated not only for present day conditions but also for conditions that may exist over the expected lifetime of the pump station.

v. The Hazen-Williams friction coefficient, C, appropriate for the force main pipe material and age of the force main shall be used. The following maximum values shall be allowable for C:

Pipe Type	Initial Service C	End-of-Service C
DI	125	100
PVC	140	120
HDPE	140	120

vi. Friction head and minor losses associated with the system shall be evaluated at both the initial service condition and the end-of-service condition.

vii. The design operating point(s) shall be defined as the intersection of the pump curve and the calculated system curve(s).

viii. Pumps shall be selected such that all design operating points are on the pump curve as supplied by the pump manufacturer. In addition, pumps shall be selected such that the net positive suction head available ($NPSH_A$) shall be greater than the net positive suction head required ($NPSH_R$) at each of the design operating points.

ix. Pumps shall be selected such that the pumps will not cavitate at any of the design operating points. Pumps that operate within the unstable portion of the pump curve under any of the expected design conditions shall not be allowed. Freewheeling (i.e., operating at pump run-out) or deadheading (i.e., operating at pump shut-off) of pumps shall not be allowed.

x. To the greatest extent possible, pumps shall be selected such that their operating efficiency is maximized during all hydraulic conditions that may exist over the expected lifetime of the pump station.

b. Consideration shall be given to minimizing motor speeds during the pump selection process.

c. The horsepower rating of each pump motor shall be at least 1.15 times that required. by the pump when operating at all design operating conditions.

iv. Cycle and Pump Run Times

a. Constant speed pumps shall be cycled such that the number of starts is minimized, and resting times are maximized to avoid overheating and overstressing of the pump motor.

i. Automatic pump alternation shall be provided in the control panel for the proper alternation of the pumps. .

ii. Pumps shall be designed to operate between two and eight times per hour at design daily flow in accordance with 15A NCAC 02T .0350(h)(1) whenever practicable (see NC DENR's "Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains" Section 2.04A.2.b.).

1. The following equation shall be used to determine the active storage volume in the pump station (i.e., the volume between the pump-on and all pump-off elevations) required to elicit the required pump cycle time:

$V = T\ Q_{ddf}\ [1-(Q_{ddf}/Q)]$

V = active volume within the pump station (gallons)
T = allowable cycle time between starts (minutes)
Q_{ddf} = design daily flow to pump station (gallons per minute)
Q = pumping rate of a single pump (gallons per minute)

2. If the wastewater generation patterns are such that less than two pumping cycles per hour will occur at design daily flow or if the pump station is intended to provide equalization of hydraulic surges, measures to control odor and corrosion shall be employed when resultant detention times cause septic conditions. These measures shall take into consideration protection of the pump station, the force main, the outfall sewer, any related appurtenances, and the surrounding area.

b. Consideration shall be given to using variable speed pumps for main pump stations or those pump stations that discharge directly into the wastewater treatment facility.

c. Pump run times shall be such that excessive wear of the pumps does not occur.

d. At design daily flow, adequate time shall be provided to allow a constant speed pump to "ramp up" to full speed before the pumping cycle ends.

e. Pump run times at design daily flow shall not be less than or greater than those recommended by the pump manufacturer.

m. Pump Station Design

i. General Requirements

a. Pump stations shall be designed to achieve total containment of the influent wastewater prior to being conveyed through the force main

b. Pump stations shall be designed such that infiltration and inflow are minimized.

c. Precast polymer concrete may be utilized.

ii. Site Selection

a. Location and Access

i. Pump station sites shall be accessible by an all-weather roadway in accordance with 15A NCAC 02T .0350(h)(4)

1. The roadway shall be a solid surface road. The minimum acceptable surface shall be a six (6) inch compact gravel base able to support large commercial vehicular traffic loads that do not cause deflection.

2. Wherever practicable, no portion of the roadway shall be located below the 100-year flood elevation as identified on the most recent FEMA Flood Insurance Rate map when available or as established through appropriate modeling techniques.

3. The roadway shall be designed to accommodate the largest vehicle expected to service the pump station. In no case shall the roadway be less than fourteen (14) feet in width.

b. Security

i. Access to the pump station structures as well as all associated equipment and appurtenances shall be restricted in accordance with 15A NCAC 02T.0350(h)(4)

1. All ports of entry into pump station, valve vault, electrical panels shall be locked.

2. Fencing provided around pump station structures shall be of sufficient height and material to deter entry. Locked gates, a minimum of fourteen (14) feet wide, shall be provided in the fence to allow vehicular access by operation and maintenance staff. Consideration shall be given to complying with the requirements in Section 3.02B.1.c. as well. All chain link fencing shall use privacy slates.

3. There shall be no overhead obstruction above the pump station to allow the use of a boom truck at the pump station for lifting pumps. Additionally, stainless steel chain shall be used for lifting out the pumps, and the cable shall be in a single length and able to extend fifteen (15) feet above the wet well hatch.

ii. The pump station shall be provided with adequate outdoor and indoor lighting to facilitate normal and emergency operation and maintenance activities during daylight and non-daylight hours.

iii. Safety placards for all pump station structures and equipment, as required by OSHA, shall be provided and be readily visible.

iii. Structural Design

a. Materials of Construction

i. Pump station structures shall be designed and built in complete compliance with all applicable state, local, and federal codes as well as any applicable OSHA standards.

ii. Material selection for pump station structures shall be based on installation and operating factors including, but not limited to, the following:

1. Physical, chemical, and biological wastewater characteristics.

2. Corrosive gas production.

3. Soil characteristics.

4. Groundwater presence.

iii. Pump station structures shall be completely separated unless made completely watertight and gas tight.

iv. Pump station structures shall be adequately protected to minimize damage from vehicular traffic.

b. Buoyancy Protection

i. Below-ground pump station structures shall be protected from flotation due to buoyant forces of groundwater.

ii. Buoyancy protection shall be demonstrated using flotation calculations.

1. Flotation calculations shall be performed on below-ground pump station structures using the assumption that the elevation of the groundwater table is equivalent to the ground elevation.

2. Flotation calculations shall not add the weight of the pumps, internal piping and appurtenances, or wastewater present in the pump station, including the wastewater below the “all pumps-off” activation level into the downward forces used to counteract buoyancy.

3. The use of the saturated weight of any soil above the extended footing of the pump station structure shall be allowed in the flotation calculations.

iii. Flotation calculations shall show that the design of the below-ground pump station structures will be protected from buoyancy with a factor of safety that is equal to or greater than one.

c. Flood Resistance

i. Pump station structures and all associated equipment and appurtenances shall be protected from the 100-year flood, in accordance with 15A NCAC 02T .0350(e).

ii. Such protection measures shall ensure that the pump station remains fully functional, operational, and free from physical damage during a 100-year flood.

iii. The pump station shall be protected from inundation of floodwaters by elevating structures at least two (2) feet above the 100-year flood elevation. An alternate design shall include providing all pump station structures with watertight ports of entry as well as electrical, instrumentation/control, and ventilation systems that are elevated at least two (2) feet above the 100-year flood elevations.

iv. The 100-year flood elevation shall be that as identified on the most recent FEMA Flood Insurance Rate map when available or as established through appropriate modeling techniques.

d. Solids Collection

i. Wet wells shall be designed to minimize pump or pump suction piping operational problems resulting from the accumulation of solids and grit material within the wet well.

1. Acceptable designs include the use of fillets and sloped wet well floors alone or in conjunction with a hopper bottom.

2. The design of fillets and slopes shall be such that solids are effectively moved toward the pump or pump suction piping.

ii. No projections within the wet well, which would allow deposition of solids under normal operating conditions, shall be allowed.

e. Depth

i. Pump Submergence Depth

1. Sufficient submergence of the pump or pump suction piping shall be provided to prevent the occurrence of vertexing within the wet well.

2. In no case shall the “all pumps-off” activation level be less than the minimum level required for successful pump operation, as recommended by the pump manufacturer.

ii. The wet well shall be provided with a depth as required to maintain the active storage volume as required in Section 2.04A.2.a of the NCDEQ Minimum Design Criteria.

iii. The wet well shall be provided with a depth required to maintain the emergency storage volume as required in Section 5.04B.3 and Section 5.04B.4. of the NCDEQ Minimum Design Criteria.

iv. Piping and Valves

a. Suction and Discharge Piping Configurations

i. Each pump shall be provided with separate suction and discharge piping systems.

1. Pump suction and discharge piping shall be no less than four (4) inches in diameter unless the pump capable of grinding, chopping, or cutting solids or a mechanical means of reducing the size of a three-inch solid and any trash or stringy material that can pass through a four-inch hose is installed in the pump station. Acceptable mechanical means of solids reduction shall be as defined in Section 2.01C.1.b of the NCDEQ Minimum Design Criteria.

2. The ultimate pump suction and discharge piping size shall be selected such that a velocity of between two (2) and eight (8) feet per second is achieved.

ii. The discharge piping systems shall be provided with sufficient valves so as not to affect the proper operation and maintenance of the pump station during both normal and emergency conditions.

1. Selected valves shall be suitable for use with raw, unscreened wastewater and shall be of a design suitable for its function, its installation location, as well as the normal and maximum operating pressures expected at the pump station.

i. A full-closing, shut-off valve shall be provided on the discharge piping of each pump and on the suction piping of each dry well pump.
ii. A swing check valve with weighted hammer lever shall be provided on the discharge piping of each pump between the pump and the shut-off valve. Check valves shall be placed in the horizontal position.
iii. No ball check style valves are permitted.

2. All valves shall be located such that they are readily accessible. Valves shall be placed either in the dry well or in a separate valve vault.

b. Pipe Connections

i. Pipe inlets and outlets of pump station structures shall be made watertight.

ii. Existing pump station structures shall be core drilled or saw-cut when connections are made through the structure wall. In no case shall penetrations into pump station structures be made by hammering.

iii. A minimum two (2) inch diameter PVC schedule eighty (80) conduit shall be installed for the float switch cords.

c. Water Service

i. Wherever practicable or required by the design, potable or reclaimed water service shall be provided to the pump station.

ii. Cross-connection control for potable water services shall be provided in accordance with 15A NCAC 18C .0406(b). Cross-connection control for reclaimed water services shall be provided in accordance with 15A NCAC 02T .0909(f).

d. Pig Launching/Retrieval Stations

i. When pig launching and retrieval stations are made part of the pump station, their design shall be such that they may be isolated from the force main.

ii. The design of the pig retrieval station shall be such that accumulated material dislodged from the force main may be safely removed and disposed.

v. Appurtenances

a. Consideration shall be given to protecting pump station structures and equipment from physical damage or clogging from solid material normally present in wastewater by screening and other solids reducing equipment.

b. Pump Removal Methods/Equipment Provisions shall be so that the largest piece of equipment installed at the pump station may be removed. Such provision may include supplying hoisting equipment and/or designing sufficient clearance around the pump station for mobile hoisting equipment access. All lift stations shall have a hand operated stainless steel hoist installed for submersible pump removal unless the size of the pumps make it impractical to do so. In such cases, PLURIS staff shall be consulted on the appropriate method of emergency pump removal.

ii. Pump station structures shall be provided with access hatches, doors, and skylights of sufficient size such that the largest piece of equipment may be removed without damaging the integrity of the structural design.

iii. Pump stations utilizing submersible pumps installed in wet wells shall be provided with a system that allows for the removal and installation of the pumps without requiring entry into the wet well.

1. Each pump shall be provided with a guide rail system and a lift-out chain.

2. Both the guide rail system and the lift-out chain shall be capable of withstanding the forces required to disengage the pump from the wet well.

3. Both the guide rail system and the lift-out chain shall be manufactured of stainless steel. Under no circumstances shall steel or galvanized steel be used.

c. Access Equipment

i. Each pump station structure shall be designed such that access to perform routine and emergency operation and maintenance is easy, unobstructed, and safe.

ii. Each pump station structure shall be provided with a separate means of access. Under no circumstance shall access to the wet well be provided through a dry well.

iii. Steps, ladders, stairs, landings, hatches, and other means of access shall conform to OSHA standards as well as all applicable local and state building codes regarding design characteristics.

d. Ventilation Equipment

i. Pump stations shall be adequately vented in accordance with 15A NCAC 02T. .0350(h)(3) as well as in complete compliance with all applicable local and state building codes as well as OSHA and NFPA standards.

ii. At a minimum, pump station wet wells shall be provided with a gooseneck-type vent. Active ventilation units shall also be acceptable.

1. Vents shall be constructed of sturdy material that is resistant to ultraviolet light and adequately supported to withstand damage during normal and emergency operation and maintenance.

2. Vent elevations shall be a minimum of two (2) feet above the 100-year flood elevation as identified on the most recent FEMA map when available or as established through appropriate modeling techniques.

3. Vents shall be provided with an insect/bird screen of stainless steel, aluminum, corrosion-resistant material. Under no circumstances shall steel or galvanized steel be used.

iii. Dry wells or other enclosed pump station structures into which routine operator entry is required shall either have a positive-pressure ventilation system that meets, at a minimum, the requirements of NFPA 820 “Standard for Fire Protection in Wastewater Treatment and Collection Facilities.” Consideration shall be given to installing sensor and alarm systems to detect the accumulation of dangerous levels of hazardous gases.

e. Other Equipment

i. Consideration shall be given to controlling the pump station temperature and humidity to a level appropriate for reliable operation of the electrical and instrumentation/control systems.

ii. Pump station structures other than the wet well shall be provided with a means to remove accumulated water and wastewater from the structure. All floor and walkway surfaces shall be sloped such that water and wastewater drains to the removal area under the influence of gravity. “Acceptable removal means” includes the following:

1. An appropriately sized drainage pipe.

(i) The drainage pipe shall convey accumulated water and wastewater to the wet well or other available entry point into the wastewater collection system. Under no circumstances shall the drainage pipe convey accumulated water and wastewater to daylight, into surface water, or into the ground.

(ii) The discharge of the drainage pipe shall be higher than the high-water alarm activation level in the wet well or the maximum water level expected at the other available entry point into the wastewater collection system.

(iii) The drainage pipe shall be provided with a device to prevent backflow of wastewater and gases from the wet well into the structure.

n. Electrical and Instrumentation/Control Systems Design

i. General Requirements

a. Electrical systems for pump stations shall be designed and installed in strict conformance with NFPA 70 “National Electric Code,” ANSI, as well as all applicable federal, state, and local codes.

i. In general, electrical and instrumentation/control systems and components shall be protected against corrosive conditions.

ii. If located in a wet well or other location where explosive or flammable gases may concentrate, electrical and instrumentation/control systems and components shall meet the requirements for a Class I, Group D, Division 1 location.

b. Each pump and motor unit shall be provided with a separate electrical supply, motor starter, alarm sensors, and electrical and instrumentation/control systems and components.

i. Electrical and instrumentation/control systems and components shall be located such that they may be disconnected from outside a wet well.

ii. Cables and conduits shall be provided with seals that are both watertight and gas tight, shall be protected from corrosion, and shall allow separate strain relief.

c. The main power feed to all pump stations shall be equipped with an above-grade, fused disconnect switch.

ii. Enclosures

a. Enclosures for electrical and control components for the pump station shall be located outside of the wet well and in a location such that they are readily accessible, ensure maximum electrical and personnel safety, and are protected from damage due to vehicular traffic and flooding.

b. Enclosures shall have a NEMA-rating that is appropriate for the installation location at the pump station.

i. If not housed, enclosures shall have a minimum stainless steel NEMA 4X rating. Stainless steel NEMA 4X enclosures shall be used in locations where the potential for flooding and the development and accumulation of corrosive gases exists. NEMA 4X stainless steel enclosures shall be used for all outdoor installations.

ii. Enclosures shall be protected by a conduit seal or other appropriate sealing method that meets the requirements of NFPA 70 to protect the wet well atmosphere from gaining access to the enclosure. This seal shall be located such that it will not be disturbed during routine operation and maintenance functions at the wet well for a Class I, Division 2 location.

All enclosures and all switches and indicator lights, whether mounted on an inner door or face of the enclosure, shall be provided with a label that conforms to UL descriptions and procedures.

c. All interior components shall be mounted on a stainless steel backboard.

d. The Applicant's lock-out/tag-out procedures shall be considered in the design of all enclosures to be installed at the pump station.

iii. Instrumentation and Controls

a. Wastewater Level Sensing Equipment

i. Pump station cycles, as described in Section 2.04A.2., shall be controlled by wastewater level sensing equipment in the wet well.

ii. At a minimum, wastewater levels within the wet well shall be detected by Anchor Scientific Mini Floats. If an alternate method of level detection, including but limited to bubble tube, and/or ultrasonic meter, is used, a float switch at the high-water alarm level shall be installed as a back-up, all of which is subject to acceptance by PLURIS.

iii. Wastewater level sensing equipment shall be used to indicate the following levels and operate the pump station correspondingly: all pumps off, lead pump on, lag pump on, and high-water alarm.

iv. Wastewater level sensing equipment shall be located so as not to be affected by flows entering the wet well or the turbulence created by the suction of the pump.

b. Components

i. The pump station shall be equipped with sufficient instrumentation/control systems and components to monitor and control key operating conditions.

ii. At a minimum, the following systems and components shall be provided for the pump station:

1. Pump Station Function

(i) Each pump installed at the pump station shall be provided with a “hand-off-auto” selector switch so that the operational mode of the pump may be selected.

(ii) Each pump installed at the pump station shall have a pump run timer that can keep a cumulative log of the operational time of each pump.

2. Sufficient indicator lights shall be used to demonstrate the operational status of the pump station. The indication lights shall be specific to the condition detected. At a minimum, indicator lights shall be provided for each pump to indicate a “pump on” condition and a pump alarm/failure condition.

3. Weather-proof audible and visual alarms that are external to any structure or enclosure shall be provided at the pump station in accordance with 15A NCAC 2H .0219(h)(5). In the event of a power loss at the pump station or a failure of the automatically activated stand-by emergency source, the alarm system shall be operated from a battery back-up power source. This battery back-up power source shall be provided with continuous charge. At a minimum, the following conditions shall be monitored by the system, and each shall cause activation of the audible and visual alarms:

(i) Pump failure.

(ii) Wastewater level sensing failure (if applicable).

(iii) High-water level in the wet well.

(iv) High-water level in the dry well sump (if applicable).

(v) Loss of telemetry transmission line (if applicable).

(vi) Loss of power supply.

(vii) Automatically activated stand-by power generation source failure (if applicable).

4. A telemetry system shall be installed at all pump stations regardless of the reliability method employed in the pump station design.

(i) The telemetry system shall contact personnel capable of initiating a response to a pump station alarm condition 24 hours per day, 365 days per year.

(ii) In the event of a power supply loss at the pump station or a failure of the automatically activated stand-by emergency source, the telemetry system shall be operated from a battery back-up power source. This battery back-up power source shall be provided with continuous charge.

(iii) The telemetry system shall be activated for any of the following alarm conditions: high water in the wet well, pump failure, loss of power supply, and automatically activated stand-by emergency source failure (if applicable).

5. Appurtenances

(i) Sufficient 110-volt electrical receptacles shall be provided to facilitate maintenance at the pump station. If located in an outdoor area, the receptacles shall be of the ground fault interruptible type and shall be protected from the weather elements.

(ii) If reliability for the pump station is based on a contingency plan that involves portable bypass pumping units, the pump station shall be provided with a suction and discharge quick connection plumbing port for a mobile bypass pump.

iv. Reliability

a. Pump station reliability shall be in accordance with 15A NCAC 02T .0350(h)(1) and shall be considered a key, integral part of the overall pump station design.

b. The following reliability infrastructure shall be incorporated into the pump station design:

i. The pump station shall be connected to an automatically activated stand-by bypass pumping system. The pumping system will operate independently from the pump station submersible pumps and be activated by an independent level sensor/float system.

1. The permanently installed emergency back-up pump set specified in this section will be used to pump wastewater and raw sewage in applications requiring a suction lift or as an inline booster pump.

2. The pump and accessories shall be supplied by the pump manufacturer.

3. The pump shall be fitted with a fully automatic priming system incorporating an air compressor, air ejector assembly, and an air/water separation tank. The priming system shall be capable of priming the pump from a completely dry pump casing. The air ejector shall operate on the discharge side of the compressor, eliminating the possibility of water being drawn into the air source. The pump must be capable of running totally dry for periods up to twenty-four (24) hours, then automatically repriming and returning to normal pumping volumes without need for any adjustment.

4. The priming system shall not use a vacuum or diaphragm pump, nor require the use of a "foot"-type valve. It shall contain no moving parts or protective float gear. Priming systems that require manual water additions to facilitate pump priming are not acceptable. A demonstration of the pump's ability to repeatedly cycle from dry suction/pump/snore/repriming/pump shall be required. This will necessitate the draining of all residual water from the pump case to initiate a dry suction starting condition.

5. Pump and priming system shall be fully automatic, needing no form of adjustment or manual addition of water for the priming system. The pump shall be capable of static suction lifts to twenty-eight (28) vertical feet, at sea level. It shall also be capable of operation using extended suction lines.

6. Equipment acceptance shall be contingent upon the pump's ability to run continuously at full speed in a completely dry condition for periods up to twenty-four (24) hours. This may require the draining of all residual water in the pump casing to simulate a dry suction/case condition. The Developer's Engineer of Record may require a demonstration.

7. The engine and pump shall be completely enclosed with fourteen-gauge sheet metal panels backed with one-inch and two-inch layers of poly damp acoustical sound-deadening material. The acoustical enclosure shall reduce pump and engine noise to sixty-eight (68) dBA or less at thirty (30) feet. The enclosure shall be removable for easy access to the engine/pump for maintenance and repair. The enclosure doors shall all be equipped with latches that are keyed alike. For maintenance and service needs, the enclosure sides shall have hinged doors for quick access to the engine oil fill, fuel fill port, oil dipstick, and filters.

8. A complete submittal of the bypass pumping system shall be submitted to PLURIS for review. This submittal shall include all engineering calculations for the system. PLURIS may be contacted prior to bypass system design for additional specifications and acceptable system manufacturers.

9. The suction piping shall be a minimum of 4-inch stainless steel when located in the wet well, 4-inch DIP when located in the valve vault or above ground. Above ground stubs for a mobile pumping unit shall extend a minimum of twenty-four (24) inches with a maximum of thirty-six (36) inches above the adjacent finished grade. The stubs are to have four (4) Bauer connections on both the suction and discharge. The discharge line should be plumbed to the discharge line in the valve vault with a 4-inch weighted swing arm check valve.

10. For lift stations that do not meet the standard NCDEQ requirement for permanent reliability systems, the station shall be plumbed to accept a portable bypass pump. The suction piping shall be a minimum of 4-inch stainless steel when located in the wet well and 4-inch ductile ironDIP when located in the valve vault or above ground. Above ground stubs for a mobile pumping unit shall extend a minimum of twenty-four (24) inches with a maximum of thirty-six (36) inches above the adjacent finished grade. The stubs are to have 4-inch Bauer connections on both the suction and discharge. The discharge line should be plumbed to the discharge line in the valve vault with a 4-inch weighted swing arm check valve.

o. Operations and Maintenance (O&M) Manuals

i. An O&M Manual shall be prepared for each pump station and shall be made available to the applicant upon start-up of the pump station/force main system.

ii. A copy of the O&M Manual shall be kept at the Applicant's central office. The O&M Manual shall be kept on file for the life of the pump station and updated as required.

iii. At a minimum, O&M Manuals shall contain the following minimum information:

a. Approved shop drawings, including design data for all installed equipment and each major component and a pump curve/system curve analysis showing the design operating point(s).

b. Control panel wiring diagrams.

c. Warranty information for all installed equipment and each major component.

d. Inventory, functional descriptions, and complete operating instructions for all installed equipment and each major component.

e. Instructions for start-up/shutdown, as well as for calibration and adjustment of all installed equipment and each major component.

f. Recommended maintenance management system, including preventative and predictive maintenance, for all installed equipment and each major component.

g. Contingency plan and analysis of critical safety issues.

h. Contact information for local service companies, as well as instructions for replacement of all installed equipment and each major component.

i. Contact information for local contractors capable of performing emergency repairs.

j. Contact information for regulatory and other agencies.

3. Testing

a. Operational Test - Before the operational test is conducted, the required copies of the Operation and Maintenance Manuals shall be delivered to PLURIS, and the wet well shall be thoroughly cleaned to remove dirt, mud, gravel, and other foreign debris. The operational test shall check the proper functioning of the pumps and pump controls. The pump, motor and related components' serial numbers shall be verified. All components of the pump station shall be checked to ensure that they can perform the service intended. The operational test shall be performed by PLURIS. The Contractor or Developer shall ensure that a representative from the pump station equipment manufacturer is present at the operational test to review proper operation of the equipment with PLURIS personnel.

b. Contractor's Responsibility - The Contractor shall furnish all materials, labor, and equipment to perform all testing, including water.

c. Watertightness Testing (Pump Station Testing)

i. Wet wells and other wastewater-containing structures at the pump station shall be inspected and evaluated for watertightness.

ii. The watertightness test for the wet well and other wastewater-containing structures at the pump station shall be completed separately and independently of the leakage test performed on the force main as required in Section 6.04D of the NCDEQ Minimum Design Criteria.

iii. The watertightness test shall be performed in the presence of the applicant, the PE, or other authorized representative.

iv. The watertightness test shall be performed in accordance with ACI 350.1R "Testing Reinforced Concrete Structures for Watertightness," AWWA D100 "Welded Steel Tanks for Water Storage," or the manufacturer's recommendations. A vacuum test method in accordance with ASTM C1244 "Standard Test Method for Concrete Sewer Manholes by Negative Test Pressure (Vacuum) Test" may be used for small diameter wet wells in lieu of a hydraulic test.

a. Unless the pump station wet well is constructed of cast-in-place concrete, testing shall not commence until the structure being tested has been fully assembled and backfilling is complete.

b. All inlets and outlets in the structure shall be temporarily plugged and braced or otherwise sealed prior to initiating the test.

c. Pump station wet wells that fail to meet the watertightness test requirements shall be inspected, made watertight, and retested until the test passage is assured.

d. Pump Testing

i. Factory Testing

a. All pumps shall be tested by the manufacturer in accordance with the appropriate UL standard prior to shipment for installation.

b. The results of all factory testing shall be maintained by the applicant as part of the construction record documentation as stipulated in NC DENR's "Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains" Section 1.03B.

ii. Drawdown Testing

a. Following installation, each pump in the pump station shall be subjected to a drawdown test or other similar testing procedure to confirm that the pump is operating at or near the required design operating point(s).

b. The drawdown test shall be performed in the presence of the applicant, the PE, or other authorized representative and a PLURIS representative.

c. The results of all drawdown testing shall be maintained by the applicant as part of the construction record documentation as stipulated in NC DENR's "Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains" Section 1.03B.

iii. Witnessed Testing

a. Consideration shall be given by the applicant to require a witnessed test for large pumps, pumps in critical installations, or pump replacement/repair situations.

b. All witnessed testing shall be performed in accordance with the appropriate HI standard.

c. Witnessed testing shall be performed in the presence of the Applicant, the Engineer of Record, or another authorized representative.

d. The results of all witnessed testing shall be maintained by the applicant as part of the construction record documentation as stipulated in NC DENR's "Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains" Section 1.03B.

e. Electrical and Instrumentation/Control System Testing

i. The Applicant shall ensure that a formal testing program of all electrical as well as instrumentation and control systems installed at the pump station is developed and performed.

ii. The program may consist of a combination of unwitnessed/witnessed factory tests, field readiness tests, and witnessed field tests. At a minimum, however, the Applicant shall witness a field test of the pump station's electrical and instrumentation/control systems. The basic functions that shall be tested for operation as intended by the pump station design shall include, but not be limited to, the following:

    a. Pump operational functions.

    b. Level-sensing equipment.

    c. Alarm system.

    d. Telemetry system.

    e. Emergency Bypass Pump system.

iii. All testing of the electrical and instrumentation/control systems shall be performed in the presence of the Applicant, the PE, or other authorized representative.

iv. The results of all testing shall be maintained by the applicant as part of the construction record documentation as stipulated in NC DENR's "Minimum Design Criteria for the Fast-Track Permitting of Pump Stations and Force Mains" Section 1.03B.

4. Electrical

a. General - Electrical service to all pump stations shall be three (3) phase, 240 or 460 V AC with a wye connection. The electrical power entrance shall be through a meter base, followed by a NEMA 4X heavy duty, single throw, fusible safety switch with a solid neutral; followed by a NEMA 4X heavy duty, double throw, three (3) pole safety switch which feeds the control panel from one side and heavy duty, circuit breaking four (4) wires, four (4) pole receptacle assembly as manufactured by Crouse-Hinds or other equivalent receptacle to Crouse-Hinds approved by PLURIS from the other side. All these electrical components shall be suitably sized to be capable of service with both sewage pumps running.

   All electrical components, including panel, shall be sealed off with duct seal type sealant in accordance with the N. C. Electrical Code requirements for electrical service to gas pumps.

b. Control Equipment Enclosure

i. NEMA4X Enclosure - Enclosure shall be a NEMA type 4X and be of suitable size to house all components. A locking hasp shall be provided in addition to screw clamp type latches. Enclosure shall be fabricated from 14-gauge steel. The top of the enclosure shall serve as a drip shield, and the seam free sides shall prevent rain and sleet from entering. The inner panel shall be made of 12-gauge steel and shall be painted white. The enclosure and interior panel shall be painted with heat-fused, modified polyester powder, electrostatically applied over a phosphatized base. Enclosure shall be ANSI/ASI 61 grey.

ii. Hinged Inner Door - An inner door shall be furnished. Overload reset push buttons, circuit breakers, switches, and pilot lights shall be the only components accessible with door closed. The door shall be hinged and may be opened when service is required.

iii. Line Terminal Block - A terminal block shall be furnished with properly sized line lugs to accept the main power source entering the control panel. Load lugs shall be adequate to accept all required load side wiring requirements. All live parts shall be fully shielded.

iv. Motor Circuit Breakers (240 V AC) - A properly sized, molded case, thermal magnetic circuit breaker shall be provided for each pump motor. Line and load sides shall be equipped with lugs properly sized for the horsepower and current rating of the motor(s). They shall be attached to mounting brackets that are specifically manufactured for use with the circuit breaker. The interrupting rating shall be 10,000 RMS symmetrical amps.

v. Transformer Primary Circuit Breaker (when transformer is required) - A properly sized, two pole, molded case circuit breaker shall be furnished ahead of the control power 120 V AC power transformer for short circuit protection and disconnecting power to the transformer. The circuit breaker shall conform to the specifications for the motor circuit breaker(s).

vi. Control Power Transformer (when neutral is not available at jobsite - Std. on 460 V AC) - An industrial quality control transformer shall be furnished to provide control voltage. The transformer shall be sized with an adequate KVA rating to provide 120 V AC power for all items required in the control and alarm circuits. The transformer shall be protected in its secondary by properly sized fuses and/or circuit breaker(s).

vii. Magnetic Contactor and Overload Relays - A magnetic contactor shall be furnished for each motor. A separate, panel-mounted, 3-leg (three phase) or 1-leg (single phase) overload relay shall be supplied for each motor. Each leg of the overload relay shall be equipped with a properly sized overload heater. Contractor and overload relay shall be properly sized for the required horsepower, voltage, and phase.

viii. Elapsed Time Meters - Six-digit, non-resettable elapsed time meters shall be mounted in the control panel enclosure to record the running time of each pump.

ix. Condensation Strip Heater with Thermostat - A strip heater shall be furnished to prevent condensation within the control panel enclosure. The heater shall be controlled by a panel mounted, adjustable thermostat.

x. Phase and Voltage Monitor - A phase failure, reversal, and under voltage monitor shall be supplied to prevent the motors from running under low voltage, phase loss, or phase reversal conditions. The monitor will lock out the control circuit until the problem is corrected and automatically reset.

xi. Lightning Arrestor - Suitable lightning arrestors shall be provided to protect motors and control equipment from lightning-induced line surges.

xii. Thru-Door Overload Reset Push Buttons - Overload reset push buttons shall be provided for each overload relay. Push buttons shall be mounted so that with the inner door closed, overload relays may be reset without entering a high-voltage compartment.

xiii. Switches - Heavy duty industrial grade oiltight switches shall be provided for each pump for "Hands-Off-Automatic" operation selection. All switch components shall be made of corrosion resistant metals and polyesters. Contact blocks shall be made of see-through polycarbonate for simplified inspection of contacts. Cams and strokes shall be Teflon impregnated for abrasion free service without lubrication. The switches required shall be as follows:

Switch Function (Name Plate)	Voltage
Manual-off-Automatic	120 V AC

xiv. Pilot Lights - Full voltage heavy duty industrial grade oiltight pilot lights shall be provided. All pilot light components shall be made of corrosion-resistant metals and polyesters. An insulated socket shall be furnished to eliminate the possibility of shock during bulb change. Lens shall be made of Lexan. The pilot lights required shall be as follows:

Pilot Light Function (Name Plate)	Voltage	Lens Color
PUMP 1	120 V AC	GREEN
PUMP 2	120 V AC	GREEN

xv. Seal Failure Circuit Test Push Button (illuminated) - Heavy duty, industrial grade, oiltight push buttons shall be provided for each submersible pump motor. All push button components shall be made of corrosion-resistant metals and polyesters. Contact blocks shall be made of see-through polycarbonate for simplified inspection of contacts. An insulated socket shall be furnished to eliminate the possibility of shock during bulb change. Lens shall be made of Lexan. The push buttons required shall be as follows:

Pilot Light Function (Name Plate)	Voltage	Lens Color
P1 SEAL FAIL	120 V AC	AMBER
P2 SEAL FAIL	120 V AC	AMBER

xvi. Pump Alternator Circuit (For Duplex Pump Operation) - The electromechanical alternator relay shall be of industrial design specifically for use in pump applications. It shall have single pole, double throw, heavy duty, 10-amp, silver cadmium, oxide contacts enclosed in a transparent cover. The snail action contacts shall transfer when the unit is deenergized. The circuit shall never be closed or opened while current is being conducted. The alternator circuit shall alternate the lead pump position between the pumps and shall allow the lag pump to start in response to a rising water level in the wet well. (P1 – ALT – P2 selector switch).

xvii. Power Failure - Once power is restored after a failure and the pump has pumped the water from alarm level down to pump off, the alarm should automatically reset.

xviii. Control Relay(s) - Plug-in control relays with 120 V AC coils shall be provided as required. Contact rating shall be five (5) amps (minimum). Sockets shall be from the same manufacturer as the relays, and hold-down clips shall be furnished to prevent relay form sliding out of the socket.

xix. High Wet Well Level Alarm - The control panel shall be provided with a suitable alarm circuit, activated by a separate level control. This alarm shall signal a high-water condition in the sump. Terminals shall be furnished in the control panel for connection of an externally mounted alarm device. A red flashing light shall be provided as a visual alarm and a horn provided as an audible alarm of the high-water condition in the wet well. The pump station shall also be equipped with buttons to both test and silence the horn.

Part VIII Simplex Stations

1. PLURIS Policy on Allowing Simplex Stations

It is the intention of PLURIS to limit the addition of new simplex pump stations to the current collection system. New simplex pump stations will be allowed only under the following conditions:

a. Service areas with gravity collection systems will require a gravity service for residences. In the case where a gravity service is not practical due to low lot elevations, a simplex station may be allowed on a case-by-case basis. These situations will allow for a simplex station to pump to a gravity line only. In this situation the pump station is the sole jurisdiction of the NC Plumbing Code and will not be incorporated into the collection system.

   Large numbers of simplex stations pumping to gravity collection lines will not be allowed in new developments and will in no way account for more than 5% of the total services for any development.

b. In areas where force mains are installed and no gravity line is within reasonable distance, simplex pump stations will be allowed by PLURIS approval on a case-by-case basis. PLURIS reserves the right to require any developer or applicant to install gravity collection lines and standard duplex pump stations as outlined in Part VII of these specifications. Multiple homes, multifamily structures, and areas of new development will not be permitted to install simplex pump stations in lieu of conventional gravity collection systems.

c. Simplex pump stations will be permitted for single family home sites only. The use of simplex pump stations for commercial use shall not be permitted unless the following conditions apply:

    i. The projected average daily flow for the facility is less than the current single-family equivalent for a three-bedroom residence in the same area. This includes areas that have been granted flow reductions. In no way shall a commercial service be allowed to use a simplex pump station that exceeds the average daily flow of 360 gallons per day. The applicant must provide flow calculations signed and sealed by a NC Professional Engineer outlining the average daily flow for the facilities. These calculations shall reflect the standard rates of discharge allowed for such facilities by NCDEQ regulation., specifically 15A NCAC 02T .0305 and all applicable design criteria and future revisions of this rule.

    ii. The applicant will obtain a variance for the use of a simplex pump station from the NCDEQ.

    iii. The applicant will provide all required permits and design documents for the pump station. All required permitting, design fees, permit fees, material costs, installation costs, and any other applicable costs will be the responsibility of the Applicant.

d. All costs associated with the installation of a simplex pump station will be the responsibility of the Applicant. This includes but is not limited to the cost of any required permits or variances, design fees, material costs, installation costs, testing and inspection costs or any other applicable fees.

e. If required by NCDEQ the Applicant will furnish, at its expense, a hydraulic model of the proposed simplex station and its effect on the collection system. This model will be used to determine required head pressures, pump size, and other design criteria. This model data will be provided to PLURIS for review and will become the intellectual property of PLURIS.

f. If required by NCDEQ, the Applicant will apply for a variance for a simplex pump station based on the rules and requirements of NCDEQ, specifically the August 2008 “Draft Alternative Design Criteria for Minimum Separation for Sewer Systems to Wetlands” 15A NCAC 2T .0305(f) and the “Policy for Meeting the Reliability Requirements” of 15a NCAC 2T .305(h)(1)(D) for pressure sewers utilizing simplex pump stations.

g. The electrical service and power consumption for all simplex stations will be the responsibility of the Applicant. This responsibility will transfer to any person or entity that purchases any real estate served by a simplex pump station.

2. Simplex Pump Station Design

a. Siting – All simplex pump stations will be sited on the Applicant's private property and not located in a public right of way. The location of all simplex pump station connections to the force main will be approved by PLURIS. The simplex pump station will be in a recorded utility easement in an area that provides the shortest distance from the pump station to the connection point in the collection system. All applicable separations as stated in NCAC 2T .0305 will be met ~~for~~ for installations that are unable to meet the required separations, the Applicant may apply for a variance from NCDEQ.

   Care will be taken not to locate the pump station in excessive vegetation or landscape position that hinders maintenance of the station.

b. Approved manufacturers – All simplex stations will be manufactured for use as a package system complete with all required valves, piping, level control devices, wet wells, control panels and all other appurtenances required. Simplex pump stations will be manufactured by Meyers or another approved manufacturer. The applicant will furnish all specifications, shop drawings, cut sheets, and other applicable information to PLURIS prior to approval for installation and connection to the collection system.

c. Materials – All materials used in the simplex pump station will correspond to industry standards for use with sanitary sewage. All materials shall be non-corrosive, such as stainless steel, aluminum, plastic, fiberglass, or composite whenever practical. PLURIS reserves the right to deny the installation of any package system that uses substandard corrosive materials.

d. Wet Well Storage

   i. The wet well of a simplex pump station will meet the "Policy for Meeting the Reliability Requirements" of 15a NCAC 2T .305(h)(1)(D) for pressure sewers utilizing simplex pump stations. The requirements for storage are as follows:

      1. The first option for meeting reliability requirements is to provide 24-hour storage in the wet well above the pump-on elevation as requested in the permit application. However, since this may add to the cost and make installation difficult in certain areas, another option may be pursued.

         Alternatively, the applicant may provide documentation regarding both power reliability and response times for pump replacement.

         a. In the case of power reliability, 3 years of power history data in the area from the power company must be provided. The amount of storage required shall be equal to the duration of the longest power outage (minus catastrophic events such hurricanes). Storage shall be provided above the pump-on elevation.

b. For response times, the applicant shall provide an estimate of the response time to replace a failed pump. The estimate shall include time for answering after-hours calls, travel time to maintenance shop, preparing equipment to respond, travel time to site, and time to replace the pump. For existing systems, the Permittee should indicate whether they currently maintain a supply of pumps on hand at the time (a permit condition). Also, personnel must be on call 24 hours a day, 7 days a week, as well as provide a phone number with 24-hour answering service clearly posted on the pump station. Storage shall be provided above the high-water alarm.

2. A minimum of 120 gallons of storage above alarm shall be included in the evaluation.

3. These storage requirements are not cumulative; rather, the storage that provides the largest wet well shall be specified.

4. Storage in the service line to the pump station will not be included in these calculations.

ii. All wet wells shall be installed a minimum of two (2) feet above the 100-year flood elevation unless a variance is granted by NCDEQ.

e. Pump Sizing – Simplex pumps will be sized based upon a hydraulic model of the collection system and the anticipated head pressure at the force main connection point. At no time will the pump size be less than two (2) HP. Where a hydraulic model of the system is not required by NCDEQ, the default pump size will be a two (2) HP grinder pump. The pumps shall be a Meyers WGL20-21 2 HP capable of pumping 20 gallons per minute at 56 feet of total dynamic head or equal.

f. Control Panel – The control panel shall be a single phase 230-volt simplex panel with visual and audible alarms. The enclosure shall be a NEMA-4X rated enclosure with a gasketed door. The control circuit shall be single phase 120 volts. The control panel shall meet or exceed the specifications of the pump manufacturer and have the following:

i. A hand-off, automatic control switch

ii. Cycle counters and elapsed time meters

iii. Audible alarm and visual alarm

iv. The control panel shall meet all NC building codes and NEC codes, and the power to the panel shall be installed by a licensed electrician.

v. All control panels shall be installed a minimum of twelve (12) inches above the 100-year flood elevation unless a variance is granted by NCDEQ.

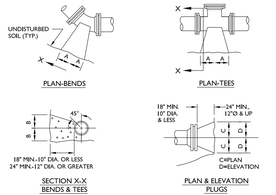
g. Venting – The wet well shall be vented above the 100-year flood elevation, and the vent shall have a no corrosive insect screen installed.

h. Anti flotation – The Applicant will demonstrate through signed and sealed engineering calculations a method of restraining the wet well from flotation during flood events or high ground water. Typical restraints shall include a concrete lug poured around an extended lip manufactured into the wet well.

3. Testing

a. All simplex pump stations and associated force mains will be tested for operation and leakage. All control mechanisms, alarms, and control panel functions will be verified.

b. In cases where the system was designed by a NC Professional Engineer and permitted through NCDEQ, the Engineer's and Owner's certifications will be provided to PLURIS prior to the system being activated.



PIPE SIZE	90° BEND		45° BEND		22-1/2° BEND		11-1/4° BEND		TEE		PLUG	
	A	B	A	B	A	B	A	B	A	B	C	D
4"	18"	12"	10"	13"	7"	10"	7"	10"	12"	14"	13"	6"
6"	18"	12"	10"	13"	7"	10"	7"	10"	12"	14"	19"	9"
8"	24"	18"	13"	18"	10"	12"	10"	12"	16"	18"	25"	11"
10"	28"	22"	15"	22"	12"	15"	12"	15"	20"	22"	31"	14"
12"	32"	28"	19"	28"	14"	18"	14"	18"	22"	28"	37"	17"
16"	54"	38"	30"	36"	18"	36"	18"	36"	36"	42"	54"	24"

ASSUME 2000 PSF SOIL (SAND & GRAVEL WITH CLAY)

NOTES:

1. BASED ON 200 PSI STATIC PRESSURE PLUS AWWA WATER HAMMER ALLOWANCE.
2. ALL BEARING SURFACES TO BE CARRIED TO UNDISTURBED GROUND.
3. THRUST BLOCKS TO BE USED AT ALL LINES OPERATING UNDER PRESSURE.
4. CONCRETE SHALL NOT CONTACT BOLTS OR MECHANICAL FITTINGS.
5. CONCRETE SHALL BE 3000 PSI.
6. TRENCHES SHALL CONFORM WITH STANDARD EMBEDMENT DETAIL.
7. ALL BENDS AND INTERSECTIONS SHALL HAVE CONCRETE THRUST BLOCKING.
8. SEE STD. THRUST BLOCK SHEET 2 OF 4 FOR OTHER SOILS.

PSD NO. 1 - THRUST BLOCKING DETAIL

NOT TO SCALE

REACTION BEARING AREAS FOR HORIZONTAL WATER/SEWER PIPE BENDS

BASED ON TEST PRESSURE OF 200 P.S.I.

ALL AREAS GIVEN IN SQUARE FEET.

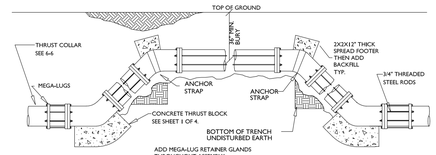
SIZE AND DEGREE OF BEND	STATIC THRUST IN POUNDS	POORLY GRADED SAND WITH CLAY	SOFT CLAY OR MUCK	SILTY CLAY, COMBINATIONS OF SAND, CLAY AND SILT	CLAYEY SAND OR GRAVEL WITH SILT	SAND, GRAVEL VERY STIFF OR HARD CLAY	SAND, GRAVEL VERY WELL GRADED COMPACT	ORDINARY, VERY FIRM GROUND	ROCK, FIRM TO HARD	
6"										
11 1/4 °	1,108	1	1	1	1	1	1	2	1	
22 1/2 °	2,207	1	2	2	1	1	1	3	1	
45 °	4,328	2	3	3	1	1	2	5	1	
90 °	7,996	2	4	5	1	1	2	8	1	
PLUG	5,655	2	3	4	1	1	2	6	1	
8"										
11 1/4 °	1,970	1	1	2	1	1	1	2	1	
22 1/2 °	3,922	1	2	3	1	1	1	4	1	
45 °	7,694	2	4	5	1	1	2	8	1	
90 °	14,215	4	8	9	2	2	4	15	2	
PLUG	10,053	3	5	6	2	2	3	10	1	
12"										
11 1/4 °	4,433	2	3	3	1	1	2	5	1	
22 1/2 °	8,826	3	5	6	2	2	3	9	1	
45 °	17,312	5	9	11	3	3	5	18	2	
90 °	31,983	8	16	19	4	4	8	32	4	
PLUG	22,619	6	12	14	3	3	6	23	3	
16"										
11 1/4 °	7,881	2	4	5	1	1	2	8	1	
22 1/2 °	15,691	4	8	10	2	2	4	16	2	
45 °	30,779	8	16	19	4	4	8	31	4	
90 °	56,861	15	29	35	8	8	15	57	6	
PLUG	40,233	10	21	25	5	5	10	41	5	

REACTION BEARING AREAS ARE IN SQUARE FEET MEASURED IN A VERTICAL PLANE IN THE TRENCH SIDE AT AN ANGLE OF 90° TO THE THRUST VECTOR.

USE 6" - 90° BEND VALUE FOR HYDRANTS FOR ADDITIONAL SAFETY FACTOR.

PSD NO.2 - THRUST BLOCKING DESIGN QUANTITY TABLE

NOT TO SCALE



ROD REQUIREMENTS

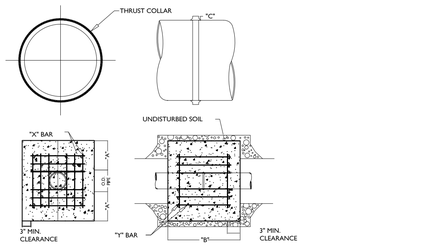
SIZE OF 45 BEND	STATIC THRUST IN POUNDS	NO. OF RODS REQUIRED
6"	4,328	4
8"	7,694	4
12"	17,312	4
16"	30,779	8
24"	69,252	8

GENERAL NOTES:

1. STEEL RODS AND BOLTS SHALL BE 3/4" STAINLESS STEEL.
2. CONCRETE SHALL NOT CONTACT BOLTS OR ENDS OF MECHANICAL JOINT BENDS.
3. MEGA-LUGS TO BE USED AT ALL FITTINGS.
4. MUST USE DUCTILE IRON EYE BOLTS WHERE NECESSARY.

PSD NO. 3 - VERTICAL BEND DETAIL

NOT TO SCALE



REINFORCING REQUIREMENTS

I.D. PIPE	REBAR SIZE	"X" BAR LENGTH	"X" BAR WEIGHT	"Y" BAR LENGTH	"Y" BAR WEIGHT	NO. REQUIRED
6" - 36"	#5	2'-2"+ O.D. PIPE	1.043 LBS/FT	1'-1"	1.1 LBS. EACH	X-24, Y-12
48" & greater	#6	3'-0"+ O.D. PIPE	1.502 LBS/FT	1'-3"	1.9 LBS. EACH	X-24, Y-12

THRUST COLLAR, AND THRUST SCHEDULE

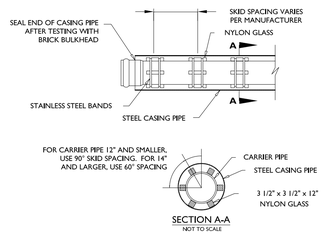
I.D. PIPE	"A"	"B"	"C"-6"-16", 20"-24", 30"-36", 48"			
6" - 36"	1'-4"	1'-7"	2"	3"	4"	
48" & greater	1'-8"	1'-9"				6"

NOTES:

1. CONCRETE SHALL BE 3000 PSI AND TRANSIT MIXED.
2. REINFORCING BARS SHALL BE DEFORMED AND TIED TOGETHER.
3. TRENCH BOTTOM WIDTH IN VICINITY OF THRUST BLOCK INSTALLATION SHALL BE THE MINIMUM WIDTH AS SHOWN ON STANDARD EMBEDMENT DETAIL.
4. BACKFILL TAMPED IN 6" LIFTS PER STANDARD EMBEDMENT DETAIL.
5. THRUST COLLAR MUST BE FACTORY WELDED ON BOTH SIDES ALONG BOTH EDGES OF COLLAR AROUND CIRCUMFERENCE.

PSD NO. 4 - THRUST COLLAR DETAIL

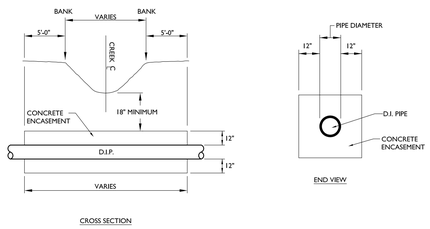
NOT TO SCALE



NOTES:
1. SKID TO BE PLACED TO PROVIDE PROPER SUPPORT, ALIGNMENT, AND GRADE AS SPECIFIED. CONTINUOUS SKIDS MAY BE USED AS ALTERNATIVE. 2. OIL, GREASE, OR PETROLEUM PRODUCT MAY NOT BE USED AS LUBRICANT.
3. CASING PIPE TO BE OF FERROUS METAL AND HAVE A MINIMUM DIAMETER TWICE THATOF THE CARRIER PIPE.
4. CASING PIPE TO HAVE A MINIMUM THICKNESS OF .25".
5. FOR ALL BORES UNDER NCDOT RIGHT OF WAYS FOLLOW ALL NCDOT GUIDELINES FOR PIPE SIZE AND THICKNESS.

PSD NO. 5 - PIPE CASING DETAIL

NOT TO SCALE

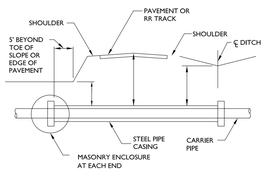


NOTES:

1. CONCRETE SHALL BE 3,000 P.S.I.
2. CONCRETE ENCASEMENT NOT REQUIRED WHEN PIPE IS AT LEAST THREE (3) FEET UNDER CENTERLINE OF CREEK BOTTOM.
3. ALL STREAM CROSSINGS TO BE PERMITTED BY NCDENR.
4. ALL WETLAND CROSSINGS AND COASTAL WETLAND CROSSINGS TO BE PERMITTED BY ALL APPROPRIATE AGENCIES.

PSD NO. 6 - STREAM/WETLAND CROSSING DETAIL DETAIL

NOT TO SCALE



TYPICAL PIPE CROSSING

CASING PIPE SIZE (O.D.)	WALL THICKNESS
4" - 12 3/4"	0.250"
16"	0.250"
18"	0.250"
20"	0.250"
24"	0.250"
30"	0.312"
36"	0.375"
48"	0.500"

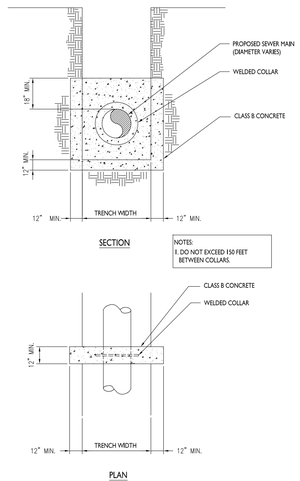
ENCASEMENTS SHALL EXTEND FROM DITCH LINE TO DITCH LINE IN CUT SECTIONS, FIVE (5) FEET BEYOND THE TOE OF SLOPES IN FILL SECTIONS, AND TEN (10) FEET BEYOND EDGE OF PAVEMENT IN SECTIONS WITH NO DITCH OR FILL AREA.

NOTES:

1. STEEL ENCASEMENT PIPE SHALL CONFORM TO ASTM A-139 WITH WALL THICKNESS AND GRADE AS DEFINED IN THE SPECIFICATIONS. MINIMUM ALLOWABLE YIELD STRENGTH IS 35,000 PSI.
2. CARRIER PIPE SHALL BE ADEQUATELY SUPPORTED THE ENTIRE LENGTH WITHIN THE CASING BY USING "SPIDER" STEEL SUPPORTS AT A MAXIMUM OF 9 FOOT CENTERS (ONE AT EACH JOINT AND ONE INTERMEDIATE). OTHER METHODS MUST MEET APPROVAL OF THE ENGINEER.
3. NO EXCAVATED MATERIAL SHALL BE PLACED IN ANY STREAM, DITCH OR DRAINAGE WAY.
4. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING ALL UNDERGROUND UTILITIES PRIOR TO THE START OF CONSTRUCTION.
5. THE CONTRACTOR IS RESPONSIBLE FOR ANY SEDIMENT AND EROSION CONTROL PRACTICES REQUIRED DURING CONSTRUCTION AND THE SUBSEQUENT STABILIZATION OF ALL DISTURBED AREAS AFTER CONSTRUCTION.
6. THE CONTRACTOR IS RESPONSIBLE FOR ALL LAY DOWN AND STOCKPILE AREAS.
7. FOR BORES ON THE NCDOT RIGHT OF WAY, NO WORK WILL BEGIN UNTIL THE CONTRACTOR HAS A COPY OF THE NCDOT ENCROACHMENT PERMIT FOR THE PROJECT.

PSD NO. 7 - BORE DETAIL DETAIL

NOT TO SCALE

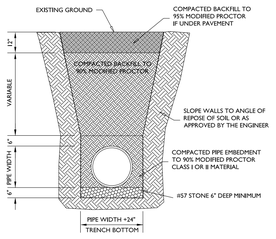


PSD NO. 8 - ANTI SEEP COLLAR DETAIL

NOT TO SCALE

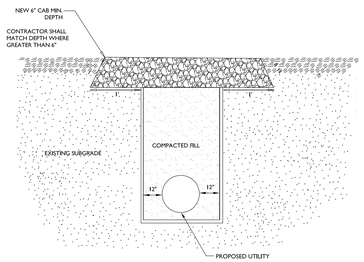
STANDARD DETAILS SHEET A

PLURIS



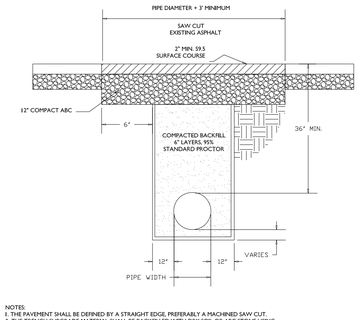
NOTES:
1. MINIMUM BURY DEPTH FOR ALL FORCE MAINS AND GRAVITY LINES IS 36" UNLESS SPECIFICALLY ALLOWED BY THE ENGINEER. ALL LINES SHALLOWER THAN 36" MUST GIVE CONSIDERATION TO USING HIGHER PRESSURE AND THICKNESS CLASSES OF DIP.
2. ALL LINES TO BE BEDDED IN 6" OF #57 STONE MINIMUM. FOR LINES INSTALLED BELOW THE WATER TABLE #57 STONE SHOULD EXTEND TO THE SPRING LINE OF THE PIPE AT A MINIMUM.
3. THE USE OF #57 STONE BEDDING AND BACKFILL SHOULD BE COMMENSURATE WITH THE CONDITIONS IN THE TRENCH. THE CONTRACTOR IS RESPONSIBLE FOR PROPER BEDDING AND BACKFILLING TO INSURE PIPE STABILITY AND UNIFORM GRADE.

PSD NO. 9 - PIPE TRENCH AND BEDDING DETAIL
NOT TO SCALE



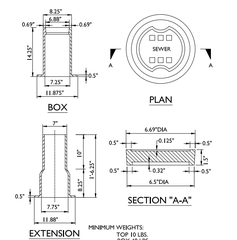
NOTES:
1. THE REPLACED STONE SHALL CONSIST OF ABC MATERIAL COMPACTED TO A DENSITY EQUAL TO 100% OF THAT OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH ASSMTO T-180 AS MODIFIED BY NCDOT.

PSD NO. 10 - GRAVEL DRIVEWAY REPAIR DETAIL
NOT TO SCALE



NOTES:
1. THE PAVEMENT SHALL BE DEFINED BY A STRAIGHT EDGE, PREFERABLY A MACHINED SAW CUT.
2. THE TRENCH SUBGRADE MATERIAL SHALL BE BACKFILLED WITH DRY SOIL OR ABC STONE USING MAXIMUM 6" LIFTS TO WITHIN 10" OF THE ROAD SURFACE. THE BACKFILL SHALL BE COMPACTED PER ASTM D698 TO A DENSITY OF 95% OF THE STANDARD PROCTOR DENSITY.
3. WITHIN ROADS MAINTAINED BY NCDOT, THE TRENCH SHALL BE BACKFILLED AND COMPACTED USING FLOWABLE FILL OR ABC STONE TO WITHIN 12" OF THE ROAD SURFACE. WHERE ABC STONE IS USED, IT SHALL BE COMPACTED TO A DENSITY OF AT LEAST 95% OF THAT OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH AASHTO-99 AS MODIFIED BY NCDOT.
4. THE FINAL 1' OF FILL SHALL CONSIST OF ABC MATERIAL COMPACTED TO A DENSITY EQUAL TO 100% OF THAT OBTAINED BY COMPACTING A SAMPLE OF THE MATERIAL IN ACCORDANCE WITH ASSHTO T-180 AS MODIFIED BY NCDOT. BITUMINOUS BASE OR BINDER MAY BE SUBSTITUTED IF APPROVED BY THE ENGINEER.
5. THE ENTIRE THICKNESS/VERTICAL EDGE OF THE CUT SHALL BE TACKED.
6. THE SAME DEPTH OF PAVEMENT MATERIAL WHICH EXISTS SHALL BE REINSTALLED, BUT IN NO CASE SHALL THE ASPHALT BE LESS THAN 2" THICK.
7. THE ASPHALT PAVEMENT MATERIAL SHALL BE INSTALLED AND COMPACTED THOROUGHLY TO ACHIEVE A SMOOTH LEVEL PATCH.

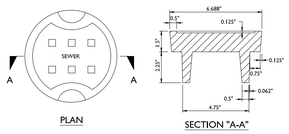
PSD NO. 11 - ASPHALT PAVING REPAIR DETAIL
NOT TO SCALE



MINIMUM WEIGHTS:
TOP 10 LBS.
BOX 40 LBS.
EXTENSION 40 LBS.

NOTE:
VALVE BOX LID NOT FOR USE IN ROADWAY LOCATIONS. HEAVY DUTY LID REQUIRED. SEE SD 14-08.

PSD NO. 12 - CAST IRON VALVE BOX DETAIL
NOT TO SCALE

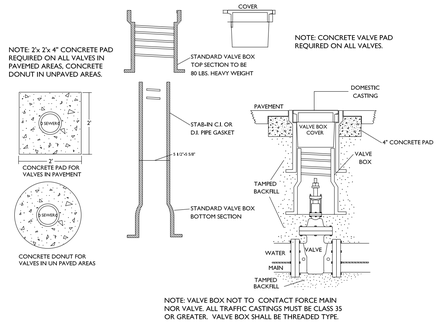


GRE-WVC-6HD, CAST IRON OR EQUAL
APPROX. WEIGHT 178lbs.

PSD NO. 13 - HEAVY DUTY CAST IRON VALVE BOX LID DETAIL
NOT TO SCALE

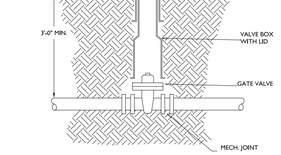
NOTE: CONCRETE VALVE PAD REQUIRED ON ALL VALVES.

APPROVED METHOD FOR EXTENSION OF VALVE BOX

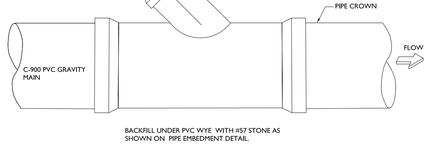


NOTE: VALVE BOX NOT TO CONTACT FORCE MAIN NOR VALVE. ALL TRAFFIC CASTINGS MUST BE CLASS 35 OR GREATER. VALVE BOX SHALL BE THREADED TYPE.

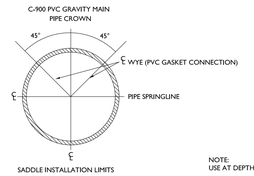
PSD NO. 14 - VALVE BOX INSTALLATION AND EXTENSION DETAIL
NOT TO SCALE



PSD NO. 15 - GATE VALVE DETAIL
NOT TO SCALE

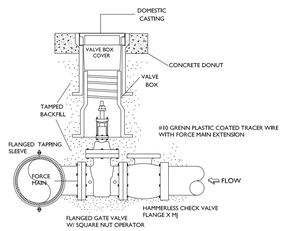


BACKFILL UNDER PVC WYE WITH #57 STONE AS SHOWN ON PIPE EMBEDMENT DETAIL.



NOTE:
USE AT DEPTHS FROM 3 TO 6-FEET

PSD NO. 16 - GRAVITY SERVICE CONNECTION DETAIL
NOT TO SCALE

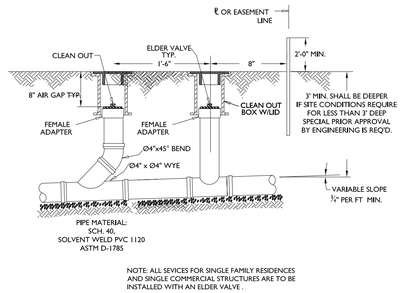


NOTE: VALVE BOX NOT TO CONTACT FORCE MAIN NOR VALVE. ALL TRAFFIC CASTINGS MUST BE CLASS 35 OR GREATER. VALVE BOX SHALL BE THREADED TYPE.

PSD NO. 16A - FORCE MAIN TAP AND CONNECTIONN DETAIL
NOT TO SCALE

STANDARD DETAILS SHEET B

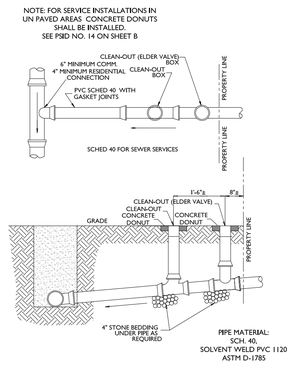
PLURIS



NOTE: ALL SEVICES FOR SINGLE FAMILY RESIDENCES AND SINGLE COMMERCIAL STRUCTURES ARE TO BE INSTALLED WITH AN ELDER VALVE .

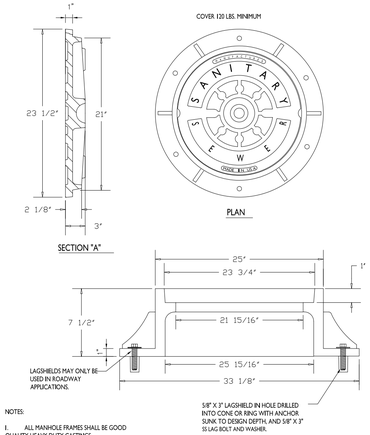
PSD NO. 17A - STANDARD SERVICE CLEAN OUT DETAIL FOR PAVED AREAS/ CONCRETE DRIVES

NOT TO SCALE



PSD NO. 17 - STANDARD SERVICE DETAIL (UNPAVED AREAS)

NOT TO SCALE

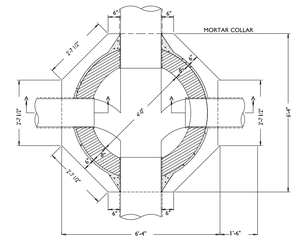


NOTES:

1. ALL MANHOLE FRAMES SHALL BE GOOD QUALITY HEAVY DUTY CASTINGS
2. FRAME SHALL BE A MINIMUM WEIGHT OF 182 LBS.
3. COVER SHALL WEIGH A MIN. OF 120 LBS.
4. MANHOLES WITHIN PAVED SURFACES SHALL BE CONSTRUCTED IN ACCORDANCE WITH DETAIL.
5. CONSEAL SHALL BE USED BETWEEN RING AND CONE

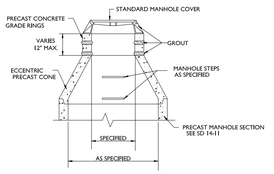
PSD NO. 18 - STANDARD MANHOLE RING AND COVER DETAIL

NOT TO SCALE



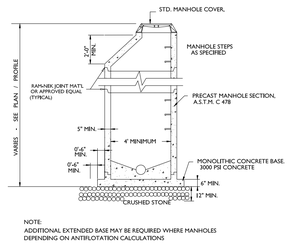
PSD NO. 19 - SANITARY SEWER MANHOLE PLAN VIEW DETAIL

NOT TO SCALE



PSD NO. 20 - SANITARY SEWER PRECAST RING EXTENSION DETAIL

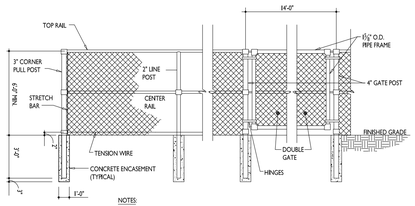
NOT TO SCALE



NOTE:
ADDITIONAL EXTENDED BASE MAY BE REQUIRED WHERE MANHOLES DEPENDING ON ANTIFLOTATION CALCULATIONS

PSD NO. 21 - SANITARY SEWER PRECAST MANHOLE DETAIL

NOT TO SCALE

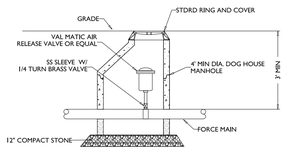


NOTES:

1. DOUBLE GATE SHALL HAVE A LOCKING MECHANISM, DROP ROD, AND TRUSS ROD.
2. ALL FENCE COMPONENT MATERIALS SHALL BE EITHER HOT DIPPED GALVANIZED STEEL WITH PRIVACY SLATS.

PSD NO. 23 - LIFT STATION FENCING DETAIL

NOT TO SCALE



NOTE:

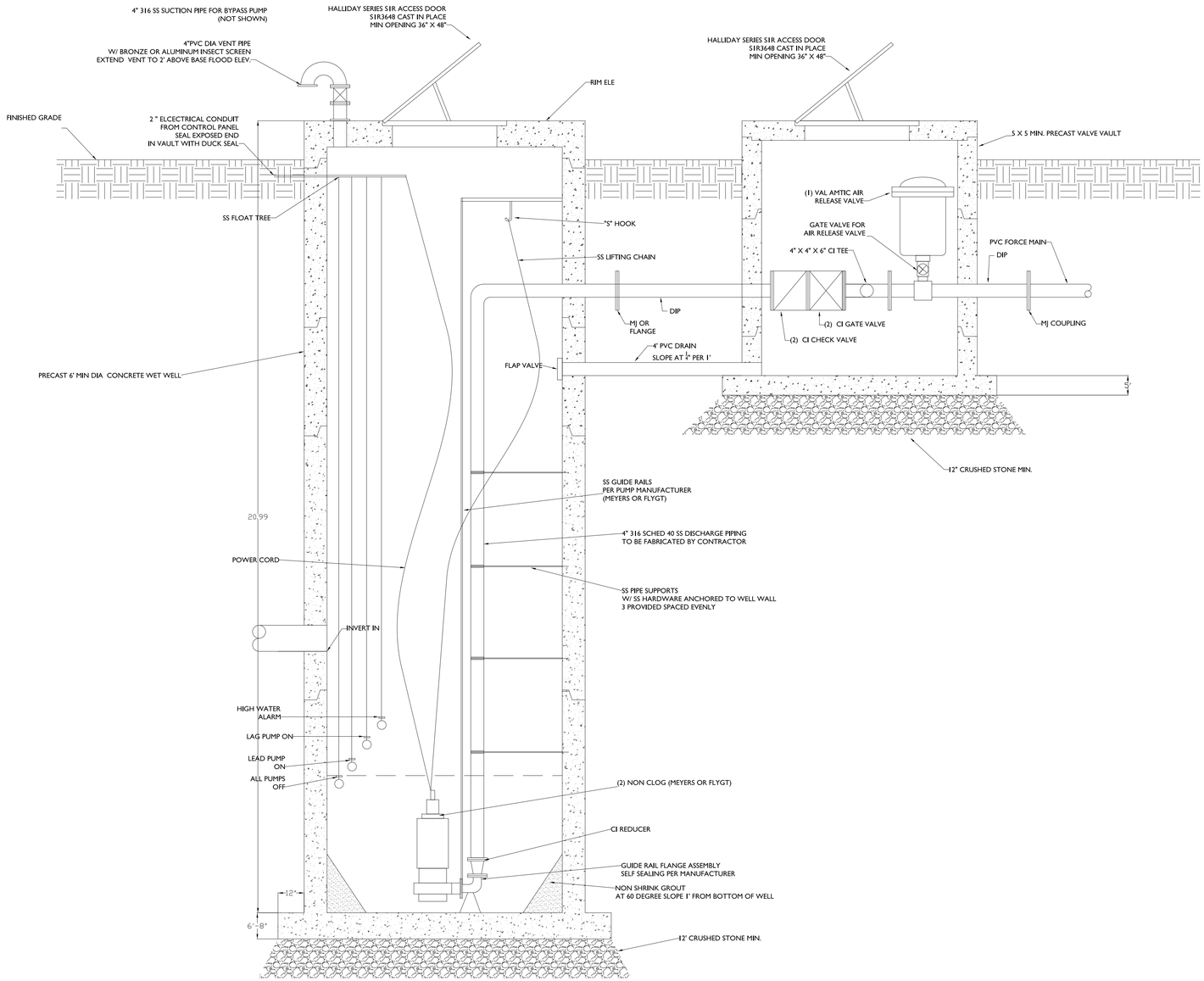
AIR RELEASE VALVES TO BE LOCATED AT HIGH POINTS OF THE FORCE MAIN WHERE GRADE DIFFERENCES EXCEED 10' IN ELEVATION.

PSD NO. 24 - AIR RELEASE MANHOLE DETAIL

NOT TO SCALE

STANDARD DETAILS SHEET C

PLURIS

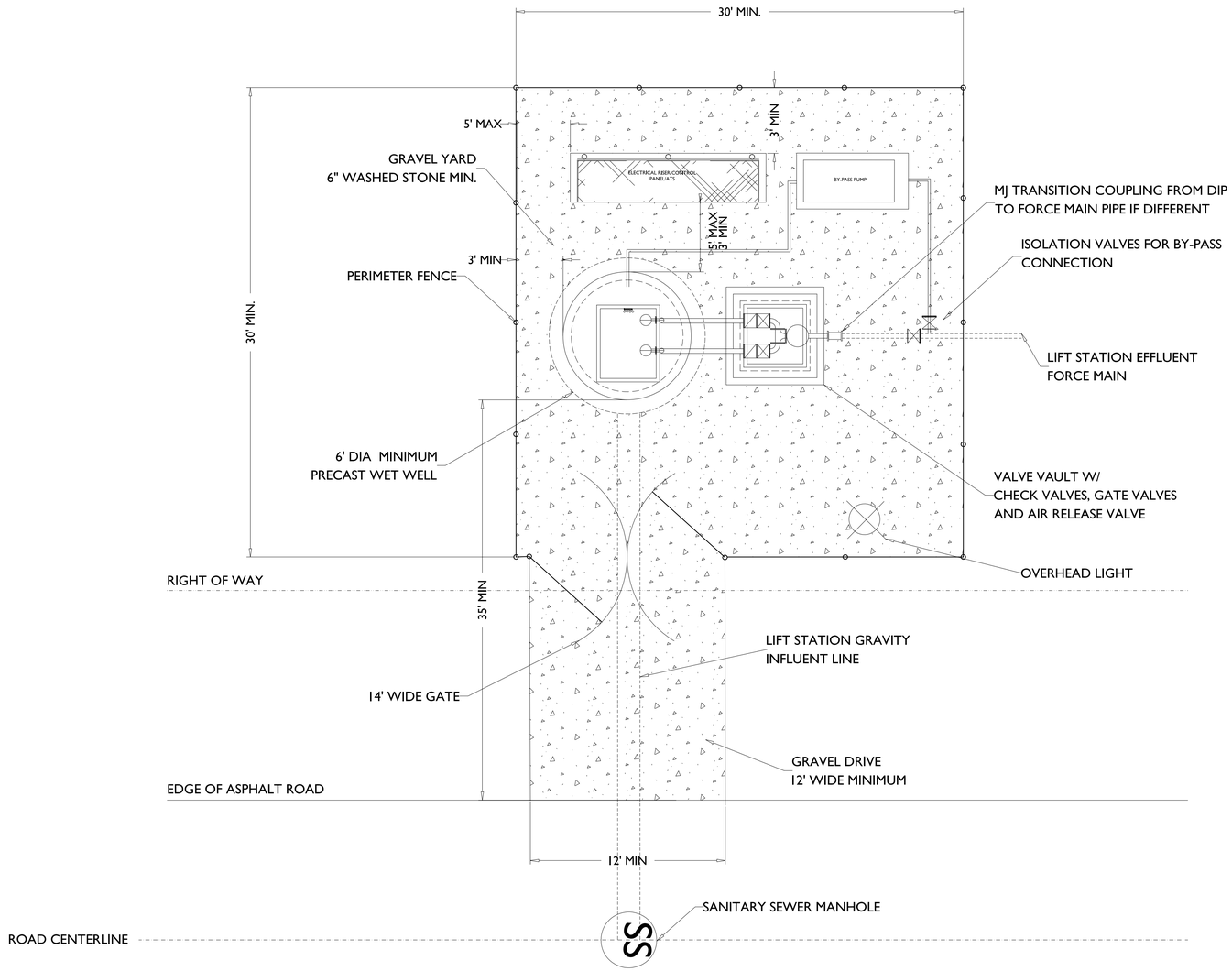


PSD NO. 25 - TYPICAL DUPLEX LIFT STATION SECTION DETAIL

NOT TO SCALE

STANDARD DETAILS SHEET D

PLURIS

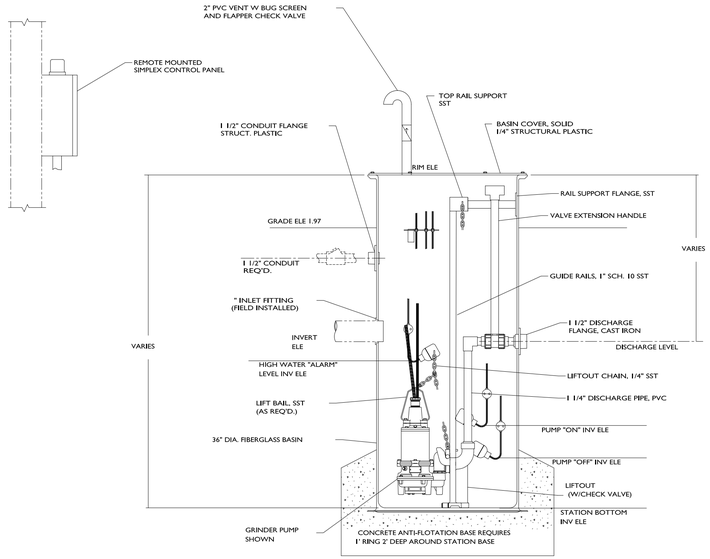


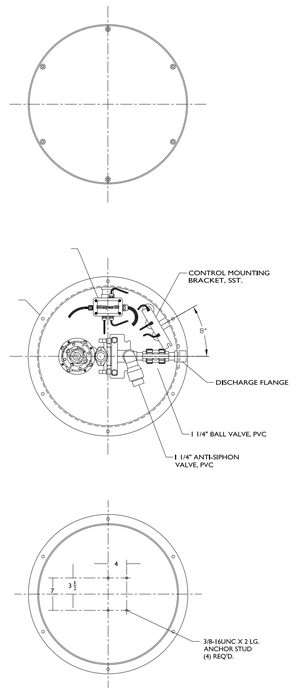
PSD NO. 26 - TYPICAL DUPLEX LIFT STATION PLAN DETAIL

NOT TO SCALE

STANDARD DETAILS SHEET E

PLURIS





NOTES:

1. MANUFACTURER MUST BE APPROVED BY PLURIS.
2. GRINDER PUMP MUST BE SIZED BY ENGINEER
3. ALL STATIONS MUST MEET ALL NCDENR REGULATIONS FOR STORAGE.
4. ALL SIMPLEX CONTROL PANELS SHALL BE MOUNTED ON A 4 X 4 PT POST IN CLOSE PROXIMITY TO THE STATION.
5. PLURIS SHALL APPROVE THE LOCATION OF ALL SIMPLEX GRINDER STATIONS.
6. NO ELECTRICAL CONNECTIONS INSIDE OF WET WELL. ALL FLOAT AND PUMP CORDS TO TERMINATE IN THE CONTROL PANEL ONLY.

PSD NO. 27 - TYPICAL SIMPLEX GRINDER STATION DETAIL

NOT TO SCALE

PLURIS